COMMUNITY WEIGHT MANAGEMENT, OBESITY PREVENTION and TREATMENT, ACROSS THE LIFE-COURSE

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Thesis submitted to the University of Nottingham for the degree of Doctor of Philosophy (on the basis of Published Works)

September 2016

Abstract

Obesity results from complex interactions between biological, behavioural, social and environmental factors. The focus of this thesis, both the collection of papers presented and the extended abstract, is on community-based approaches to the prevention and treatment of obesity across five important key life stages.

The importance of early life influences, including the intrauterine environment, and the subsequent impact on body fatness across the life-course is discussed. Published research included considers the impact of interventions which aim to limit gestational weight gain on baby's' birthweights and the wider influence on sustained breastfeeding. However research presented also suggests that pregnant women receive limited information from healthcare professionals and whilst pregnancy should provide an ideal opportunity for public health intervention, the postnatal period may be more acceptable as a time to provide support and advice.

The prevalence of childhood obesity has continued to increase. The most significant predictor of childhood obesity is parental obesity. A paper is presented which demonstrates that engaging adults in lifestyle programmes can have a positive impact on both the diet and activity habits of their family. A systematic review considers how TV viewing during meal-times may influence the foods and drinks consumed with the findings suggesting that the practice of eating whilst watching TV has a negative impact on the diet quality. It is recognised that sugar-sweetened beverages (SSBs) contribute significantly to the free sugar dietary intake, particularly the %total energy intake of children and adolescents. A further published review asks the question, which interventions that aim to reduce the intake of SSBs lead to reduced body fatness in children.

There is a need for both primary prevention activities to prevent unhealthy weight gain and interventions to treat overweight and obese children/adolescents. Published data provides evidence for an intervention which does lead to weight loss in obese adolescents, leading to enhanced self-esteem which helps to improve their lifestyles behaviours.

Young adulthood represents a period of change with increasing independence. There may be few occasions to discuss weight management with young adults but a presented paper explores the opportunities in primary care.

Obesity is associated with a number of chronic diseases, one example being type 2 diabetes which is now presenting in adolescents and young adults. Losing weight can have a significant clinical impact

on the glycaemic control of people with diabetes and thus reduce the health burden associated with the condition. Type 2 diabetes is now reversible if significant weight loss is achieved. A paper is presented which evaluates weight management in people with diabetes and the associated impact on glycaemic control.

Prevalence data suggests that 25 million adults in the UK are either overweight or obese. Given the health burden to both the individual and society, scalable solutions are required which are delivered in a community setting. Through collaboration with a commercial weight management organisation (CWMO), a series of papers are presented which explore the feasibility and effectiveness of referral from primary care to CWMOs. CWMOs, using behavioural strategies, are well placed to support the large numbers of people who need weight management guidance and a referral scheme may address the health inequalities seen in obesity prevalence.

One example of a well-established behavioural strategy, target setting, is considered in more detail with evidence of the importance of target setting presented.

As with all research, weight management research is confounded by methodological issues. Community- based programmes are often more complex than clinical trials and contamination may be an issue. The extended abstract explores the methodological issues related to the presented papers in more detail. Whilst we can continue to improve our methodology it is important that we advance our knowledge as to what works to reduce the obesity epidemic. Sadly there will probably not be one solution which is effective at an individual level given the psychosocial complexities of obesity. Ideally we need to promote a nutritionally balanced diet and adequate levels of daily activity which enable children and adults to maintain a healthy weight across the life-course starting at the very beginning of conception.

ACKNOWLEDGEMENTS

Completing this PhD has been an enjoyable learning experience but one which could not have been completed without the support of others.

I am particularly grateful to the guidance received from both supervisors, Professor Simon Langley-Evans and Dr Judy Swift. Their constructive feedback has been invaluable at all times along the journey.

I would also like to thank the Nutrition and Research team at Slimming World, headed by Dr Jacquie Lavin. They have consistently supported my research ideas through allowing me access to healthy volunteers participating in community weight management programmes. We have worked well together in developing ideas and seeing research projects through from conception to publication. Indeed Jacquie and myself developed the idea of referral from primary care into the commercial weight management sector and were able to see the idea conceived and through the foetal and infancy stages, with on-going evaluation, but it is now too big for just the two of us.

Given that the thesis contains a collection of papers where I have either led on the research or made a significant contribution, I need to acknowledge the work and commitment of all my co-authors. Thank you all.

As a reviewer myself, I respect and acknowledge the time taken and the efforts of reviewers of peer reviewed papers to make the paper even better and more scientifically robust. I have been supported by many such people.

At the start of the journey, it was difficult to find information about ‘submission for a higher degree by published works’ so was very grateful to Professor Andrew Hill for providing some guidance.

Finally I would like to thank my family, colleagues and friends for their never-ending support and encouragement.

LIST of ABBREVIATIONS

ALSPAC	Avon Longitudinal Survey of Parents and Children
BMI	Body Mass Index
CVD	Cardiovascular Disease
CWM	Commercial Weight Management
CWMO	Commercial Weight Management Organisation
DINE	Dietary Instrument for Nutrition Education
GWG	Gestational Weight Gain
HbA1C	Glycated Haemoglobin
HELP	Healthy Eating and Lifestyle in Pregnancy
HSE	Health Survey for England
IOM	Institute of Medicine
IOTF	International Obesity Task Force
IPAQ	International Physical Activity Questionnaire
LGA	Large for Gestational Age
LWOCF	Last Weight Observed Carried Forward
MEND	Mind, Exercise, Nutrition and Do-it
MRC	Medical research Council
NCMP	National Child Measurement Programme
NHANES	National Health and Nutrition Examination Survey
NHLBI	National Heart, Lung and Blood Institute
NHS	National Health Service
NICE	National Institute for health and Clinical Excellence
NIHR	National Institute for Health Research
NOO	National Obesity Observatory
ONS	Office for National Statistics

OR	Odds Ratio
PHE	Public Health England
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analysis
QALY	Quality-Adjusted Life Year
RC	Rosemary Conley
RCT	Randomised Controlled Trial
SACN	Scientific Advisory Committee on Nutrition
SCT	Social-Cognitive theory
SDT	Self-determination theory
SGA	Small for Gestational Age
SIGN	Scottish Intercollegiate Guidelines Network
SPAWN	Stockholm Pregnancy and Women's Nutrition longitudinal study
SSB	Sugar Sweetened Beverage
SW	Slimming World
SWAN	Supporting Women with PostnAtal Weight MaNagement
TPB	Theory of Planned Behaviour
TTM	Trans-theoretical model
T2DM	Type 2 Diabetes
UK	United Kingdom
UPBEAT	UK Pregnancies and Better EAting Trial
US (A)	United States (of America)
WHO	World Health Organisation
WW	Weight Watchers

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1. Introduction

This collection of published works represents studies conducted between 2000 and 2016, which have provided unique insights into weight management and obesity prevention and treatment across the life-course, in community settings. The life-course approach accepts that key life stages and transition points can both make individuals more vulnerable to negative health outcomes but also present opportunities for appropriate interventions. Six stages or critical periods of the life-course are generally identified (Mayer, 2009). These stages include pregnancy and foetal development, infancy and childhood, adolescence, young adulthood (ages 18-35), adulthood (35-65) and later life (>65years). These stages, whilst distinct, can merge into a continuum particularly pregnancy, the pre- and postnatal periods and parenthood. The work presented in this thesis considers the first five stages, the rationale being that there needs to be an emphasis on preventing obesity tracking into the later years and thus reducing the risk of the non-communicable diseases associated with obesity.

Obesity results from complex interactions between biological, behavioural, social and environmental factors. Both the causes and drivers for obesity are complex. For most population groups, an excess consumption of energy dense, nutrient poor foods and drinks, alongside sedentary behaviours, are generally considered to be primary drivers (Prentice & Jebb, 2003; Popkin, Adair & Ng, 2011). However obesity is not that simple. It is more than just a failure of will and self-discipline and lack of ability to make behavioural changes and represents a complex interplay of genetics and environment

(Butland *et al.,* 2007). It is now well recognised that early-life influences, commencing with the intrauterine environment and continuing through the first few years of life, can influence weight gain and body fatness across the life-course (Gluckman, Hanson & Buklijas, 2010; SACN, 2011). A nutritionally compromised environment in early life influences an individual's metabolic ability to cope with gluttony and sloth. Individuals are perhaps epigenetically mismatched to their later energy-rich environment (Wells, Chorntho & Fewtrell, 2007; Stöger, 2008). Heijmans *et al.,* (2008) have extensively studied individuals who were prenatally exposed to famine during the Dutch Hunger Winter. This research group have found persistent epigenetic differences associated with the prenatal exposure, early in gestation, to famine particularly in the regulation of insulin-like growth factor 2 (IGF2). IGF2 is a key regulator in growth and development and is maternally imprinted via DNA methylation and altered IGF2 methylation can be detected many years later. The exposure of over-nutrition during early development may give rise to similar associations (Heijmans *et al.,* 2008).

There is also evidence that the period soon after birth is a time of 'metabolic plasticity'. Rapid weight gain, particularly in lower birth weight babies, increases the risk of subsequent obesity and related disorders (Barker, 2002; Eriksson *et al.,* 2003). Beyond the initial six months of life, breastfed babies show slower growth rates than those formula- fed (Toschke *et al.,* 2007) and this may be a plausible explanation as to why breastfed infants are less likely to become obese in later life (Arenz *et al.,* 2004; Singhal & Lanigan, 2007). Increasing breastfeeding rates and duration is an important public health measure.

As previously suggested, early over-nutrition may also increase the risk of subsequent obesity and associated disease such as type 2 diabetes. The risks of becoming overweight and obese may start at an early age. Growth patterns in the first few weeks and months following conception affect the risk of subsequent obesity (Barker, 2007). Whitaker and Dietz (1998) hypothesised that prenatal over-nutrition might affect lifelong risk of obesity. According to their hypothesis, maternal obesity increases transfer of nutrients across the placenta, inducing permanent changes in appetite, neuroendocrine functioning, and/or energy metabolism. Results of their observational studies showed a direct correlation between maternal obesity, birth weight, and obesity later in life for the child. These findings have been replicated. In their systematic review, Lau *et al.,* (2014) found that higher total gestational weight gain (GWG) significantly increased the risk of overweight or obesity by 1-23% in children aged between 2 and 19 years at follow-up. Compared to the children born to mothers who gained an appropriate amount of gestational weight, the children to born to mothers who gained an excessive amount had a significantly higher BMI z-score (0.74 to 1.73 units) (Lau *et al.,* 2014). In a random sample of 5,125 Greek children, those born to mothers who exceeded the Institute of Medicine (IOM) GWG recommendations had an increased risk of obesity at the age of 8 years (OR: 1.45; 95%CI 1.26, 1.67) compared to those born to mothers with a GWG within the recommended range (Mourtakos *et al.,* 2015).

Child and adolescent obesity is associated with major short and long-term health risks (Reilly *et al.,* 2003). In children of all ages the emotional and psychological impact can have the most immediate negative consequences. The teasing and discrimination by peers may result in low self-esteem, body dissatisfaction, anxiety and depression with a negative effect on quality of life (Griffiths, Dezateux & Hill, 2011). There are many risks to physical health but of concern is the heightened risk of type 2 diabetes. Analysis of the National (USA) Longitudinal Study of Adolescent Health found that diabetes risk was particularly high in adults who were obese as adolescents compared to those with adult-onset obesity (Richardson & Gordon-Larsen, 2013).

Of interest is the persistence of risk factors over the lifespan and whether overweight and obese children/adolescents become overweight or obese adults. In the epidemiological literature, this concept of persistence or relative stability over time is referred to as ‘tracking’. Tracking includes the relationship between early measurements and measurements of body composition later in life or the maintenance of a relative position, perhaps related to weight centiles, over time (Twisk, 2003).

Whilst demonstrating the tracking of obesity from childhood to adulthood is methodologically quite difficult, it is an important concept as widespread tracking would emphasise childhood obesity as a major risk factor and provide justification for targeting childhood as a major anti-obesity intervention. The one thousand families study, commenced in 1947, still continues to follow up the children born in Newcastle. Previous work produced BMI data for 688 children at the age of 9 years; 628 at the age of 13years and 412 at the age of 50 years. Whilst some significant differences are seen, strongest for the older age-group, suggesting that there is some tracking of obesity into adulthood we can also see that many obese adults were not obese children (Wright *et al.,* 2001).

In the Bogalusa Heart Study (Freedman *et al.,* 2001), 77% of overweight children became obese adults whilst only 7% of normal weight children became obese adults. In their systematic review of the literature published up until 2007, Singh and colleagues found that all of the studies included in their review reported increased risk for overweight or obese children and adolescents to become overweight or obese as adults. The studies also showed that persistence of overweight was greater with increasing level of overweight and that persistence of weight status increased with age (Singh *et al.,* 2008).

A review of the literature suggests that people who were obese as children but then were a healthy weight as an adult were not at any greater risk of cardiovascular disease (CVD) than those who were not obese as a child (Lloyd, Langley-Evans & McMullen, 2010). Indeed researchers have reported that it is children in the lowest BMI decile as children who go on to become obese adults, who have the greatest risk of having a high blood pressure (Li, Law & Power, 2007).

From these tracking studies one

can conclude that if overweight and obesity do not persist into adulthood then the adverse health outcomes can be prevented particularly if the interventions can target adolescents. However many overweight or obese adults were not overweight or obese as children and indeed some may have been quite lean. This latter group should not be overlooked as they may be at even greater risk of metabolic complications associated with a high BMI in adulthood (Lloyd, Langley-Evans & McMullen, 2012).

Whilst there is a wealth of published literature related to obesity we know very little about what actually works at a population level and for the different age-groups to prevent, manage and treat obesity across the different life stages. For adults with BMIs above 35kg/m^2, particularly for those with co-existing type 2 diabetes, bariatric surgery is currently considered as the only effective option, (Welbourn *et al.,* 2016), but requires careful clinical management and monitoring given the invasiveness of the procedures. Bariatric surgery offers effective treatment, yet it is taken up by less than 1 % of those who could benefit from it (Welbourn *et al.,* 2016).

The focus of this thesis and extended abstract is on community-based approaches to the prevention and treatment, and the included papers have all examined weight management in community rather than clinical settings. This makes the findings much more meaningful to the quest for effective solutions to the current obesity epidemic and of interest to public health practitioners. Also the interventions demonstrate the power of working collaboratively with industry and thinking outside of the traditional biomedical/NHS model. Given the high prevalence of obesity in most population age-groups there is a need to challenge traditional concepts and look towards more novel and scalable approaches. The author fully accepts that there is not one solution which will work for everyone but that it is vital to aim to deliver chronic disease healthcare using a biopsychosocial framework.

The full list of published works put forward to support this thesis is presented in Table 1.1 with accompanying papers and abstracts in Appendices 1&2 respectively.

<u>Table 1.</u> <u>Papers put forward</u>

Paper	Study design/Aim of study	Data reported	% contribution
1) Lavin, J.H., **Avery. A**., Whitehead. S.M., Rees. E., Parsons. J., Bagnall. T., Barth. J.H. & Ruxton. C.H.S. (**2006**). Feasibility and benefits of implementing Slimming on Referral service in primary care using a commercial weight management partner. *Public Health*, 120(9): 872-881	Prospective longitudinal feasibility study examining the potential of referring obese patients from primary care to a commercial slimming organisation. N=107	Mean weight and BMI changes for both women and men; attendance data; mental well-being and ability to self-fund after the 12 week referral period.	60%
2) Pallister, C., **Avery, A**., Stubbs, J. and Lavin, J. (**2009)**. Influence of Slimming World's lifestyle programme on diet, activity behaviour and health of participants and their families. *Journal of Human Nutrition and Dietetics*, 24(4): 351-358.	Use of independent market research data using self-reported observational changes to determine changes in dietary and activity behaviours and the health of people since accessing support from a commercial slimming organisation N= 2812	Changes in food choices, activity levels, health and well-being. Including changes for other members in the family	35%
3) Avery, A., Pallister, C., Allan, J., Stubbs, J. and Lavin, J. (**2012**). An initial evaluation of a family-based approach to weight management in adolescents attending a community weight management group. *Journal of Human Nutrition and Dietetics*, 25(5):469-76.	Retrospective evaluation of a family based approach for weight management in young people aged 11-15 years Quantitative survey and analysis of weekly weight record cards. N=106	Mean weight and BMI z score change. Acceptability of using adult weight management groups to support adolescents.	80%
4) Stubbs, J., Pallister, C**., Avery, A**., Allan, J. and Lavin, J. (**2012**). Weight, body mass index and behaviour change in a commercially run lifestyle programme for young people. *Journal of Human Nutrition and Dietetics*, 25(2): 161-166	On-line survey; quantitative and qualitative data collection to determine whether a family based approach to weight management can influence behaviour and weight change in 11 – 15 year olds. N = 79	Mean weight and BMI z score change. Self-reported changes in dietary and physical activity behaviours.	20%

<u>Table 1</u><u>. Papers put forward</u>

Paper	Study design/Aim of study	Data reported	% contribution
5) Avery, A., (**2012**). Managing obesity in young adults. *Practice Nursing 23(3): 239-242.*	A review aimed at practice nurses emphasising the importance and discussing the possible opportunities to discuss weight management with young adults using brief interventions.		100%
6) Brown, A., **Avery, A.,** (**2012**). Healthy weight management during pregnancy: what advice and information is being provided. *Journal of Human Nutrition and Dietetics 25(4): 378-387.*	Observational data (quantitative and qualitative) analysis to explore what advice pregnant women from different BMI categories received about healthy weight management. N=60 (women recruited via NCT)	Number of times women weighed during pregnancy and by whom; what advice given and by whom; what advice women would have liked. Comparison of all data between BMI groups.	50%
7) Stubbs, R.J., Brogelli, D., Pallister, C., **Avery, A**., McConnon, A. and Lavin, J.H. (2012). Behavioural and motivational factors associated with weight loss and maintenance in a commercial weight management programme. The Open Obesity Journal. 4, 35-43.	This study considers self-reported behaviour changes associated with weight loss (WL) and WL maintenance. N=292, two samples; WL maintainers and SW members who had taken part in the Diogenes study. Use of 5pt Likert scales or check boxes. Use of correlations between specific behaviours and weight change and regression model analysis.	Reasons (e.g. different aspects related to feeling healthier, level of confidence in being able to make changes, to please others, for special occasions) for losing and maintaining weight loss. Importance of not feeling hungry.	15%
8) Stubbs, R.J., Brogelli, D.J., Allan, J., Pallister, C., Whybrow, S., **Avery, A**. and Lavin, J. (**2013**). Service evaluation of weight outcomes as a function of initial BMI in 34,271 adults referred to a primary care/commercial weight management partnership scheme. *BMC Research Notes*, 6:161 doi:10.1186/1756-0500-6-161 Related paper included in Appendix 1	Service evaluation data; use of regression analysis with adjustment for age and gender to determine whether commercial slimming organisations successfully support people with higher starting BMIs. N= 34,271	Absolute and % weight losses for different BMI categories.	15%

Table 1. Papers put forward

Paper	Study design/Aim of study	Data reported	% contribution
9) Jewell, K., **Avery, A**., Barber, J., Simpson, S.A. (**2014**). The healthy eating and lifestyle in pregnancy (HELP) feasibility study. *British Journal of Midwifery* 22(10) 625-634. Related presentation material included in Appendix 3	Non-randomised single arm feasibility trial, following the Medical Research Council(MRC) framework for complex interventions to inform the need, design, processes and outcomes for a future definitive randomised controlled trial. N=148	Acceptability of intervention using both attendance and qualitative data analysis. Gestational weight gain, baby birth weights, mode of delivery, Apgar scores, mode of infant feeding.	50%
10) John, E., Cassidy, D. M. Playle, R. Jewell, K. Cohen, D. Duncan, D. Newcombe, R.G., Busse, M. Owen-jones, E. Williams, N. Longo, M. **Avery, A**. Simpson, S. A. (**2014**) Healthy eating and lifestyle in pregnancy (HELP): a protocol for a cluster randomised trial to evaluate the effectiveness of a weight management intervention in pregnancy. *BMC Public Health* 14:439.	Protocol paper describing the effectiveness of a theory-based intervention developed for obese pregnant women. If successful the intervention will equip women with the necessary knowledge and skills to enable them to make healthier choices for themselves and their unborn child N=590	Primary outcome; 12 month post natal weight compared to baseline weight at booking. Secondary outcome measures to include gestational weight gain, birth weights, mode of infant feeding, adverse events, dietary and activity behaviours.	10%
11) Avery, A., Bostock, L., McCullough, F. (**2015**). A systematic review investigating interventions that can help reduce consumption of sugar-sweetened beverages in children leading to changes in body fatness. *Journal of Human Nutrition and Dietetics* 28 (Suppl. 1): 52–64 DOI: 10.1111/jhn.12267 *Abstract presented at the BDA Research Symposium 2014. Material incorporated in the PEN guidance.*	A systematic review following the PRISMA statement for study inclusion. Research question: to clarify which interventions aimed at children help to reduce the consumption of SSBs and whether these interventions lead to subsequent changes in body fatness?	Sugar-sweetened beverage intake. Body fatness measures in children. The methods of delivery are considered to help practitioners plan future interventions in this area.	50%

<u>Table 1. Papers put forward</u>

Paper	Study design/Aim of study	Data reported	% contribution
12) Stubbs, J., Hillier, S. Pallister, C., **Avery, A.,** McConnon, A., Lavin. (**2015**). Changes in self-esteem in participants associated with weight loss and maintenance of commercial weight management programme. *Obesity & Control Therapies* 2(1): 1-5. Abstract presented; **Avery, A**. et al., (2013). Changes in self-esteem associated with weight change in longer-term participants of a commercial weight management programme. Obesity Facts 6(1):178	This study examines associations between weight loss, its maintenance and self-esteem. Use of the Rosenberg self-esteem questionnaire. N=292	Weight loss, % weight change, BMI, self-esteem (self-worth, self-satisfaction, self-respect, self-efficacy)	20%
13) Avery, A., Langley-Evans, S., Harrington, M., Swift, J. (**2016**). Setting targets leads to greater long-term weight losses and 'unrealistic' targets increase the effect in a large community based commercial weight management population. *Journal of Human Nutrition and Dietetics.* DOI: 10.1111/jhn.12390 *Abstract presented at the ASO annual conference 2015.*	Use of secondary data, electronically reported. This study investigates the effect of number and size of weight-loss targets on 12month weight outcomes in a community sample of obese adults (n=24,447). Use of linear regression to determine the importance of target setting in predicting weight loss.	% weight loss at 12 months the dependent variable. Size of first target as a % of starting weight; length of attendance; age; sex; starting weight/BMI as independent variables. Size of targets split into quintiles to add further depth to the analysis	

Table 1. Papers put forward

Paper	Study design/Aim of study	Data reported	% contribution
14) Avery, A., Anderson C., McCullough, F. (**2017**). Associations between children's diet quality and watching television during meal or snack consumption: a systematic review. *Maternal and Child Nutrition.*e12428. https://doi.org/10.1111/ mcn.12428 *Abstract presented at the BDA Research symposium, 2014*	A systematic review following the PRISMA statement for study inclusion. This review examines the influence that eating whilst watching TV has on the food and drink consumed by children and influence on BMI as a secondary outcome. It considers the role of parents and socioeconomic background as key variables.	Food and drink intake BMI Parental role Socioeconomic status	50%
15) Avery, A., Nagar, R., Hillier, S., Pallister, C., Lavin, J., Mellor, D**.** (2017). Impact on weight and glycaemic control in people with diabetes attending a group- based commercial weight management organisation. *Practice Nursing* 28(2): 60-66. *Abstracts presented (*Appendix 2*).*	A cross-sectional online survey of people (n= 620) with diabetes attending a weight management programme. Data statistically analysed to determine % of individuals meeting targets for weight reduction and glycaemic control.	Self-reported changes in HbA1c%, physical activity levels, Age, sex, type of diabetes, medication taken and level of healthcare professional support. Electronically recorded weight data used for the analyses.	50%
16) Avery, A., Hillier, S., Pallister, C., Barber, J., Lavin. J. (2016). Factors influencing engagement in postnatal weight management and subsequent weight and well-being outcomes. *British Journal of Midwifery 24(11):2-8.*	Online questionnaire hosted on the SW member website to investigate factors influencing engagement in postnatal weight management and subsequent weight loss and well-being of women up to two years postnatally. Quantitative data analysis. N=590	Weight loss, % weight change, BMI, attendance, influence of time of attendance after child-birth on weight outcomes, influence of a range of factors on desire to lose weight postnatally, self-reported changes in self-esteem, self-confidence. Accessibility.	40%

This supporting commentary will contextualise the research undertaken by:

- Presenting background information about obesity – prevalence and key time periods across the life-course to prevent, manage and treat obesity.
- Examining the associations between a raised BMI and chronic diseases which increase the health burden.
- Examining the key lifestyle factors influencing obesity prevention and treatment.
- Examining the different behavioural theories which may be chosen to underpin a weight management intervention.
- Discussing the development of partnership working between the public and private sectors in weight management.
- Describing the methodological considerations when researching weight management in community settings.
- Making recommendations for future research in this field and how services can be further developed.

Throughout the commentary body mass index (BMI) will be used as the measure for overweight and obesity in adults. The classifications shown in Table 1.2 are used throughout. These are based on a report by the International Obesity Task Force (2000), for adults of Caucasian origin.

Classification	BMI kg/m^2
Normal/healthy range	18.5 -24.9
Overweight/pre-obese	25.0 – 29.9
Obese class 1	30.0 – 34.9
Obese class 2	35.0 – 39.9
Obese class 3/ morbid obesity	≥40.0

Table 1.2. Classification of overweight and obesity based upon body mass index (BMI).

For children age specific BMI centiles and centile change based on the UK 1990 Growth charts or the International Obesity Task Force (IOTF, Cole *et al.,*

2000) charts have been used to compare data with other published studies. These standard reference charts are described later in the thesis. The WHO Child Growth standards (www.rcpch.ac.uk), which describe the optimal growth for healthy, breastfed infants, were introduced in 2009 and have been less widely used in epidemiological studies reported to-date.

2. Obesity – prevalence and key time periods across the life-course to both prevent and manage obesity

2.1 Adults: Increasing prevalence and future predictions

The World Health Organisation (WHO) estimates that there are around 1.9 billion people in the world who are overweight, of whom at least 600 million are obese (WHO, 2016). In some countries, including the UK, the rates of adult obesity have almost trebled over the last three decades and being overweight has become the norm (Ng *et al.,* 2014; NCD-RisC, 2016). The Foresight Tackling Obesities: Future Choices report (Butland *et al.,* 2007), commissioned by the Chief Scientific Adviser to HM Government, predicted that by the year 2050, 60% of UK males and 50% of females could be obese with the proportion of men having a healthy BMI decreasing from about 30% as at present to just 10% by 2050. The proportion of women in the healthy weight BMI category could decrease from just over 40% to approximately 15%.

In the UK, as in other high-income countries, obesity is associated with socioeconomic deprivation, with a higher prevalence in the lowest income quintile (Law *et al.,* 2007). Previous research suggests that this gradient is embedded, with little evidence of change over time (White *et al.,* 2007). Data derived from longitudinal analyses suggest that social disadvantage accumulated throughout the life course has an impact on widening inequalities in relation to obesity in adulthood with the trend being particularly marked amongst women (Law *et al.,* 2007).

2.2 Age-related prevalence in adults and health risk

Health Survey for England (HSE) data shows how the prevalence of overweight and obesity varies with age and that the highest prevalence of obesity is in both men and women in the 55 – 64 age brackets, where the mean BMI is 28.8 kg/m^2. However the increase is gradual and the numbers overweight and obese in the 25 -34, 35 -44 and 45- 54 age brackets are still significant with the mean BMI values being 26.3, 27.4 and 28.3 kg/m^2 respectively (HSE, 2015). Indeed young adults are at a high risk for weight gain as demonstrated by a mean increase in BMI from 24.1kg/m2 for 16 -24 to 26.2kg/m2 for 25 -34 year olds (HSE, 2015).

In the UK we have followed closely behind obesity trends in America. Findings from US government studies, for adults ages 25-74, the major weight gain was reported to be highest between ages 25-34 (NHLBI Working Group Report, 2005). In the Coronary Artery Risk Development in Young Adults Study (CARDIA), where the study participants were aged between 18 and 30yrs at baseline, the mean adjusted 20 year weight change ranged between +11.2 and +13.9kg for whites and between +17.8 and +19.4kg for blacks depending on diet quality. The weight gain was greater in the early to mid-20s (Zamora *et al.,* 2010).

Tracked data from the Health Survey for England presented in the UKs Foresight report (Butland *et al.,* 2007) clearly shows a shift in the proportion of both men and women in the different BMI classifications across different age groups. There is a clear reduction in the numbers who are of a healthy weight and increases in the numbers who are both overweight and obese from 16-24yrs upwards until the prevalence peaks, 55-64yrs in men and 65-74yrs in women. From the predictive modelling techniques used by the Foresight team it is predicted that for 21-30yr old males the prevalence of obesity is going to increase from 15% in 2007 to 42% in 2050 and the figures for females are 13% and 30% respectively (McPherson *et al.,* 2007). The average young adult is predicted to gain an average of between 0.5-1.0kg each year if there are no changes to lifestyle behaviours (Hill *et al.,* 2003). This would be the consequence of consuming approximately 100 surplus kilocalories per day.

Data from the CARDIA study clearly demonstrated that maintaining a stable weight and healthy lifestyle during young adult years was associated with less progression of CVD risk factors and decreased risk of developing metabolic syndrome and subclinical atherosclerosis early in middle age. (Norman *et al.,* 2003). Waiting until middle age to treat CVD risk factors may not be the optimal public health approach. Drug therapy frequently fails to meet guideline goals (Meade, 2007), may produce side effects (Talameh & Kitzmiller, 2014), and adherence is often inadequate (Ho, Bryson & Rumsfeld, 2009). Irreversible damage may occur prior to treatment and having one or more risk factors may lower quality of life (Tylee *et al.,* 2016). Avoiding excess weight gain during early adult years may be pivotal in preventing adverse changes in risk factors and subsequent CVD and in reducing, delaying or negating the need for drug therapy in later life.

Endometrial cancer is a further example where weight management in early adulthood can have a significant impact on the subsequent development of the disease. Lu *et al.,* (2011) in their population-based case-control study, reported women who were overweight in their 20s or 30s and maintained their overweight status through life were at significantly higher risk of endometrial cancer than those who became overweight at ages 40-50s. Women with substantial weight gain (>35%) in their early adulthood (20s) developed the disease 10 years earlier than those without such weight change in early adulthood. Pregnancy is a significant factor in the development of obesity in women; many women retain cumulative weight gained over several pregnancies (Gunderson, 2009; Lipsky, 2012; Kirkegaard *et al.,* 2015). Women with high weight gain during pregnancy retain more weight at follow-up (Amorim *et al.,* 2007; Kirkegaard *et al.,* 2015).

Our study aimed at practice nurses, both identified some of the problems associated with obesity in young adulthood and suggests opportunities where the practice nurse may intervene including family planning sessions (**Avery**, 2012). The paper identified young adulthood as a period of change with increasing independence. During this period, we learn to prepare meals, moving away from home and living with partners or flat-mates, and starting new work or study lifestyles. Often all of these are combined with living on a relatively low income which may impact on food choices. Heavier work and study commitments combined with less structured opportunities for physical activity all have an impact on the amount of exercise undertaken with young adults becoming more sedentary. Freshers 15 has been used to describe the average fifteen pounds gained by undergraduate students gain during their first academic year (Strong *et al.,* 2008). Alcohol may add a significant number of calories to the overall energy intake in this age-group (Lukasiewi *et al.,* 2005). Less sleep also has been found to be positively correlated to increases in body weight (Horne, 2008). Young adults are likely only to attend primary care for limited appointments and there might not be an obvious reason for discussing weight management. However, the evidence does suggest that brief interventions can lead to at least short term changes in body weight and behaviour if they are focused on both diet and physical activity, incorporate behavioural change techniques and encourage the person to seek support from other people, (NOO, 2011). Therefore, all contact opportunities should be considered. These may include;

- Family planning
- Holiday vaccinations
- Vaccinations prior to commencing university e.g. meningitis
- Review of medications e.g. for asthma, migraines, skin conditions
- Injuries where dressings might need to be replaced
- Mental health issues

2.3 Children and adolescents: prevalence data

In parallel with the increasing prevalence of overweight and obesity in the UK adult population there has been an increase in childhood obesity levels (HSE, 2015).

In children, the relationship between BMI and being overweight or obese is dependent on age, height and gender variables and the classification must use age-specific and sex- specific references. There have been a number of different ways of defining childhood obesity – in the UK it has been common to use the 85th and 95th centiles from the 1990 UK Growth charts but the IOTF put forward an alternative method using data collected from children from six countries. The IOTF identifies the centile in the dataset corresponding to a BMI of 25 or 30 (overweight or obese) at the age of 18 and then tracking backwards to birth, makes the assumption that this is the overweight or obese centile. It has been proposed, based on sensitivity and specificity analysis, that the IOTF cut off may underestimate obesity prevalence and that this effect is greater for boys than girls (Reilly, Dorosty & Emmett, 2000).

Applying the IOTF classification to the HSE raw data for 2004, 10% of 6-10 year old boys and girls and 5% of 11-15 year old boys and 11% of 11 – 15 year old girls were in the obese category with the Foresight predicted levels for the years 2025 and 2050 presented in Table 1.3 (Butland *et al.,* 2007). Whilst not directly comparable because of the different methodologies used, 2014 HSE data based on the UK growth charts is included.

	Age (years)	2004	2014*	2025	2050
Boys	6-10	10%	18%	21%	>35%
	11-15	5%	22%	11%	23%
	All under 20	8%	19%	15%	25% (70% overweight or obese)
Girls	6-10	10%	17%	14%	20%
	11-15	11%	19%	22%	35%
	All under 20	10%	16%	15%	25% (55% overweight or obese)

Table 1.3; percentage of children obese, actual and predicted. (IOTF) criteria using Foresight Modelling and a 95% Confidence interval (Butland *et al.,* 2007). 2014* data derived from HSE reporting (HSE, 2015) and using UK Growth charts.

The latest National Child Measurement Programme (NCMP) data for the 2014/15 school year and representing 1,141,859 valid measurements or 95% of the eligible population does provide some hope that preventative strategies are being effective. In the reception age-group, (4-5years), just over one fifth (21.9%) were recorded as being either overweight or obese and this was lower than the 22.5% reported for 2013/14. For year 6 children (10-11years) the equivalent data reported were 33.2% and 33.5% respectively. But the health inequality is striking with the obesity prevalence levels almost double in children from the most deprived areas compared to those from the least deprived, an association also seen in adult women. (NCMP, 2015; HSE, 2015).

2.4 Parental influence on childhood obesity prevalence

Level of maternal education attainment is often used as an indicator of socioeconomic status. Data from the Avon Longitudinal Study of Parents and Children (ALSPAC) reported the differences in BMI trajectory between maternal education groups which started to emerge at 4 years and widened with increasing age. By age 8 years, there was a clear gradient in girls; the higher the educational attainment of the mother, the lower the BMI trajectory. For boys at age 8 years, only those with mothers within the highest educational attainment differed from the other 3 groups. At age 10 years, the mean BMI difference between the highest and lowest maternal education categories was 0.89 kg/m^2 for girls and 0.38 kg/m^2 for boys (Emmett & Jones, 2015).

The most significant predictor of childhood obesity is parental obesity where obesity in a parent increases the risk of childhood obesity by 10%. At age 7yrs, 11% of children from the ALSPAC study had a parent who was obese prepregnancy and these children were more likely to be overweight (21%) or obese (10%) at age 7 years compared with children of normal-weight parents (15% and 3%, respectively). In a fully adjusted model, the risks of obesity were OR, 10.44; 95% CI, 5.11–21.32; $P < 0.001$ when both parents were obese pre-pregnancy (Emmett & Jones, 2015). Having two obese parents is related to greater weight gain from birth to 24 months (Fuemmeler *et al.,* 2013). Whitaker *et al* (1997) suggest that parental obesity more than doubles the risk of adult obesity among both obese and non-obese children less than 10 years of age. Whether this generational dimension is the result of the interaction of many biological, social and/or environmental factors, it is important to break the reinforcing pattern.

Our study entitled 'Influence of Slimming World's lifestyle programme on diet, activity behaviour and health of participants and their families' used independently collected market research data and showed that if parents engaged in weight management programmes that encouraged them to change their lifestyles, including dietary and activity patterns, then this could indirectly influence the rest of their family's lifestyle (Pallister, **Avery**, Stubbs *et al.,* 2009). A systematic review (Avery *et al*., 2016) presented data that showed that pre-school children limited to ≤2 hours per day of screen viewing were 23% less likely to be obese, but that eating whilst watching TV did influence food and drink choice. Whilst the number of days that meals were eaten as a family was positively associated with servings of fruits and vegetables, having dinner as a family did not overcome the adverse effects of having the TV on at mealtimes (**Avery**, Anderson & McCullough, 2016).

2.5 Public health importance of breastfeeding

It is well established that breastfeeding protects against obesity in later life. Owen *et al* (2005) in their quantitative review showed an inverse association even when the major confounding factors (parental obesity, maternal smoking and socioeconomic status) were adjusted for. Armstrong & Reilly, (2002), had shown the same association in their large Scottish sample of infants who were exclusively breastfed versus exclusively formula fed at the 6-8 week post-natal check-up. The adjusted odds ratio for obesity was 0.70 (95%CI 0.61-0.80), with adjustments for socioeconomic status, birthweight and sex). It is highly likely that there is a dose-response effect with longer durations of breastfeeding having the greater influence on subsequent obesity levels (Arenz *et al.,* 2004). But how long is the optimal duration of exclusive breastfeeding is highly debated. Currently the WHO (2001) recommends exclusive breastfeeding for the first six months of life. Based on the Belarusian study, a large cluster randomised trial, six months of exclusive breastfeeding conferred no benefit (versus three months of exclusive breastfeeding followed by continued partial breastfeeding through six months) on height, weight, or body mass index at 6.5yrs of age (Kramer & Kakuma, 2012).

The biological mechanisms behind the protective effect of breastfeeding against obesity include regulation of energy and protein intakes, insulin secretion, and an influence on adipocyte development and fat deposition. Formula-milk feeding stimulates a higher postnatal growth velocity whereas breastfeeding promotes slower growth. The higher protein content of formula baby milk compared to the lower protein content in breastmilk is responsible for the increased growth rate and adiposity during this influential period of infancy. Breastfeeding, on the other hand, has a protective effect on child overweight and obesity by inducing lower plasma insulin levels, thereby decreasing fat storage and preventing excessive early adipocyte development (Oddy, 2012). Plausible biological mechanisms underlying the protective effect of breastfeeding against obesity are based on the unique composition and the metabolic and physiological responses to human milk.

Any intervention which aims to either prevent excessive gestational weight gain, or to promote loss of weight retained in the postnatal period, should view breastfeeding rates as an important secondary outcome. The Healthy Eating and Lifestyle in Pregnancy (HELP) feasibility study', was a single-arm feasibility trial which recruited women with a BMI ≥ $30kgm^{-2}$ (mean $37.4kgm^{-2}$). The HELP feasibility study found that at 28 days post-delivery 70% of the mothers were still breastfeeding despite obese women finding it more difficult to breastfeed compared to non-obese (Jewell, **Avery**, Barber *et al.,* 2014). This outcome compared favourably with the then 44% Welsh breastfeeding rate at 5-6 days postpartum (Welsh Government, 2012). Similarly, the Bumps and Beyond intervention study (McGiveron *et al.,* 2015) found that obese women participating in a programme which aimed to limit antenatal weight gain were significantly more likely to initiate breastfeeding than women who did not participate.

2.6 Pregnancy and the significance of gestational weight gain (GWG)

Around 1 in 5 women receiving antenatal care are obese (Heslehurst *et al.,* 2010). In Europe and the US approximately 50% of healthy weight and 60-70% of overweight or obese women gain more weight than is routinely advised (Phelan *et al.,* 2011). Pregnancy is a significant factor in the development of obesity in women, many women retain cumulative weight gained over several pregnancies and women with high weight gain during pregnancy retain more weight at follow-up (Amorim *et al.,* 2007: Gunderson, 2009; Lipsky, 2012: Kirkegaard *et al.,* 2015). Maternal obesity and excess gestational weight gain both increase the risk of infants being born large for gestational age (LGA) with birthweights above 4000g referred to as macrosomia. Scott-Pillai *et al.,* (2013), in their large cohort from Belfast found that mothers with a BMI ≥ $40kgm^{-2}$ were 3.2 times more likely to give birth to an infant with a birthweight above 4000g. The immediate associated risks for the mother and neonate include gestational diabetes, caesarean delivery, shoulder dystocia, congenital abnormalities, fetal and neonatal death and still-birth (Sebire, Jolly & Harris, 2001; Cedegren, 2004; Bhattacharya *et al.,* 2007; Chu, Kim & Lau, 2007: Heslehurst, Simpson & Ells, 2008). Increased intrauterine growth may also programme the infant to be more susceptible to obesity in later life. Excess weight gain during pregnancy is associated with child obesity at 3 years and in adolescence (Oken *et al.,* 2007; Oken *et al.,* 2008).

Thus, in terms of preventing obesity, it is important for mothers to be a healthy weight prior to conception and to discourage excessive gestational weight gain (GWG). However, there is limited evidence available to determine what a healthy weight gain should look like for women of any BMI classification. UK guidelines on appropriate weight gain during pregnancy are lacking but the American Institute of Medicine (IOM) guidance is often used with the BMI specific recommended weight gains of 7.0-11.5 kg for women overweight and 5.0-9.0 kg for women obese at the start of pregnancy (IOM, 2009). Using population-based data for 5125 Greek children, it was found that excessive GWG, (defined using IOM guidelines), was associated with a significantly higher risk of greater infant size at birth and a higher BMI status ate the ages of two and eight years (Mourtakos *et al.,* 2016).

A limitation of the IOM guidelines is that there is no separate guidance for women who commence the pregnancy morbidly obese with a BMI ≥40kgm^{-2}.

Kiel *et al* (2007) in their study of 120,251 women found that, for women with a baseline BMI ≥40 kgm^{-2}, outcomes for preeclampsia, caesarean delivery and large for gestational age (LGA) babies were much improved if the mothers lost between 2-9lbs or even lost ≥10lbs. Only in the case of small for gestational age (SGA) babies was there a slightly impaired outcome with gestational weight losses greater then 10lbs. Collectively the data showed minimal risks for all four of their outcomes, for example where the risk of LGA and SGA births lines intersect, equated to a weight gain of 10-25lbs for class1 (BMI≥30) obese women, a gain of 0-9lbs for class 2 (BMI≥35) obese women and a loss of 0-9lbs for class3 (BMI≥40) obese women.

Based on limited evidence and without guidelines for appropriate weight gain, the National Institute for health and Clinical Excellence (NICE) 2010 guidance on weight management before, during and after pregnancy recommends that restrictive diets and weight loss during pregnancy should be avoided due to a small increased risk of SGA babies. If pregnant women improve their eating habits and physical activity levels they may improve the nutritional quality of their diet but lose some weight. The HELP feasibility study included birthweight data for 132 of the infants. The mean birthweights were almost identical for those born to mothers who lost small amounts of weight during pregnancy compared to those who gained small amounts, (3.59 v. 3.53kg), with similar numbers of LGA babies but a fewer number of SGA babies born to mothers losing weight. Where maternal weights were available 3 weeks before delivery, a mean gestational weight gain of 4.3(0.7)kg was reported and for the total sample, 24 women gained weight within the IOM guidelines, 96 gained less and 7 gained more (Jewell, **Avery**, Barber *et al.,* 2014).

The LIMIT study, (Dodd *et al.,* 2014), where healthy eating and activity advice was offered to pregnant women who were overweight or obese showed a significant reduction in the number of babies born over 4kg in weight. Whilst the relatively intensive dietetic advice and assistance to adopt a healthy diet and regular exercise during pregnancy led to an 18% reduction in the chance of a baby being born over 4kg, there was no significant difference in the maternal weight change between the intervention and control groups. The UK Pregnancies and better eating trial (UPBEAT), where pregnant women were randomised to either standard care or eight behavioural intervention sessions delivered by a health trainer (Poston *et al.,* 2015), found that there was no difference in the number of LGA babies or risk of developing gestational diabetes. However the intervention did result in improvements seen in the maternal diet, physical activity levels and reduced gestational weight gain compared to standard care.

Health care professionals are often uncomfortable raising the issue of maternal obesity (Smith *et al.,* 2012). Our study 'Healthy weight management during pregnancy: what advice and information is being provided', aimed to explore the information and advice women of different pre-pregnancy BMI classifications were receiving about managing their weight during pregnancy and what they would like to receive**.** Over half of the participants said that they would like some form of information or advice on the recommended weight gain during pregnancy and perhaps the appropriate weight gain for each trimester. Some also would have liked their weight to be monitored during the pregnancy and there was a perception that no-one bothered with weight monitoring anymore – currently weight is only routinely recorded at the first booking appointment. The participants who were either overweight or obese did not seem to receive any additional support (Brown & **Avery**, 2012). The HELP studies, both the feasibility study and the main trial, (as described in the HELP study protocol paper – John *et al.,* 2014), have ensured that training has been provided before the intervention to increase midwife's confidence in raising the issue of weight management and resources have been produced to support this important step .

Pregnancy is a key time of change in women's lives and is a potentially important point at which to influence women's health behaviours as well as other family members given the antenatal period involves regular contact with health care professionals who can provide advice and monitoring. It is commonly cited that many women do find pregnancy an excuse to 'relax' their eating habits (Olander *et al.,* 2011; Swift *et al.,* in press) and eat more than the additional 200kcal recommended during the third trimester only. They may be naïve if it is their first pregnancy and think that it is going to be easy to lose excess weight gained after pregnancy (Chu *et al.,* 2009). In one study, the majority of obese women taking part in either semi-structured interviews or focus groups in London felt that pregnancy was not the best time to address weight (Khazaezadeh *et al*., 2011). General concerns about pregnancy and complications were felt to be the priority by the service-users. Instead those interviewed reported that the motivation for weight management efforts would be higher following childbirth or prior to conception (Khazaezadeh *et al*., 2011). This finding is reinforced (Hodgkinson, Smith & Wittkowski, 2014) where it was concluded that postpartum is a period where women need more support. As such, the evidence is unclear if pregnancy can be considered as an opportune time to encourage weight management.

2.7 Post-natal weight retention

Research, from a number of countries, suggests mean weight gains of between 0.4 and 3.8kg as a result of pregnancy up to two and a half years post-delivery (Gunderson and Abrams, 1999, Linne *et al*., 2002). Gunderson & Abrams (1999) claim that whilst most women do manage to return to their pre-pregnancy weight within 1 year of delivery, 15-20% retains ≥5kg. However Linné and colleagues have presented data from Sweden where 73% of female patients presenting at the obesity clinic, identified pregnancy as an important trigger for weight retention with the majority having retained more than 10kg after each pregnancy (Linne *et al*., 2002). In the Stockholm Pregnancy and Women's Nutrition (SPAWN) longitudinal study weight retention at the end of the postpartum year was the main predictor of being overweight 15 years later (Linne *et al*., 2004).

A current lack of services to tackle maternal obesity, with inconsistency in the supporting evidence as to what works, and no clear pathway to sensitively raise the issue and offer appropriate support are cited as barriers to weight management during pregnancy (Dodd, Crowther & Robinson, 2008; Oteng-Ntim *et al*., 2010). Whilst in the ideal world it is preferable to be able to offer choice, perhaps the post-natal period may be the preferred time to offer weight management support to women and to enable them to commence any subsequent pregnancies at a healthier weight. However postnatal trials from non UK settings report methodological issues such as small numbers (Pligt *et al.,* 2013) and in UK deprived community settings, high loss to follow up (31%, Craigie *et al* 2009). Montgomery *et al.,* (2011), in their phenomenological study looking at the reality of losing weight after childbirth found that women do struggle to balance the demands of postpartum life with weight management. There are time and motivation issues, a need for support and changes in self-esteem related to their body image (Montgomery *et al.,* 2011).

Our paper entitled, ‘Factors influencing engagement in postnatal weight management and subsequent weight and well-being outcomes’ (**Avery**, Hillier, Pallister, Barber & Lavin, 2016), found that for the 1015 women who completed the on-line survey, a significant mean BMI reduction (2.8 ±0.2) was achieved though attendance at community weight management groups. Women joined the weight management groups at various times during the postnatal period and whilst 46% joined between 6-26 weeks after giving birth, 23% waited until 1 year after giving birth. The main motivations to lose weight were ‘to improve how I feel about my body size and shape’ and ‘improve my self-confidence’ rather than being health related. The postnatal period can be a challenging time in terms of women’s well-being, self-esteem and body image and potential pressures to lose weight but participants attending the weight management group reported improvements in self-confidence, self-esteem, wellbeing and confidence in body shape and size alongside their weight loss. They also found the supporting groups, both time and location, to be convenient and accessible (Hillier *et al.,* 2016).

Thus pregnancy, breastfeeding, early growth, childhood and being a parent are critical periods associated with the long term risk of being overweight or obese and offer opportunities for interventions to both address and prevent obesity.

3. Obesity and the risk of chronic disease

One of the challenges for public health practitioners is that the public and the media focus on excess weight as an appearance issue rather than the effect on health, physical and psychological. Obesity leads to a number of chronic health conditions for people of all ages, children and adults alike, adversely affecting people’s quality of life and leading to rising financial and social burdens to both the individual and to the wider society (Lim *et al.,* 2012).

3.1 Physical health

Type 2 diabetes (T2DM) is directly related to the metabolic abnormalities which occur as a consequence of overweight and obesity. The risk of developing T2DM is about seven times more likely for people who are obese compared to those who are a healthy weight (Abdullah *et al.,* 2010).

Hyperinsulinaemia, hyperglycaemia and hyperlipidaemia are characteristic pre-cursors of both T2DM and cardiovascular disease. The transition from pre-diabetes to T2DM in adults is usually a gradual progression that occurs over a period of 5-10 years (Weiss *et al.*, 2005). Fundamental to the development of T2DM is a level of insulin resistance (Reaven, 1995). When the muscle and liver become resistant to the action of insulin, as is often the case in overweight and obese individuals, the pancreas tries to compensate by producing more insulin to maintain normal blood glucose levels and this is characterised by hyperinsulinaemia. When pancreatic function is not able to maintain this level of activity, blood glucose levels gradually rise and in the early stage of declining function this would be associated with impaired glucose tolerance. Obesity is probably the most important cause of insulin resistance and impaired glycaemic control (Pi-Sunyer, 2002). Insulin resistance and hyperinsulinaemia also impair lipid metabolism and are associated with higher circulating triglyceride and free fatty acid levels and lower levels of circulating HDL-cholesterol, the latter being beneficial in reducing the risks of raised cholesterol levels (Kahn, Hull and Utzschneider, 2006).

Approximately a quarter of some adult population groups may be found to have pre-diabetes, according to World Health Organisation guidelines, on screening (Abraham & Fox, 2013). Some ethnic groups are genetically more sensitive to abdominal adiposity and the metabolic changes are seen at a lower BMI and it is recommended that different BMI 'cut off' values are used with different ethnic groups (NICE, 2013).

T2DM is now being seen in children as a consequence of the increase in overweight and obesity prevalence and the metabolic changes associated with obesity (Dabelea *et al.,* 2014). Early onset of T2DM is associated with an increased risk of morbidity and mortality during the most productive years of life. Microvascular complications can be present at time of diagnosis. Adolescents with T2DM are also prone to secondary obesity-related complications, including hypertension, non-alcoholic fatty liver disease, and metabolic syndrome, all of which are associated with increased cardiovascular risk. The earlier that a person develops T2DM the earlier and more likely they are to be affected by the associated macro- and microvascular complications. This has a significant impact on the quality of their life (Pinhas-Hamiel & Zeitler, 2007).

Given that 80-90% of people with T2DM are either overweight or obese, weight loss and weight loss maintenance have become the primary focus of lifestyle management of T2DM (PHE, 2014). Our paper entitled, 'Weight losses and improved glycaemic control achieved in people with diabetes attending a commercial weight management organisation' showed that support provided, via weight management groups, led to clinically significant weight losses and improvements in HbA1C (the marker for glycaemic control) alongside reductions in diabetes medications. Of the 620 people with diabetes in this study, a mean loss of 10.0±8.0% bodyweight was achieved with mean reduction in HbA1c of 18±21mmol/mol; 72.5% had lost >5% body weight after 12 weeks; 58.2% lost >10% body weight after 24 weeks and 51.5% had achieved a HbA1c of <48mmol/l, a level considered to be within the normal range (Mellor, Nagar, Hillier, Pallister, Barber, Lavin & **Avery**, 2016).

People who are overweight or obese are encouraged to lose 5 -10% of their weight in order to achieve clinical benefits such as improved glycaemic control. A weight loss of this magnitude is perceived as being both beneficial to health, achievable and sustainable. Wing *et al.,* (2011) looked at the benefits at one year of modest weight loss in improving cardiovascular risk factors in overweight and obese individuals with T2DM and did find significant improvements with weight losses of this size, but greater weight losses had greater benefits.

3.2 Psychological health

Psychological health may also be adversely affected by being overweight and obese (Wardle & Cooke, 2005). The National Obesity Observatory's report on 'Obesity and Mental Health' highlights the bi-directional associations between the obesity and depression. The relationships between actual body weight, self-perception of body weight and weight stigma are complex and vary across culture, age and ethnic group. The relationship is greater in women and the evidence is strong for teenagers and adults but less so for younger children (NOO, 2011). However the health related quality of life for severely obese children in a clinical setting was found to be very similar to children of the same age diagnosed with cancer (Schwimmer, Burwinkle & Varni, 2003).

Self-perception, rather than actual body weight, has the greater influence on psychological well-being (NOO, 2011). Weight can influence self-esteem and vice versa. High BMIs tend to be related to lower self-esteem in both adults and children (O'Dea, 2006; Wang *et al.,* 2009; Kiviruusu *et al.,* 2016). Self-esteem reflects a person's overall subjective emotional evaluation of his or her own worth and encompasses beliefs, (for example I can/cannot lose weight) and emotions such as despair, pride and shame (Rosenberg, 1979). Self-efficacy refers to an individual's belief in their ability to successfully change certain behaviours and to be able to maintain the behaviour change. Those with high levels of self-efficacy feel confident in their own ability to be able to achieve certain targets. Self-esteem and mental well-being are important outcome measures of any weight management programme. To sustain behaviour change, such as adopting healthier eating habits and increasing physical activity levels, self-esteem needs to be enhanced.

Our paper 'Changes in self-esteem in participants associated with weight loss and maintenance via a commercial weight management programme' used the Rosenberg questionnaire to measure self-esteem. In this sample of people who had achieved and maintained weight loss significant improvements were seen across all of the dimensions- 'I wish I could have more respect for myself', 'I feel I do not have much to be proud of', 'I am inclined to feel that I am a failure', 'I feel that I have a number of good qualities', 'I am able to do things as well as most other people', 'I feel I am a person of worth', 'I take a positive attitude towards myself', 'I feel I can achieve anything', 'On the whole I am satisfied with myself' (Stubbs, Hillier, Pallister, **Avery** *et al.,* 2015).

The paper 'Weight, body mass index and behaviour change in a commercially run lifestyle programme for young people', included health related behaviour change as one of the outcome measures. Whilst the changes in eating and activity levels were self-reported, the results demonstrate a belief in the young person's ability to make changes, particularly with respect to their greater confidence in engaging in team sports and increasing their fruit and vegetable intake. They were also more confident in going out and socialising with friends (Stubbs, Pallister, **Avery** *et al.,* 2012).

Mental well-being was reported in the original referral feasibility study, (Lavin, **Avery**, Whitehead *et al.,* 2006). Compared to a representative sample, obese patients had a lower level of 'well-being' before enrolment (using a validated questionnaire). Improvements in all aspects measured (feeling calm and peaceful, having a lot of energy, feeling downhearted and low) were seen in those attending both 12 weeks ($p= 0.001, 0.001, 0.015$ respectively) and 24 weeks ($p= 0.02, 0.001, 0.001$) at a commercial weight management organisation (CWMO). The emphasis of the training received by the lay people facilitating CWM is very much on developing behaviour change techniques and using a compassionate approach to promote self-worth (Stubbs *et al.,* unpublished/ in press).

4. Obesity and lifestyle factors

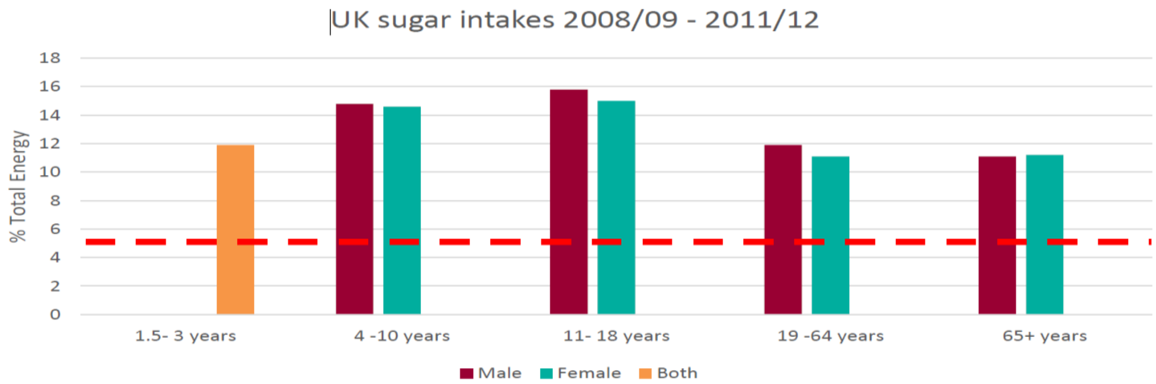
Whilst the causes of obesity are complex, for most population and age-groups, an excess consumption of energy dense, nutrient poor foods and drinks, alongside sedentary behaviours, are generally considered to be the primary drivers. The consumption of high energy processed foods and drinks, high in fats and sugar, increases the risk of obesity compared to low energy dense foods such as fruit and vegetables (Swinburn *et al.*, 2004). The EPODE, a European nutrition education programme started 25 years ago as a long-term whole population approach to help reduce childhood obesity. There are four themes; promoting water consumption, an active lifestyle, promoting fruit and vegetable consumption and adequate sleep. In a prospective study, a total of 1,062 children aged 6-8 years and their parents from different socioeconomic backgrounds were observed for 2 years and improvements in fruit and vegetable consumption were observed across all socioeconomic groups (Borys *et al.,* 2016). A questionnaire, including a food frequency questionnaire and questions about lifestyle, sent in 2008 to all 15 year olds in a specific region within Sweden found that a low reported frequency of intake of vegetables was associated with a 20% increased risk of the adolescents being overweight or obese (OR 1.20, 95%CI 1.08, 1.33) (Winkwist *et al.,* 2015).

An intervention which is able to achieve sustained increases in fruit and vegetable consumption is likely to assist in long-term weight loss maintenance. In our study looking at the behaviour changes made by young people attending a commercially run lifestyle programme, regression analyses showed improved BMI Z score changes to be related to increased fruit and intake (p=0.012). There was a mean difference of 1.6 in response to the five-point Likert scale about whether they had five portions of fruit and vegetables per day before and after joining the programme (Stubbs, Pallister, **Avery** *et al.,* 2012).

Many people have a diet which is too high in free sugars which can lead to weight gain and poor dental health (SACN, 2015). The main sources of free sugars in our diet include soft drinks, table sugar, confectionery, fruit juices, biscuits, cakes, pastries, puddings and breakfast cereals all of which can be replaced by alternatives with a lower sugar content. Free sugars provide no other important nutrients other than being an energy source.

There has been a growing trend globally in the consumption of sugar-sweetened beverages (SSBs) amongst children. A large US study of trend and cross-sectional analyses (Han and Powell, 2013) drawn from National Health and Nutrition Examination Survey (NHANES) data between 1999-2008 showed that 5% children were classified as 'heavy' total SSB consumers (≥ 500kcal/day), an increase of 1%. A large cross-sectional study of European adolescents (Duffey *et al.*, 2012) highlighted how SSBs provide more daily energy intake (30.4% of total beverage intake) than any other beverages. Amongst British children, energy from drinks accounts for 14% of total energy intake in children aged between 4 and 18 years with sugary drinks accounting for the bulk of that energy and SSB intake being particularly high amongst adolescents (Ng *et al.*, 2012). It is recommended that the maximum free sugar intake is 5% total energy which is considerably less than the current intake as illustrated in figure 4.1 (SACN/PHE, 2015).

Figure 4.1: Dietary sugar intake across the life-course.



The World Health Organization (WHO) carried out a meta-analysis of cohort studies in children which found that a higher intake of SSBs was associated with a 55% (95% CI 32-82%) higher risk of being overweight or obese (Morenga, Mallard & Mann, 2013).

Our systematic review (investigating interventions that can help reduce consumption of sugar-sweetened beverages in children leading to changes in body fatness, **Avery**, Bostock & McCullough, 2015) answered the research question; which interventions aimed at children can help to reduce consumption of SSBs and do these interventions lead to subsequent changes in body fatness? The systematic review followed the relevant criteria of the PRISMA statement (Preferred Reporting Items for Systematic reviews and Meta-Analysis) (Liberati *et al.,* 2009). Eight studies met the inclusion criteria and the interventions were grouped under four headings; school based educational programmes, school based educational programme combined with environmental change, school distributed drinks and home delivered drinks. A number of the studies included children from lower socio-economic groups. The review suggested that a medium intensity nutrition education programme focussing on beverage choices and delivered by peers, teachers or nutritionists could be an effective way of reducing consumption of sugary drinks in both primary and secondary school aged children. Use of computer or web-based nutrition education delivered via school and home may also offer an effective contemporary educational route in reducing SSB consumption in children (Ezendam *et al*. 2012).

A consistent theme running through a number of the studies highlighted in this review is the suggestion that maintenance sessions are necessary to remind children to maintain any change in SSB consumption over time. Interventions which encourage possible alternative drinks to SSBs for children (water, diet drinks rather than 100% fruit juice) can be effective and increasing the access to free, safe drinking water in public places to encourage water consumption instead of SSBs is an important public health measure. Studies which involved providing either water or diet drinks to children as an alternative to SSBs resulted in significant reductions in SSB intake and significant reductions in BMI in the intervention groups (**Avery**, Bostock & McCullough, 2015).

Further work is needed to develop practical interventions for reducing SSB consumption that can be implemented on a large scale possibly involving altering the school and community environments and involving the availability, pricing and marketing of SSBs and non-SSBs besides better provision of free drinking water. The naturally occurring free sugars in 100%

fruit juices do mean that they contribute to energy intake and may be associated with an increased risk of excess weight gain particularly amongst children who are already overweight (Faith *et al*., 2006).

Policies which could be considered include higher taxation on SSBs. The mixed methods review undertaken by Public Health England (PHE) identified 11 publications (2010 onwards) and concluded that increasing prices of high sugar foods is likely to reduce the purchase of these products. However it is suggested that a tax of 10% to 20% would be required to have a significant impact on consumption (PHE, 2015). Nutrition education would still be important to prevent compensatory behaviours reducing the health benefits. Indeed The Centre for Health Economies in their report on ‘The Impact of Taxation and Sign-posting on Diet’ which used an on-line field survey and a virtual supermarket to look at the impact of either a 20% or 40% tax on breakfast cereals and soft drinks, found around a 50% drop in demand for a 20% tax (Zizzo *et al.,* 2016). So yes taxes on less healthy products can lead to healthier diet choices in relation to soft drinks and the effect was independent of sign-posting. However sign-posting or ‘nudging’ may matter more relevant to the product and overall aim and was seen as being less important for soft drinks but more important for breakfast cereals where food-related taxation could be more effective when combined with sign posting on the price tag (Zizzo *et al.,* 2016).

People and families with lower incomes, (in developed countries), generally have a less healthy diet with a lower intake of fruit and vegetables and a higher intake of processed high energy dense junk foods (McLaren, 2007). Whilst many people may be aware of what a healthy balanced diet includes, there is a need to make this diet more accessible and affordable and attractive as well as to support people to develop the skills and confidence needed to prepare healthier foods. Our paper, ‘Influence of Slimming World’s lifestyle programme on diet, activity behaviour and health of participants and their families’ shows how a commercially available programme can have a beneficial impact on making a healthier diet more accessible. The results are based on a random selection of 2812 responses (mean age 42.0 years) with 78% buying more fruit and vegetables, 74% eating less fatty foods and 61% eating fewer sugary foods. These results were even greater for those respondents cooking for a family. Over half of the respondents reported eating fewer ready meals and take-aways suggesting an increase in both the skills and knowledge to be able to prepare attractive meals at home (Pallister, **Avery**, Stubbs *et al.,* 2009).

Insufficient physical activity is the fourth leading risk factor for mortality (WHO, 2009). People who are insufficiently physically active have a 20-30% increased risk of all-cause mortality compared to those who engage in at least 30 minutes of moderate intensity activity on most days of the week (WHO, 2010). In 2010, globally, 23% of adults, aged over 18 years were insufficiently active, having less than 150 mins of moderate intensity physical activity, or the equivalent, per week. The percentage of adolescents, aged 11-17 years, insufficiently active in 2010 was 80% (WHO, 2014). Increasing physical activity levels and reducing sedentary behaviour are important components of any lifestyle intervention to prevent and manage obesity. It is ideal if the intervention can positively influence both diet and physical activity behaviours. The paper, 'Influence of Slimming World's lifestyle programme on diet, activity behaviour and health of participants and their families' also showed that 56%-65% of respondents became more active after engaging in the lifestyle programme. The number of people who reported being sedentary decreased from 21% to 4% and those not very active from 37% to 12%. Among those who reported being more active, 28% said that their activity also involved their family/children (Pallister, **Avery**, Stubbs *et al.,* 2009).

The sedentary lifestyle of children has been implicated in the steady rise in the obesity epidemic and television viewing has been positively associated with increased BMI in children (Steinbeck, 2001, Braithwaite *et al.,* 2013). It is commonly hypothesised that increased television viewing replaces hours spent undertaking physical activity, thereby leading to reduced energy expenditure and subsequent weight gain (Dietz, 2001). However this might not be the full explanation. The increased weight associated with higher rates of television viewing may be unrelated to physical inactivity and due to other factors (Biddle *et al.,* 2004). These other factors include the influence that TV viewing has on children's diet in terms of advertising energy-dense foods, promoting mindless eating during viewing, increased snacking and 'junk foods', including higher consumption of sugary drinks (Dubois *et al.,* 2008; Boulos *et al.,* 2010; Andreyeve, Kelly & Harris, 2011; Carson & Janssen, 2012; Ogden *et al.,* 2013).

Whilst many studies have examined associations between television viewing and obesity in children, there is limited data investigating the associations between television viewing and the foods and drinks which are consumed during this time. Our systematic review, 'Associations between children's diet quality and watching television during meal or snack consumption ', examined the influences that watching television during meal or snack consumption have on children's food and drink intake. The studies included represented 61,674 children aged 1-18 years and the overall results showed small but significant differences in diet quality. This included more SSBs, more high fat and high sugar foods and fewer fruit and vegetables being consumed by children who eat/drink whilst watching TV. The findings remained after adjustment for socioeconomic status. Whilst the differences were generally small, the cumulative effect may contribute to the positive association seen between time spent watching TV and childhood obesity (**Avery**, Anderson, McCullough, 2016).

5. Obesity and Behavioural factors

Whilst lifestyle factors, notably an energy dense diet and sedentary behaviours, are the primary drivers for the energy imbalance seen in obesity, behavioural interventions can help individuals develop a set of skills to achieve a healthier weight and maintain weight loss. It is more than helping people to decide what to change; it is helping them identify how to change and improve or maintain levels of motivation and commitment. The behaviour change process is facilitated through the use of self-monitoring, target or goal setting, and problem solving (Foster, Makris & Bailer, 2005).

An understanding of why and how some people succeed in changing their weight-related behaviours, whereas the majority do not is an important research priority. Despite having clear guidelines on how successful weight management can be achieved through controlled dietary intake and physical activity, Wing & Phelan (2005) found that only 20% of individuals trying to lose weight were able to maintain their weight loss for at least one year.

The conceptual review of factors associated with weight loss maintenance (Elfhag & Rossner, 2005) found the following to be linked to success at one year;

- An internal motivation to lose weight
- More initial weight loss
- Reaching a self-determined target weight
- Having a physically active lifestyle
- Having a regular and healthy meal pattern, including breakfast
- Social support
- Control over over-eating
- Self-monitoring of behaviours
- Better coping strategies and ability to handle life stresses
- Self-efficacy
- Autonomy
- Assuming responsibility in life
- Overall more psychological strength and stability

A greater understanding of psychosocial theories is important for practitioners working in the field of weight management. Why do some people feel that they have 'failed' and then abandon their efforts if they only lose a small amount of weight? Teixeira *et al.,* 2012 asked the question 'What makes the difference between self-sustained and less consistent forms of motivation and associated behaviours?' The author's critical discussion suggests that weight management interventions may have been unsuccessful in weight loss maintenance because of the lack of emphasis on the qualitative dimensions of motivation, such as perceived autonomy. They recommend that individuals need to both feel competent and autonomous in their strife for attaining weight loss targets (Teixeira *et al.,* 2012).

In a more recent systematic review looking for successful behaviour change strategies in obesity interventions, both in clinical and community settings, higher autonomous motivation, self-efficacy and self-regulation skills emerged as the best predictors of beneficial weight loss outcomes. A positive body image and flexible eating restraint were found to additionally improve outcomes (Teixeira *et al.,* 2015).

A number of psychosocial theories/models have been developed to predict, explain and change health behaviours such as those related to weight management.

These models include the Social-Cognitive theory (SCT), the Theory of Planned Behaviour (TPB), the Trans-theoretical model (TTM) and the Self-Determination theory (SDT) (Teixeira *et al.,* 2005).

Social Cognitive Theory (SCT) is the most frequently used paradigm in weight management interventions being based on the reciprocal influences between behaviour, environment and the individual (Baranowski *et al.,* 2003). Constant interactions form the basis for individual action, influencing beliefs and attitudes. Self-efficacy represents the most powerful component within SCT and is where a person has the belief that they are capable of successfully making changes and reaching targets. Self-efficacy is crucial to motivation but may be influenced, both positively and negatively, by past experiences in an activity and social factors, such as encouraging words and successful peer models can boost self-efficacy. Belonging to a group where the facilitator has themselves been successful in their weight loss journey is an example of an effective peer model (Bandura, 1981; Powell, Calvin & Calvin, 2007).

The Theory of Planned Behaviour (TPB) is similar in its origin to SCT being dependent also on beliefs and attitudes as the proximal determinants of behaviour (Aizen, 1991). TPB is about a person's intention to engage in a behaviour change and also about their perceived behaviour control. Intentions feed the influencing motivational factors and reflect how much effort the individual is prepared to exert to perform the behaviour change. Perceived behaviour control reflects the confidence that the person has in their ability to be able to make changes and achieve targets. It is influenced by beliefs about the supporting resources. A person's intention to perform a behaviour is both the immediate determinant and the single best predictor of the behaviour change, predicting 40-50% of the variance seen (Sutton, 1998).

The Trans-theoretical Model (TTM) is an example of a 'stage' model which is different in structure to social cognition models and suggests that behaviour change involves movement through a sequence of discrete, qualitatively distinct, stages (pre-contemplation, contemplation, preparation, action and maintenance) (Prochaska and Velicer, 1997). Different factors are assumed to be important at each stage and thus people are assumed to require different interventions or processes to encourage and assist them to move to the next stage in the sequence. Target setting may be useful at each of the active stages.

Self-determination theory (SDT) provides a framework for the study of human motivation. It is the only motivational theory that highlights the importance of the basic psychological need for autonomy with three basic psychological needs – competence, autonomy and relatedness being central to SDT (Ng, 2012). These basic psychological needs are essential for ongoing psychological growth, integrity and well-being (Deci & Ryan, 2000). In the context of weight management, an individuals need for competence can be satisfied if they are able to achieve a weight loss target; the need for autonomy can be satisfied if the slimmer genuinely feels that it is their choice and they can make a

decision as to what foods they choose to eat to lose weight and what weight loss target they wish to achieve. Relatedness refers to 'feeling connected to others, to caring for and being cared for those others or having a sense of belonging both with other individuals and with one's community' (Ryan *et al.,* 2008). Thus being a member of a weight management group where one can share and solve problems can contribute towards relatedness.
In contrast these basic psychological needs can be undermined. For example if an individual was made to feel incapable of making the desired changes, if unattractive choices are 'forced' upon them, or if they feel alone in their attempts.

SDT differentiates quality from quantity of motivation and rationalises how different types of quality of motivation can lead to opposite outcomes (Teixeira *et al.,* 2012). Motivation can be broadly classified into three types; intrinsic, extrinsic and amotivation. Intrinsic motivation refers to doing something for fun and enjoyment where there is an inherent satisfaction of the behaviour rather than there being any contingencies. Extrinsically motivated behaviours are undertaken to achieve certain associated outcomes and perhaps also because there may be a feeling of guilt if not. Amotivation refers to the state where individuals feel that they are acting without a reason (Ng, 2012). The most important type of motivation for successful outcomes is that which is intrinsic in nature, where the construct reflects an individual's inherent tendency to seek a challenge, whilst feeling competent and autonomous in the process (Palmeira *et al.,* 2007).

Targets can be an important source of motivation and target setting is now recognised as an important behavioural change component within the different theories. Research from the work-place shows that when employees are set targets they do better than if they had simply been encouraged to 'do your best' (Locke & Latham, 2002). According to Locke & Latham, targets may affect outcomes through four different ways;

1) Targets focus energies on activities which are target relevant

2) Targets serve in an energising manner in that higher targets lead to greater effort being made
3) Targets correlate with persistence in that higher targets correlate with prolonged effort
4) Targets can have an indirect impact through the application of task related strategies and knowledge.

Taking into account that the best available obesity interventions, other than bariatric surgery, lead to weight losses between 8% - 10%, individuals are generally encouraged to set realistic weight loss targets of between 5% and 10% (NICE, 2006). However the underpinning evidence for this is mixed. These ‘realistic’ weight loss targets may be unsatisfactory to many obese individuals (Foster *et al.,* 1997) and may not be of clinical benefit to the person who is morbidly obese at base-line (SIGN, 2010).

Targets set by slimmers are often much higher than what is actually achieved (Fabricatore *et al.,* 2008) which has led to high targets being considered ‘unrealistic’ (NICE, 2006) and a cause for concern. A cyclical relationship exists between target-setting and self-efficacy. People who achieve their goals increase their levels of self-efficacy and people with higher self-efficacy set more ambitious goals than people with a lower self-efficacy. A downward cycle develops when people fail to meet their targets, causing self-efficacy levels to fall and perhaps abandonment of effort (Locke & Latham, 2002). However, evidence demonstrates that non-attainment of goals does not necessarily stop successful weight losers from maintaining their weight loss (Fabricatore *et al.,* 2007; Gorin *et al.,* 2007). With many individuals being more satisfied by smaller weight losses than they expected, it is suggested that weight loss goals become less important in the long-term (Rothman, 2000; Crawford & Glover, 2012), and maintenance may become easier (Wing & Phelan, 2005). A meta-analysis concluded that there was no empirical evidence that setting realistic goals led to greater weight loss, or that unrealistic goals had any negative impact on weight loss (Durant *et al.,* 2013).

Others have gone further and suggested that higher targets may be motivational to some participants who wish to avoid the feeling of disappointment (Fabricatore *et al.,* 2007). A review looking at the effect of expectations on weight loss outcomes concluded that higher targets may lead to higher weight loss at 6-12 months (Crawford & Glover, 2012).

Indeed De Vet *et al.,* (2012) claim that setting high weight loss targets predict effort and lead to greater weight loss, albeit short-term. Casazza *et al.,* (2013) go further and state setting realistic targets to be one of the seven myths about current obesity treatment with insufficient evidence to support the practice.

Thus there is much debate as to the effect weight loss targets have on long-term weight loss. In our study, 'Setting targets leads to greater long-term weight losses and 'unrealistic' targets increase the effect in a large community-based commercial weight management group', their effect within a large community-based, commercial weight management group that positively encourages personal target weight setting was considered. The aim was to consider whether target setting predicts weight loss at 12 months. Three aspects of targets were investigated as predictors; (1) whether target setting was reported or not, (2) the number of targets set over the 12 month data collection period, (3) the size of the first target set. For the 24 447 adults with an initial BMI equal or greater to 30kg/m^2 mean weight loss was 12.9±7.8% and for both sexes, weight loss at 12 months was greater for those who set targets ($p<0.001$). Those that set ≥ 4 targets achieved the greatest loss ($p<0.001$), OR for weight loss ≥10% at 12 months was 10.3 (CI 9.7- 11.1, $p<0.001$) where targets had been set compared to none. At the highest quintile of target size, the size of the first target explained 47.2% ($p<0.001$) of the variance in weight loss achieved at 12 months. The mean BMI reduction in those with a target >25% was 7.6±4.0kg/m^2 representing a mean weight loss of 19.0 ± 9.4%. At the lowest quintile of target size, 0-10.4%, a BMI reduction of 4.3±3.2kg/m^2 was achieved, representing a mean weight loss of 11.4 ± 7.6%. The paper concludes that whilst people with obesity were less likely to set targets, doing so increased the likelihood of achieving clinically significant weight loss and for some ‘unrealistic’ targets improved outcomes at 12 months (**Avery**, Langley-Evans, Harrington *et al.,* 2016).

The level of self-efficacy and thus resulting weight loss outcomes are positively influenced by the initial weight loss achieved. The paper, ‘Weight Outcomes Audit for 34,271 Adults Referred to a Primary Care/Commercial Weight Management Partnership Scheme’ suggests that the amount of weight lost in week 1 explained 18.4% of the variance in weight loss achieved at the end of the 12 week referral period (Stubbs, Pallister, Whybrow, **Avery** *et al.,*2011; Appendix 1). In a feasibility study, looking at referral from primary care to a commercial programme, adults with obesity who attended the weight management programme for 24 weeks were more likely to have experienced a 5% weight loss during the first 12 weeks (Lavin, **Avery**, Whitehead *et al.,* 2006).

6. The challenge – scalable solutions for prevention and management, accessible to all

6.1 Setting the scene

England has a population of 54.3 million people (ONS, 2015), approximately 90% under the age of 70 years and approximately 6.8 million young people under the age of 18 years.

Given the prevalence of overweight and obesity is 67% in men and 59.6% in women (PHE, 2015) this means that approximately 25 million adults are either overweight or obese and the population mean BMI continues to increase. Given that approximately one third of young people are overweight or obese, 2 million young people could benefit from weight management support given the associated health risks. Scalable, effective solutions which are widely accessible, and which aim to address health inequalities, are required to halt the obesity epidemic. The NHS has limited resources and these limited resources are currently being drained by the burden of obesity related chronic diseases such as diabetes, cardiovascular disease and their related co-morbidities including renal disease. One may question the ethics of private organisations providing some of the services traditionally delivered by the NHS, but in the case of weight management one may equally question whether it is ethical not to work in partnership with commercial weight management organisations when there is good evidence for doing so.

6.2 The role of commercial weight management organisations

Commercial weight management organisations (CWMOs) are well positioned to be able to support the large numbers of people who need weight management guidance in a community setting. The National Institute for Health and Clinical Excellence (NICE, 2006, 2014a) and Scottish Intercollegiate Guidelines Network (2010) recommended that CWMOs, alongside self-help and community weight management programmes may be endorsed if they meet the following criteria;

- Provide a multi-component programme – including dietary and physical activity support employing behaviour change techniques.
- Focus on lifelong lifestyle change and the prevention of future weight gain – people need to be equipped with the necessary skills to develop lasting self-determined behaviour change.
- Developed by a multi-disciplinary team –to include registered dietitians and nutritionists, psychologists, behavioural scientists and experts in physical activity.
- Personnel involved in the delivery of the programme are appropriately trained and supported and receive regular professional development – training content to be based on current evidence and latest thinking in weight management.
- Last at least 3 months; offer at least fortnightly sessions including a ‘weigh-in’.
- Ensure achievable goals for weight loss are agreed for different stages of the weight loss journey.

- Ensure specific dietary targets are agreed and tailored to individual needs.
- Provide support on how to reduce sedentary behaviour and how to incorporate activity into everyday life.
- Employ a variety of behaviour change methods.
- Tailor programmes to support the needs of different population groups – for example women, men, younger people, people from different cultural backgrounds and ethnic groups,
- Adopt a respectful, non-judgemental approach to the overweight/obese individual.

6.3 The evidence to support the role of CWMOs as a provider of community weight management across age-groups

In a qualitative study comparing commercial and health service weight loss groups, Allan *et al.,* (2011) suggested that health service leaders had less opportunity for supervision, peer support, or specific training in how to run a group when compared to group facilitators from the commercial sector. Tod and Lacey (2004) in their qualitative survey concluded that limited NHS resources mean that patients may not receive the support they require to move through the stages of change, improve their self-esteem and have a successful weight loss. The authors proposed that partnership working with a CWMO may help to make more efficient use of NHS resources.

a) Adults

In many geographical areas within the UK, public, private or voluntary sector weight management providers may be commissioned to provide individual or group lifestyle weight management services. Local policies vary but generally funded referrals to a lifestyle weight management programme (in tier 2 services) lasts for around 12 weeks or 12 sessions. In 2013, approximately 69,000 adults in England were referred to Weight Watchers (WW) and Slimming World (SW) under the NHS referral schemes (NICE, 2014b). According to Jolly *et al*. (2011) 71% of adults who attended a weight management programme opted for a commercial or not-for-profit programme. Inflating the figure of 69,000 to account for the 29% of people who attend other types of weight management programmes gives a total of approximately 97,000 adults in England. This is equivalent to less than 1% of overweight or obese adults, or 170 adults per 100,000 population. Going forwards NICE (2014b), in their costing model assumed that the proportion of overweight or obese adults attending lifestyle weight management programmes each year will increase by 1% or approximately 680 overweight or obese adults per 100,000 population.

We (Lavin, **Avery**, Whitehead *et al* 2006) first reported the feasibility and benefits of a referral programme from primary care to a CWMO with 107 NHS patients recruited. Eighty-five percent of these patients attended a local community-based slimming group with 58% completing the full 12 week programme. A mean weight loss of 6.4% was reported with significant improvements in mental well-being also observed. Forty-four percent of the original population sample chose to self-fund further attendance at the CWMO groups and study follow-up continued until the end of the 12 week self-funding period. Seventy-two percent of these patients completed the second 12 week period achieving a mean weight loss of 11.3%. The original aim of the referral scheme was to increase accessibility to CWM programmes to people who may not otherwise have been able to afford to benefit from the support.

The research group have continued to evaluate referral programmes where patients have been referred into community slimming groups with competitor organisations also demonstrating the benefits of partnership working with the private sector.

Our audit of 34,271 adults referred into a CWM/ primary care partnership scheme (SW) (Stubbs, Pallister, Whybrow, **Avery** *et al.,* 2011) reported a mean BMI change of -1.5kg/m2. For the 19,907 patients who attended at least 10 of the 12 sessions, mean BMI change was -2.0kg/m2, mean % weight change -5.5% and rate of weight change -0.4kg/week. 35.8% of all patients enrolled and 54.7% of patients attending 10 or more sessions achieved >5% weight loss at 12 weeks. The mean start BMI was 36.8kg/m^2 with 25.4% of the referred population having a starting BMI in excess of 40kg/m^2. It is not clear if CWM programmes are more or less effective for weight management in people with high BMIs compared to those who are moderately overweight or less obese. Therefore, using a Last Weight Observed Carried Forward (LWOCF) approach, the audit data was split into four BMI categories, <30; 30-34.9; 35-39.9; >40kgm^{-2} and re-analysed. The % weight loss at 12 weeks was remarkably similar in each category, 3.7, 4.0, 4.0 and 3.9% respectively, suggesting that people who clinically are described as being morbidly obese would also benefit from the support (Stubbs, Brogelli, Pallister, Whybrow, **Avery** *et al.,* 2013).

Results from further work looking at referral over a six month period in a study population of 4,754 (Stubbs *et al.,* 2012) suggest that if patients are offered a second 12 week referral and continue to attend after the initial 12 week referral period these weight losses persist. Extending the audit period to 24 weeks resulted in a mean weight loss of 8.6% and a mean BMI change of -3.3kg/m^2. 74.5% of all patients offered the referral programme achieved at least a 5% weight loss and weight gain was prevented in 96.3% A WW observational study including 29,326 referred patients reported similar results (Ahern *et al.,* 2011). Median weight change for all commenced referrals was -2.8kg, equating to a 3.1% weight loss from baseline after the 12 week initial referral period. Median weight loss increased as number of meetings attended increased. 54% of the initial sample attended all 12 sessions. For the 11,851 participants who attended all 12 sessions a median weight loss of 5.4kg representing 5.6% median loss was reported. 57% lost greater than 5% of their starting weight and 12% more than 10%.

A randomised control trial reported by Jebb *et al.,* 2011 showed that in all analyses, participants in the commercial programme group (WW) lost twice as much weight as those in the standard care group. For example mean weight change at 12 months was -5.06 kg for those in the commercial programme compared to -2.25 kg for those receiving standard care or conservatively in the 'best observation carried forward' analysis, -2.99 to -1.58kg respectively. Participants assigned to the commercial programme had increased odds of losing 5% or more, (odds ratio: 3.0, CI: 2.0-4.4) and >10% (3.2, 2.0-5.3) initial weight at 12 months than those assigned to standardised care. The greater weight loss in participants attending the commercial programme also resulted in larger reductions in both waist circumference and fat mass in all the analyses and significant improvements in circulating insulin and total to HDL cholesterol levels. All of the study participants (n=772 overweight and obese) were referred through primary care practices in Germany, Australia or the UK. As with many other clinical obesity trials, the dropout rate was high but more participants completed the commercial programme (61%) compared to 54% completing the standard care programme. The numbers of men recruited to the study were low; 12% referred to the commercial programme and 14% to standard care but these figures are very consistent with similar referral data reported by both Stubbs *et al.,* 2011 and Lavin *et al.,* 2006.

Lighten Up was a randomised control trial conducted by independent researchers in Birmingham and comparing a range (n=7) of commercial and NHS weight reduction programmes with a control group where patients were provided with 12 vouchers enabling free access to a local leisure centre. (Jolly *et al.,* 2011). All programmes resulted in a significant weight loss at 12 weeks, with the commercial options resulting in a significantly greater weight loss than the primary care led options (mean difference 2.3kg). The NHS dietetic led programme and the commercial options all led to significant weight loss at one year but not the general practice and pharmacy provision when compared to the control group. The authors in their conclusion suggest that because the primary care programmes were the more costly to provide commercially provided weight management services are more cost effective. A further non-inferiority analysis has been reported by the Lighten Up study group (Madigan *et al.,* 2014) with a larger population sample but just comparing weight loss outcomes at 12 months for those people referred to either the NHS group based programme or RC or SW and comparing outcomes with those achieved by people selecting to go to WW. Follow up rates at 3 months were 74.5% for the NHS, 69.9% for RC, 81.4% for SW and 77.6% for WW and 80.2%, 60.7%, 71.8% and 63.1% respectively at 12 months. At 12 month follow up the weight losses for both SW and RC were similar to those achieved by people attending WW with the losses being significantly greater for the SW programme (4.5 v.3.7kg).

CWMOs are often criticised because of the small numbers of men who access the programmes although a systematic review of the literature published before October 2014 found that men were underrepresented in all the included studies (Robertson et al., 2015). To evaluate the benefits of setting up men only commercial weight management groups, Bye, **Avery** & Lavin, (2005) analysed data collected from seven men-only Slimming World groups (n=67) (Appendix 1). Mean weight loss at 12 weeks was 9.2% (range 0.2 to 21.1%). At least 5% weight loss was achieved by 90% of the sample. In those who had been members for 24 weeks the mean weight loss was 11.4% (range 5.0 to 17.9%), 69% achieved a 10% weight loss. The remaining 31% had all achieved at least a 5% weight loss. At the point of data collection, mean BMI had decreased from 35.9 to 32.5kg/m^2. Data from the referral studies, cited earlier, suggest that if men do engage and access mixed groups then equally good clinical weight losses can be achieved.

In a presentation comparing a bespoke men's weight management programme, MOTIVATE, and attendance at mixed SW groups, NHS Nottingham City Public Health (unpublished, 2013) reported that men were able to overcome hesitancies around attending female-dominated programmes, thanks to a feeling of team spirit and everyone being in the same boat.

Barraj *et al.,* (2014) presented men's data from a pooled analysis of weight loss and related physiologic parameter data from 2 randomized clinical trials. After 12 months, analysis of covariance tests showed that men in the

commercial programme group (n = 85) lost significantly more weight (P < 0.01) than men in the control group (n = 84); similar significant differences were observed for body mass index and waist circumference.
These results suggest that participation in a commercial weight loss programme may be an effective means for men to lose weight and maintain weight loss but there needs to be a greater insight into the barriers to men attending commercial weight management group sessions and how engagement can be improved.

b) Young People

Since 2006, young people aged 11-16 have been able to attend SW community groups at no cost providing they attend with a supporting adult and have the approval of a health care professional. The initial evaluation of the support offered to these adolescents is presented in our paper, 'An initial evaluation of a family-based approach to weight management in adolescents attending a community weight management group', (**Avery**, Pallister, Allan *et al.,* 2012). Complete weight data was available for 106 young people, all with a base-line BMI > 91st centile, with 68% >98th centile. The mean (SD) number of weeks attended was 12.5 (8.1), with 19% (20) having attended for more than 20 weeks and 62% still attending. A mean (SD) BMI *Z*-score change of 2.49 (0.72) to 2.27 (0.74) was achieved ($P < 0.001$). There are only a small number of UK based evaluated programmes available to help obese children to lose weight. The MEND (Mind, Exercise, Nutrition and Do it) programme is designed to support 7–13 year olds with managing their weight. In a randomised controlled study, Sacher *et al.* (2010) reported a mean body mass index (BMI) *Z*-score change of −0.24 after 6 months in children attending this educational and activity-based programme.

6.4 Evidence supporting the role of CWMOs in weight loss maintenance

For all programmes achieving successful weight losses over a short time period there are concerns that the weight lost is easily regained (Wing &

Phelan, 2005). However Lowe *et al.,* 2001, suggest that most of the data on weight regain was from research conducted within either university or hospital environments and hence the study population was not representative of a typical overweight/obese community population. In their study of people achieving their target weight following a CWM programme (WW), it was found that weight loss maintenance was better than this. From a sample of 1002 adult target members at five years after achieving their target weight, 19.4% were still within 5lbs of this weight, 18.8% maintained a loss >10%, 42.6% maintained a loss >5% and 70.3% were still below their initial weight.

Heshka *et al.,* (2003) reported greater weight loss in an adult population who received support through CWM groups than a clinically matched group who received two 20 minute counselling sessions with a dietitian plus supporting self-help materials. The 423 people, overweight or obese, were randomly assigned to one of the two interventions and weight losses compared over a two year period. Whilst the self-help group lost a mean of 1.4kg at one year, there was a return to baseline weight observed at two years. In contrast the commercial group lost 5.0kg at one year and the mean weight loss was still 2.8kg lower than baseline at two years. Those participants who attended 78%, (70% overall completion rate versus 75% for the self-help group), or more of the CWM weekly sessions maintained a mean weight loss of 5kg at the end of the two year study period. Waist circumference was also reduced in the commercial group by 4.5cm at one year and 2.5cm at two years.

Weight loss maintenance is particularly important in any obesity strategy. The CWMOs have strategies in place, including free membership, to incentivise weight loss maintenance for those members achieving their personal target weights. People are able to attend the groups for as long as they feel they need support rather than for a fixed amount of time. They also have on-line materials available for members to provide additional support. Commercial programmes use many of the techniques that are used in more intensive behavioural treatments, delivered by health care professionals, such as self-monitoring, target setting, problem solving, stimulus control and relapse prevention (Jebb *et al.,* 2011).

A qualitative investigation into how hunger and satiety influence food choice in slimmers and non-slimmers found that slimmers find the sensation of hunger particularly detrimental to their efforts to lose weight and prevent relapse. In contrast satiety was perceived as being beneficial (Talbot & Avery, 2011; Appendix 2).

In our survey examining self-reported behaviour changes associated with weight loss and maintenance in a group of 292 longer-term SW members, primary factors reported by participants as important in achieving their weight loss included not going hungry by satisfying appetite with low energy density food eaten ad libitum, following a flexible diet, peer-group support and having tools to cope with small lapses. A range of eating and activity behaviours was associated with weight loss maintenance and the paper concluded that it is important to offer consumers flexible solutions which they can adapt to their individual lifestyle needs to support long-term weight control (Stubbs, Brogelli, Pallister, **Avery** *et al.,* 2012).

6.5 Evidence for cost effectiveness

In the modern NHS and given the scale of the obesity epidemic finding cost effective solutions is of paramount importance to commissioners. Trueman and Flack, 2006 used an economic model to determine the cost effectiveness of WW groups in the prevention and management of obesity. In the base case analysis, the incremental cost per quality-adjusted life year (QALY) gained compared to no treatment was £1,022. This compares favourably with other interventions, for example the incremental cost of other non-pharmacological interventions was reported to range from £174 to £9,971 per QALY: anti-obesity medication £3,200 to £24,431 per QALY and surgery which ranged from £6,289 to £8,527 per QALY, (NICE, 2006).

More recently, Meads *et al* (2014) have reported on the cost effectiveness of primary care referral to SW. At twelve months, the incremental cost-effectiveness ratio was £6,906, indicating that referral was cost-effective. Over a lifetime, referral to the CWMO was dominant as it led to a cost saving of £924 and an incremental benefit of 0.22 QALY over usual care, defined as information provision but with no active component. Threshold analyses suggested that weight loss of 1.25kg was sufficient to make 12 weeks of the commercial programme cost effective at 12 months. Sub group analyses showed that the programme is even more cost effective for men. (Meads *et al.,* 2014)

7. Methodological issues in weight management research

Developing an evidence base for making public health decisions requires using data from evaluation studies with both randomised and non-randomised designs. The Standard Evaluation Framework for weight management recognised that there is a lack of high quality evidence on the efficacy and safety of weight management interventions (NOO. 2009). For example a study by the EPPI-Centre reviewed schemes to promote healthy weight in overweight and obese children (Aicken, Arai & Roberts, 2008). It found that whilst interventions are being commissioned by a variety of organisations, data informing the relative 'success' of the interventions, in terms of the intended health outcomes, was limited and inconsistent.

In order to maximise collective learning and ensure increasingly effective interventions over time, it is important that individual interventions are assessed for their effectiveness (including cost-effectiveness), and that interventions can be compared with one another.
In evidence-based practice, randomised controlled trials (RCTs) have historically been considered to be the 'gold standard' for a scientifically robust assessment of whether an intervention is effective. However, RCTs are often not practical or are too expensive for evaluating public health interventions and other research designs may be more pragmatic and thus appropriate.

Community-based programmes are often more complex than clinical trials and **contamination** may be more of an issue. This is particularly the case when the primary outcome is weight change at 12 months. People generally consent because they want to be part of the intervention group rather than the control. In the HELP RCT, where women were offered the intervention during pregnancy and up until 6 weeks post-partum, the primary outcome is weight change at 12 months (ref HELP protocol paper; John *et al.,* 2014). Preliminary analysis of the data suggests that there are women, randomised to the control group, who chose to go to a CWM group (the intervention) before the end of the study period despite being told that they would be given vouchers for free attendance at the end of the study. It is difficult to prevent people who are highly motivated from accessing weight management support particularly when looking at long-term weight change in a community setting.

For all of the SW intervention studies standard participant inclusion criteria includes that the participant is not currently attending a weight management programme nor has done so in the previous three months.

In large multi-centred studies cluster randomisation is often used as pragmatic methodology. This was the case in the HELP RCT where whole maternity centres were referred to either the intervention or control. Geographical differences may have slightly affected the results despite there being the same number of north/south/Welsh sites in each arm – some of the intervention sites for example were more ethnically diverse, some were more rural and access to the intervention groups may have been more difficult for the pregnant women. Usual care may have looked different in the different geographical locations; commitment and motivation of the research staff at the individual sites may have been different. The site where the feasibility study had been conducted was randomised to the control arm.

In any randomised study it is very difficult to match for every characteristic which may influence weight outcomes. Base-line BMI, age and sex are the obvious but also socioeconomic status and motivation to lose weight should also be matched. In the HELP RCT there were some differences in how concerned the women were about their weight (HELP main paper, in draft). When designing RCTs involving pregnant and post-natal women parity may also be important. Women who have experienced excessive weight gain in previous pregnancies and struggled to lose the excess weight postnatally may be more motivated to prevent excess weight gain in subsequent pregnancies.

When reporting outcomes it is important that there is some adjustment for the key confounders including base-line BMI, age and sex. We can clearly see from the paper looking at setting targets (Avery *et al.,* 2016) that people with higher base-line BMIs were slightly more reluctant to set targets but when they did they tended to be higher. Given the association between socioeconomic status (SES) and obesity prevalence (Ball & Crawford, 2005), adjustment for SES would be beneficial and may indicate whether an intervention is equally as effective across different socioeconomic groups or better still even more effective in people of lower SES. It would be of interest to re-analyse the data-set for the 'setting targets' paper to see if SES influenced the size of target set and the weight outcomes at 12 months.

Typically, RCTs evaluate a specific single intervention and its effects on specified outcomes. By contrast, community programmes often have multiple elements, complex partnerships and may be less amenable to strictly scientific evidence generation. The Medical Research Council's *Developing and evaluating complex interventions: new guidance (2008)* includes non-experimental methods and complex interventions outside the health service (Craig *et al.,* 2008). It recognises that there are methodological and practical constraints to carrying out complex interventions that need to be considered when carrying out an evaluation.

Indeed when looking at feasibility and acceptability, randomisation may be impractical if the intervention is already in widespread use.

The Medical Research Council emphasise feasibility studies as being an important component of the development-evaluation-implementation process (Craig *et al.,* 2008) as clearly demonstrated by our study exploring the feasibility and benefits of implementing Slimming on Referral service in primary care using a commercial weight management partner (Lavin, **Avery** *et al.,* 2006). This feasibility study, project managed by myself, showed that it was acceptable to people to be referred from primary care to local slimming groups, confirmed by both the published quantitative data and unpublished qualitative data. Retention was also good and unlike many trials, recruitment was easy with recruitment targets exceeded. However there was no control group as at that time no other options were available to the practices to be able to offer their patients alternative weight management support. A control group, who were patients on a waiting list for weight management support, may have been selected but this may have raised ethical issues particularly if weight loss was being advised to reduce the risk of co-morbidities. Again, as a free-living community population, the waiting list group may have chosen to go to a CWM group themselves.

CWMOs do offer a tremendous opportunity to be able to recruit participants to trials investigating many aspects of weight management. Randell *et al.,* (2015), found that working with SW was a much more effective and resource friendly way of recruiting eligible volunteers to their community based RCT looking at weight loss maintenance. They needed to recruit people who had lost 5% of their initial weight and were able to confirm this weight loss. Having weekly weight data recorded on scales calibrated to the nearest 200g is advantageous when conducting weight-related studies. Of even greater benefit is the electronic reporting of weight and attendance.

Self-reported weight data tends to be associated with under-reporting (Gunnare, Silliman & Morris, 2013) so absolute weights are the ideal. In contrast self-reported heights tend to be over-reported which means that a combination of both self-reported weight and self-reported height data leads to an under-reporting of individual BMI (Gorber *et al.,* 2007) and absolute weights and self-reported height will lead to a greater under-reporting of actual BMI. At present SW rely on self-reported heights for the majority of their research although efforts are being made to source a measuring device that electronically records both weight and height and which is easily transportable for use in community settings.

Other researchers have questioned the accuracy of on-line self-reported height and weight in a group of young Australian adults aged 18- 35 years (Pursey *et al.,* 2014).Within one month of completing the on-line reporting, participants were invited to attend a measurement session where anthropometric measurements were taken by trained assessors using a standardised protocol. Whilst self-reported height was significantly over-estimated by a mean (SD) of 1.36 (1.93) cm and self-reported weight was significantly underestimated by 0.56 (0.08) kg, the discrepancy resulted in a misclassification of BMI category in only three out of the 117 participants. The authors concluded that there was actually a moderate to high agreement between self-reported and measured anthropometric data and that on-line self-reported weight and height data is a valid method for collecting this data (Pursey *et al.,* 2014).

The Nutrition and Research team at SW has undertaken a similar piece of work. In total 41 matched height and weight measures were collected from participants in the Nottinghamshire and Derbyshire area. Generally individuals over estimated their height with a 7% range in the variation from actual height but a mean difference of 1%. In contrast individuals tended to underestimate their weight, with a maximum underestimation of weight of 5.7kg and the largest overestimation of weight being 3.2kg. However, when taken as a group this resulted in a 0.4% mean difference between self-reported and researcher measured weight equating to a -0.4kg mean difference between individual self-reported weight and researcher measured weight. This resulted in a small variation in mean BMI between actual and self-reported measures (0.85 kg/m^2) (Smith, Avery *et al*., unpublished).

For a weight management intervention which targets children and/or adolescents it is important that linear growth is not compromised and hence the real importance of being able to accurately measure height in this population group. Also given that BMI Z score change, dependent on age-appropriate individual start and end BMI, is routinely used to evaluate children's' weight management programmes. Recent height data collected by a trained healthcare professional is not always available even though SW do try and work in partnership when supporting 11-16 year olds. Literature has been developed to support both the young person and healthcare practitioners which emphasises the need for regular height measurements.

There is very little information available as to whether the time of the year when a weight management study commences makes any difference to the results seen. It is generally accepted that people are more motivated to lose weight at the start of the year, when people make resolutions, and there is a surge in new adult members accessing weight management support in January. With children and adolescents the school holidays can make a difference to their normal dietary intake and physical activity levels and also to their ability to commit to support programmes. This was reported in the initial evaluation of a family-based approach to weight management in adolescents attending a community weight management group (**Avery** *et al.,* 2012).

Not all participants will complete a weight management intervention. The evaluation data may be based on participants who complete the programme, use of last weight observed carried forward (LWOCF) or the gold standard of intention to treat analysis. The studies cited by both major CWMOs with large sample sizes report both LWOCF and intention to treat data. This is not always the case for NHS based weight management programmes. Definition of completion may also vary between studies and ideally should be standardised. From the original feasibility study onwards a completer has been defined as someone who attends 10 or more of the 12 sessions available. Given that weight loss success correlates highly with attendance (Wadden *et al.,* 2009) better standardisation of this term across studies to allow easier comparison would be welcomed.

When analysing the data to look at the effect of target setting (**Avery** *et al.,* 2016), a LWOCF analysis was undertaken. However the results were even stronger in favour of setting targets. It was rationalised that just using the data for people who had weight changes recorded at 12 months would present a more accurate account of the interactions and the influence on long-term weight change. This rationale was based on the observation that for most weight management programmes, where there is a good level of engagement, good weight losses are seen in the first 6 months and then there is either a plateauing of weight or small weight increases as the person does or does not adapt to a different lifestyle. Alternatively people may stop going to a group, and for this study weight data was no longer available when they stopped attending, either because they are very happy with the weight loss they have achieved and they feel quite happy to carry on without the support of the group or they feel disappointed in their weight loss journey.

Collecting accurate data on changes in dietary intake and physical activity levels is difficult for both adults and children. NOO provide an excellent guide on the tools available to measure diet and physical activity levels in weight management interventions (Richardson *et al*., 2011).

The Dietary Instrument for Nutrition Education (DINE) has been used for many years to look at dietary intake, specifically dietary fat and fibre, with the ability to rank intakes as low, medium or high. The results correlate well to those obtained from 4-day semi-weighed food diaries (Roe *et al*., 1994). DINE was initially designed to be used in clinical settings and to be interviewer administered but has for many years been used in the collection of HSE dietary data. Whilst in the early 1990s the foods listed in the 19 item questionnaire may have represented 70% of the fat and fibre in a typical UK diet, this may no longer be the case. For both the HELP and SWAN studies an updated version of DINE, including additional questions about fruit and vegetable and sugar and sweet consumption, have been used. Alternative food frequency questionnaires were considered but the main advantage of dietary data collected using DINE is that it is easier to handle and interpret. Similarly the International Physical Activity Questionnaire (IPAQ) is widely used and the shorter version was the questionnaire of choice for the HELP and SWAN studies. IPAQ was designed as a population level surveillance instrument for the monitoring of physical activity/inactivity rather than to be used to evaluate the effectiveness of intervention studies. However the 7-item (short version) questionnaire is free to use and collects self-reported data on the frequency, intensity and duration of activities undertaken in the past seven days (Ekeland *et al*., 2006).

The use of retrospective questionnaires to compare self-reported values for dietary intake and physical activity levels before and after weight loss represents a pragmatic approach but which needs to be acknowledged as a limitation (Stubbs, Brogelli, Pallister, **Avery** *et al.,* 2012). Whilst there are a number of validated survey tools available none are perfect. Hence the questionnaire used in this study was specifically developed with the questions designed to capture changes in behaviour that were meaningful and useful to the participants. The questionnaire was piloted in a small number to ensure that it was understandable and easy to complete.

The Rosenberg self-esteem scale is an internationally recognised tool used to measure self-esteem (Rosenberg, 1979). Self-esteem is an important secondary outcome measure for all evaluative research of weight management programmes. However the use of retrospective data means that it is not possible to determine if changes in self-esteem occurred during or as a consequence of weight loss. The ethical considerations are greater when looking at the impact of weight management on self-esteem and self-worth in children and the questions asked need to be carefully considered. Indeed, all research which involves recruiting people who are either overweight or obese, needs to respect that potential participants have a low self-esteem and should not be further stigmatised. Style of questioning needs to be carefully considered and it should not be implied that they are obese because of their poor diet or lack of exercise.

Evaluation is not a fixed or stand-alone process: it needs to be flexible and adaptable to the needs of the intervention being studied. Evaluation is important for not only finding out whether a project's aims and objectives have been achieved but also assessing what else has been achieved, finding out what went well and what could be improved, influencing a project's development, feeding back progress to everyone involved including funding bodies and supporters and demonstrating that resources are well-allocated.

Healthcare decisions should be based on the best available evidence. Given the wealth of published literature now electronically available, health providers, practitioners and policy makers will find it impossible to review all articles related to a prevention or treatment strategy for a given health condition without a rigorous and defined methodology in place. A systematic review is an exhaustive review of the literature addressing a clearly defined research question, using a systematic and robust methodology to identify, select and critically evaluate all relevant studies and collecting and analysing the data extracted from the included studies. Depending on the homogeneity of the data extracted, a meta-analysis may be undertaken to quantitatively summarise the results obtained (Abalos *et al.,* 2001).

In terms of the hierarchy of evidence to support best practice, a systematic review establishes whether the results obtained from research studies are consistent and whether the findings can be generalised to different populations by quantifying the quality and the various possible forms of bias.

As such a systematic review is ranked higher than even a randomised controlled trial in the hierarchy of research evidence (Evans, 2003). A systematic review which aims to determine best practice should consider not only effectiveness in terms of the primary outcomes but also the appropriateness, and thus the psychosocial aspects of an intervention and the impact of an intervention from the perspective of its recipient, and also feasibility which considers both the impact and the resources required to deliver an intervention. The collection of papers put forward do consider these three important domains; effectiveness, appropriateness and feasibility. Going forward it is important that future research which aims to contribute to the evidence base in community weight management interventions also considers effectiveness, appropriateness and feasibility and importantly considers the views of the service user.

The SWAN study (trial reference 14/67/14; **Avery**, co-applicant), a NIHR funded study looking at postnatal weight management, asks the research question '*is it feasible to conduct a future RCT to determine the effectiveness/cost effectiveness of Slimming World groups to enable postnatal women who had excessive gestational weight gain, or were obese or overweight when pregnancy commenced, to achieve and maintain weight management, healthy eating and positive lifestyle behaviour?'* One of the additional aims is to consider women's experiences of the intervention and its acceptability through the use of post-intervention focus groups.

8. Recommendations for future research in community weight management across the life-course

This abstract has set the scene with respect to the prevalence of overweight and obesity and the significance at key time-points across the life-course. The relationship between a raised BMI and chronic diseases, both physical and psychological has been considered and the lifestyle and behavioural strategies which under-pin community-based weight loss philosophy have been discussed. The role of CWMOs in helping to provide scalable and accessible weight management interventions has been explored. A collection of supporting peer reviewed papers is presented (Table 1) with additional related papers and abstracts in Appendices 1&2.

There are a number of methodological issues in weight management research but where do we go from what we already know? How can we better deploy limited resources to both prevent and reduce obesity levels and the associated chronic diseases such as type 2 diabetes and depression? At the same time we still want people to be able to enjoy and have a healthy relationship with food and to be able to enjoy recreational activity. Furthermore what are the most effective interventions which address the health inequalities associated with weight-related lifestyle behaviours and disease prevalence?

The period from preconception through pregnancy provides a '*window of opportunity'* to reach not only mothers and their unborn but also their immediate family. Providing guidance during this window of opportunity may nurture a commitment to positive eating habits and a healthier lifestyle throughout the life-course. Whilst there is currently a focus on maternal obesity, and rightly so given the prevalence and associated negative impact on maternal and neonatal outcomes, a common-sense approach would ensure that this focus is delivered in the form of dietary and lifestyle advice which is well-received and may have a lasting effect on the maternal and child's nutritional status. However to-date there is a lack of evidence as to the effectiveness, appropriateness and feasibility of interventions delivered during pregnancy and the preconception period and the impact on subsequent dietary and lifestyle behaviours and later physical and psychological health. The HELP follow-up study is attempting to follow the off-spring for a further period until the age of 3years and considers the wider family diet. Some preliminary findings have been presented with the quantitative and qualitative data due to be submitted for publication 2017 (Gallagher, Simpson, Avery *et al.,* unpublished).

Given that the preconception period is ill-defined, the pregnancy-preconception period could be seen as a continuum and nutritional interventions designed to be delivered during pregnancy where women and their partners, across all socioeconomic backgrounds, are receptive and keen to get the best advice for their baby's health (OnePoll, 2014).

As a public health practitioner/researcher, prevention of a condition occurring is desirable. However the obesity epidemic is not going to go away quickly or in the foreseeable future. Hence we do need scalable and cost-effective options which are proven to help people lose and maintain their weight loss. These solutions need to be accessible in terms of cost to the person who wants to lose weight. This cost includes not just the immediate cost but also the indirect costs of getting to the sessions and whether the sessions are available at times convenient to them and in an appropriate location. CWMOs delivering weight management groups in the community present a viable option with a wealth of supporting literature demonstrating effectiveness, appropriateness and feasibility. Referral from primary care and community settings allows access for people who may otherwise not be able to afford to go. Healthcare practitioners need to embrace CWMOs and work together. There are too many overweight and people with obesity to not forge partnerships and the question should be 'do the benefits outweigh the potential harm and costs?'

CWMOs utilise many of the behavioural strategies discussed and perceived as important. These organisations are thirsty to know more, through research, on how best to support their members. They are no different to healthcare practitioners in their desire to deliver best practice and what works for their service users. I have focussed on the importance of target setting but it would also be valuable to know more about people's weight loss expectations and how these interrelate with targets and how the advice given at the start of their weight loss journey can influence long-term outcomes. Indeed this piece of work is currently being undertaken under my supervision.

Some of the research presented has measured changes in self-esteem and self-efficacy where improvements can have a profound effect on an individual's ability to find their own solutions to manage their weight (Maddux & Gosselin, 2003). Current work is investigating the importance of self-worth through a more compassionate approach to support people through their weight loss journey. If we can improve self-worth, in people of all ages, then this may help to prevent relapse and abandonment of attempts to improve diet and lifestyle.

It would be good to know more about the benefits of social support in weight management for both young people and adults. Are CWMOs more effective because of the carefully considered group dynamics? What are the main features of a group which are effective in promoting sustained weight loss? Key attributes may be the peer modelling, the sharing of ideas and perhaps even some element of competition. How important is a reward system?

There is an increasing body of research and emerging evidence supporting the use of health technology in weight management (Tate, Wing & Winett, 2001; Khaylis *et al.,* 2010; Free *et al.,* 2013). Some people will prefer accessing on-line support rather than going to a community group or seeking individual advice particularly if there is the same perceived level of social support (Womble *et al.,* 2004; Poncela-Casasnovas *et al.,* 2015). In the very near future there are likely to be virtual on-line support groups and it will be interesting to be involved with CWMOs in the evaluation of this mode of delivery, again in terms of effectiveness, appropriateness and feasibility. Preliminary work suggests only small clinical differences between those who access on-line versus the traditional weekly group support.

Obesity results from malnutrition and as such may co-exist with other consequences of malnutrition such as micronutrient deficiencies (Schweiger *et al.,* 2010; Peterson *et al.,* 2016). It would be good to know more about some of these micro-nutrient deficiencies and the 'double burden' of obesity. For example obesity and iron deficiency can co-exist (Cepeda-Lopez *et al*., 2015). If we can address these micronutrient deficiencies at the same time as supporting weight loss, are effectiveness and appropriateness enhanced? We also know that obesity represents a state of low grade inflammation and this impacts on a number of metabolic pathways (Ishii *et al.,* 2012). How can we reduce the low grade inflammation effectively?

The answer to most of these questions lies in a nutritionally balanced diet and adequate levels of daily activity which enable children and adults to maintain a healthy weight across the life-course. Behavioural strategies are required to maintain these behaviours given we live in an environment where energy dense food options and sedentary behaviours are the norm. In a world of limited resources we ideally need to act earlier with an emphasis on 'Early Nutrition for Later Health'.

On-going personal research activity which will help address some of these questions includes;

- The design of an intervention to address low grade inflammation in the person with obesity by influencing the gut microbiota.
- Changes in dietary patterns, focussing on a range of nutrients, before and after engaging in a weight management programme using factor analysis.
- Using secondary data analysis to further explore the role of socioeconomic status as an important variable in weight management.
- Longer-term follow up of interventions delivered in pregnancy and post-natally to assess the longer term influences on the child's weight and dietary habits.

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Paper 1

Lavin, J.H., **Avery. A**., Whitehead. S.M., Rees. E., Parsons. J., Bagnall. T., Barth. J.H. & Ruxton. C.H.S. (2006). **Feasibility and benefits of implementing Slimming on Referral service in primary care using a commercial weight management partner**. *Public Health*, 120(9): 872-881

Public Health (2006) **120**, 872–881

PUBLIC HEALTH

JOURNAL OF THE ROYAL INSTITUTE OF PUBLIC HEALTH

www.elsevierhealth.com/journals/pubh

ORIGINAL RESEARCH

Feasibility and benefits of implementing a Slimming on Referral service in primary care using a commercial weight management partner

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Received 22 July 2005; received in revised form 10 March 2006; accepted 17 May 2006
Available online 25 July 2006

KEYWORDS
Obesity;
Treatment;
Primary care;
Public–private partnership;
Feasibility

Summary *Objectives:* To assess participation in a costed Slimming on Referral service and identify factors associated with success.
Study design: Simple intervention offering participation in a new service to 100 eligible patients. The setting was two Derby general practices, one inner city and one suburban.
Participants: One hundred and seven patients (mean age 50 years) attending general practice for non-obesity reasons. Inclusion criteria: BMI $\geq$ 30, age $\geq$ 18 years, not pregnant, no recent commercial weight management group membership, willingness to attempt weight loss.
Methods: Patients were offered free attendance at a local Slimming World group for 12 consecutive weeks. Body weight and height were measured at baseline, and questionnaires established perceived health, motivation to lose weight, employment, concerns, responsibilities and well-being. Weight was measured at each group visit. The main outcome measures were: (1) changes in body weight at 12 and 24 weeks, (2) social and demographic factors associated with barriers to enrolment, continued attendance and successful weight loss.
Results: Ninety-one (85%) patients attended a group, with 62 completing 12 weeks. Average weight loss in participants was 5.4 kg (6.4% baseline weight). Forty-seven then chose to self-fund, with 34 (37% original group) completing a further 12 weeks. Average weight loss over the total 24 weeks was 11.1 kg (11.3% baseline weight).

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doi:10.1016/j.puhe.2006.05.008

Regular attendance was affected by income, financial concerns (independent of actual income), age, perceived importance of weight loss and initial weight loss success. Well-being of patients significantly improved between baseline and both 12 and 24 weeks.
Conclusions: Collaboration with an appropriate commercial weight management organization offers a feasible weight management option that is either similar to, or better than, other options in terms of attrition, efficacy and cost.

Introduction

Obesity is a serious but preventable challenge to health. Currently more than 20% of adults are obese,[1] i.e. a body mass index (BMI) over 30, increasing their risk of cardiovascular disease, metabolic syndrome, some cancers, depression and poor mobility.[2] While the benefits of treating obesity are clear, not least as a way of helping to meet clinical targets for hypertension, hyperlipidaemia and type 2 diabetes, less is known about how to manage obesity within the resource and training constraints of primary care.

The most effective treatment for obesity is reported to be a combination of diet, exercise and behavioural therapy.[2] However, the availability of treatments varies across the UK. A survey of 340 Primary Care Organizations (PCOs) found that less than 50% of these offered an obesity service and, where one existed, patients from only 25% of GP clinics were able to access it.[3] Reasons for this may include low prioritization of specialist obesity services or uncertainty about effectiveness.[4] Inadequate provision of obesity services has also been highlighted by a UK Government White Paper (Choosing Health),[5] which recently set out new policy ideas to address the deficit. The introduction of drugs for weight control, notably orlistat and sibutramine, has also advanced treatment options for primary care, although the costs of these remain a legitimate concern. In addition, these drugs are approved for use by the National Institute for Clinical Excellence (NICE) only as adjuncts to core lifestyle advice and not as stand-alone treatment.[6,7] Indeed, there is better standardization for the provision of drugs and surgery than for core advice, e.g. for dietary intake and physical activity. This needs to be addressed, particularly to support prescribing in line with the guidance of NICE.[6,7]

Choosing Health[5] recommended that obesity services be upgraded across England and Wales to include regular monitoring and personalized advice on diet, physical activity and behavioural strategies to tackle the causes of over-eating and under-exercising. Offering free or reduced cost attendance at commercial weight management groups was recognized in this document and others as a means of expanding PCO capacity.[5,8] There is evidence from the USA that regular slimming group attendance leads to clinically significant weight loss that is maintained in the long term. Two randomized controlled trials compared commercial weight management group attendance with a self-help programme at 4 weeks,[9] 26 weeks[10] and 2 years.[11] Weight loss for subjects attending the commercial programme was significantly greater than after the self-help programme (4.8 kg more at 26 weeks; 2.9 kg more at 2 years). Weight regain is a problem for all weight management methods, with reports that 30% of lost weight is regained within a year, and virtually all by 5 years.[12] However, people attending commercial weight management groups do better than predicted at 5 years,[13] perhaps due to frequent contact and group support, both known to influence better outcomes.[14]

No UK studies have been carried out to assess the feasibility of building commercial weight management group referral into primary care. Nor has there been an assessment of potential barriers to enrolment and attendance—an important aspect since accessibility is a key factor for any new service. To remedy this, a collaboration was developed between public sector stakeholders in Southern Derbyshire and Slimming World (SW), generating the research reported here.

Aim

The aim of the study was to assess the feasibility of referring obese patients from primary care to a commercial weight management group. Outcomes were:

- Enrolment, attendance and weight loss.
- Factors associated with participation.
- Cost of the referral scheme in comparison with in-house options.

It was not the aim of the study to compare the efficacy of commercial weight management groups with in-house options offered by primary care for two reasons. Firstly, the provision of in-house weight management advice in those practices participating in the study was not uniform. Secondly, research in the USA has already established that attendance at commercial weight management groups leads to clinically significant weight loss.[9–11]

Methods

Overview

An overview is shown in Fig. 1. Obese patients from two general practices were referred to a local SW group by primary care health professionals using a voucher system. The vouchers covered membership and weekly group fee costs for 12 consecutive weeks attendance, after which time patients could continue attending the group at their own expense. Attendance, weight and attrition were monitored for up to 24 weeks.

Setting

Approval was given by the Southern Derbyshire Ethics Committee. The study was based in two general practices in the former Southern

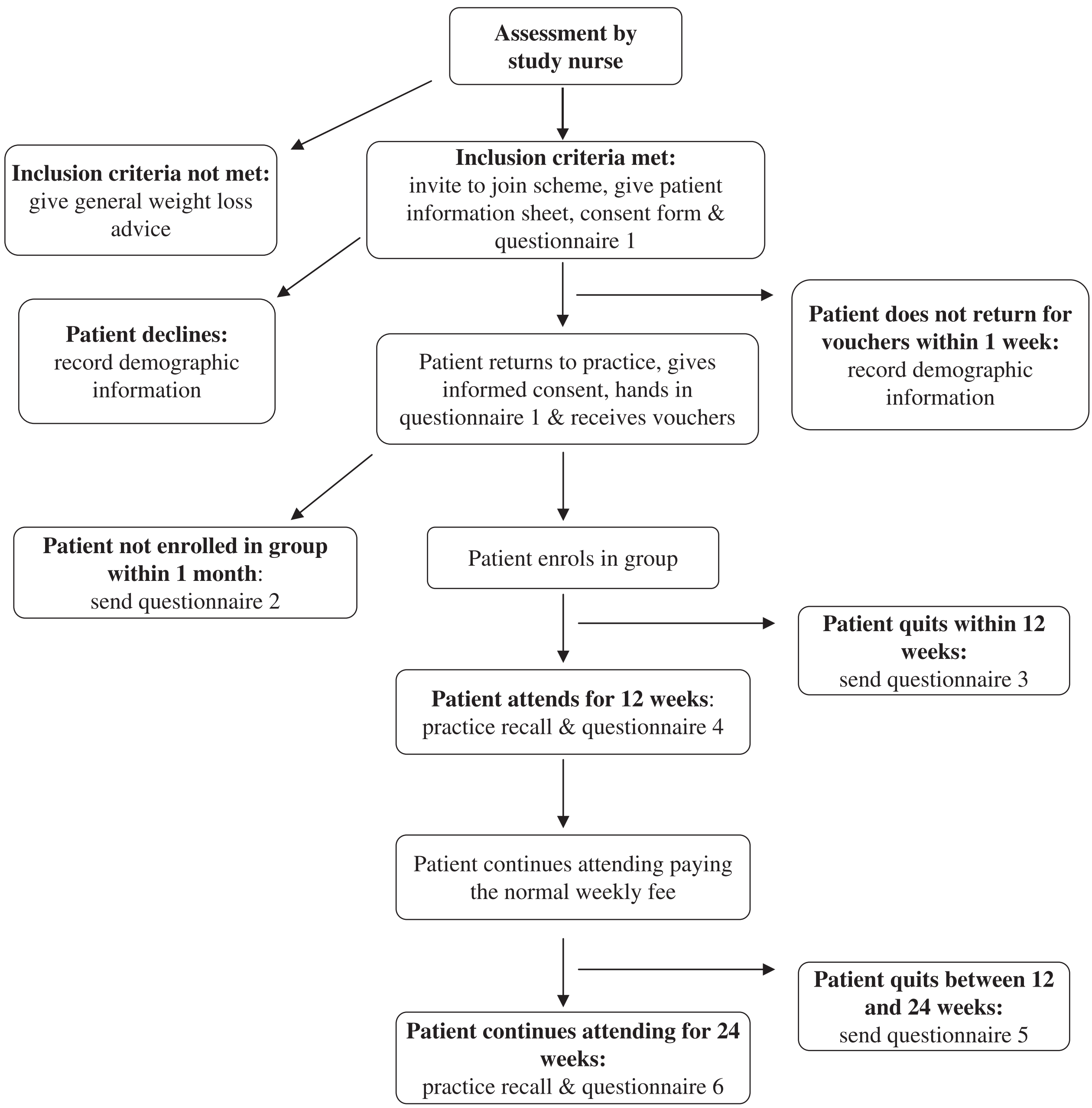

Figure 1 Flow of participants through the study.

Derbyshire health district, one serving an inner city population and the other a suburban area. Training was provided to ensure that practice staff understood how SW groups operated and the type of advice that would be given to patients. This advice includes modest, sustained energy restriction (in line with National Obesity Forum guidelines[15]) and support to change behavioural patterns that promote over-consumption of energy. Patients involved in the study were treated no differently from regular SW members.

Protocol

The recruitment target was 100. General Practitioners and practice nurses identified patients visiting practices for reasons other than weight management. Patients were eligible if their BMI was $\geq 30\,kg/m^2$, they were between 18 and 75 years of age, they were not pregnant and they had not attended a commercial slimming group within the previous 3 months. Patients interested in participating were referred to a study nurse who gave a full explanation of the study and obtained informed consent. The study nurse recorded baseline data and issued a voucher pack valid for 1 month from the date of issue. Vouchers covered membership and group fees for 12 consecutive weeks, in order to remove cost as a barrier to attendance. Patients had the choice of attending any SW group within the Southern Derbyshire area. Following the 12-week free period, patients could self-fund at a cost of £3.75/week, and attendance was monitored for a further 12 weeks. Patients were recalled at 3 and 6 months for a review by their own practices.

Data collection

The data recorded at baseline were height, weight, medical conditions, prescribed drugs and relevant biochemical results, most from existing GP records. Questionnaire 1 (Fig. 1) was used to establish motivation to lose weight, income category, employment status, financial concerns and family responsibilities.

Questionnaires 2–6 were administered during the study depending upon attendance at SW groups (Fig. 1). A postal questionnaire (with one reminder) was sent to patients failing to enrol after being given vouchers that explored reasons for non-attendance. Patients completing the free 12-week period were asked to fill out a questionnaire evaluating the ease of attendance and their interest in self-funding future sessions. Patients who wished to discontinue were invited to give reasons for this. Similar questionnaires were used at the end of the self-funded 12-week period. Enrolled patients who did not complete 12 or 24 weeks were sent questionnaires that explored reasons for non-completion.

Well-being was assessed using identical methods to those employed by the South Derbyshire Health Survey[16] at baseline and completion of the 12 and 24-week periods (questionnaires 1, 4 and 6). Patients were asked to rate how calm/peaceful, energetic and downhearted/low they felt. Results were compared with those from the general population in South Derbyshire.[16]

Attendance and weekly weights were recorded by SW group leaders and shared with the referring practices on a regular basis. Patients were classified as '12-week completers' if they had attended at least 10 of the 12 free sessions, including one of the two final sessions. Patients who continued by self-funding were classified as '24-week completers' if they were still attending at 24 weeks.

Data handling

Postcodes were given a Townsend deprivation score and classified into one of five deprivation levels. Weight change at 12 weeks and, where appropriate, 24 weeks was expressed as a percentage of baseline weight. This was to enable comparison with National Obesity Forum guidelines,[15] which suggest that a 10% weight loss is clinically significant. Data were analysed using SPSS version 11.5. Data obtained from participants on recruitment (questionnaire 1) were used to assess barriers to enrolment and continued attendance. Categorical variables of those who did and did not enrol, and those who did and did not complete 12 and 24 weeks, were compared by χ^2 tests, where $P<0.05$ was taken as significant.

Results

Subjects

Between September 2001 and January 2002, 107 patients were recruited into the study. Characteristics of this group are given in Table 1. The mean age was 49.5 years (range 22.5–77.5 years), while mean BMI was $36\,kg/m^2$ (range $30–47\,kg/m^2$), with 50% exhibiting a BMI in excess of $35\,kg/m^2$.

Of the 107 patients initially recruited, 91 enrolled at a SW group with 62 of these completing the free 12-week period. At the end of this period,

Table 1 Subject information ($N = 107$).

	% Participants[a]
Practice	
Inner city	49
Suburban	51
Age (years)	
<40	24
40–50	23
50–60	30
>60	24
Gender	
Female	89
Male	11
Ethnicity	
Caucasian	92
Other	8
Area of residence	
Most affluent	18
2	28
3	11
4	16
Most deprived	27
Household income (£)	
<10K	43
10–20K	28
>20K	28
Money worries	
Yes	45
No	55
Responsibility for children	
No	52
Yes	48
Paid employment outside home	
Yes	45
No	55
Confidence in losing weight at recruitment stage	
Yes	54
No/unsure	46
Perceived importance of weight loss	
Yes	68
No	32
BMI	
30–34.9	50
35–39.9	26
>40	23
Previous attendance of a slimming group	
None	28
Once	26
2 to 4 times	35
5 or more	11
Diabetes	
Yes	10
No	90

[a]Where numbers do not add up to 100%, this denotes missing data.

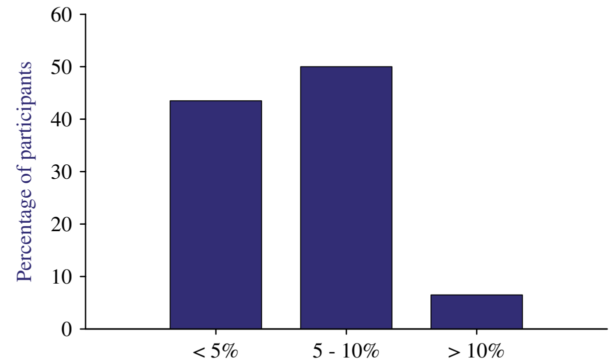

Figure 2 Mean weight change (as % baseline) in 12-week completers ($n = 62$).

47 went on to self-fund additional sessions and 34 of these were still attending at 24 weeks.

Weight loss

The mean weight change in the 12-week completers ($n = 62$) was −5.4 kg (standard deviation (SD) 3.19 kg, range −17.1 to +1.4 kg). Fig. 2 shows weight change expressed as a percentage of baseline weight. The mean change was −6.4% (SD 2.96%, range −10.6 to +1.1%). Most of the 12-week completers (57%) achieved at least a 5% weight loss.

For the 24-week completers ($n = 34$), 29 records were available due to missing data. The mean weight change was −11.1 kg (SD 5.5 kg, range −3.2 to −30.9 kg). Fig. 3 shows weight loss in this group expressed as a percentage of baseline weight at weeks 12 and 24. The mean change at 24 weeks was −11.3% (SD 4.6%, range −22.3 to −2.8%). Most (86%) achieved at least 5% weight loss, while over half (59%) achieved a 10% weight loss.

Factors associated with participation

Tables 2 and 3 summarize the factors associated with enrolment and completion of both the free and extended periods.

Enrolment

Patients who chose to enrol after recruitment ($n = 91$) were significantly more likely to be over 50 years of age, live in a household with an income greater than £10 000 per year and regard weight loss as important to themselves.

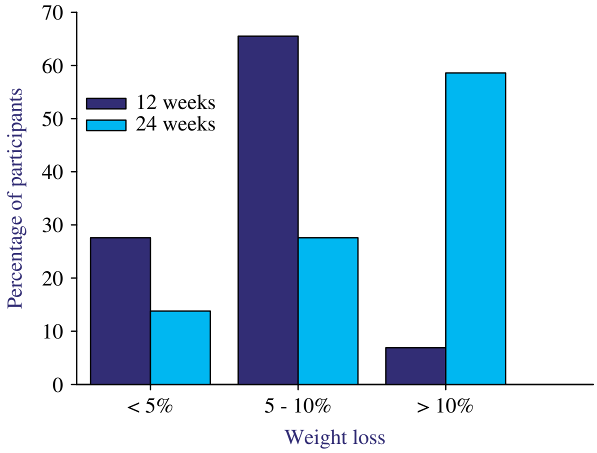

Figure 3 Mean weight change (as % baseline) at 12 and 24 weeks in 24-week completers ($n = 29$).

Completion of free period

Twelve-Week completers ($n = 62$) were significantly more likely to be Caucasian, aged between 50 and 60 years and reported no financial worries in the few weeks prior to recruitment. Interestingly, actual household income was not related to likelihood of completion. Those who did not complete the funded 12-week period were asked to give their reasons for non-completion. However, only nine out of 29 participants responded to this question. The reasons cited by participants were: time of meeting was not convenient ($n = 4$), felt too anxious/stressed ($n = 3$), location of group was not convenient ($n = 3$), health problems ($n = 2$), lack of transport ($n = 2$), childcare difficulties ($n = 2$), commitments at work or home ($n = 2$), other caring responsibilities ($n = 2$), difficulty understanding dietary advice ($n = 1$), money worries ($n = 1$), had stopped losing weight ($n = 1$), lack of support from family ($n = 1$), difficulty fitting dietary advice with family meals ($n = 1$), did not enjoy being part of group ($n = 1$).

Intention to self-fund

Twelve-Week completers were asked if they intended to continue on a self-funding basis. Of the 54 patients responding, 41 declared an interest in continuing. The reasons given for discontinuation were: the cost of weekly fees ($n = 12$), a desire to continue weight management alone ($n = 7$), the opinion that benefits had dwindled ($n = 5$), too busy ($n = 1$) and had achieved sufficient weight loss already ($n = 1$).

Completion of extended period

Twenty-four-Week completers ($n = 34$) were significantly more likely to come from the suburban practice, have an annual household income above £10 K and have experienced at least 5% weight loss during the 12-week period. Of those completing 24 weeks, 72% expressed a desire to continue once the study had finished.

Well-being

At baseline, patients had low ratings of well-being compared with the South Derbyshire population. However, these ratings improved significantly by week 12 (calm $P<0.001$, energy $P<0.001$, downhearted $P<0.05$) and were maintained at week 24 (calm $P<0.05$, energy $P<0.001$, downhearted $P<0.001$).

Comparative costs

Based on SW fees in 2004, the cost per patient to cover membership and 12 weeks attendance at a group was £44.50 with primary care trust (PCT) discount. Practices estimated that each referral utilized 20 min of nurse and administrator time, which added a notional £7 per patient when salaries were taken into account. Referral without the constraints of a research study would take less time since there would be minimal data collection. In comparison with these figures, we estimated that 12 weeks of other treatments would cost £112 for sibutramine and £124 for orlistat. However, this does not include the cost of providing a concomitant weight management programme (to include support for diet, physical activity and behavioural strategies) as recommended by NICE. One-to-one treatment from a dietitian would cost £55 to £115 per patient, depending upon the employment contract. Group treatment for 10 patients using dietetic input would cost £45 to £108 per patient. In-house options need to factor in additional costs for training, telephone support between sessions, scales, literature, travel and cover for staff absence. These figures were estimated in consultation with the practices involved in the study and are based on pro-rata salaries and costs in 2004.

Discussion

Obesity is a major risk factor for chronic conditions.[2,4] It is worth treating in primary care since even reductions of 5% baseline weight can improve

Table 2 Factors affecting enrolment in scheme ($N = 107$)

	Enrolled *n* (%)	Not enrolled *n* (%)	*P* value
Number of participants	91 (85.0)	16 (15.0)	
General practice location			
Inner city	45 (86.5)	7 (13.5)	0.674
Suburban	46 (83.6)	9 (16.4)	
Age			
Under 50	38 (77.6)	11 (22.4)	0.025
50 and over	52 (92.9)	4 (7.1)	
Gender			
Female	80 (84.2)	15 (15.8)	0. 495
Male	11 (91.7)	1 (8.3)	
Ethnicity			
Caucasian	84 (84.8)	15 (15.2)	0.245
Other	6 (85.7)	1 (14.3)	
Area of residence			
Most affluent	17 (89.5)	2 (10.5)	0.571
2	25 (89.3)	3 (10.7)	
3	11 (91.7)	1 (8.3)	
4	13 (76.5)	4 (23.5)	
Most deprived	22 (76.8)	6 (21.4)	
Household income			
<10K	30 (75.0)	10 (25.0)	0.029
10–20K	25 (96.2)	1 (3.8)	
>20K	24 (92.3)	2 (7.7)	
Money worries			
Yes	36 (80.0)	9(20.0)	0.06
No	51 (92.7)	4 (7.3)	
Responsibility for children			
No	50 (90.6)	4 (7.4)	0.06
Yes	40 (80.0)	10 (20.0)	
Paid employment			
Yes	43 (91.5)	4 (8.5)	0.179
No	47 (82.5)	10 (17.5)	
Confidence in losing weight			
Yes	52 (92.9)	6 (8.1)	0.146
No/unsure	39 (79.6)	10 (20.4)	
Perceived importance of weight loss			
Important	64 (92.8)	5 (7.2)	0.006
Not important	24 (72.7)	9 (27.3)	
BMI			
30–34.9	49 (90.7)	5 (9.3)	0.263
35–39.9	22 (78.6)	6 (21.4)	
>40	20 (80.0)	5 (20.0)	
Previous attendance of a slimming group			
None	24 (82.8)	5 (17.2)	0.550
Once	23 (85.2)	4 (14.8)	
2–4 times	32 (86.5)	5 (13.5)	
5 or more times	11 (100)	0 (0)	

health outcomes and reduce the need for medication.[15] The most effective first level treatment is a combination of modest energy restriction (around 600 kilocalories below usual daily energy intake), increased physical activity, behavioural strategies and long-term follow-up.[17] The issue for many practices is whether this can be offered in-house. Where this is not possible, a practical alternative is to implement Slimming on Referral using a local commercial group that offers this combination of treatments. Partnership with commercial weight management groups has been recommended by

Table 3 Factors affecting 12 week ($n = 91$) and 24 week ($n = 62$) attendance.

	12 week attendance			24 week attendance		
	Completed *n* (%)	Not completed *n* (%)	*P* value	Completed *n* (%)	Not completed *n* (%)	*P* value
Number of participants	62 (68.1)	29 (31.9)		34 (54.8)	28 (45.2)	
General practice location						
Inner city	27 (60.0)	18 (40.0)	0.1	11 (39.3)	16 (60.7)	0.025
Suburban	35 (76.1)	11 (23.9)		23 (65.7)	12 (34.3)	
Age						
<40	8 (42.1)	11 (57.9)	0.008	3 (37.5)	5 (62.5)	0.394
40–50	12 (63.2)	7 (36.8)		5 (41.7)	7 (58.3)	
50–60	25 (89.3)	3 (10.7)		14 (56.0)	11 (44.0)	
>60	16 (66.7)	8 (33.3)		11 (68.8)	5 (31.2)	
Gender						
Female	55 (68.8)	25 (31.2)	0.73	30 (54.5)	25 (45.5)	0.825
Male	7 (63.6)	4 (36.4)		4 (57.1)	3 (42.9)	
Ethnicity						
Caucasian	60 (71.4)	21 (28.6)	0.019	33 (55.0)	27 (45.0)	0.365
Other	2 (28.6)	5 (71.4)		1 (50.0)	1 (50.0)	
Area of residence						
Most affluent	14 (82.4)	3 (17.6)	0.11	9 (64.3)	5 (35.7)	0.942
2	18 (72.0)	7 (28.0)		10 (55.6)	8 (44.4)	
3	8 (72.7)	3 (27.3)		5 (62.5)	3 (37.5)	
4	10 (76.9)	3 (23.1)		5 (50.0)	5 (50.0)	
Most deprived	10 (45.5)	12 (54.5)		5 (50.0)	5 (50.0)	
Household income						
<10K	20 (66.7)	10 (33.3)	0.947	7 (35.0)	13 (65.0)	0.03
10–20K	17 (68.0)	8 (32.0)		13 (76.5)	4 (23.5)	
>20K	17 (70.8)	7 (29.2)		11 (64.7)	6 (35.3)	
Money worries						
Yes	20 (55.6)	16 (44.4)	0.04	8 (40.0)	12 (60.0)	0.839
No	39 (76.5)	12 (23.5)		24 (61.5)	15 (38.5)	
Responsibility for children						
No	34 (68.0)	16 (32.0)	0.96	18 (52.9)	16 (47.1)	0.116
Yes	27 (67.5)	13 (32.5)		15 (55.6)	12 (44.4)	
Paid employment						
Yes	28 (65.1)	15 (34.9)	0.605	14 (50.0)	14 (50.0)	0.554
No	33 (70.2)	14 (29.8)		19 (57.6)	14 (42.4)	
Confidence in losing weight						
Yes	29 (58.0)	21 (42.0)	0.075	19 (61.3)	12 (38.7)	0.445
No/unsure	31 (79.5)	8 (20.5)		15 (48.4)	16 (51.6)	
Perceived importance of weight loss						
Yes	43 (67.2)	21 (32.8)	0.744	22 (51.2)	21 (48.8)	0.592
No	17 (70.8)	7 (29.2)		10 (58.8)	7 (41.2)	
BMI						
30–34.9	35 (71.4)	14 (28.6)	0.799	22 (62.9)	13 (37.1)	0.397
35–39.9	14 (63.6)	8 (36.4)		6 (42.9)	8 (57.1)	
>40	13 (65.0)	7 (35.0)		6 (46.2)	7 (53.8)	
Previous attendance of a slimming group						
None	16 (66.7)	8 (33.3)	0.971	9 (56.3)	7 (43.8)	0.4
Once	16 (69.6)	7 (30.4)		7 (43.8)	9 (56.3)	
2–4 times	21 (65.6)	11(34.4)		14 (66.7)	7 (33.3)	
5 or more times	8 (72.7)	3 (27.3)		3 (37.5)	5 (62.5)	
Weight loss at 12 week						
<5%				9 (36.0)	16 (64.0)	0.025
5% or more				20 (62.5)	12 (37.5)	

various bodies as one means of expanding provision of obesity services in primary care.[4,8,18]

Comparison with other studies and guidelines

The aim of this study was to assess the feasibility of referring obese patients to a SW group. Most patients took the opportunity to enrol, and attrition compared favourably with other treatments. In our study, 32% of patients failed to complete the first 12 weeks. However, the attrition rate in the extended 12-week period, which was self-funded, was much lower at 17%. Other short-term studies have reported drop-outs of 53% for a one-to-one combination therapy approach,[19] 25% for a commercial weight loss programme (both 12 weeks) and 31–56% for very low calorie diets with group counselling (20–26 week programmes).[20] One-year studies report attrition rates of 40% for a dietary/behavioural programme,[21] 22% for a group approach in men[22] and 41–67% for a self-help programme.[20]

Mean weight loss in our 12-week completers was 5.4 kg, corresponding to a rate of 0.45 kg per week; similar to that expected for modest energy restriction.[23] Twenty-four-Week completers lost, on average, 11 kg. Studies of 12-month programmes report weight losses of 5.7 kg with energy restriction, 5–6 kg with drug treatment, 11 kg with very low calorie diets (less than 1000 kilocalories per day) and 7.3 kg with diet and behavioural therapy.[2]

The National Obesity Forum[15] suggests that a clinically significant weight loss is 10% of baseline, although it is also claimed that a weight loss between 5% and 10% of baseline produces measurable health benefits. When weight loss in the present study was translated into percentages, 57% of 12-week completers lost at least 5% of baseline weight, while nearly 60% of 24-week completers achieved a clinically significant weight loss of 10%.

Reported barriers

Barriers to successful attendance varied but a pattern emerged of age, financial situation (real and perceived) and how patients viewed the importance of weight loss. It was unexpected that money worries impacted on completion of the first 12 weeks since attendance was free. Lower income people are less likely to access healthcare and yet experience a greater risk of obesity.[5] This highlights the importance of providing accessible, free treatments for this group. Early success at losing weight determined whether patients completed their self-funded programme.

Cost comparisons

Between 2001 and 2003, NHS spending on sibutramine increased from £0.45 m to £7.69 m, and from £13.6 m to £23 m for orlistat.[24] Cost comparisons show that a Slimming on Referral option is less expensive than drug treatment (particularly since drug treatment requires a concomitant weight management programme) and may be less expensive than in-house options (depending on how such clinics are set up). The efficacy of commercial weight management groups compares favourably with other treatments where published studies exist. The efficacy of in-house primary care treatments is, as yet, relatively unknown.

Strengths and limitations of the study

Limitations could include the absence of a control group and the fact that results were based upon completion, rather than intention to treat. The reason for the lack of control group was that no comparable and consistent in-house options were available in the recruiting practices. However, the purpose of the study was not to compare the efficacy of SW group with other treatments, but to assess the feasibility of implementing Slimming on Referral in a primary care setting. To that end, the methods served the purpose of the study. A key strength was that the study fitted into the normal day of the practices and SW groups.

Conclusion

One implication of the Choosing Health White Paper is that PCOs will be asked to provide evidence-based obesity services. Our study has demonstrated that partnership working is feasible, benefits patients and can be less expensive than in-house options. Because feedback on attendance and weight is possible, practices retain overall responsibility for patients. Minimal extra resources were needed to administer the referral process.

Acknowledgements

The study was funded jointly by the former Southern Derbyshire Health Authority and Slimming World.

Competing interests: JL is employed by Slimming World, AA was funded by the former Southern

Derbyshire Health Authority and Slimming World to undertake the study, JB has received consultancy fees from Slimming World for medical advice, CR received a consultancy fee from Slimming World for writing this paper.

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Paper 2

Pallister, C., **Avery, A**., Stubbs, J. and Lavin, J. (2009**)**. **Influence of Slimming World's lifestyle programme on diet, activity behaviour and health of participants and their families**. *Journal of Human Nutrition and Dietetics*, 24(4): 351-358

THE OFFICIAL JOURNAL OF THE BRITISH DIETETIC ASSOCIATION
Journal of Human Nutrition and Dietetics

RESEARCH PAPER

Influence of Slimming World's lifestyle programme on diet, activity behaviour and health of participants and their families

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Keywords
commercial slimming organisation, diet, exercise, family, health, weight control.

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doi:10.1111/j.1365-277X.2009.00959.x

Abstract

Background: Understanding the impact of commercial weight management programmes on behaviour change is an area that requires greater evidence. The present study investigated the impact of a commercial weight management organisation's diet and activity programmes on the lifestyles of those accessing the services and their families.

Methods: This survey was based on self-reports from a group of people involved in their own weight control. A questionnaire consisting of multiple choice and open-ended questions regarding diet, activity patterns and health was distributed in a commercial slimming organisation's magazine and was available on the website for a 4 week period. Two thousand eight hundred and twelve respondents were analysed, including the organisation's members (53%) and nonmembers (47%).

Results: Those following the dietary programme reported significant changes towards healthier food choices in line with current guidelines ($P < 0.01$). Over 80% reported an improvement in their own health and over 26% reported an improvement in their partner's or family's health ($P < 0.01$). Respondents reported increasing physical activity after being made aware of the organisation's activity programme ($P < 0.001$). Members were more likely to have become more active than nonmembers ($P = 0.011$). The longer respondents had been members, the more likely they were to report an increased participation in physical activity ($P = 0.02$). Half of those reporting increased activity indicated that their partner or whole family had also increased their activity levels.

Conclusions: The commercial slimming organisation's programme appeared to be having a beneficial impact on the diet and activity behaviours of those accessing the service. Group members were more likely to make positive behaviour changes and health improvements tended to increase with the duration of membership. The improvements observed with respect to both diet and activity levels also reached the wider family network.

Introduction

The obesity epidemic is predicted to become the most widespread public health problem affecting UK adults and children (House of Commons Health Committee, 2004; Department of Health, 2006; Government Office for Science, 2007).

The physical and psychological health consequences of obesity are well-documented (World Health Organization, 1998). These problems are also present in childhood and may be associated with an increased risk of adult obesity (Reilly *et al.*, 2003). Accordingly, the Government has placed much emphasis on the prevention of childhood obesity and family-based approaches to healthy eating and physical activity (Department of Health, 2008). A key problem in this respect is how to engage the whole family and effectively disseminate health-based messages to children.

Many people in the UK do not follow nutrition guidelines recommended by health professionals. For example, although reported fat intakes appear to be at target levels, adults are consuming more than twice the recommended levels of saturated fat and half the recommended intake of fibre and fish (Food Standards Agency, 2005). Fruit and vegetable consumption is also poor in comparison with the recommended five portions a day (Department of Health, 2008).

Physical activity plays an important role in weight control and general health. Habitual physical activity prevents weight gain and regain (Garrow, 1999; Garrow & Summerbell, 1995; Department of Health, 2004; Jakicic *et al.*, 2008). However, activity levels in England are low, with approximately two-thirds of men and three-quarters of women achieving less than the current recommended levels (Department of Health, 2008). Some studies suggest that many adults are simply not aware of their own inactivity (Health Education Authority & Sports Council, 1992) nor that effective quantification of the true level and pattern of an individual's activity behaviour yet exists (Department of Health, 2004). This makes the process of disseminating healthy habits to their children less likely.

Moderate weight loss (5–10% of baseline body weight) is associated with clinically significant improvements in a number of health parameters (Goldstein, 1992; Reilly *et al.*, 2003; NICE, 2006; Swanton & Frost, 2007), quality of life (Seidell & Tijhuis, 2002) and a decrease in negative emotions such as depression and anxiety (Garrow, 1999; House of Commons Health Committee, 2004). The current NICE guidance on the management of obesity recommends that first-line treatment should be based on a multi-component approach, including behaviour change strategies to improve diet and increase physical activity (NICE, 2006). When providing dietary weight management services, it is recommended that trained personnel be responsible for frequent patient contacts, preferably as part of a support group. Behavioural modification techniques should be routinely employed and a system to increase physical activity also should be included (NICE, 2006). The patient's household should be involved in dietary changes to improve patient compliance (Scottish Intercollegiate Guidelines Network (SIGN), 1996). A whole family approach is particularly beneficial because a child is at higher risk of experiencing weight problems if they have overweight parents (Department of Health, 2006). Many children are also not achieving recommended levels of activity, particularly older girls, where there is a steady decline in activity as they progress through adolescence (Department of Health, 2004). It has recently been suggested that Primary Care Trusts and health professionals collaborate with the infrastructure provided by commercial weight control organisations in the treatment of overweight and obesity. This strategy is of considerable value, particularly as a result of the lack of NHS resources available for meeting the current consumer demand for amenable weight control solutions (NICE, 2006; Swanton & Frost, 2007).

The objectives of the survey were to assess the impact of the organisation's diet and activity programmes on eating and activity behaviours among respondents accessing the advice (i.e. through group membership, the magazine and/or website) and to ascertain how widely these behaviours are disseminated to their families. Data obtained from the survey are presented.

Materials and methods

Dietary and exercise programme

Slimming World is a commercial weight management organisation with over 5500 support groups held each week across the UK, reaching between 250 000 and 300 000 people every month. Groups are located in a variety of local venues at different times, making the groups easily accessible for all members of the community. The programme is accompanied by a commercially successful magazine. The magazine, available in groups and magazine retailers, contains dietary advice, sample eating plans and activity information. There is a general website for information as well as a website available to members that offers continued support between group meetings. The aim of the programme is to empower members to make healthier food choices and increase physical activity levels while continually supporting them in making these behaviour changes. Members' commitment and effort towards current government recommended levels of activity and the benefits of an initial 10% weight loss are encouraged and recognised within award systems. Individual weekly and long-term targets are agreed with every member and the importance of weight maintenance and weekly group attendance is emphasised.

The dietary programme, Food Optimising, is structured around *ad libitum* intake of low energy dense foods, as well as principles of energy balance and appetite regulation to reduce energy intake, with additional guidance to ensure a balanced diet. The activity programme, Body Magic, is designed to facilitate behaviour change towards becoming more physically active and is particularly aimed at helping those who may have avoided activity for many years. Members do not take part in structured exercise within group sessions; instead, the group support structure is used to share ideas and experiences, aiming to build commitment among members and support them to encourage behaviour changes towards both healthy eating and increases in physical activity.

A survey was carried out through a questionnaire featured in the commercial slimming organisation's magazine and public websites.

Survey questionnaire

The questionnaire was devised and analysed independently by NSM research (Summertown, Oxfordshire). By filling in the questionnaire, participants were aware that they would be entered into a prize draw to win a spa break. The questionnaire was inserted in the August/September (2004) issue of the magazine and was available online on their public websites for 4 weeks.

The questionnaire consisted of 49 questions within eight categories (membership, Slimming World magazine, other magazines, activity and exercise habits, food shopping habits, dietary habits, lifestyle and general slimming information). The questions were predominantly closed, multiple choice response categories, where more than one option could be ticked where appropriate. When asked about their physical activity levels, participants were asked whether they were currently participating in the physical activity programme and whether they considered themselves more active in their daily life after learning about the programme. They were also asked to rate their activity levels before learning about the programme and at present. The categories: sedentary (inactive); not very active; averagely active; and very active were used and personally interpreted by the respondents to rate their activity levels. Some questions were open ended where more detail was required (the questionnaire can be accessed as a pdf file at: http://www.slimmingworld.com/health/science-evidence/publications.aspx).

Statistical analysis

Data were summarised as numbers and percentage of subjects responding to each question or sub-question. Where relevant, we have summarised data as mean percent differences and standard errors (SE). These figures all represent proportions and the SE, dependent on the sample size, was given in order to indicate sampling uncertainty. In this situation, the standard deviation is not an independent parameter: to quote it would add no information. When comparing different categories of subject response in relation to one or more questions (e.g. activity levels in members versus nonmembers), chi-squared statistics were used to test for significant departures from independent distributions of response across the categories. Differences in responses before and after, for example being introduced to the activity programme, were examined by McNemar's test. All analyses were performed using Microsoft Excel (Microsoft Corp, Redmond, WA, USA), except the McNemar's tests, which were conducted using the GENSTAT 5 statistical software (Genstat 5 Committee of the Statistics Department, AFRC, Harpenden, UK).

Results

The study population

There were a total of 23 914 responses, of which 2812 were analysed. This sample was collected by the research company to represent the proportions of respondents who completed the online or postal response and those who were group members (53%) and nonmembers (47%) (i.e. nonmembers comprising those who accessed the magazine and/or the website for information but were not attending a group). A representative sample was chosen because of the cost of transposing all of the paper responses into an electronic format.

The mean age of respondents was 42 years with a split of 4% males and 93% females (3% did not specify gender).

Reasons for wanting to lose weight

The main reasons given were to improve their health (46%), to look better in clothes (44%) and to improve their energy and fitness levels (22%).

Dietary behaviour

Seventy-eight percent of the study population ($n = 2197$) were following the dietary programme (Food Optimising). Of these, 49% had been following the plan for between 1 month and 1 year and 27% for longer than 1 year.

Of those following the dietary programme ($n = 2197$ members and nonmembers), more than 80% said that they found it easier to follow (81%) and maintain (83%) than other weight loss plans. Respondents were asked to describe how the dietary programme has changed their lifestyle. Of the sample 78% (SE 1%) said that they bought more fruit and vegetables now, 74% (SE 1%) ate less fatty foods and 61% (SE 1%) ate fewer sugary foods. Over half of respondents said they ate fewer ready meals and takeaways (58%, SE 1%) and bought more low fat dairy products (55%, SE 1%). Respondents who cooked for the whole family and followed the dietary programme ($n = 709$) were even more likely to report buying more fruit and vegetables (85%; SE 1%, $P = 0.01$), eating less fatty food (80%; SE 2%,

$P = 0.467$) and eating fewer sugary foods than before (71%; SE 2%, $P = 0.006$). Members were much more likely than nonmembers to buy more fruit and vegetables, eat less fatty foods and eat fewer sugary foods (all $P < 0.001$).

Dissemination of healthy eating practices and messages

Thirty-seven percent of all respondents who followed the dietary programme ($n = 2197$) reported buying and cooking food for themselves and their partner, whereas 32% reported doing so for the whole family. We have termed these respondents 'food providers'. Of those respondents who followed the dietary programme and who had partners ($n = 1653$), 34% reported that their partners also followed the programme. Those with children at home ($n = 982$) reported that 14% followed the dietary programme. Forty-one percent of food providers with a partner ($n = 821$) said that they followed the healthy eating principles together. Sixty-three percent of food providers with a family ($n = 709$) said they all ate more healthily now.

Seventy-five percent of respondents reported that they had influenced other people to make healthy food choices as a result of their knowledge of the dietary programme. When asked if they pass on healthy eating tips and recipes to family members, the percentage increased from 49% to 66% in respondents who had been members for less than 1 month to over 6 months. Similar trends were apparent for dissemination to friends, work colleagues and to fellow members.

Perceived impact of the dietary programme on health

Over 80% of the 2197 respondents following the dietary programme said that it had improved their health. In those who had been members of the slimming group for more than 3 months ($n = 900$), this figure rose to 90%. Of those respondents who had a partner ($n = 1653$), 34% (SE 1%) felt it had improved their partner's health. Of those who had children at home ($n = 982$), 26% (SE 1%) felt it had improved their child's health. When the same question was asked of food providers ($n = 709$), 87% (SE 1%) thought the dietary programme had improved their own health ($n = 602$), 37% (SE 3%) reported improvements to their partner's health ($n = 260$) and 30% (SE 3%) felt it had improved their children's health ($n = 211$) (Fig. 1).

Duration of membership influenced reported health improvements with respect to the dietary programme. Respondents reported a significant improvement in their own health ($P < 0.001$), that of their partners ($P = 0.026$) and their children ($P = 0.003$) with an increased duration of membership.

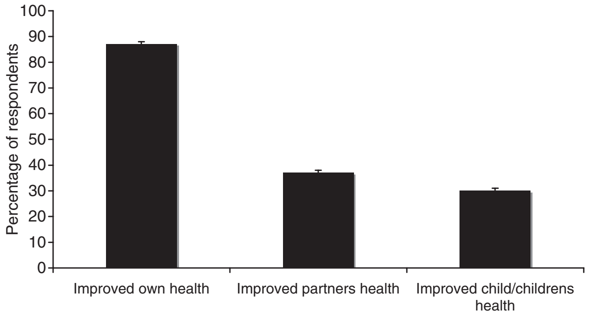

Figure 1 The percentage (SE) of food providers who reported that Slimming World's dietary programme had changed their own health and that of their partners and children ($n = 709$).

In response to an open-ended question, subjects reported that their own health had improved as a result of being slimmer or from losing weight (19%), because of eating more healthily or buying more fruit and vegetables (17%), and they also reported feeling that they had more energy (14%). Other responses were that they felt/looked better (7%), felt healthier (6%) and felt fitter (5%).

A number of respondents reported that the dietary programme had improved conditions such as raised blood pressure, breathlessness, joint pain, asthma, high cholesterol, irritable bowel syndrome and heartburn. After following the programme, 7% of the 2053 respondents who answered this question reported that their doctor had advised them to stop taking or reduce their medication. Of those reporting reduced medication usage, the most common reductions were for high blood pressure (21%), asthma (10%) and diabetes (6%). In those who had been group members for more than 6 months ($n = 638$), 10% reported a reduction in medication. People aged over 55 years ($n = 354$) were even more likely to report reduced medication (12%). People who reported having a greater amount of weight to lose also reported greater reductions in medication usage. Thus, 11% of respondents with over 5 stone (31.75 kg) to lose reported a reduction in medication usage after following the dietary programme.

Physical activity

In total, 54% ($n = 1505$) of respondents were aware of the physical activity programme (Body Magic). Seventy-five percent (SE 1%) of members were aware of the programme, compared to 28% (SE 1%) of nonmembers ($P < 0.001$).

Figure 2 shows the number of respondents who reported becoming more active after learning about the physical activity programme. Respondents were more likely than not to report having become more active after learning about the programme [64% (SE 1%) versus 36%

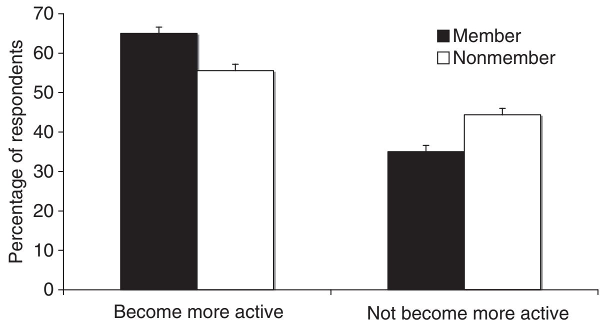

Figure 2 Percentage (SE) of members and nonmembers who reported becoming more active after learning about the physical activity programme (n = 1130). Differences between members and nonmembers were significant at P = 0.011.

(SE 1%); $P < 0.001$]. Members were more likely than nonmembers to report becoming more active [65% (SE 2%) versus 56% (SE 4%); P = 0.011]. Reported participation in physical activity also increased with the duration of membership, being 47% (SE 1%) for members of less than 1 month and 55% (SE 1%) in respondents who had been members for more than 6 months (P = 0.02).

Those respondents who reported being aware of the physical activity programme were asked how they had changed their activity levels after being introduced to it. The responses (n = 1168) are shown in Fig. 3. After learning about the physical activity programme, more people reported being either averagely (55%) or very (29%) active compared to before they had been introduced to the programme (35% and 7%, respectively). The number of people reporting being sedentary correspondingly decreased from 21% to 4% and those in the not very active category decreased from 37% to 12% (all values $P < 0.001$; SE for all percentages is 1%).

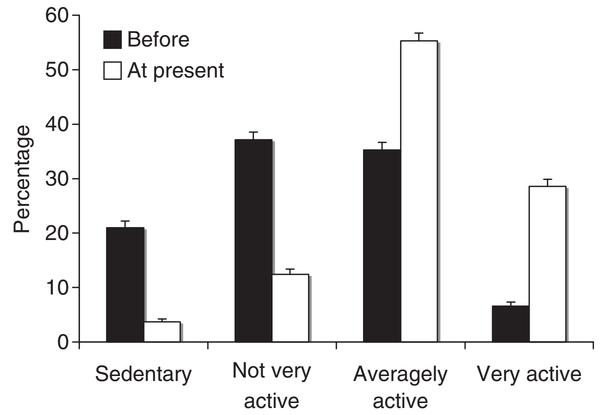

Figure 3 Mean (SE) reported levels of activity before and after learning about the physical activity programme (n = 1168) ($P < 0.001$).

Respondents (n = 1505) reported a number of benefits arising from their participation in the physical activity programme, including having more energy (37% of respondents), enjoying exercise now (33%), improved shape and posture (31%), being more mobile in daily life (29%), improved mood (25%), being calmer and less stressed (25%) and being able to sleep better (22%) (SE for all percentages is 1%).

Among those who had become more active in daily life (n = 718), 33% included their partners and 28% said that their activity also involved their children. Fourteen percent reported that it involved a friend or relative.

Discussion

The respondents in the present study primarily comprise women, with an average age of 42 years, most of whom are married or living with a partner, and who wish to lose a substantial amount of weight. The most popular reason for wanting to lose weight given by all respondents was to improve health. Short-term aims such as wanting to lose weight for a specific occasion, such as a holiday or wedding, were only given by 5% of respondents. This fact, along with over a quarter of respondents reporting following the dietary programme for over 1 year, suggests that these members subscribe to the programme for long-term lifestyle change rather than a 'quick fix' or cosmetic reasons. Many people in the UK do not follow nutrition guidelines recommended by health professionals (Food Standards Agency, 2005; Government Office for Science, 2007). However, in this survey, dietary changes appeared to be moving in the direction of current government guidelines. Those cooking for the whole family showed greater movement towards these changes, suggesting these healthier eating practices are also reaching their children.

Between 1990 and 2000, purchases of convenience foods rose by 24% and the average time spent preparing a meal decreased from 1 h to 13 min between 1983 and 2004 (House of Commons Health Committee, 2004). Those following the dietary programme in this survey appear not to be following these trends because over half reported now consuming fewer ready meals and takeaways. This latter change most likely gave respondents more control over their own dietary intake.

Changes in dietary practices led to a number of perceived changes to health among the respondents, their partners and their families. The majority of respondents (80%) believed that following the dietary programme had a beneficial effect on health. The longer that someone had been following the programme, the greater the perceived health benefits, because over 90% of those who had been following the dietary programme for more than 3 months reported improvements in health. The finding that a number of respondents reported being able to stop taking, or were able to reduce, their medication after following the programme supports this. These trends were also more prevalent in older members and those with the most weight to lose. A reduction in reported medication usage was largely for weight-related conditions, such as high blood pressure, asthma, diabetes and heart disease. The ability of commercial programmes and self-help groups to affect behaviour change in the general population has been demonstrated elsewhere (Grimsmo *et al.*, 1981; Heshka *et al.*, 2003; Lavin *et al.*, 2006). The present study details the key behavioural pathways by which such changes occur in a population of British slimmers.

Although diet is a key factor for weight loss, a combination of physical activity and a calorie-controlled diet results in a greater loss of fat mass and conservation of lean tissue than diet alone (Garrow and Summerbell, 1995; Wing, 1999; Government Office for Science, 2007). The reported changes in activity levels indicate that, in general, respondents had become more active after learning about the programme. As might be expected, members were more likely than nonmembers to report increases in activity after learning about the programme because they would have been receiving weekly exposure to the information available within the groups. Furthermore, the reported increase in participation in physical activity with the duration of membership suggests that new members were more likely to focus on making dietary changes initially before also incorporating further lifestyle changes.

Regular physical activity provides significant health benefits regardless of body size (Health Education Authority & Sports Council, 1992; Department of Health, 2004; Government Office for Science, 2007); in particular, it reduces the risk of coronary heart disease and diabetes (U.S. Department of Health and Human Services, 1996). Many of these health benefits were reported in the survey, such as improved mood, confidence, mobility and sleep.

In the UK, levels of obesity in children are increasing (Government Office for Science, 2007; Department of Health, 2008) and activity levels remain low (Department of Health, 2004). One of the greatest challenges in public health is how best to communicate dietary and activity messages to the whole family. Recent evidence from the *America on the Move* programme suggests that, in this regard, the central player in the family is the mother. It appears that children seek and trust advice from their mothers over and above all other sources of information, including schools, TV and even their fathers (American on the Move, 2006). In this context, it is of significance that the majority of respondents are female and many act as the provider of food for the household. In this survey, there was clear evidence that both messages and practices relating to healthy eating and increased physical activity were disseminated from those accessing the service to their partners and children, particularly where the respondent was providing food for other family members.

In the UK, men's health compares badly to that of women, with health problems such as heart disease, high blood pressure and cancer all being more prevalent among men. In general, men are much less likely to access health services (Cooper, 2001; Office for National Statistics, 2001) and slimming clubs (Wardle & Johnson, 2002). Because the majority of respondents were female, it is likely that those reporting information on their partners were mostly referring to male partners. The reported improvement in health alongside the significant involvement of partners in physical activity and dietary practices is a very positive result because, even though only approximately 5% of those attending this organisation's groups are men (Bye *et al.*, 2005), it shows that the benefits are reaching further into the male population.

Given current demands on public health resources, it is important that any intervention should reach a wide audience (Humphries, 1997; Humphries & Ribisl, 1999; Government Office for Science, 2007; Department of Health, 2008). The results of the survey are promising in terms of promoting cost-effective behaviour change towards healthier habits for the whole family. It must be acknowledged that this was a consumer survey, which relied on self-reported behaviour changes. However, it does indicate that the healthy lifestyle messages are reaching those accessing the service as well as the wider family, including partners and children.

It should be acknowledged that this survey was entirely based on self-reports and, as with all questionnaires of this nature, the measures were highly subjective. Measures such as dietary intakes and medication usage and adherence to the slimming plan were from self-reports, and estimates of activity levels were based on the respondents' own interpretation of activity categories. There is the possibility that respondents may tend to respond in a biased manner that they interpret as fitting the demand characteristics of the questions asked. For example, overweight and/or obese individuals are thought to be particularly prone to underestimate their energy intakes, and perhaps intakes of particular foods (Livingstone & Black, 2003). However, some of these biases were likely to have been reduced by using respondents as their own control in the questions asked as well as by the use of a large sample size. This survey was also primarily conducted among women, who were largely middle aged; however, this is representative of the people who access the service.

Given the limitations of this survey, current follow-up studies are collecting more detailed quantitative measures of dietary and activity behaviour, as well as personality and psychological traits of participants, in relation to weight change over the course of 12 months.

The results of the survey suggest that the commercial slimming organisation's dietary (Food Optimising) and physical activity (Body Magic) programmes are having a beneficial impact on the behaviours of those accessing the service. Respondents report that they feel better, and some report improvements to their health. In general, members attending a group were more likely to make positive behaviour changes, and health improvements tended to increase with the duration of membership. Importantly, the reported improvements with respect to healthy lifestyle changes were also seen to be reaching the wider family network, indicating that participation in the weight loss programme leads not only to health benefits for the individual, but also transfers those benefits to their families and friends.

Acknowledgments

We are most grateful to Dr Graham Horgan (Biomathematics and Statistics Scotland) for providing independent statistical analyses and advice with respect to the data.

Conflict of interests, source of funding and authorship

All authors work for Slimming World.
This work was funded by Slimming World, Alfreton, Derbyshire.
CP and AA contributed to the data interpretation and drafting of the manuscript. JS contributed to the analysis and drafting of the manuscript. JL was involved in design of the study and the drafting of the manuscript. All authors critically reviewed the manuscript and approved the final version submitted for publication.

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Paper 3

Avery, A., Pallister, C., Allan, J., Stubbs, J. and Lavin, J. (2012). **An initial evaluation of a family-based approach to weight management in adolescents attending a community weight management group**. *Journal of Human Nutrition and Dietetics*, 25(5):469-76.

THE OFFICIAL JOURNAL OF THE BRITISH DIETETIC ASSOCIATION

Journal of Human Nutrition and Dietetics

PUBLIC HEALTH NUTRITION AND EPIDEMIOLOGY

An initial evaluation of a family-based approach to weight management in adolescents attending a community weight management group

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Keywords
behaviour change, commercial slimming organisation, family, obesity, weight management in adolescents.

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How to cite this article
Avery A., Pallister C., Allan J., Stubbs J. & Lavin J. (2012) An initial evaluation of a family-based approach to weight management in adolescents attending a community weight management group. *J Hum Nutr Diet.* **25**, 469–476
doi:10.1111/j.1365-277X.2012.01277.x

Abstract

Background: Family-based approaches are recommended for the prevention and management of childhood obesity. Given the large numbers of obese children, scalable practical solutions are required. The present study evaluated a family-based national programme that aimed to empower adolescents to adopt healthier lifestyles.
Methods: Group facilitators supporting more than six young members (11–15 years) participated in the study. A questionnaire was designed to determine the characteristics of the adult attending with the adolescent, any health professional recommendations given and the young member's integration within traditional adult weight management groups. Data on measured height and weight [and calculated body mass index (BMI)], sex and attendance were collated from member's records.
Results: Questionnaires were completed by 22 facilitators (15% response rate), representing data for 128 young members with complete weight data available for 106. All members had a joining BMI > 91st centile, with 68% >98th centile. The mean (SD) number of weeks attended was 12.5 (8.1), with 19% (20) having attended for more than 20 weeks with 62% still attending. A mean (SD) BMI *Z*-score change of 2.49 (0.72) to 2.27 (0.74) was achieved ($P < 0.001$). The relationship of the adult supporter to the young member was varied, with 62% either already members or joining alongside their daughter/son. Limited guidance was provided by health professionals before or during attendance. Facilitators were comfortable about the age mix within groups.
Conclusions: The community weight management organisation studied takes a family-based approach and successfully supports young members to manage their weight.

Introduction

Childhood obesity is one of the most significant health challenges currently facing the UK because it is difficult to treat and is increasing in prevalence (Department of Health, 2008). Presently, 36% of boys and 34% of girls, aged 11–15 years, are overweight or obese (NHS Information Centre, 2010). It is predicted that, as a result of our increasingly obesogenic environment, the prevalence will rise to almost 70% of girls and 55% of boys by the year 2050 (Foresight, 2007).

Obesity affects not only the current physical and psychological health of the child, but also future health because unaddressed obesity tends to persist into adulthood (Singh *et al.*, 2008). The physical consequences of childhood obesity include an increased risk of type 2 diabetes diagnosed in childhood, and a predisposition to cardiovascular risk factors, such as hypertension, dislipidaemia and hyperinsulinaemia (Srinivasan *et al.*, 1996; Figueroa-Colon *et al.*, 1997; Malecka-Tendera & Molnar, 2002).

Overweight and obese children show greater signs of psychological distress than their slim counterparts and are more likely to have poor self-esteem, be depressed, have body image dissatisfaction, be perceived as unattractive and present with disordered eating or bulimia, all of which may have long-term effects on the child, continuing into adulthood [NICE, Department of Health, 2006; Department of Health, 2008; Scottish Intercollegiate Guidelines Network (SIGN), 2010].

Current UK strategies to tackle the rising prevalence of obesity focus on prevention and management in children; for example, Healthy Weight, Healthy Lives (Department of Health, 2008). As such, the Government has set a target to stem the rise in prevalence of obesity in children by 2020 (Public Service Agreement 12) and launched family-based initiatives (Department of Health, 2009). Current guidelines focus on lifestyle, physical activity and behavioural change strategies that account for the child's preferences, risk factors/co-morbidities, social circumstances and previous treatment results. These include the promotion of habitual physical activity, the reduction of sedentary behaviour (including time spent in front of a screen) and healthier eating practices (NICE, Department of Health, 2006; SIGN, 2010). Family-based approaches are recommended because there is continuing evidence of an association between overweight and obesity in children and parental overweight and obesity (Davison & Birch, 2001). Also, many young people are unable to make changes without the support of an adult family member (SIGN, 2010)

There are a small number of evaluated programmes available to help obese children to lose weight. The MEND (Mind, Exercise, Nutrition and Do it) programme is designed to support 7–13 year olds with managing their weight. In a randomised controlled study, Sacher *et al.* (2010) reported a mean body mass index (BMI) *Z*-score change of −0.24 after 6 months in children attending the educational and activity-based programme.

The WATCH IT programme was developed to address the needs of obese children from disadvantaged communities in Leeds. The results of the pilot phase showed significant weight change in the 94 children, mean age 12.2 years, attending the community service, with a significant BMI *Z*-score change being achieved by the teenage subpopulation (Rudolf *et al.*, 2006). The Scottish Childhood Overweight Treatment Trial (SCOTT) involved randomising overweight children (aged 5–11 years) to either normal dietetic support or to the intervention, which was delivered by experienced paediatric dietitians offering a family-centred behavioural support programme. A significant change in BMI *Z*-score was observed for both the control and the intervention groups (Hughes *et al.*, 2008). In addition, residential weight management camps have been well evaluated, with a BMI *Z*-score change of −0.25 in 61 teenagers with a mean age of 14.1 years (Barton *et al.*, 2004), although there are no published data available for the weight management groups that Carnegie have introduced for obese children.

The present study aimed to evaluate a national family-centred weight control programme run within a commercial weight management group setting where young people aged 11–15 years were able to attend the weekly group sessions at no charge, although with the proviso that they attend with a supporting adult. The programme focused on facilitation of behaviour change through the consumption of lower energy dense foods, healthier snacks and increases in physical activity. To date, there has been no evaluation of a mixed age weight management programme where young people attend with a supporting adult.

Materials and methods

Weight management programme

A family-based group programme, Family Affair, was launched in January 2006. This aimed to support adolescents (aged 11–15 years) with their weight management via engagement of the whole family in adopting healthier lifestyle habits. All group facilitators were provided with additional training emphasising key nutritional points pertinent to adolescents. In an 8-month period, 4704 young people aged 11–15 years had or were currently accessing group support. Facilitators of groups with 6–18 young members were identified and asked to take part in the survey.

Questionnaire design and distribution

A questionnaire was developed for completion by group facilitators and was piloted with a small number. The questionnaire aimed to identify which adults attended with the young members, whether this adult was already a member of the group or if they joined as a member at the same time as the young person and, if so, whether they joined to also receive weight management support themselves or just to support their child. Information was also requested on whether other immediate family members attended the group and what recommendation was provided to the facilitator by the supporting health professional (e.g. the level of support required in terms of whether the young person should be weighed or not, whether they would benefit just from lifestyle advice, or direction as to whether the young person should be losing weight or just halting weight gain).

Also, the feelings of the group facilitator about having young people as part of their group were assessed via two questions included in the questionnaire and an open question inviting qualitative comments.

Questionnaires were distributed via the group facilitators and, once completed, returned to the principal investigator for analysis by post. Where returned data were incomplete, every effort was made to retrieve missing data.

Demographics and anthropometrics

Age, sex, weight and height measures were routinely collected in the groups and recorded. Young members were weighed using bespoke Seca scales (Seca GmbH & Co. KG., Hamburg, Germany) accurate to 0.23 kg and height was measured using a stadiometer by their healthcare professional. From the raw data collected, age-appropriate individual start and end BMI were then calculated by the principal investigator.

Statistical analysis

The results are presented using simple descriptive statistics [mean (SD)], calculated using MICROSOFT EXCEL 2003 (Microsoft Corp., Redmond, WA, USA). Where appropriate, Z-scores were used to describe the distribution of BMI relative to reference values (Cole & Green, 1992). The lead researcher analysed the qualitative data by thematic content analysis. A rigorous process was employed that included careful transcription of the reported information. This process resulted in recurring themes that were not predefined, but which best reflected participants' perceptions. The data were analysed using a cyclical, reflective process (Carter, 2004). Discussion of the themes and sub themes, including a second researcher, was undertaken and agreed upon. Analysis of the data involved the processes of data reduction, data display and data complication. These three processes involved selecting and focusing the data, and data organisation followed by data construction to draw conclusions (Miles & Huberman, 1994). Identified themes that best support the quantitative data are presented.

Ethical approval was not sought because the focus is on service evaluation, in accordance with the NRES (2009) guidance differentiating between audit, service evaluation and research.

Results

The response rate was 15%, with 128 (of 852) completed questionnaires being returned by 22 group facilitators.

Table 1 Body mass index (BMI) centile range of participants on joining the group

	BMI centile range of participants on joining		
	91st–98th	98–99.6th	>99.6th
Number of girls	16	18	13
Number of boys	2	3	5

Complete data on weight, height and age were available on 47 females and 10 males (Fig. 1). All members had a joining BMI >91st centile, with 68% >98th centile. Starting weights are described in Table 1.

Attendance

The mean (SD) number of weeks attended was 12.5 weeks (8.11), with 20 out of the 106 having attended for more than 20 weeks, 37 having attended for more than 10 weeks, and 66 (62%) still attending the weekly group.

Weight changes

There was a wide range of weight changes (a gain of 2.0 kg to a weight loss of 10.5 kg). The mean (SD) weight change was −3.0 kg (9.5). The mean BMI change was −1 (29.3 to 28.3 kg m^{-2}) This represented a mean (SD) BMI Z-score change of 2.49 (0.72) to 2.27 (0.74) at the end of the study period, with this change being statistically significant ($P < 0.001$). BMI Z-score changes are shown in Fig. 2.

Supporting family members

The majority of young members attended group with their mother (84.4%), with 1.5% attending with their father and 3.9% with both parents. The remaining 10.2% attended with a grandparent or other supporting adult.

Sixty-two percent of supporting family members were already members themselves, accessing group support to lose weight. Of the 48 adults who were not already a member, 38 (79.2%) joined with the young person to obtain weight management support for themselves too.

Sixty-four (60%) of the responses highlighted that other immediate family members, in addition to the young member's supporting parent, also attended the weekly weight management group (Fig. 3).

Guidance by a health professional

Only 76 of the 128 (59%) young members were given guidance by a health professional, usually their general

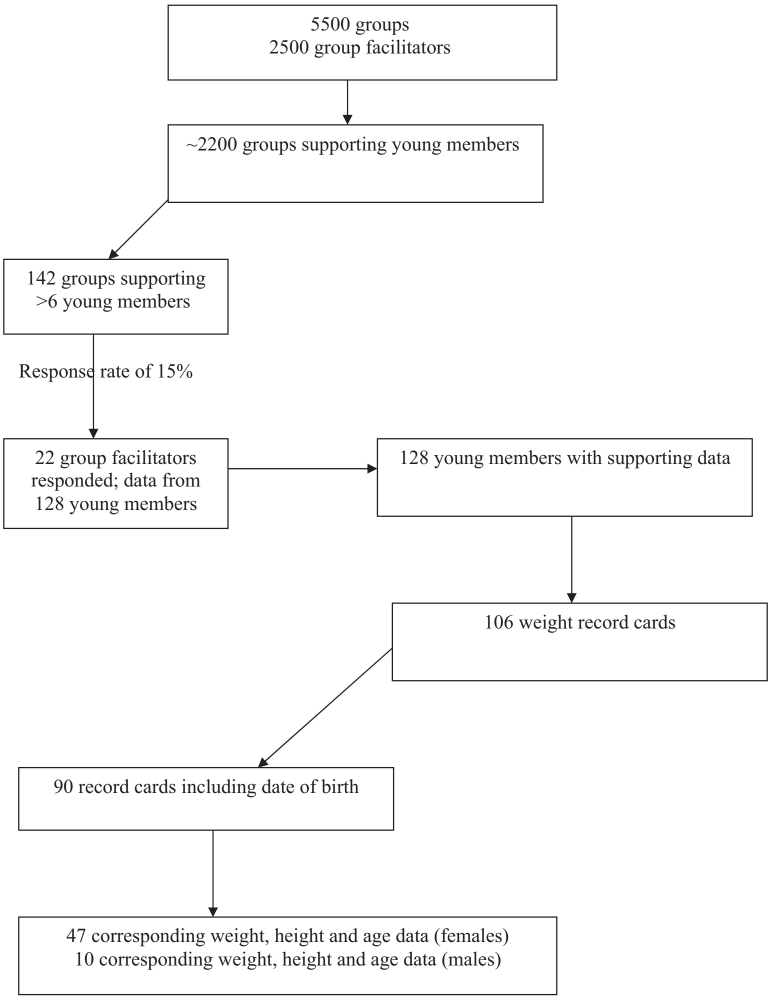

Figure 1 Flowchart summarising recruitment of the study population.

practitioner, with respect to the appropriate level of support required in terms of whether the young person should be weighed or not or whether they would benefit just from lifestyle advice, or direction as to whether the young person should be losing weight or just halting weight gain. Where health professional guidance was given, 27.6% of the health professional recommendations were to aim to slow current weight gain, 10.5% to maintain current weight, 40.8% to lose weight, and 21.1% for healthy eating and activity advice only with no need to weigh the young person.

Feedback from group facilitators

Analysis of how the group facilitators felt about having young members in their weekly weight management groups suggests that 77.7% felt either ‘very comfortable’ or ‘comfortable’ about welcoming and supporting them. Nineteen percent said that they were ‘okay’ with the introduction of the family-based group programme and only 3.4% felt ‘uneasy’. No-one stated that they felt ‘very anxious’ about having young people in the group environment. With respect to how well the 11–15 year olds had fitted into the group, 64.9% of the group facilitators felt ‘very well’, 16.7% felt ‘quite well’, 16.7% felt ‘okay’ and only 1.8% felt ‘not at all well’. There were a number of qualitative comments to this last question, which alluded, for example, to how well the young person participated in the group environment:

> ‘female M joins in with the group really well, comes up with different recipes and ideas’, ‘female R was delighted with her weight loss and it totally changed her, giving her so much confidence, and now she no longer attends hopefully she will have a better understanding of healthier eating’

However, there were also general comments regarding the importance of the family support and concern that lack of support from some parents could sabotage the young person’s weight management journey, either through their inability to commit to supporting their teenager or because of their own personal issues with weight management and inability to lose weight. Examples of this type of comment

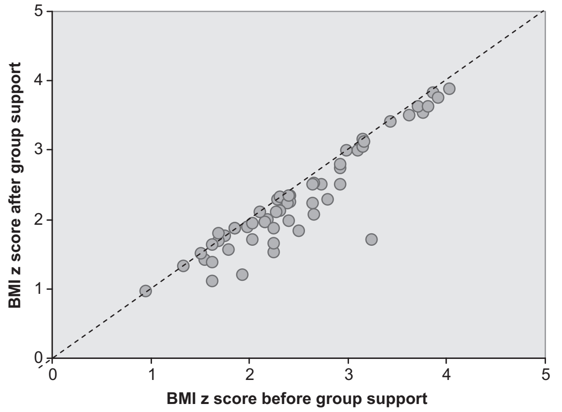

Figure 2 Changes in body mass index (BMI) *Z*-score achieved through the attendance at a community weight management group (n = 57).

included: 'I felt mum lost interest', 'mum never had time to cook or to be much help', 'mum herself put on weight and then stopped coming', 'her mum won't make time to stay to each group – always too busy', and:

> 'female K is a very sensible girl and knows about healthy eating and she loves cooking and experimenting with foods; it's K's mum who is up and down with her weight loss and sometimes causes the problem with female K' (quote from a group facilitator)

An additional observation made by the principal investigator, from both the qualitative data and the individual weight record cards, was that many of the young people found weight management more difficult over a long school holiday period. Approximately 65% of those young people who were members over the summer vacation gained a small amount of weight, whereas other young members (8%) did not return to the group following a holiday and/or during the holiday period.

Discussion

The family-based group programme for young members was introduced following consultation with adult members, particularly parents, a review of current literature on the effectiveness of weight management in this age group and consultation with an advisory panel, including nutritionists, dietitians, medical experts and psychologists. Given the well documented increase in prevalence of excess weight in the adolescent population (National Health Service Information Centre, 2010), it was considered appropriate to investigate the possibility of providing support for 11 and 15 year olds within existing groups free of charge. The proviso was that young people should attend with the parent or guardian who was responsible for providing the majority of their food, and have the support of a health professional who would be involved in monitoring and weight management goal setting.

The mean weight loss of 3.0 kg represents a range of weight changes, as one would expect from an age group that represents young people at differing pubertal stages. Only nine of the 106 young people who participated (and for whom weight records were available) actually gained any weight during the study period, with the greatest weight gain being 2.0 kg. The BMI *Z*-score change of −0.22 is very similar to the change of −0.24 reported by Sacher *et al.* (2010) in the randomised control trial using the MEND programme as the intervention. This was also similar to the BMI *Z*-score change of −0.13 achieved by the teenagers attending the health trainer-led Watch IT groups in Leeds (Rudolf *et al.*, 2006) and to the change of −0.25 achieved by teenagers attending a residential weight management programme (Barton *et al.*, 2004).

Where complete data are available, the findings suggest that all young people accessing the group support were initially above the 91st and many above the 98th centile, and were therefore classified as clinically overweight or very overweight (Child Growth Foundation, 2009). Thus, an interesting discussion point is whether, without some weight loss, these young people would be able to achieve a healthy body weight during the transition from puberty to adulthood. In the past, health professionals have tended to 'sit on the fence' and suggest halting weight gain as being appropriate for this age group and that 'hopefully' they will 'grow out' of their obesity. Given the increasing rise in obesity and the fact that all of those with a complete data set available would be classified as

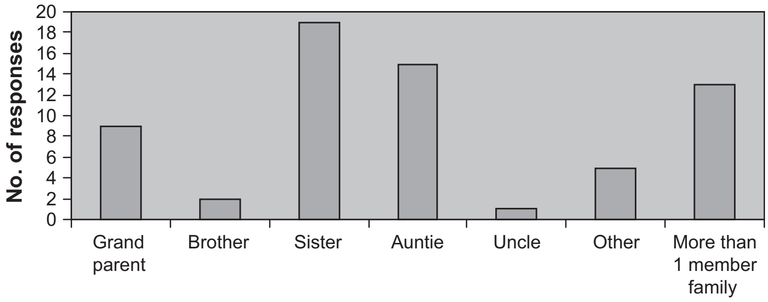

Figure 3 Immediate family members also attending the community weight management support group.

clinically overweight or obese (NICE, Department of Health, 2006), some weight loss should be considered as appropriate; after puberty, projected linear growth is unlikely to result in a healthy and age-appropriate BMI if weight remains stable.

Community weight management organisations have been criticised as only attracting females and, indeed, for this particular organisation, 95% of the adult group members are female. However, 20% of the young people in this study population were male, with some being very successful in managing their weight. One male had lost 10.5 kg at the end of the study period and continued to attend the weekly groups until he had achieved his own 'happy' weight, despite the fact that he had to start paying a weekly fee on reaching the age of 16 years. Nineteen out of the twenty males with complete data showed reductions in BMI at the end of the study period, with the remaining one male showing no change.

The actual mean number of weeks attended by the young people is unknown because 62% were still attending at the end of the evaluation period. However, 20 had attended for more than 20 weeks and 37 had attended for more than 10 weeks. Young people in this age-range do not generally commit to attending a weekly group for this length of time unless they feel they are benefitting in some way and certainly they would need to feel comfortable within the group environment and with other group members (Cohen & Emanuel, 1998). Other weight management programmes available for this age group, such as MEND and Carnegie Weight Management clubs, tend to be for a fixed period of 10–12 weeks with limited follow-up. However, the data presented in this evaluation would suggest that young people may wish for a longer period of group support and there may be benefits from having a flexible approach where they can attend groups for as long as they feel appropriate.

The evidence base for the management of childhood obesity (NICE, Department of Health, 2006) emphasises the need for family support and some child weight management programmes just target the parents. SIGN guidance recommends that treatment programmes for managing childhood obesity should incorporate behaviour change components, be family-based, involving at least one parent/carer, and aim to change the whole family's lifestyle. Programmes should target decreasing overall dietary energy intake, increasing levels of physical activity and decreasing time spent in sedentary behaviours (screen time).

In this programme, 11–15 year olds are welcomed into groups free of charge, with the proviso being that they attend with a supporting adult family member (ideally the major food provider). Although the majority (84%) of those supporting the young person turned out to be the mother, other family members were important in this role and, given the structure of some families, this is important to respect. Ideally, as the qualitative data suggests, this supporting family member needs to be someone who has time and enthusiasm to commit to further empowering the young person. Perhaps, unsurprisingly, the majority (62%) of those adults supporting the young person were already members of the group themselves and accessing the weekly group support to address their own weight problems. Thus, a family-based approach to changing shopping and cooking habits, as well as increasing activity levels, would be most appropriate. Some of those parents or guardians who were not already members did join at the same time as their child, whereas a minority of the supporting adults either did not wish to address their own weight or did not (from visual observation) have a weight problem themselves. What was very clear from the qualitative data is that the adult figure often played a very important role in the young person's weight management journey. For example, an adult having the skills and abilities to facilitate healthier eating for the whole family and having the time to attend weekly was important. The commitment and understanding of such an individual was considered, by all the group facilitators, to be quite pivotal. Those parents or guardians who had particular problems in supporting the young member tended to be those who themselves struggled with their own weight management journey.

A major difficulty is ensuring that parents/guardians only express positive encouragement and facilitate an appropriate home environment that supports weight management. The qualitative evaluation would suggest that a written parental guide to supporting their teenagers' weight management journey could be helpful, although there is much emphasis on the benefits of a supportive environment within the group sessions.

Only 59% of all health professionals supporting the young member provided any weight management guidance. As a consequence of this evaluative observation, a booklet was produced to both outline the nature of the support that the young person would receive and thus hopefully ensure that the health professional appreciated the evidence based nature of the support. This booklet (Slimming World, 2007) contains a simple form and directional guide for the health professional to sign alongside the age-specific BMI chart. It is also suggested within the booklet that the health professional review the young person's BMI goal every 3 months to encourage collaboration between the young person, their health professional and the group facilitator. The aim for the partnership proforma is also to minimise any insensitivity in the tone of the recommendation that may have been read by the young person. Regular height measurements are necessary given that this age group potentially experiences natural growth spurts, which in turn influences the BMI measurement, as well as to ensure that any changes in dietary habits do not have a negative effect on linear growth.

Generally, the group facilitators felt either 'very comfortable' or 'comfortable' about having 11–15 year olds in the group that had previously only been attended by adults. Less than 4% of the facilitators had reservations, which may have simply been a result of the newness of the challenge/concept, and which required slight adaptation to the way the group ran, and particularly the behaviour change techniques employed. Facilitating parents' support required additional skills, which then may have contributed to the slight uneasiness as to how the young person has fitted into the group because the facilitator was very conscious of the impact that any negativity may have on the young person's weight loss journey. The responses may be different if the enquiry was repeated now that the facilitators are more familiar with this age group attending the weekly support meetings.

Limitations

The response rate (of approximately 15%) to the questionnaire was poor and this may add some bias to the data reported. The group facilitators had also not fully appreciated the need for height data to be recorded for this age group and therefore the complete data set for corresponding weight, height and age was reduced.

The 8-month study period ended at the same time as the long summer holiday period and so it is unknown whether those young members returned to group following this period. This may have affected both the attendance and weight change data.

Conclusions

Childhood obesity is one of the most significant health challenges currently facing the UK and thus requires a number of interventions to be available to support young people to lose weight. The community weight management organisation studied has the capacity (with over 9000 weekly UK weight management groups) to adopt a family-based approach supporting young people aged 11–15 years in managing their weight for as long as they need the support. Approaching 10 000 young people each year have chosen to attend one of these groups and have been successful in moving towards a healthier weight and adopting healthier lifestyles with their families support.

It is important that an evidence-based approach is employed; that on-going evaluation is undertaken to ensure that young people are being empowered to make long-term lifestyle changes; and that there is partnership working with both parents/guardians and health professionals. Subsequent to the present evaluation being undertaken, more quantitative research looking at actual lifestyle changes made by young people has taken place and has recently been reported (Stubbs *et al.*, 2012).

The findings of the present study suggest that 11–15 year olds are quite happy to attend a weight management group primarily attended by adults. The community weight management organisation studied takes a family-based approach and successfully supports young members to manage their weight.

Conflict of interest, source of funding and authorship

All of the named authors are employed in some capacity by Slimming World.

All aspects of the data collection were funded by Slimming World.

AA was the lead researcher and CP, JA, JL critically reviewed the manuscript and approved the final version submitted for publication. JS provided statistical advice.

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Paper 4

Stubbs, J., Pallister, C**., Avery, A**., Allan, J. and Lavin, J. (2012). **Weight, body mass index and behaviour change in a commercially run lifestyle programme for young people.** *Journal of Human Nutrition and Dietetics*, 25(2): 161-166

THE OFFICIAL JOURNAL OF THE BRITISH DIETETIC ASSOCIATION
Journal of Human Nutrition and Dietetics

PUBLIC HEALTH NUTRITION AND EPIDEMIOLOGY

Weight, body mass index and behaviour change in a commercially run lifestyle programme for young people

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Keywords
adolescents, commercial slimming organisation, diet, exercise, health, weight control.

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How to cite this article
Stubbs J., Pallister C., Avery A., Allan J. & Lavin J. (2012) Weight, body mass index and behaviour change in a commercially run life-style programme for young people. *J Hum Nutr Diet*. **25**, 161–166
doi:10.1111/j.1365-277X.2011.01224.x

Abstract

Background: There are few practical, scalable, community-based solutions that provide ongoing support to combat the recent rapid rise in obesity in young people. A commercial weight management organisation (CWMO) has developed a tailored version of its programme for young people. The present study assessed the programme's impact on self-reported body weight, body mass index (BMI; kg m^{-2}) and health-related behaviour changes in participating young people.
Methods: Seventy-nine current young members completed a web-based questionnaire on age, height, weight and self-reported eating and activity behaviours for when they joined the programme and at the time of survey. Inclusion criteria were age 11–15 years old and membership for at least 1 month. Subjects completed the questionnaire online via the CWMO website. This was a retrospective observational study without a control group. All data were self-reported.
Results: Mean (SD) age was 13.4 (1.4) years and start weight was 78.5 (16.7) kg; 67% were >99th centile for BMI. Mean (SD) attendance was 23 (19) weeks; weight change was −5.0 (4.5) kg; BMI change was −2.5 (2.0) kg m^{-2}; and BMI *Z*-score change was −0.5 (0.4) (all $P < 0.001$). Height increased by 0.01 (0.03) m ($P < 0.01$); however, height *Z*-score remained unchanged. Regression analysis showed that BMI *Z*-score change was related to increased fruit and vegetable intake ($P = 0.012$), as well as a decrease in avoidance of moderate and intense activity (both $P < 0.003$).
Conclusions: This programme for overweight and obese young people helped implement behaviour and lifestyle changes that were associated with significant reductions in self-reported weight and BMI *Z*-score, without compromising growth in height.

Introduction

The Foresight report on predicting obesity to 2050 identified two vulnerable groups at risk of being more overweight than they are now, namely men and young people (McPherson *et al.*, 2007). Young people are considered to be at particular risk of obesity and associated diseases because people tend to gain weight through life rather than lose it (Kant *et al.*, 1995; Herman *et al.*, 2009). There has been a rapid rise in the prevalence of childhood obesity in recent years, driven by societal changes favouring a greater consumption of ready to eat foods outside of the home and an increase in sedentary activities [Scottish Intercollegiate Guidelines Network (SIGN), 2010]. According to the National Child Measurement Programme, by school year 6 (aged 10–11 years), almost one in three children (32.6%) in England are overweight or obese (National Child Measurement Programme, 2008). Since 1995, obesity has increased among boys aged 2–15 by 6%, and in girls by 4% (The Health and Social Care Information Centre, 2008). An overweight adolescent often becomes an obese adult (Wardle *et al.*, 2006; McPherson *et al.*, 2007; Herman *et al.*, 2009). It is therefore important to help young people adopt healthier eating and activity behaviours to reach a healthy weight as they grow (Celermajer, 2009). According to the SIGN guidelines on the prevention and management of obesity in children, it is necessary to ensure that dietary energy restriction, increases in activity and decreases in sedentary behaviour must not compromise normal growth and development. They note that weight maintenance is often a suitable goal, rather than weight loss, and that gradual, measured and sustainable weight loss may be an appropriate target in some cases where the degree of obesity is more severe. More dramatic weight loss aims should perhaps be targeted at post-pubertal teenagers with extreme obesity (SIGN, 2010).

There are relatively few practical community-based solutions on offer to young people in the UK that provide ongoing support for as long as necessary, for each individual. For example, the Carnegie programme and MEND (Mind, Exercise, Nutrition ... Do it!) programmes for young people are approximately 12 weeks in duration with some additional follow-up and support (Holt *et al.*, 2005; Sacher *et al.*, 2010). It is important that nationwide and ongoing infrastructures of assistance are available to young people to help them grow into a healthy body mass index (BMI; kg m^{-2}), without compromising growth in height.

The recent SIGN guidelines note that the expanding evidence base regarding the management of childhood obesity supports the use of family-based approaches to achieve changes in diet, physical activity and sedentary behaviours, as well as the use of behavioural change tools within childhood weight management programmes. Lifestyle interventions can produce significant, clinically meaningful reductions in overweight/obesity in children and adolescents compared to standard care or self-help (SIGN, 2010).

With these considerations in mind, in 2006, a British commercial weight management organisation (CWMO) expanded its group support and lifestyle programme to include young people, aged 11–15 years. With support from a health professional, parents/guardians are able to bring their child, free of charge, along to the weekly group. The purpose of the present study was to assess the programme's impact on self-reported body weight and BMI, and health-related behaviour changes, as well as the relationships between these variables, in the participating adolescents who were under investigation.

Materials and methods

The young persons' programme

The programme was specifically designed for young people aged 11–15 years and focused on behaviour change rather than weight loss *per se* (Slimming World, http://www.slimming-world.com/health; accessed on 1 October 2010). Weight goals were set by a health professional (general practitioner, school nurse, practice nurse) in discussion with the young person and their parents. Weight goals were monitored every 3 months by the consultant for the group they attended, in discussion with the young person, with the focus on moving towards a healthier BMI centile as the young person grew. A gradual shift in healthier food choices, decreased sedentary behaviours and increased participation in active pastimes was emphasised. Young members attended weekly groups with a parent or guardian who was normally responsible for their meals. They also required the support of their general practitioner or other health professional before joining a group and the organisation worked with the health professional to establish appropriate weight management goals using UK guidelines (National Institute for Health and Clinical Excellence, 2006; SIGN, 2010) and height/weight charts (Child Growth Foundation, London, UK).

Tailored literature was created to encourage small changes to eating and activity habits, and a package of guidance was developed for healthcare professionals, the organisation's group consultants and the young member to use jointly to monitor their starting BMI, log any recommended weight control targets and check progress.

The sample

Young members were recruited over 1 month via a notice that was placed on the CWMO website, in the area dedicated to young people. The notice stated that, by completing a short questionnaire on their weight management experience and behaviour changes, they would be entered into a draw to win one of three iPod Nanos (Apple Inc., Cupertino, CA, USA). Inclusion criteria for the study were that young members had to be between 11 and 15 years old and have been members for at least 1 month. By clicking the link to the questionnaire, participants consented to taking part in the study. They were informed that all data would be anonymised. The present study comprised an evaluation of the service the CWMO provided to young people who were prepared to participate at the point of the study. It was reviewed by Nottingham Research Ethics Committee (REC reference number 06/Q2404/140), who gave constructive advice but did not feel that approval was necessary because a service evaluation was not within the remit of the Ethics Committee.

The questionnaire

The questionnaire was developed using feedback from the consultants who ran the CWMO groups and the young members themselves. It was developed in parallel to a similar questionnaire used for adults with the intention of being easy to complete and in vernacular language with which the participants in the programme were familiar. Questions were designed to capture changes in behaviour that were both meaningful and useful to the participants of the programme. The questionnaire was piloted in a small number of young people to ensure it was understandable and easy to administer. It consisted of 24 questions, in which the participant selected drop-down menus to describe their age, height, level of activity, date of birth and weight goals. The remainder of the questionnaire comprised of five-point Likert scales asking questions regarding sources of information about healthy eating; behaviour changes that are perceived to be important to their long term health; factors that influenced them to become members; their main concerns about their weight; how they felt when they attended their first group; how they had felt since attending their group; their opinions of the programme; the changes that being a member made to their lives and self-reported changes in eating habits and activity patterns since joining. Participants were also asked how much time per day they spent being active, before and since joining the programme. They could answer, ‘less than half an hour’, ‘about half an hour’, ‘about an hour’, ‘about 1.5 h’, ‘about 2.0 h’ or ‘more than 2.0 h’. Data were correspondingly coded by time, assuming linearity (i.e. that less than half an hour was zero and more than 2 h was 2.5 h). Weight, age and height were reported by the participants themselves for when they had first joined their group and at time of survey. Particpants used their record cards to complete questions on weight, age and height on joining. Only data on weight, height, BMI, eating and activity behaviours are reported in the present study. This was a retrospective observational study without a control group because the questions asked about their views before and after they joined the programme. The questionnaire was constructed and administered using Checkbox, version 4.4 (Prezza Technologies, Inc., Watertown, MA, USA)

Statistical analysis

Start height, weight and BMI; end height, weight and BMI; BMI change; weight change; and *Z*-scores for these variables were calculated and compared using paired *t*-tests. The effects of specific behaviour changes on weight change were assessed by fitting linear models and examining the significance of fitted terms in these models via regression and analysis of variance. Associations between specific behaviour changes and weight change were examined by Pearson correlation co-efficients. All analyses were performed using Microsoft Excel 2003 (Microsoft Corp., Redmond, WA, USA) and the GENSTAT statistical program (VSN International, Hemel Hempsted, UK). Results are expressed as the mean (SD) or as percentages where relevant.

Results

A total of 96 young members completed the survey. Of these, 17 were excluded because of incomplete data. Thus, 79 participants (20 boys and 59 girls) were included in the analysis. The ratio of girls to boys was approximately 3 : 1 and so, unless otherwise stated, the group statistics are described for the whole group. Where significant gender differences occurred, these are stated. The sample size was low relative to the average number of young members who attended the programme’s groups in the weeks during which the study was conducted (approximately 1000–1200 young members in any given week).

Weight history and goals

Table 1 gives the self-reported weight, height, BMI, associated *Z*-scores and changes in these variables. The mean (SD) joining age was 13.4 (1.4) years, with a range of 11.2–15.7 years, joining weight was 78.5 (16.7) kg, which placed them on the 99th (range 87–100) centile for BMI (Cole & Green, 1992). One participant had a BMI on the 87th centile and the rest were at the 92nd or above. Mean

Table 1 Changes in weight, height, body mass index (BMI) and associated *Z*-scores for participants in the survey (n = 79)

	Start of study		End of study		Change		
	Mean	(SD)	Mean	(SD)	Mean	(SD)	*P*
Weight (kg)	78.5	(16.7)	73.5	(16.18)	−5.0	(4.5)	<0.001
Height (m)	1.61	(0.09)	1.62	(0.09)	+0.01	(0.03)	<0.001
BMI (kg m^{-2})	30.3	(5.1)	27.8	(5.1)	−2.5	(2.0)	<0.001
Weight *Z*-score	2.8	(0.9)	2.3	(1.0)	−0.5	(0.5)	<0.001
Height *Z*-score	0.9	(1.2)	0.9	(1.2)	0.0	(0.3)	NS
BMI *Z*-score	2.7	(0.7)	2.2	(0.9)	−0.5	(0.4)	<0.001

Analysis was conducted using paired *t*-tests.

duration of membership at the point of survey was 23 weeks. Both BMI and BMI *Z*-scores were significantly reduced ($P < 0.001$). Seventy-three percent decreased BMI by ≥1 BMI point. Height increased by 0.01 (0.03) m during this time ($P < 0.01$) but height *Z*-score remained unchanged.

Twenty-seven percent of this population reported they were aiming to keep their weight stable as they were growing; 62% were aiming to lose weight; 6% were aiming to slow down their current rate of weight gain; and 5% had other goals (unspecified). There were no gender differences in any of the parameters described in Table 1. When asked how much weight they wanted to lose, girls stated a mean desired weight loss of 15.6 kg and boys aspired to a weight loss of 16.8 kg.

Self-reported changes in eating and activity habits since joining the programme

Participants were asked to describe their eating and activity habits before and since joining. The changes in these behaviours are described in Tables 2 and 3, respectively. All of the changes described were significantly different from zero at $P < 0.01$. Participants reported a mean (SD) increase of 0.7 (0.7) hours day^{-1} with respect to being physically active when participating in the programme compared to before ($P < 0.001$).

Associations between behaviour change and body mass index, body mass index *Z*-score and weight change

Correlations and regressions are quoted after adjusting for age, gender, joining weight and joining height. A decrease in the avoidance of moderate activity (i.e. decreased sedentary behaviours) was significantly related to decreased BMI and BMI *Z*-score ($P = 0.002$). The same was true for avoidance of any intense physical activity ($P = 0.009$). The first and second of these effects accounted for 11% and 8%, respectively, of the variance in BMI change.

The relationships between change in eating behaviour and BMI *Z*-score showed a similar pattern. Change in the statement 'I eat whatever I am given' accounted for 5% of the variance in change in BMI *Z*-score ($F_{1,74} = 4.22$; $P = 0.044$). Relationships between eating behaviour change and weight change were similar, except that increased fruit and vegetable intake was significant at $P = 0.012$, accounting for 7% of the variance in weight change. Adding other behaviour change scores to the regression analyses in a stepwise manner did not improve the capacity of these models to predict either BMI or BMI *Z*-score change or weight change. Correlations showed a similar pattern.

Table 2 Mean (SE) difference in response to a five-point Likert scale asking participants to describe their eating behaviours before and after joining the programme (*n* = 79)

Eating behaviour	Mean	(SE)	*P*
Unhealthy snack food – school	−2.4	(0.17)	0.000
Unhealthy snack food – home	−2.3	(0.16)	0.000
Unhealthy preprepared meals	−2.0	(0.17)	0.000
Take-aways/fast food	−1.6	(0.13)	0.000
Eat less healthily in leisure time	−1.6	(0.18)	0.000
Sugary drinks	−1.5	(0.17)	0.000
Don't eat a lot – but always the wrong food	−1.3	(0.14)	0.000
Eat whatever I am given	−1.0	(0.18)	0.000
Eat out regularly	−0.8	(0.16)	0.000
Eat regular meals	0.5	(0.14)	0.001
Five portions of fruit and vegetables/day	1.6	(0.17)	0.000

Table 3 Mean (SE) difference in response to a five-point Likert scale asking participants to describe their activity behaviours before and after participating in the programme (*n* = 79)

Activity behaviour	Mean	SE	*P*
Play a lot of sports	1.2	(0.13)	0.000
Often active (e.g. hockey/football)	0.7	(0.16)	0.000
Go out with my friends a lot	0.6	(0.14)	0.000
Play a lot of computer games	−0.9	(0.14)	0.000
Tend to avoid even moderate activity	−0.9	(0.18)	0.000
Hardly ever play sports	−0.9	(0.18)	0.000
Tend to avoid any intense activity	−1.2	(0.18)	0.000
Less active in leisure time than other times	−1.3	(0.19)	0.000
Hardly walk anywhere	−1.3	(0.16)	0.000
Watch television a lot	−1.4	(0.14)	0.000

Discussion

The findings of the present study suggest that community-based behaviour change can be effective, at the level of the family, in implementing the Department of Health's recommendations for behaviour and lifestyle change (Department of Health, 2008). This can be achieved at the same time as avoiding restrictive (calorie counting) or temporary, artificial solutions (e.g. specialised diets). Adolescents can learn to navigate towards a healthy body weight and BMI through fundamental changes in their patterns of eating and activity behaviours. A previous large-scale survey of 2700 members of this CWMO described how participation in the programme led to marked changes in the eating and activity behaviour of adult members, which had an influence on their families' diet and lifestyle (Pallister *et al.*, 2009). The present study suggested that encouraging parents to bring their adolescent children into weight management groups can provide an infrastructure, which becomes part of their support network to facilitate lifestyle and behaviour change.

Key significant correlates of weight and/or BMI *Z*-score change reflect changes for the whole study population on average. It is likely that specific individuals will have used different combinations of behaviour change to reach a healthier body weight. Therefore, it is important to help young people develop flexible solutions, from which they can select the behaviours most appropriate to their individual lifestyle needs with the aim of adopting long-term healthy eating and activity habits. In this way, they can develop habitual, sustained behaviour changes, which contribute to weight maintenance at a lower BMI centile, and grow into their weight.

It would appear that the weight loss goals of this young population were, as in many adults trying to control their weight, overly optimistic (Dalle Grave *et al.*, 2004; Finch *et al.*, 2005; Gorin *et al.*, 2007; Fabricatore *et al.*, 2008). Girls wanted to lose almost 16 kg and boys wanted to lose 17 kg. This is far higher than currently recommended (National Institute for Health and Clinical Excellence, 2006; SIGN, 2010). Participants actually did lose almost 25% of the weight that they aspired to lose in the first 23 weeks of their attendance. However, weight loss tends to slow with time and so it is likely that, by continuing to attend, they would progress gradually towards a healthier weight, at this relatively early age (Finch *et al.*, 2005; Gorin *et al.*, 2007). This is important because weight management in adolescence contributes to obesity prevention in adulthood (National Institute for Health and Clinical Excellence, 2006). Although weight and BMI *Z*-scores dropped significantly, height *Z*-score remained unchanged. Thus, children at this age can lose moderate amounts of weight without compromising their growth trajectories in height (The Surgeon General, 2009).

Limitations of the present study

The present study was completed online and it is possible that the questionnaire was only completed by young people who did well, which may have led to under-representation of those who did less well. Indeed, this is likely because it is well known that those who do less well drop out of weight control programmes earlier and so are lost to study. Studies of this nature tend to be biased towards those who are more successful. Although this does not negate the need to collect such data, the limitations should be borne in mind. The sample size was low, relative to the average number of young members who attended the organisation's groups in the weeks during which the study was conducted (approximately 1000–1200). It is not known how many of those who attended groups were able to access the website during that time. Weight and height were self-reported and this may have led to some bias towards more successful respondents because 17 participants gave incomplete data (see *Materials and methods*). To young people, being overweight is an extremely personal, stigmatic and emotive issue and obtaining a structured or stratified sample is difficult if not impossible to achieve. Thus, there is a danger that these data may under-represent those who have struggled to a greater extent with their weight. Completion of the questionnaire was incentivised by entry into a draw for one of three iPod Nanos. This may have skewed the sample that responded. Self-reported body weight and physical activity tend to be biased in that people (including those who are overweight and including young people) tend to under-estimate their weight, under-estimate their energy intake and over-estimate their physical activity levels. Using retrospective questions, the present study compared the responses of the same subjects to how they felt before and after their participation in the programme. Thus, although the absolute levels of these estimates may be subject to some error and bias, the direction and nature of the change in responses are likely to have been more robust indicators of outcomes.

Conclusions

The programme for overweight and obese young people helps implement current recommended lifestyle and behaviour changes (National Institute for Health and Clinical Excellence, 2006; Department of Health, 2008, 2009; SIGN, 2010). These behaviour changes were associated with significant reductions in weight and in BMI *Z*-score, without compromising growth in height.

Conflict of interest, source of funding and authorship

All authors work for Slimming World.
The audit was funded by Slimming World.
JS, JL and CP were involved in design, analysis and write up of the study. JA worked on data analysis and AA was involved in the study design and manuscript review. All authors critically reviewed the manuscript and approved the final version submitted for publication.

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Paper 5

Avery, A., (2012). **Managing obesity in young adults.** *Practice Nursing 23(3): 239-242*

Managing obesity in young adults

The transition from teenage years to young adulthood involves changes that can have a negative impact on food choices; Amanda Avery identifies the problems associated with obesity in young adults and possible ways to intervene

Young adulthood involves many changes and an increasing independence. This article aims to encourage health professionals to recognize that the late teens and early 20's is a vulnerable age where lifestyle changes can increase the risk of young adults becoming overweight, and identifies the opportunities where health professionals may be able to offer guidance and prevent progressive weight increase from becoming the normal trend in young adults.

During this time, young adults begin taking control of arranging their own meals, moving away from home, living with partners or flatmates, and starting new work or study lifestyles. Often, all of these changes, combined with living on a relatively low income can have an impact on food choices.

A heavier workload and different study commitments, combined with less structured opportunities for physical activity, may have a negative impact on the amount of exercise undertaken, with young adults becoming more sedentary (Telama et al, 2005). This age group may well be 'parked' at a desk for 40 hours or more every week for the first time in their lives.

A good example of the influence of lifestyle changes during young adulthood on food choices is the 'Freshers 15' effect, where undergraduate students gain an average of 7 kg (15 lbs) during their first academic year (Strong et al, 2008). Changes, such as moving away from home and having different diet and activity habits, all contribute to this weight gain (Strong et al, 2008). Alcohol is another contributing factor that is likely to increase calorie consumption significantly compared to overall energy intake. Less sleep has also been found to be positively correlated to an increase in body weight (Horne, 2008).

Many universities in the UK are now offering some level of support to help students prevent this increase in weight. For example, Loughborough University offer free informal healthy living and weight loss groups, an online food diary system which allows the tracking of food choices and shows the amount of calories consumed, and also have produced podcasts with tips for students on buying and cooking foods.

The problems associated with obesity during young adulthood

Young adults are at a high risk for weight gain. The UK is now following closely behind the US for obesity trends. Findings from US government studies for adults aged between 25–74 years indicate that weight gain is reported to be highest between those aged 25–34 years (National Heart, Lung, and Blood Institute (NHLBI), 2005). The Coronary Artery Risk Development in Young Adults Study (CARDIA) (Lewis et al, 2000) found that even though trends were constant across follow-up studies for 10 years, age-related weight gain was higher in the early to mid-20s than it was for older-age groups.

Tracked data from the health survey for England presented in the UK Foresight report (McPherson et al, 2007) shows a shift in the proportion of both men and women in the different body mass index (BMI) classifications across different age groups. There is a clear reduction in the number of people who are of a healthy weight, and an increase in the number of those who are both overweight and obese from 16–24 to 25–34 years, and then from 25–34 to 35–44 years, before a reduction in weight begins to occur (McPherson et al, 2007).

From the modelling techniques used by the Foresight team, it is predicted that the prevalence of obesity will increase from 15% in 2007 to 42% in 2050 for 21–30-year-old males, and from 13–30% for females throughout the same period (McPherson et al, 2007). These are daunting figures given the health implications associated with obesity. Already, the diagnosis of type 2 diabetes at a younger age is more prevalent, and there is an increase in the number of immobile younger adults owing to their weight (Peeters et al, 2004). As a result of this, obesity in young adults is associated with a greater number of life years lost. Sometimes this can be up to 13 years (McPherson et al, 2007).

Data from the CARDIA study demonstrate that maintaining a stable weight and healthy

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Submitted 2 March 2011; accepted for publication following peer review 13 March 2012

Key words: Young adulthood, weight gain, obesity, management

Figure 1. The eatwell plate provides recommendations on the appropriate balance of each food group

Table 1. What are brief interventions?
• Short interventions delivered in a structured way to provide a step beyond brief advice through the provision of more formal help that may include follow-up support
• When practices aim to identify risk factors and motivate an individual to do something about these risk factors
• Actions aimed at bringing about behaviour change, these actions can be delivered at an individual or community level using a variety of means or techniques
• Can include opportunistic advice, discussion, negotiation or encouragement and are common in many areas of health promotion, e.g. physical activity promotion
• Can vary from basic advice to more extended individually focused attempts to identify and change factors that influence behaviour
• Are time limited (between 5–30 minutes)
• Are practices that can be delivered by a range of primary and community care professionals
From: National Obesity Observatory, 2011

lifestyle during the young adult years is associated with less progression of cardiovascular disease (CVD) risk factors, and a decreased risk of developing metabolic syndrome and subclinical atherosclerosis early in middle age (Lewis et al, 2000). However, waiting until middle age to treat CVD risk factors may not be the optimal public health approach. Drug therapy, while effective, frequently fails to meet guideline goals, can produce side effects, and adherence is often inadequate. Irreversible damage from above optimal levels can occur before treatment, and having one or more risk factors may lower quality of life. Avoiding excess weight gain during the early adult years may be pivotal in preventing adverse changes in risk factors and subsequent CVD, and in reducing, delaying or negating the need for drug therapy in later life (Lewis et al, 2000).

Endometrial cancer is an example where weight management in early adulthood can have a significant impact on the subsequent development of the disease. A population-based case-control study reported that women who were overweight in their 20s or 30s, and maintained this weight throughout their life, were at significantly higher risk of endometrial cancer than those who became overweight aged between 40–50 years (Lu et al, 2011). Women with a substantial weight gain of >35% during their 20s were reported to develop endometrial cancer 10 years earlier than those without such weight change during this time.

A balanced diet

The average young adult is predicted to gain an average of between 0.5–1 kgs (1–2 lbs) each year if there are no changes to lifestyle behaviours (Hill et al, 2003). This equates to approximately 100 surplus kilocalories per day. For most people wanting to prevent progressive weight gain, habits such as skipping meals, fasting, grazing, and frequent snacking should be tackled first. Encouraging a regular structured eating pattern as the first step will help establish a sound foundation on which further support can be based (Grace, 2011). Research has shown that by improving the quality of food eaten, people not only benefit from improved comorbidities (Grace, 2011), but may also experience spontaneous weight loss, even without purposeful energy restriction (Astrup et al, 2000).

The 'eatwell plate' (Department of Health (DH), 2011) is a popular resource for helping people achieve the dietary changes required for healthier eating (*Figure 1*). The visual model is based on five food groups and aims to encourage the consumption of a variety of foods from each, therefore promoting an intake of all the necessary nutrients required for a healthy diet. However, on a budget this may prove to be difficult, the British Heart Foundation (BHF) website provides some excellent tips on healthy eating on a budget which compliments the eatwell plate (BHF, 2012).

Smarter food choices can also create an energy deficit as illustrated by the freely available 'eat more, lose weight' leaflet produced by the British Nutrition Foundation (2010).

This leaflet illustrates how selecting foods with a lower energy density, but with a high satiety value can prevent both the feelings of hunger and weight gain, while promoting weight loss in an appropriate manner.

Opportunities for practice nurses

Although young adults are at high risk for weight gain, most are not interested in solely preventing weight gain. If they are overweight or obese, they may already be trying to lose weight and may appreciate some additional support or sign-posting to other services available locally.

Young adults are likely to visit general practices only for limited appointments, and there might not be an obvious reason for the health professional to discuss weight management. However, evidence suggests that if brief interventions (*Table 1*) are focused on diet and physical activity, incorporate behavioural change techniques, and encourage the person to seek support from others, then they can lead to at least short-term changes in body weight and behaviour (National Obesity Observatory (NOO), 2011a). Therefore, all opportunities when practice nurses can discuss these changes should be considered. Appropriate situations may include:

- Family planning
- Baby immunizations
- Holiday vaccinations
- Vaccinations before commencing university, e.g. meningitis
- Review of medications, e.g. for asthma, migraines, and skin conditions
- Injuries where dressings might need to be replaced
- Support for mental health issues
- Support for smoking cessation.

Family planning

Young female adults who are planning a family should be encouraged to aim for a healthy weight before conception. A number of studies suggest that adverse pregnancy outcomes are clearly linked to high pre-pregnancy BMI (Cnattingius, 1998; Cedergren, 2004). The National Institute for Health and Clinical Excellence (NICE) (2010) public health guidance emphasizes the need to encourage overweight or obese women to lose weight before pregnancy, therefore ideally commencing pregnancy with a healthy BMI.

Excessive gestational weight gain is linked to adverse pregnancy outcomes (Kiel et al, 2007) (*Table 2*). However, few women contemplating their first pregnancy are aware of these outcomes. Health professionals and practice nurses may be able to offer support to young women who are planning a pregnancy, and also postnatally where self-esteem, in addition to physical health, may be affected by excess weight retention.

Table 2. Difficulties encountered as a result of a high pre-pregnancy BMI and/or excessive weight gain during pregnancy

- Maternal pre-eclampsia and gestational diabetes
- Post-partum haemorrhage
- Caesarean or instrumental delivery
- Foetal distress
- Large for gestational age babies
- Shoulder dystocia
- Meconium aspiration
- Still-birth
- Early neonatal death
- Birth defects, including spina bifida
- Post-partum maternal weight retention
- Difficulties in establishing breast-feeding

From: Kiel et al, 2007

In addition, interventions may establish an early foundation for maintaining lifelong healthy habits in adulthood, and as parents, young adults serve as lifestyle role models for their children. Parental obesity is the strongest predictor of childhood obesity (Semmler et al, 2009).

Vaccinations and review of medications

During holiday vaccinations, vaccinations before commencing university, and medication reviews, practice nurses should feel able to raise the issue of weight management. Having a weight and height range chart or a BMI wheel readily available may help to sensitively discuss how weight can affect health, even if BMI is scarcely in the slightly overweight range.

Higher education

For those young people about to commence higher education, the DH provides excellent resources about alcohol. Information may also be provided about simple cooking skills and eating a healthy diet on a budget. The new Change4Life materials for adults are appropriate and attractively produced. These materials include ideas for snack swaps, simple recipe ideas, and portion sizes,

KEY POINTS

- Young adulthood involves changes that can have a negative impact on food choices, and therefore young adults are at a high risk of obesity
- Practice nurses are well placed to offer opportunistic lifestyle support and sign-posting to local services available
- Brief interventions to this age group could significantly impact on long-term health risk, and reduce health burdens associated with chronic diseases

as well as information about safe drinking (Change4Life, 2012).

Mental health issues

Mental health issues and weight management may also be linked as being overweight can generate a negative impact on self-esteem and mental wellbeing (NOO, 2011b). Reports suggest that some prescribed medication to manage mental health conditions can promote weight gain, either directly or indirectly (Leslie et al, 2007).

Smoking cessation

Many young adults will be concerned that, if they stop smoking, their weight will increase,and a number of young people actively smoke to maintain a weight which they feel comfortable with (Nichter et al, 2004). Therefore, support that combines encouragement to stop smoking as well as weight management may prove helpful.

Conclusions

Young adulthood is a time of change. It is a key time where if obesity is not already a health issue, it may become one. Brief interventions, sensitively raising the issue with young adults, and offering appropriate lifestyle or weight management support may help to reverse the trend of increasing overweight and obesity prevalence in this age-group. The onset of chronic diseases such as type 2 diabetes, cardiovascular disease and certain cancers may then be delayed, and both general physical and psychological health improved. Practice nurses are well placed to offer this support, but may need to proactively engage with this population group.

Conflicts of interest: Amanda Avery is consultant dietitian for weight management with Slimming World

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Paper 6

Brown, A., **Avery, A.,** (2012). **Healthy weight management during pregnancy: what advice and information is being provided.** *Journal of Human Nutrition and Dietetics 25(4): 378-387*

THE OFFICIAL JOURNAL OF THE BRITISH DIETETIC ASSOCIATION

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DIETETIC PROFESSIONAL PRACTICE

Healthy weight management during pregnancy: what advice and information is being provided

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Keywords
body mass index, obesity, pregnancy.

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How to cite this article
Brown A. & Avery A. (2012) Healthy weight management during pregnancy: what advice and information is being provided. *J Hum Nutr Diet*. **25**, 378–388
doi:10.1111/j.1365-277X.2012.01231.x

Abstract

Background: Being overweight or obese during pregnancy increases the risk of maternal morbidity and mortality attributed to pregnancy-related complications and also poses risks to the baby. The present study explores the information and advice given to pregnant women of different prepregnancy body mass index (BMI) classifications.
Methods: Women with singleton pregnancies and members of the National Childbirth Trust were invited to take part in the study via either National Childbirth Trust antenatal classes or e-mail invitation. A questionnaire was developed to collect quantitative and qualitative data. The number of times that women from different BMI groups were weighed, whether weight gain, diet or exercise advice was received, as well as knowledge of weight gain recommendations was compared using Mann–Whitney *U*-tests and chi-squared tests. Qualitative data were analysed by thematic content analysis.
Results: Sixty women took part in the study with complete data set available for 59 of them. The majority of participants (84.1%) were weighed at least once during pregnancy; overweight/obese women were weighed significantly more times than those who were underweight/normal weight ($P = 0.014$). Only 25.4% of women received weight gain advice; 64.3% received diet/exercise advice from a healthcare source. No significant difference was found with respect to whether advice was received or not when comparing BMI groups. Underweight/normal weight women tended to underestimate, whereas those who were overweight or obese overestimated weight gain recommendations. Themes derived from the qualitative data were: weight gain advice wanted, diet and exercise advice wanted, lack of advice and support, and anxiety.
Conclusions: Advice women receive antenatally on weight gain, diet and exercise is brief and generally not related to weight management. Clearer, more detailed and personalised advice is wanted, particularly on weight gain. A lack of advice and support from healthcare professionals leads women to seek information for themselves from potentially un-regulated sources, and also to feelings of anxiety in some cases.

Introduction

Half of women of childbearing age in the UK are overweight or obese, with 18% being obese at the start of pregnancy (The Information Centre, 2008). Being obese during pregnancy increases the risk of morbidity and mortality attributed to pregnancy-related complications, and also poses risks to the baby. (Galtier *et al.*, 2008). Obesity increases the risk of impaired glucose tolerance, hypertension and thrombosis. Therefore, obese pregnant women are more likely suffer from pre-eclampsia and gestational diabetes (Ramachenderan *et al.*, 2008). There is a greater risk of infections (Metwally *et al.*, 2007) and delivery complications (Galtier *et al.*, 2008). Risks posed to the baby include congenital abnormalities such as spina bifida and oral clefts (Watkins *et al.*, 2003), macrosomia and adult obesity (Galtier *et al.*, 2008). A large review into maternal deaths found that 49% of deaths were in overweight or obese women. Thromboembolism was the most common cause of death (CEMACH, 2007).

To enable the complete physical and mental development of the foetus, maternal prepregnancy dietary intake needs to increase by approximately 0.8 MJ day^{-1} during the third trimester of pregnancy (DoH, 1991). Most requirements in early pregnancy are met by physiological adaptations that occur during gestation (Anderson, 2001). The weight gained during pregnancy is mainly attributed to the increase in maternal tissues and fat stores. A woman of 60 kg living in an affluent country gains an average of 12.5 kg during pregnancy, with only approximately 4.85 kg of this weight directly attributed to the products of conception (Gibney *et al.*, 2005). Inadequate or excessive weight gain is associated with a higher risk of adverse pregnancy outcomes. A low weight gain has been associated with poor foetal development, low birth weight (Anderson, 2001) and an increased risk of preterm delivery, particularly in underweight and normal weight women (Schieve *et al.*, 2000).

Excessive weight gain is unnecessary because it has little positive effect on foetal growth and pregnancy duration (Scholl *et al.*, 1995). A high weight gain has been associated with adverse outcomes, including a greater probability of post-partum weight retention. Linné *et al.* (2004) showed that both normal weight and overweight/obese women who gained excessive weight were more likely to have retained more weight 15 years after pregnancy compared to women who gained the recommended amount of weight during pregnancy. A high weight gain has also been associated with pre-eclampsia, caesarean delivery and large for gestational age babies in obese women. A low weight gain reduced these risks. A higher risk of pre-eclampsia and large for gestational age babies was also seen in normal weight and underweight women who had high weight gains (Cedergren, 2006). This illustrates the need to educate women on what is an appropriate weight gain specific to their own prepregnancy weight, with the aim of optimising pregnancy outcome.

The National Institute for Clinical Excellence (NICE) guidelines on maternal and child nutrition recommend that pregnant women with a prepregnancy body mass index (BMI; kg m^{-2}) of 30 kg m^{-2} or more, should be encouraged to lose weight either before they become pregnant or post-partum (NICE, 2008b). The more recent NICE guidelines on weight management before, during and after pregnancy (NICE, 2010) further emphasise pre- and post-pregnancy weight management and are rather conservative regarding weight management during pregnancy, recommending that weight loss should be avoided. There appears to be little firm evidence behind this recommendation, other than the risk that the developing foetus may be deprived of nutrients essential for normal development as a result of a restrictive intake (Anderson, 2001). The evidence from underweight and normal weight women suggests that there is a greater risk of pregnancy complications in those who diet during pregnancy (Williamson, 2006). Also, an overly restrictive diet may result in ketonaemia affecting fetal neurodevelopment. (NICE, 2010). NICE, however, do state that pregnant women with a BMI >30 kg m^{-2} should be referred for dietetic assessment and should receive advice about healthy eating and exercise (NICE, 2008b). The overall purpose of the new NICE guidelines on weight management was to 'prevent excessive weight gain in pregnancy' (NICE, 2009).

There are currently no UK evidence based guidelines outlining an appropriate BMI-based weight gain during pregnancy (NICE, 2009). The current UK guide for weight gain is 10–12.5 kg (DoH, 2009). There is concern expressed that women are not being informed of the risks associated with obesity during pregnancy, nor of the importance of a safe weight gain during pregnancy (NICE, 2009). The only available BMI based guidelines for weight gain during pregnancy were developed in the USA by the Institute of Medicine, and have recently been updated [Institute of Medicine (IOM), 2009] (Table 1). This guidance is currently included in the British Dietetic Associations Food Facts resource on Healthy Eating during Pregnancy.

NICE guidelines on antenatal care for healthy pregnant women recommend that women should have their BMI calculated at the initial appointment and should be given specific information on nutrition, diet and exercise (NICE, 2008a). Further weighing is not recommended unless clinical management is likely to be influenced.

The recent CMACE/RCOG Joint Guideline on Management of Women with Obesity in Pregnancy (CMACE/RCOG, 2010) recommends that obese women should have their weight measured at the beginning of the pregnancy (e.g. at the antenatal booking visit) and a weight measurement recorded in the third trimester, and also that they should be advised to avoid excessive weight gain.

Table 1 Institute of Medicine (2009) recommendations for weight gain in pregnancy depending on prepregnancy body mass index (BMI)

BMI (kg m^{-2})	Description	Recommended weight gain (kg)
<18.5	Underweight	12.5–18.0
18.5–24.9	Normal weight	11.5–16.0
25.0–29.9	Overweight	7.0–11.5
≥30.0	Obese	5.0–9.0

A study on the views of health professionals highlighted the issue that dietary information is often *ad hoc*, and that advice is not linked with weight management (Heslehurst *et al.*, 2007). Wiles (1998) found that above average weight women felt they did not receive relevant weight management information.

The present study aimed to explore the information and advice women of different prepregnancy BMI classifications are currently receiving about managing their weight during pregnancy. The aim is to establish whether women are receiving a consistent message, and whether NICE guidance is being followed. The study also assessed women's knowledge of weight gain recommendations and investigated the information and advice on weight management that women feel would be useful during pregnancy. This will help in the development of interventions that are tailored to the requirements and expectations of pregnant women.

Materials and methods

Ethical approval was obtained from the University of Nottingham Medical School Research Ethics Committee.

Questionnaire development

No published questionnaires could be found that explored the research objectives. Several studies used the Pregnancy and Weight Gain Attitude Scale developed by Palmer *et al.* (1985) to explore attitudes towards weight (Copper *et al.*, 1995; DiPietro *et al.*, 2003). The present study does not focus on attitudes to weight gain; therefore, this served only as a starting point for developing the questionnaire. The questionnaire was developed using the NICE guidelines on maternal and child nutrition and antenatal care as a framework for questions.

The questionnaire contains 13 quantitative and six qualitative questions. Quantitative questions include prepregnancy BMI from self-reported weight and height, parity number, the number of times women have been weighed, whether they have received information on weight gain, diet and exercise during their pregnancy care and who provided them with this information. Qualitative questions include what advice was received on weight gain, diet and exercise, opinions on what is an appropriate pregnancy weight gain, and information that women would find useful regarding weight management.

Participant recruitment and data collection

All study participants were recruited through the National Childbirth Trust (NCT). The NCT conducts research, works to improve maternity services and provides education, training, information and support services for parents and parents to be.

Recruitment and data collection were carried out via two routes to maximise the response rate.

An online version of the questionnaire was created at http://www.surveymonkey.com. Pregnant women were invited to participate via an e-mail invitation containing information about the study and a web link to the questionnaire. E-mails were sent to members of the NCT who were subscribed to the NCT online eGroup 'Announce'.

Women were also recruited via NCT antenatal classes in the Nottinghamshire area. E-mails were sent to antenatal class teachers to gain permission to distribute questionnaires in their classes. Four teachers agreed to this. At the classes, women were provided with a verbal introduction to the study either by the lead investigator or the antenatal teacher, plus an information sheet about the study. Participating women provided their written consent and completed questionnaires were collected by hand at the next class or returned by post by the antenatal teachers.

Statistical analysis

BMI was calculated from self-reported prepregnancy weight and height for each participant using the formula: weight (kg)/height (m^2).

Quantitative data were analysed using SPSS, version 17.0 (SPSS Inc., Chicago, IL, USA). The number of times that women from different BMI groups had been weighed was compared using Mann–Whitney *U*-tests. The number of women from different BMI groups who received weight gain advice and diet and/or exercise advice was compared using chi-squared tests. The number of women from different BMI groups who correctly/incorrectly identified weight gain recommendations was compared using chi-squared tests. $P < 0.05$ was considered statistically significant.

The lead researcher analysed the qualitative data by thematic content analysis. NVivo, version 9 (QSR International, Victoria, Australia) was used to manage the data. A rigorous process was employed which included careful transcription of the interview data. This process resulted in recurring themes that were not predefined but best reflected the participants' perceptions. The data were analysed using a cyclical, reflective process (Carter, 2004). Discussion of the themes and subthemes, including an independent researcher, was undertaken and agreed upon. Analysis of the data involved the processes of data reduction, data display and data complication. These three processes involved selecting and focusing the data, and data organisation followed by data construction to draw conclusions (Miles & Huberman, 1994). The themes were assigned to broader categories, creating four main themes each containing subthemes.

Results

Sixty women completed the questionnaire: 23 women recruited via the online questionnaire and 37 via antenatal classes. One participant was excluded because BMI data were not provided. Participants therefore comprised 59 women with singleton pregnancies. Participant characteristics are presented in Table 2.

Number of times weighed after entering maternity care

Of the 59 pregnant women, 15.9% had not been weighed, 55.9% had been weighed once, 27.1% had been weighed twice and 1.7% had been weighed three times.

No significant differences were found in the number of times women were weighed when comparing underweight and normal weight women or normal weight and obese women. There was a significant difference in the number of times weighed when comparing normal weight and overweight/obese women ($P = 0.038$) and underweight/normal weight and overweight/obese women ($P = 0.014$). Underweight/normal weight women were weighed a median of once and overweight/obese women a median of twice. The majority of participants (69%) were weighed by their midwife and just 18% by their general practitioner, 8% by a sonographer and very few by an obstetrician or healthcare assistant.

Information/advice received about weight gain

Eighteen of the women (30.5%) received information/advice about appropriate weight gain during their pregnancy care, with 37 (62.7%) not receiving any and four women not indicating whether they had received information.

No significant difference was found in whether weight gain information was received when comparing different BMI groups (Table 3).

Midwives provided 75% of the weight gain advice, 25% of the information obtained through self-study such as via magazines, books, leaflets and the Internet.

Table 4 shows the weight gain information/advice received, excluding information that was obtained from self-study. Eleven participants received information/advice from their midwife specifically about weight gain; 63.6% of advice was given verbally and 36.4% was via a leaflet.

Information/advice received about diet and exercise

Of the 53 women who responded, 43 (81.1%) had and 10 (18.9%) had not received information//advice about diet and/or exercise during their pregnancy care. No significant difference was found in whether diet and/or exercise information was received when comparing different BMI groups. Of the information/advice received, 82.4% came from healthcare sources with alternative sources of information including magazines, books, friends and family and the Internet, in addition to that from fitness advisors at gyms. Table 5 shows the diet and exercise information/advice received, excluding information obtained from nonhealthcare sources; 67.9% of advice was about diet and 32.1% of advice was about exercise. Many participants stated that advice was brief and lacked detail.

Knowledge of weight gain recommendations

Twenty-eight participants (47.5%) correctly identified the IOM weight gain recommendations (Table 1) for their

Table 2 Maternal characteristics (n = 59)

Characteristic	
Age (years), mean (SD)	32.7 (3.9)
Body mass index (kg m^{-2}), % (n)	
Underweight (<18.5)	11.9 (7)
Normal weight (18.5–24.9)	55.9 (33)
Overweight (25.0–29.9)	25.4 (15)
Obese (≥30.0)	6.8 (4)
Trimester (weeks), % (n)	
One (1–12)	0
Two (13–26)	23.7 (14)
Three (>26)	76.3 (45)
Previous pregnancies, % (n)	
None	71.2 (42)
One	25.4 (15)
Two	1.7 (1)
Three	1.7 (1)

Table 3 Comparison of whether weight gain information was received by different body mass index (BMI; kg m^{-2}) groups

BMI groups compared	P
Underweight and normal weight	0.59
Normal weight and obese	0.68
Normal weight and overweight/obese	0.34
Underweight/normal weight and overweight/obese	0.40

Table 4 Weight gain advice received from midwives

Advice	Number of participants
Leaflet given	4
Do not worry about gaining weight	3
Average weight gain	2
Weight gain per trimester	1
Reassurance regarding low weight gain	1

Table 5 Diet and exercise advice received from healthcare sources

Advice	Number of women
Leaflet given	14
Eat healthily	13
Food safety	8
Increase fruit and vegetables	5
Folic acid	4
Do not eat for two	2
Vegetarian advice	2
Healthy start vitamins	1
Restrict alcohol	1
Safe exercise	8
Continue regular exercise	4
Avoid over-exertion	4
Do not take up any new sports	1

own prepregnancy BMI. The remaining participants (n = 31; 52.5%) were incorrect. Table 6 shows the comparison of knowledge of weight gain recommendations between different BMI groups. Significantly more overweight/obese women had incorrectly identified weight gain recommendations compared to normal weight and underweight/normal weight women.

Of the incorrect answers, underweight/normal weight women tended to underestimate, whereas overweight/obese women tended to overestimate weight gain recommendations (Table 7).

Table 6 Comparison of knowledge of weight gain recommendations between different body mass index (BMI; kg m^{-2}) groups

BMI groups compared	Number of participants correct	Number of participants incorrect	P
Underweight	2	5	0.088
Normal weight	21	12	
Normal weight	21	12	0.14
Obese	1	3	
Normal weight	21	12	0.010
Overweight/obese	5	14	
Underweight/normal weight	23	17	0.025
Overweight/obese	5	14	

Table 7 Comparison of incorrect answers between different body mass index (BMI; kg m^{-2}) groups

BMI groups compared	Lower than weight gain recommendations	Higher than weight gain recommendations	P
Underweight	4	1	<0.0001
Overweight/obese	0	12	
Underweight/normal weight	10	4	<0.0001
Overweight/obese	0	12	

Qualitative analysis

After the thematic analysis, four recurrent themes emerged from the open question responses. Within each main theme, subthemes were identified. Themes and subthemes are shown in Table 8. Links between the themes are shown in Fig. 1.

Theme 1: weight gain advice wanted

A total of 30 participants (51%) commented they would like some form of information or advice on weight gain during pregnancy.

Thirteen participants stated they wanted to be informed of what is a 'healthy' or 'average' weight gain:

> 'I would like more guidance from the midwife on ideal/average weight gain.' (Participant 37)

Eight participants commented they would like to know when different stages of weight gain will occur:

> '[I would like to know the] expected appropriate weight gain at each trimester.' (Participant 40)

Several participants stated they would like to know more about how the extra weight is distributed during pregnancy:

> 'I would like to know how weight gain is distributed between me and my baby.' (Participant 8)

Table 8 Main themes and subthemes

Theme	Subthemes
1. Weight gain advice wanted	Healthy weight gain information Personalised weight gain advice More frequent weighing
2. Diet and exercise advice wanted	What to eat Managing hunger Consistent and personalised dietary advice Safe exercise
3. Lack of advice and support	Lack of advice from healthcare professionals Lack of support from healthcare professionals Self-study
4. Anxiety	'Abnormal' weight gain Anxiety about weight Body image

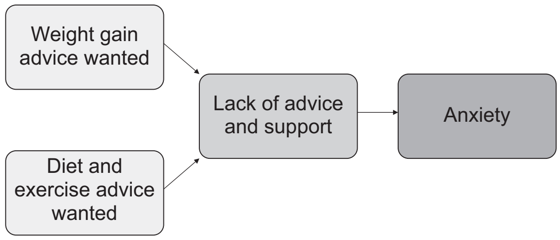

Figure 1 Links between themes identified from qualitative analysis.

Nine participants commented they would like advice on weight gain which is appropriate to their own prepregnancy weight and size:

'[I would like] ideas on roughly for my starting weight and size an indication of what the average OK weight gain would be for me, not just a leaflet advising of the UK average.' (Participant 12)

Four women commented they would like their weight to be monitored throughout their pregnancy:

'… but if it was measured by the midwife/GP then they could keep an eye on whether the weight gain was considered excessive.' (Participant 28)

Theme 2: diet and exercise advice wanted

One-third of participants (n = 17) stated they would like more dietary information or advice during their pregnancy to help manage their weight.

Six women commented they would like more information regarding appropriate foods to eat, along with foods to avoid:

'[I would like] a list of the best foods to eat, as well as what to avoid.' (Participant 27)

The quantity of food required for a healthy pregnancy was an issue that was raised. Some women were aware they didn't need to 'eat for two', whereas others were unsure how much they should be eating:

'It would be useful to be reminded that eating for two is a myth.' (Participant 47)

Two participants commented they would like advice on controlling their hunger in order to manage their weight:

'[I would like to know] how to manage hunger without gaining too much weight.' (Participant 23)

Several participants felt they were not given advice which was individually tailored:

'You get so inundated with generic leaflets that are produced by the government that to be honest I'm bored of looking through. It would be better to tailor antenatal sessions to the Mum focusing on their background and current situation rather than the 'ship them in ship them out' everyone under the same banner method as it appears to be now. It's very impersonal.' (Participant 12)

Several women commented that dietary advice was conflicting making it confusing and difficult to follow. More simple and consistent advice was wanted:

'… and less conflicting advice. It's all very well to tell people not to eat more than before pregnancy when they suddenly start feeling starving all the time. So you eat anyway, and then feel bad about it. Also, I think I'm supposed to take omega 3 supplements as I don't eat two portions of oily fish a week, but fish oil is high in vitamin A, which I'm supposed to avoid. What do I do? The midwife said the food standards agency would know how much vitamin A is safe, but how do I then find out how much vitamin A I'm eating?' (Participant 29)

Eight participants highlighted they would like more emphasis and advice on exercise which is safe during pregnancy:

'[I would like] detailed information about exercising. I was keen to keep up with exercise so asked and was just told it was okay to do so. Then I sought advice from personal trainer at gym who gave me a lot more detail about monitoring heart-rate and breathlessness – much more useful and safe advice.' (Participant 49)

Theme 3: lack of advice and support

A lack of advice and support regarding weight management was highlighted as an issue by almost one-quarter of participants (n = 12).

Several women commented that they received little advice from healthcare professionals regarding diet and exercise:

'I have had little to no info on nutrition throughout my pregnancy.' (Participant 21)

'I feel the advice about exercise from the GP and midwife was very brief and that they did not know very much, nor did they explain why exercise should be moderate which would have made it more meaningful and understandable.' (Participant 49)

Four participants stated that weight gain had been deemed 'unimportant' during their pregnancy care:

'My midwife said "no-one bothered with weight monitoring anymore."' (Participant 47)

Several women felt there was a lack of support from healthcare professionals:

'It would have been helpful to me if more information had been given to me about the different patterns of weight gain that women might encounter. Simply being dismissed as worrying about something that is inevitable has not helped … I found the whole experience difficult, as someone who has always been paranoid about being fat. There has been no help about how to deal with this.' (Participant 16)

'The guy who gave me my 12-week scan began the consultation by telling me off for riding a bicycle while pregnant.' (Participant 17)

A lack of advice and support from healthcare professionals meant that many participants searched for information themselves:

'I would welcome information regarding my diet and have been searching the Internet for some.' (Participant 15)

Theme 4: anxiety

The responses of eight participants suggested anxiety regarding their weight during pregnancy.

A lack of personalised advice left several women worried they did not match the 'normal' pattern of weight gain:

'I kept reading what was the 'normal' amount to put on … I didn't follow the pattern that the information I have been reading talks about at all. It made me anxious.' (Participant 22)

'It has only been through researching the web that I have found articles that discuss people who are slim to start with putting on more [weight] than those who are not.' (Participant 16)

Several participants were anxious about their weight during pregnancy:

'My main problem has been the fact that I've been put under consultant care because of my BMI and been terrified out of my wits by the consultant saying that I need extra appointments and scans because of my BMI, that I need a glucose tolerance test because I might be diabetic …, that any pain in my legs could be DVT and I could die. That added stress is not needed in pregnancy whatever weight you are!' (Participant 18)

Some of the participant's responses illustrated that pregnancy has had an impact on their body image:

'Weight has always been an issue for me. This stress has been increased as I have worried that I don't fit the 'normal' pattern of weight gain described.' (Participant 16)

One woman talked about how she had observed her friends struggle during pregnancy:

'I have friends who have been and/or are pregnant who have always struggled with their weight, and who I think struggle even more so during pregnancy. They don't see it as an excuse to relax their diet for once, in fact the complete opposite, and therefore women should be asked early in pregnancy if they are regular dieters.' (Participant 14)

Discussion

The results obtained in the present study show that the NICE Antenatal care guidelines (NICE, 2008a) relating to frequency of maternal weighing are generally being followed. This guideline states that maternal BMI should be calculated at least once, and that repeated weighing should only be carried out in pregnant women for whom nutrition is a concern. In the present study, overweight/obese women were weighed more often than underweight/normal weight women. However, it could be suggested that underweight women also require more frequent monitoring of weight, particularly because knowledge about weight gain recommendations shows that underweight women tend to underestimate weight gain recommendations.

Almost 16% of women were not weighed at all, including two women in the overweight/obese categories. Maternity services need to ensure that all pregnant women are weighed at least once in line with NICE guidance and, if obese at the start of pregnancy, should be weighed at booking clinic and during the third trimester in line with CMACE/RCOG guidance. Previous research has found that a lack of weighing equipment may be a barrier to obtaining maternal weight (Heslehurst *et al.*, 2007).

Approximately one-third of participants (33.9%) stated that they had received some form of weight gain advice during their pregnancy care; 25.4% of participants had received advice directly from their midwife, whereas 8.5% of participants had obtained information through self-study. These results are consistent with those of other studies investigating weight management advice received by pregnant women. In a study of above average weight women, 20 out of 37 women were provided with some form of weight or diet advice, although this usually related to nutrition and portion size rather than weight management. One woman out of the 37 was informed of what a healthy weight gain would be (Wiles, 1998). In the present study, no significant difference was found in whether weight gain advice was received when comparing BMI groups. Previous research has suggested that healthcare professionals are reluctant to broach the subject of weight as a result of the sensitivities of overweight and obese women in particular (Heslehurst *et al.*, 2007). In the present study, weight management advice was usually provided via written material, and was not specific to prepregnancy BMI. Instead, more general information was provided such as 'you will gain weight'. The NICE guidelines on antenatal care do not state specifically that women should be informed of what is an appropriate weight gain for their prepregnancy BMI. Therefore, it cannot be said that guidelines are not being followed. However, the qualitative results suggest that many women would like to be informed of this and would like to receive more detailed weight gain advice.

NICE guidelines state that women should be provided with specific information on nutrition and exercise at the antenatal booking appointment, which usually occurs around 10 weeks (NICE, 2008b). Only 64.3% of women reported that they had received diet and/or exercise advice from a healthcare source, suggesting that guidelines on the provision of diet and exercise advice are not being followed consistently. Previous research has highlighted that a lack of time at the booking appointment is a barrier to providing detailed dietary advice; instead, women are usually provided with dietary leaflets (Heslehurst *et al.*, 2007). This is illustrated in the present study because most diet and exercise information was obtained from a leaflet. This suggests that the information being provided to women may not be tailored to suit their individual needs; this feeling was echoed in the comment made by Participant 12.

Information received was also reported to be contradictory and confusing. Previous research supports this finding. In a study by Clarke & Gross (2003), one in five women reported that they had received conflicting advice.

Several women stated that they had obtained weight gain, diet or exercise information through self-study. This suggests that a lack of advice from healthcare professionals has required women to search for information independently. This was also highlighted as an issue in the qualitative responses. This presents a problem as women may be accessing unverified or unsafe advice which may have detrimental effects.

None of the women reported that they had received advice from a dietitian. NICE guidelines state that women with a BMI >30 should be referred to a dietitian for information and advice on healthy eating. Women are free to decline this offer. There were only four obese women in the study population; therefore, it is difficult to conclude whether these guidelines are being followed. More research is required to answer this question.

Less than one-half of the study population correctly identified the IOM weight gain recommendations for their prepregnancy BMI. This provides further evidence that women are not being informed of an appropriate weight gain based on their prepregnancy BMI. Underweight women tended to underestimate weight gain recommendations, whereas overweight/obese women overestimated them. The risks of an inappropriate weight gain have been discussed. Providing advice as to what constitutes a healthy weight gain could help reduce these risks in women outside the normal BMI range.

Clear links emerged between the themes identified from qualitative analysis. Participants wanted more weight gain, diet and exercise advice to help them manage their weight. In some cases, a lack of advice led participants to feel that they had a lack of support from healthcare professionals. This lack of advice and support caused feelings of anxiety in some participants.

To help them manage their weight, over half of participants commented that they would like more information or advice on weight gain during their pregnancy, and over one-third reported they would like more diet and exercise advice. Advice was wanted on a healthy weight gain, what to eat, how to manage hunger and safe exercise. The desire to receive personalised advice was raised as an issue by many participants. The importance of receiving personalised advice has been highlighted in previous research. Wiles (1998) found that above average weight women did not feel that the average weight gain advice applied to them because they were 'special cases'.

Along with a lack of personalised advice, participants were frustrated by the lack of detail and consistency of advice that they received from healthcare professionals and, consequently, found the advice difficult to follow, or sought information elsewhere. Inconsistent advice was particularly associated with exercise. Several comments illustrated that women felt they could not rely on advice from healthcare professionals:

Levy (1999) discusses the processes involved when women make informed decisions during pregnancy. Information needs to be accurate and trustworthy for women to act upon it. If healthcare professionals provide inconsistent information, they may be deemed untrustworthy. Personalising of information was also shown to be important. In the present study, the desire to obtain personalised and consistent advice led many women to seek information through self-study.

Four women stated that they would like to be weighed routinely throughout pregnancy. Previous research has shown that for some this would be reassuring, whereas, for others, it would cause anxiety (Campbell *et al.*, 2009). Healthcare professionals need to address this issue sensitively, and to ensure consent is obtained before weighing a woman. Also, women may or may not want to know what their weight is.

Along with a lack of detailed advice, some comments illustrated that participants felt they had a lack of support from healthcare professionals. Four women reported that the topic of weight gain had been dismissed as unimportant, and that their concerns had not been fully addressed. Although the weight management before, during and after pregnancy guidance (NICE, 2010) fails to give guidance on weight gain during pregnancy, the 2008 antenatal care guidelines (NICE, 2008a) include a chapter on woman-centred care and informed decision-making. It is stated that women should be provided with all the information and support they need. This is backed up by Levy (1999). Although it may not be obvious to a midwife why a piece of information has been requested, it should not be dismissed because the information may be vital to the woman, and not providing it could lead to a breakdown in trust.

As shown in Fig. 1, a lack of advice and support led to anxiety for some participants. A lack of personalised weight gain advice led to women feeling anxious that they did not fit the 'normal' pattern of weight gain. This again illustrates the need to address the concerns of each individual woman and tailor advice appropriately. One woman had been put under consultant care as a result of her BMI, which had caused her to become anxious about how her weight was affecting her pregnancy. A sensitive approach is required when discussing weight because it can be distressing for a woman, as illustrated in this case. More support and explanation may have helped to reduce anxiety. The effect of pregnancy on body image was also discussed, again demonstrating that weight is a sensitive issue for some women. Healthcare professionals therefore need to be aware of this to communicate with women effectively, as shown in previous research (Campbell *et al.*, 2009).

Limitations

The present study comprises a small study in terms of sample size. The data presented, including weight and height, are self-reported and may not provide an entirely accurate picture of the information and advice that healthcare professionals are providing. An observational study design would be more accurate for future research.

The methods of recruitment will have introduced bias. All participants were members of the NCT, which requires an annual subscription fee. Therefore, participants are potentially of a higher socioeconomic status than the general population. Members of the NCT are likely to have an interest in health, and may be more likely to actively seek health information than other pregnant women. Participants who were recruited via the online questionnaire are likely to have had an interest in the research. They also had to have Internet access to participate, which may mean they are not representative of the population. In future research, recruitment via the NHS would be preferable.

Some participant characteristics differed from the wider pregnant population. In terms of age, participants were slightly older than the national average. In the present study, the average age was 32.7 years, whereas the average age of women giving birth in 2002 was 29.3 years (Office for National Statistics, 2002). The study population had fewer women in the overweight/obese BMI categories compared to the national average. In the study population, 25.4% were overweight and 6.8% were obese compared to an average of 50% of women of childbearing age overweight or obese with 18% obese at the start of pregnancy (The Information Centre, 2008). Most of the women in the study are primigravida, which is again different from the general maternity population. The results are still likely to apply to the general population because maternity care is similar for every woman and opinions are likely to be comparable.

The methods of qualitative analysis are subjective, and therefore open to bias. Every effort was made to avoid bias. Software designed specifically for qualitative analysis was used and themes were checked by an additional person who was not involved in the study.

Some issues were raised that were not directly relevant to this study, although these do warrant further research. These include the relationship between pregnant women and healthcare professionals, and how this affects the delivery and reception of information, as well as the effects of pregnancy on body image.

Conclusions

Advice received on weight gain, diet and exercise was brief and generally not related to weight management. NICE guidelines on the provision of diet and exercise advice are not consistently being followed and advice was reported not to be personalised and sometimes confusing and contradictory. This is consistent with previous research. Clearer, more detailed and personalised advice is wanted to aid weight management. Women wanted personalised weight gain advice in particular. To provide this, consensus should be reached on what weight gain guidelines to follow. Until then, there is the risk of providing women with inconsistent advice, which may lead to mistrust and anxiety. Some participants reported a lack of advice and support from healthcare professionals. This led to feelings of anxiety in some cases, and to women seeking information for themselves. Information obtained from nonhealthcare sources, such as the Internet, may be unsafe and lead to unhealthy weight management practices. More research is required into the weight management of obese women. Too few obese women were recruited to the present study to allow conclusions to be drawn, although none of the obese subjects received specific weight gain or weight management advice.

The present study, as well as previous research, has shown that pregnancy increases awareness of weight, and could therefore incur a change in lifestyle (Fairburn, 1990; Wiles, 1998). This highlights the need to address the weight concerns of pregnant women and demonstrates that pregnancy presents an opportunity to educate women about healthy weight management.

Conflict of interest, source of funding and authorship

The authors declare that they have no conflicts of interest.

No additional funding was sourced.

This research was undertaken by AB as part of a fourth year undergraduate project and supervised by AA. All authors critically reviewed the manuscript and approved the final version submitted for publication.

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Paper 7

Stubbs, R.J., Brogelli, D., Pallister, C., **Avery, A**., McConnon, A. and Lavin, J.H. (2012). **Behavioural and motivational factors associated with weight loss and maintenance in a commercial weight management programme**. The Open Obesity Journal. 4, 35-43.

Behavioural and Motivational Factors Associated with Weight Loss and Maintenance in a Commercial Weight Management Programme

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Abstract: This survey examined self-reported behaviour changes associated with weight loss and maintenance in a group of 292 members of a commercial weight management organisation (CWMO). Mean (SD) joining weight was 89.0 (20.0) kg, duration of membership was 29.1 (16.2) months and time taken to reach their current weight was 16.3 (13.5) months. Mean (SD) weight change was -15.6 (11.4) kg and BMI change was -5.7 (4.0) kg/m^2, (both $p<0.001$), which had been maintained for 11.7 (12.8) months.

Primary factors reported by participants as important in achieving their weight loss included not going hungry by satisfying appetite with low energy density food eaten *ad libitum*, following a flexible diet, peer-group support and tools to cope with small lapses.

Several reported eating/activity behaviours significantly correlated with weight loss maintenance (WLM). However in regression analysis, while most individual changes in eating behaviour and activity behaviour were significant predictors of weight change in this group, no variables explained more than a few percent of the variance, after adjusting for age, gender, height and starting weight.

A range of eating and activity behaviours was associated with weight loss maintenance. It is important to offer consumers flexible solutions they can adapt to their individual lifestyle needs.

Keywords: Behaviour, diet, exercise, relapse-prevention, weight maintenance.

BACKGROUND

Obesity is now recognised as being at the forefront of current "lifestyle diseases" creating a future of rising disease and chronic long-term ill health [1-4]. Obesity impacts on other lifestyle diseases such as heart disease, stroke, cancer and diabetes. This in turn affects the growing burden on health care resource that currently threatens the quality of care that national health care systems can provide [3, 5]. Overweight, obesity and the attendant health burden to society will be major issues for governments, health professionals, the food industry and consumers for some time to come.

There has thus been an increased interest in helping people navigate towards dietary and lifestyle and other solutions to obesity e.g. [3]. Encouraging people to partake in healthier lifestyle choices would create the foundation of healthy habits that lead to greater wellbeing, quality of life and reduced expenditure for national healthcare systems. Changes in diet and activity patterns per se are the "mechanics" of behaviour change inasmuch as they are what people do to alter their energy balance. Of equal importance are factors that motivate people to lose weight and maintain the loss. According to Wing and Phelan, in studies that range in sample size from 225 to ~1000 about 20% of the general population do lose and maintain more than 5-10% body weight, but they are the minority of those who make the attempt [6].

It has also been suggested that the majority of those who lose weight do so independent of clinical treatment programmes, by joining commercial diet, self-help groups and/or exercise programmes [7, 8]. This apparently represents the majority of people presenting to lose weight [9]. Most available data on people who lose weight and how they maintain the loss are from highly select samples. In 1994 Brownell and Rodin noted that most data on weight loss and maintenance are from clinical trials conducted in university or clinical settings [9]. Clinical samples may show a conservative bias "because the participants are more overweight, more likely to be binge eaters, have more psychopathology, and may differ from other overweight persons in other ways not yet studied" [9]. Such individuals probably do not represent those in the general population who are overweight or even those motivated to lose weight [10-13]. They may include a high proportion of people who have failed on their own or in commercial programmes and who thus may be less predisposed to achieve long-term

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weight maintenance [10, 14]. It is also possible there is an over-representation of a range of hormonal and other physical disorders that are associated with weight gain in clinical populations [15]. Thus only a minority of people presenting to lose weight do so by the main means that are used to collect data and so information is lacking on how most people in the community achieve and maintain weight loss. Consequently the behaviours that lead to successful weight loss maintenance and the barriers that hinder these achievements are actually not well documented [15-17].

The largest body of data on this subject, outside of university settings or clinical treatment programmes, has come from the National Weight Control Registry (NWCR) in the US, which has been used to characterise the attributes of successful weight losers and maintainers in the general population [6, 18, 19].

Positive correlates of weight maintenance have been found to be physical activity, self monitoring, a positive coping style, continued social support, normalisation of eating patterns, reduction of co-morbidities during weight loss (which presumably affects motivation), flexible coping strategies and eating breakfast [6, 20-22]. Negative correlates of weight maintenance include negative life events and family dysfunction. In the NWCR, higher levels of depression, dietary disinhibition and binge eating were also predictive of weight regain [6, 20].

The NWCR is likely to be more representative, than many clinical populations studied, of people in the general population who have succeeded in maintaining a significant (at least ~15kg) weight loss over a sustained period of time. Nevertheless they are still a specific self-selected sub-group and it is not yet clear how generalisable findings in this group are. To gain further insight, it is important to study a number of groups of people who have maintained their weight loss.

A significant percentage of the adult population engage with diet and lifestyle solutions by participating in formal weight management programmes [7]. There has recently been a cluster of publications on the effectiveness of commercial weight management organisations (CWMOs), which have become a mainstream source of weight management solutions to a significant proportion of the general population [23-28]. The purpose of this study was to conduct an initial survey of members from a British CWMO who participated for a minimum of three months and who have on average lost >15 kg in weight. The survey assessed self-reported (i) behaviour changes associated with decrease in weight and BMI, (ii) factors important or obstructive to achieving and maintaining weight loss.

MATERIALS AND METHODS

Two samples were recruited for this study. Weight loss maintainers attending a CWMO (Slimming World) were contacted using the members' website, which stated that by completing a short questionnaire, they would be entered into a draw to win £100. The advert for the survey remained on the website for 1 month. The definition of WLM was that members had to have reached and maintained their personally chosen target weight for at least 3 months. A second sample who had participated in the Slimming World arm of the Diogenes study [29] and who were happy to complete the same questionnaire also participated. They were offered the same incentive (entry into a draw to win £100). With the exception that the second sample had previously answered psychological and behavioural questions, as part of the Diogenes study, there was no difference in the interactions the researchers had with each sample. Both groups of participants had been long-term members. Mean (SD) duration of membership was 29.1 (14.1) and 38.2 (13.3) months, respectively. Participants had lost substantial amounts of weight- 16.0 (9.0) and 15.3 (13.7) kg, respectively, which they had maintained for a mean of 11.1 (12.7) and 12.4 (13.0) months, respectively. By clicking the link to the questionnaire subjects consented to taking part in the study.

The questionnaire was specifically developed for this study, with the intention being easy to complete and in vernacular language with which the participants in the programme were familiar. Questions were designed to capture changes in behaviour that are both meaningful and useful to the participants of the programme. The questionnaire was piloted in a small number of people to ensure it was understandable and easy to administer. The questionnaire consisted of questions in which the participant selected drop-down menus to describe their age, height, level of activity, date of birth, duration of membership, time taken to reach current weight and time at current weight. Duration of membership, time taken to reach current weight and time at current weight, were computed by assuming linearity and taking the mid-point of each time category, (i.e. 6 months or less as 3 months, 6-12 months as 9 months, 12-18 months as 15 months, 18 months-2 years as 21 months, 2-3 years as 30 months, more than 3 years as 48 months). The remainder of the questionnaire took the form of 5-point Likert scales or checkboxes asking questions about sources of help/support and reasons for trying to lose weight, behavioural strategies that they believed have specifically helped them achieve and maintain their weight loss, previous attempts at weight loss, motivational factors important to participants in achieving weight loss and retrospective, self-reported assessments of eating/activity habits and self-esteem (using an adaptation of the Rosenberg self-esteem scale [30]) before and after the subjects lost weight. Data on self-esteem are reported elsewhere.

The participants themselves reported weight, age and height, for when they joined and at present. They were asked to consult their group records to obtain this information if they could not remember. The questionnaire was constructed and administered using Checkbox v4.4-Web Survey Software-Copyright ©2007, Prezza Technologies, Inc.

From the raw data collected (height, start weight and end weight), start and end BMI, weight and percent weight change were calculated. The effects of specific behaviour changes on weight change were assessed by fitting linear models and examining the significance of fitted terms in these models, through regression analysis. Associations between specific behaviour changes and weight change were examined by Pearson correlation coefficients. All analyses were performed using Microsoft Excel (2007) and the GENSTAT 5 statistical program (Genstat 5 Rothampstead Experimental Station, Harpenden, UK). Results are expressed as mean (SD) or as percents where relevant.

Table 1. Rank Order of Mean Response Scores, Using a 5-point Likert Scale, to the Question "Which of the Following are Important to you in Losing Weight and Maintaining your Current Weight?" (n=292)

Which of the Following are Important to you in Losing Weight and Maintaining your Current Weight?	Mean	SE
For myself	4.9	0.0
To feel better about myself	4.7	0.0
To be healthier	4.7	0.0
To feel more confident about the way I look	4.6	0.0
To be able to wear nice clothes	4.6	0.0
To increase my self-esteem	4.5	0.1
To feel more energetic	4.2	0.1
To live longer	4.1	0.1
To feel more agile	4.1	0.1
To feel less breathless	3.5	0.1
To please my partner	2.5	0.1
For a specific event/occasion	2.3	0.1
To please my family/friends	2.2	0.1
To help a treatment/operation	1.9	0.1
To please my doctor	1.7	0.1

This study was reviewed and approved by the University of Surrey Ethics Committee.

RESULTS

Participants

There was considerable overlap in the weight, height, weight changes and similarities in responses of the two samples and they were pooled for the purpose of this analysis. The first group started and ended lighter than the second (80.7 vs. 98.2 kg and 64.7 vs. 83.0 kg, respectively, $p<0.001$) and took less time to reach their current weight (10.2 vs. 23.1 months, respectively, $p<0.001$). The first group was younger than the second (43.4 vs. 50.9 years, $p<0.001$). BMI changes and time at current weight were similar. For the pooled sample, 292 participants (277 women and 15 men) completed the survey and were included in the analysis. Mean (SD) joining weight was 89.0 (20.0) kg; BMI was 32.6 (6.6) kg/m^2; height was 1.65 (0.07) m. At the point of survey age was 47.0 (12.9) years; duration of membership was 29.1 (16.2) months; time to reach current weight, 16.3 (13.5) months; time at current weight, 11.7 (12.8) months. Mean current weight and BMI was 73.4 (16.3) kg and 26.9 (5.6) kg/m^2, respectively. Mean (SD) weight change was -15.6 (11.4) kg and BMI change was -5.7 (4.0) kg/m^2, (all $p<0.001$).

Sources of Help and Support and Reasons for Trying to Lose Weight

When asked how helpful or supportive various people were in helping participants lose weight, they rated out of 5 on a Likert scale, the following: their CWMO groups (3.8), their CWMO group leader (3.8), partner (3.4), children (3.3) and friends (3.2), GP (2.4) and other health professionals (2.0). Table **1** shows that the most important factors to the participants in losing and maintaining weight were related to their own sense of well-being, personal achievement ("for myself", "to feel better about myself"), health ("to be healthier") and appearance ("to feel more confident about the way I look" and "to wear nice clothes"). Losing weight for others (be it a GP or partner, family and friends) or for specific events (e.g. operation) or occasions was rated as least important.

Previous Attempts at Weight Loss

When asked **"**How often have you lost more than 10 pounds in a slimming attempt?" 20.5% responded "never", 41.1% said "1-2 times", 21.6% reported "3-5 times", 7.2% replied "6-10 times" and 9.6% answered "more than 10 times". Fig. (**1**) shows the ranked order of reasons participants gave for giving up, if they had previously lost weight. The most important reasons that undermined their previous weight loss journey were "restricted foods", "having to eat different meals to my family" and "lack of support". Many stopped following their previous weight loss regime once they had lost weight. Factors such as "the diet was not working", "slimming did not fit in with my working life" and "lack of convenience", were deemed least important in loss of compliance with the weight loss regime they had previously followed.

Factors Important to Participants in Reaching their Current Weight

Participants were asked "Which of the following has helped you to reach your current weight?". Table **2** shows that the most important factor that participants felt had helped them achieve their current weight was not having to go hungry by satisfying appetite with low energy density food eaten *ad* libitum ("free-foods" in the terminology of the plan). Almost equally important was the ability to eat a healthy balanced diet that was flexible (including for social occasions), "being very honest with myself about what I eat",

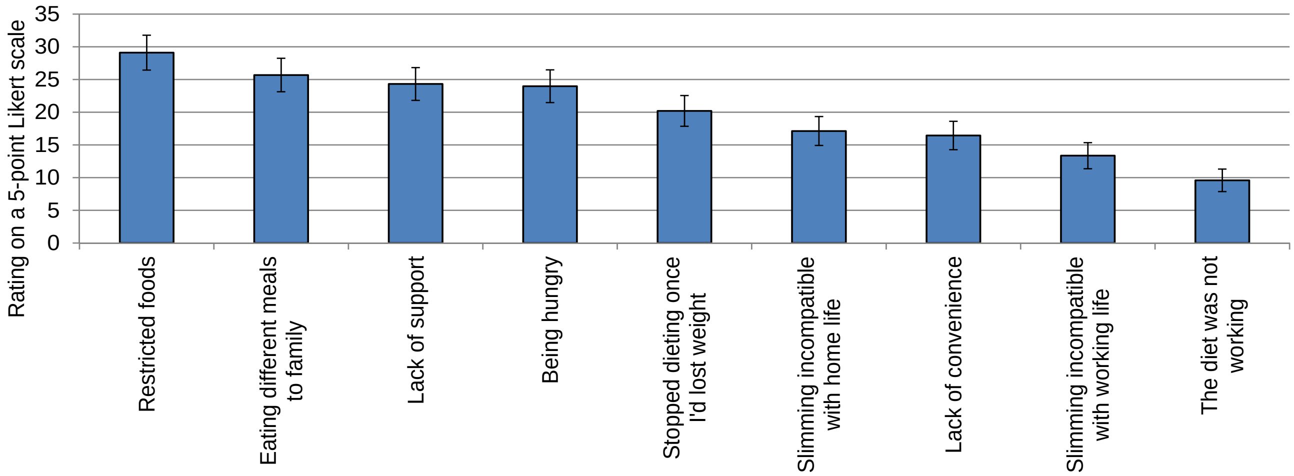

Fig. (1). Mean (SE) response to a list of questions asking "If you have lost weight previously and then given up, what made you give up?" Subjects were able to check as many of the responses as they wished. Results are presented as the percentage of the total that checked each response (n=292).

Table 2. Rank Order of Mean Response Scores, using a on a 5-point Likert Scale, to the Question "Which of the Following has Helped you to Reach your Current Weight?" (n=292)

Which of the Following has Helped you to Reach your Current Weight?	Mean	SE
Being able to not go hungry by filling up on "Free" Foods	4.7	0.0
Eating a healthy, balanced diet	4.6	0.0
Being very honest with myself about what I eat	4.6	0.0
A flexible diet that allows me to take account of specific occasions	4.5	0.0
Weekly group support	4.5	0.1
Support from those around me	4.3	0.1
Having the tools to cope with small weight gains during my weight loss journey	4.3	0.1
Setting a realistic weight loss target	4.2	0.1
Selecting the right foods that are a low risk for weight gain	4.2	0.1
Regular monitoring of body weight	4.1	0.1
Praise from those around me for my weight loss achievements	4.0	0.1
Avoiding sugary drinks	3.9	0.1
Regular monitoring of food intake	3.9	0.1
Planning what I am going to eat in the next few days	3.9	0.1
Sticking to a low fat diet	3.8	0.1
Avoiding things that sabotage my diet	3.7	0.1
Having the whole family involved in healthy eating	3.6	0.1
Avoiding fast foods and takeaways	3.5	0.1
Regular exercise	3.5	0.1
Overcoming the feeling of guilt about being overweight	3.4	0.1
Avoiding sweets and savoury snacks	3.3	0.1
Avoiding alcohol	2.3	0.1
A rigid diet that I stick to no matter what	1.5	0.1
Calorie counted diet	1.5	0.1
Skipping some meals (e.g. breakfast or lunch)	1.3	0.0
Prescribed anti-obesity medication	1.1	0.0
Over the counter anti-obesity medication	1.0	0.0
Weight loss surgery	1.0	0.0
Commercial meal replacements (e.g. Slimfast, Modifast, Nutrillet or other)	1.0	0.0

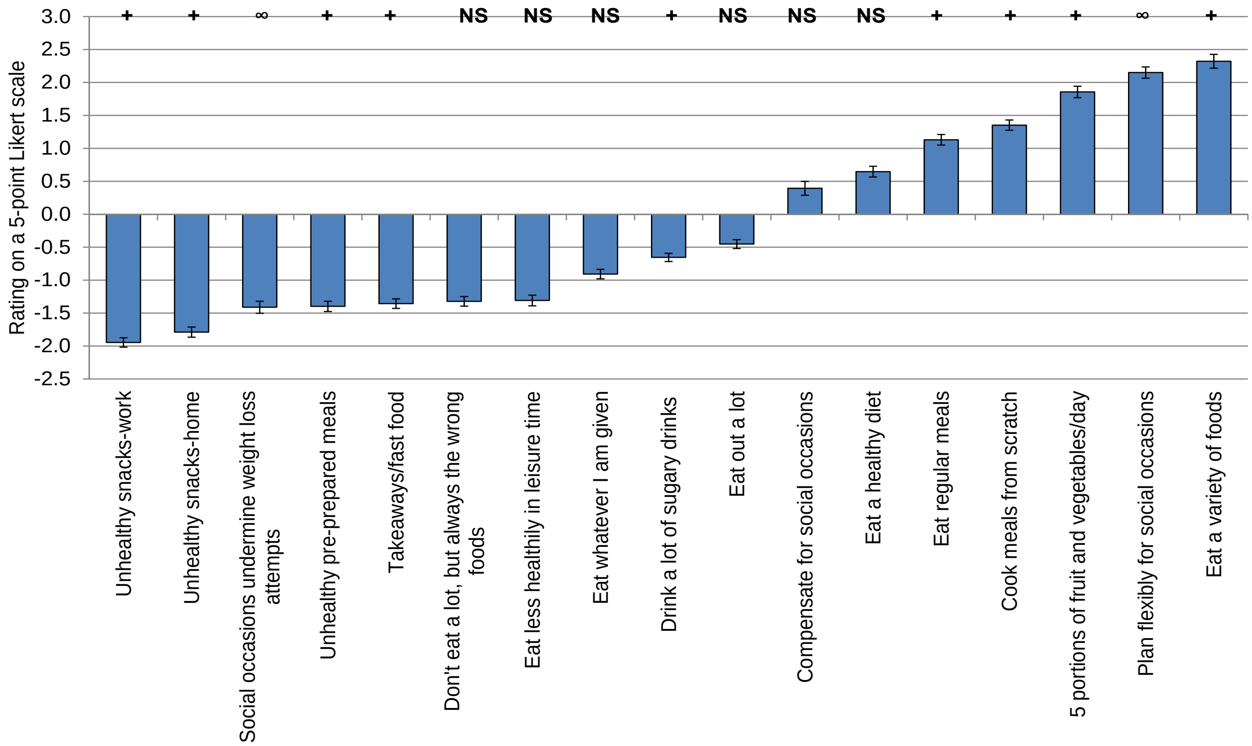

Fig. (2). Mean (SE) difference in response to a 5-point Likert scale asking participants to describe their eating behaviours before and after successful weight loss maintenance (n=292). ∞ denotes $p<0.015$; + denotes $p\leq 0.005$.

followed by peer-group support and "having the tools to cope with small gains during my weight loss journey". To this group of participants, rigid diets, calorie counting, skipping some meals, commercial meal replacements, medication and surgery were of least importance in reaching their current weight.

Self-Reported Changes in Eating and Activity Habits Associated with Weight Loss

Participants were asked to describe their eating and activity habits since joining the CWMO. For each of the measures of eating and activity, linear regression was conducted with weight change as the outcome having adjusted for age, gender, height and initial weight. As can be seen from Fig. (**2**), changes in eating behaviour associated with weight loss, (percentage of the variance in weight change associated with these variables is given in parentheses), were decreases in the intake of unhealthy snacks at work (3.6%) and home (2.6%); attending less social occasions, which tend to undermine attempts at weight control (2.2%); less intake of unhealthy pre-prepared meals (2.4%) or takeaways/fast foods (1.7%); increases in eating a bigger variety of foods (2.6%), adopting a flexible approach to planning how much they ate at important social occasions (1.4%), eating regular meals (3.0%), a greater tendency to eat 5 portions of fruit and vegetables a day (4.0%) and cooking meals from scratch (3.0%), (all $p<0.005$ except planning around social occasions, $p=0.012$).

Changes in activity behaviour (percentage of the variance in weight change associated with these variables is given in parentheses) were a decrease in hardly ever walking anywhere (4.7%), a decrease in hardly ever taking part in any physical sports (1.7%) decrease in TV viewing (1.6%) and decreased avoidance of intense activity (4.0%). These were accompanied by increases in going out for walks a lot (4.1%), gym/sports activities (1.4%) and doing a lot of physical work around the house or garden (6.8%) (Fig. **3**), (all $p<0.005$, except gym/sports, $p=0.01$).

Associations Between Changes in Eating, Activity Behaviour, and Change in Weight

Because in this study all weight changes were negative (as all subjects were weight loss maintainers), an increase in behaviour showing a negative correlation with weight indicated that an increase in that behaviour was associated with weight loss. A decrease in a behaviour showing a positive correlation with weight also indicated that the change in that behaviour was associated with weight loss.

Table **3** shows the direction of eating/activity behaviour change and rank order of correlations between these outcomes and change in weight. For both eating and activity behaviour the larger correlations with weight loss were around 0.30-0.35. For decreases in aspects of eating behaviour the largest correlations were in the intake of "unhealthy snack foods at home", "unhealthy snack foods at work", "unhealthy pre-prepared meals" and "takeaways/fast food". For increases in aspects of eating behaviour the largest correlations with weight were in "cooking meals from scratch", "eating regular meals" and eating "a bigger variety of foods". For activity the largest correlations related to moderate exertion such as walking and housework.

For weight change multiple regression models were computed. The first included age, gender, height and start weight and accounted for 35.4% of the variance in weight change. Two additional models were generated by adding change in responses for either eating behaviour and then

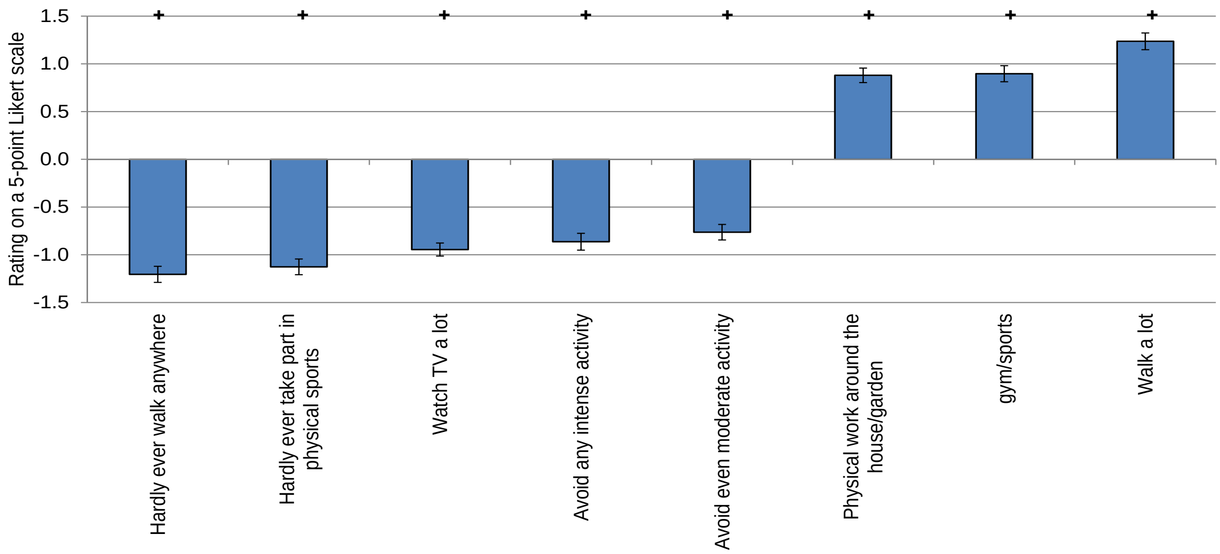

Fig. (3). Mean (SE) difference in response to a 5-point Likert scale asking participants to describe their activity behaviours before and after successful weight loss maintenance (n=292). ∞ denotes p≤0.01; + denotes p<0.001.

Table 3. Correlations between Changes in Eating and Activity Behaviours and Weight Change (n=292)

Direction Change	**Change in Behaviour**	**Weight Change**	
	Eating	r	p-value
+	Cook meals from scratch	-0.24	<0.01
+	Eat regular meals	-0.22	<0.01
+	Eat a variety of foods	-0.21	<0.01
+	5 portions of fruit and vegetables/day	-0.18	<0.05
+	Plan flexibly for social occasions	-0.15	<0.05
+	Compensate for social occasions	-0.13	<0.05
+	Eat a healthy diet	-0.05	NS
-	Eat out a lot	0.04	NS
-	Eat less healthily in leisure time	0.07	NS
-	Eat whatever I am given	0.09	NS
-	Social occasions that undermine weight loss attempts	0.11	NS
-	Don't eat a lot, but always the wrong foods	0.14	<0.05
-	Drink a lot of sugary drinks	0.25	<0.01
-	Takeaways/fast food	0.25	<0.01
-	Unhealthy pre-prepared meals	0.26	<0.01
-	Unhealthy snacks at work	0.30	<0.01
-	Unhealthy snacks at home	0.30	<0.01
+	Physical work around the house/garden	-0.35	<0.01
+	Walk a lot	-0.25	<0.01
+	Gym/sports	-0.19	<0.05
-	Watch TV a lot	0.21	<0.01
-	Hardly ever take part in physical sports	0.23	<0.01
-	Avoid any intense activity	0.25	<0.01
-	Avoid even moderate activity	0.27	<0.01
-	Hardly ever walk anywhere	0.30	<0.01

activity behaviour, which explained 42.6%, 43.6% of the variance in weight change, respectively.

DISCUSSION

Weight History and Previous Attempts at Weight Loss

It is currently estimated that one in five or six adults in the general population has accomplished WLM of at least 10% [6, 12]. In the present study a group of weight loss maintainers took an average of 16.3 months to lose 17.5% of their weight, which they maintained for 11.7 months at the point of study. This equates to a weight loss of 1.1% of their body weight per month on average, and it is perhaps likely that weight losses were punctuated by lapses and relapses. In the National Weight Control Registry 44.6% of those studied lost weight on their own [18] and relapses were frequent occurrences [31]. The present study and the data from the NWCR suggest that attainment of substantial weight loss is a protracted process, requiring persistent effort.

79.5% of the study group had lost more than 10 pounds in previous weight loss attempts, prior to their current weight loss attainments. These data are consistent with the findings from the National Weight Control Registry, which suggest that the maintenance of weight loss is not easy and often takes several repeated attempts before people learn to navigate to and remain at a healthy body weight [6, 18]. Information on why people fail to lose weight or fail to maintain weight loss is less common than descriptions of weight loss and maintenance behaviours [11, 16, 28, 32, 33]. This is despite the observation by Jeffrey et al. that the increasing prevalence of obesity and high-self reported rates of dieting in the general population suggest attempts at weight loss are being offset by failures [10]. The reasons for failed weight loss attempts are important, because one needs to learn how to cope with failure in order to succeed [34]. This is consistent with Brownell and Rodin's model of recovery from relapse [9, 35]. Thus when this group was asked the reasons why they gave up previous weight loss attempts, restriction of foods, having to eat differently to their family and lack of support featured most highly in their answers. For some, being overweight can be seen as a chronic relapsing condition that requires long-term management, control of relapse and recognition of relapse signatures at the level of the individual [9, 35]. There is evidence that there is a physiological basis to weight relapse. Weight loss can decrease energy expenditure [36] and influence hormones that are associated with weight regain [37, 38]. For example, changes in leptin and ghrelin are associated with loss of weight and body fat. These hormonal changes have also been shown (at least in the case of one study using a very low calorie diet) to be associated with increased appetite at one-year follow up [37]. It therefore seems that weight loss induces a suite of physiological changes that would tend to favour weight regain [37-42]. Those people who successfully maintain their weight loss appear to develop patterns of motivation and behaviour that oppose relapse and promote longer-term weight maintenance.

Factors Important to Participants in Losing Weight

In the present study, subjects primarily wanted to lose weight for personal reasons. The factors that helped them reach their current weight were largely based on behavioural change and dimensions of social support. There was no single factor that was specifically important to the group as a whole. Similar patterns have been noticed elsewhere [15]. Several factors important for weight loss and maintenance were of a socially interactive nature. There is evidence in the self-help support literature indicating the importance of social relations in implementing behaviour change solutions to a number of relapsing conditions [43-48]. Jeffery et al (2000) noted that approximately a dozen studies had evaluated social support involving spouses or significant others as a means to motivate weight loss [10]. They concluded that the success of such approaches has been modest. Broader approaches to social support comparing group versus individual outcomes showed more positive results [10]. There has been a notable suggestion in the literature that social networks may be important in the development of obesity [49]. This is not without controversy [50]. For some at least, social networks may help in successful weight loss and maintenance [48, 51]. This is interesting because it may be that weight loss induces changes in physiology that pose a challenge for weight loss maintenance [37-42]. Part of the solution to that challenge may be the social and motivation factors, which support patterns of behaviour, help avoid relapse and promote longer term weight loss maintenance.

Relationships Between Changes in Eating and Activity Behaviours in Association with Weight Loss and Maintenance

In the present study several eating and activity behaviours were associated with WLM, the correlations for individual behaviours were relatively weak and none explained more than a few percent of the variance in weight loss. This indicates that as a group, while many behavioural traits were significantly associated with WLM there were few specific key eating or activity behaviours that explained much of the variance. Wing *et al.* and Hill *et al.* characterised the attributes of successful weight losers in the NWCR [6, 18, 20-22, 31]. While the range of behaviours used by weight loss maintainers (compared to those who do not maintain weight loss) is broadly similar, the specific behavioural correlates of successful weight loss maintenance in the NWCR vary [20]. Similar results have recently been reported in a sample of 225 Portuguese women by Teixeira *et al.* [32]. The range of behaviours exhibited by weight loss maintainers possibly suggests that different people achieve weight loss maintenance in generically similar (i.e. diet and exercise) but specifically different ways (i.e. the specific behaviours) [15]. A recent national survey of behavioural practices associated with weight loss versus weight loss maintenance in 1165 US adults suggested that weight loss and WLM may involve two different sets of weight control practices. Both weight loss and WLM were associated with a range of behaviours, but the range of behaviours leading to weight loss differed from the range of behaviours associated with successful WLM [16]. This suggests that to have maximum impact in the general population, weight control solutions need to be flexible and varied enough to accommodate the range of behaviours associated with successful weight loss and maintenance. It has been noted that there is considerable heterogeneity in the degree to which individuals exhibit specific profiles of behaviour change when losing weight and attempting to maintain the loss [15]. There is also variability in the extent to which they relapse, at least in the studies reviewed to date [15]. While a range of behaviours and psychological traits change significantly when weight is lost and people attempt to maintain the loss, few specific traits explain much of the variance for the whole population; intra-individual variability is too great. Such models do not explain a large proportion of the variance in weight loss outcomes, because they are population models, which attempt to elucidate common pathways for groups of people. Those groups of people seem to be engaged in a range of behaviour changes but to differing degrees [15]. It would be valuable to conduct larger studies, which follow weight loss maintainers over a longer period and examine how patterns of behaviour and motivation relate to weight relapse or continued weight loss maintenance in commercial programmes.

Limitations of the Current Study

It is likely that those who attend self-help and diet groups differ from the general population. Many of those who attend self-help groups, be it for alcohol and substance dependency, mental health or weight loss tend to be characterised by a common trait – they have a tendency to relapse [35, 43-46]. Hence they seek the on-going support and stability that the safe environment of a self-help group provides [15]. This suggests that there is both a strength and a limitation to studies such as the current analyses. This sample is a specific, self-selected sub-group, who are interesting because they do not represent the vast majority of people attempting to lose weight– they represent people who successfully lose weight in a CWMO and maintain the loss. Self-reported body weight and physical activity tend to be biased in that people (including those who are overweight) tend to under-estimate their weight, under-estimate their energy intake and over-estimate their physical activity levels. Thus while the absolute levels of these estimates may be subject to some error and bias, the direction and nature of change in responses are likely to have been more robust indicators of outcomes. This study used retrospective questions to examine the responses of the same subjects regarding how they felt before and after their participation in the programme. This has to be balanced against the difficulty of identifying successful weight loss maintainers prior to their weight loss. The sample was primarily women and there are some differences between men and women in psychological and behavioural aspects of weight loss and maintenance.

CONCLUSIONS

A number of eating/activity behaviours significantly correlated with WLM. However in regression analysis, while most individual changes in eating and activity behaviour were significant predictors of weight change in this group, no variables explained more than a few percent of the variance, after adjusting for age, gender, height and starting weight. It is important to offer consumers flexible solutions they can adapt to their individual lifestyle needs.

FUNDING

Research relating to this article was part of the DiOGenes project funded by the European Commission (contract #: Food-CT-2005-513946) in the Food Quality and Safety Priority of the Sixth Framework Program. DiOGenes is the acronym of the project “Diet, Obesity and Genes” (www.diogenes-eu.org).

CONFLICT OF INTEREST

All authors (except AMC) work for Slimming World.

ACKNOWLEDGEMENT

We are most grateful to Dr Graham Horgan, of Biomathematics and statistics Scotland, for independent statistical analyses of and advice on these data.

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Received: September 30, 2012 Revised: October 22, 2012 Accepted: October 26, 2012

Paper 8

Stubbs, R.J., Brogelli, D.J., Allan, J., Pallister, C., Whybrow, S., **Avery, A**. and Lavin, J. (2013). **Service evaluation of weight outcomes as a function of initial BMI in 34,271 adults referred to a primary care/commercial weight management partnership scheme**. *BMC Research Notes*, 6:161 doi: 10.1186/1756-0500-6-161

Stubbs et al. BMC Research Notes 2013, 6:161
http://www.biomedcentral.com/1756-0500/6/161

BMC Research Notes

SHORT REPORT Open Access

Service evaluation of weight outcomes as a function of initial BMI in 34,271 adults referred to a primary care/commercial weight management partnership scheme

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Abstract

Background: It is not clear if behaviour change programmes are more or less effective for weight management in people with high BMIs than for those who are moderately overweight. An earlier service evaluation reported on the rate and extent of weight loss in a primary care/commercial weight management organisation partnership scheme, in 34,271 patients were referred by their health care professionals to a UK commercial weight management organisation, Slimming World for 12 weekly sessions. This project updated that service evaluation by examining weight loss outcomes as a function of initial BMI in the same 34,271 patients.

Findings: Patients referred to the scheme (n = 34,271) were categorised by BMI groups <30 kg/m^2, 30-34.9 kg/m^2, 35-39.9 kg/m^2 and to ≥ 40 kg/m^2. Mean weight losses after 12 weekly sessions were 2.9, 3.6, 4.1, and 4.8 kg for each BMI category respectively. Regression analysis showed that after adjusting for age and gender, relative to the <30 kg/m^2 group, absolute weight losses were 0.8, 1.4 and 2.4 kg more for the 30-34.9 kg/m^2, 35-39.9 kg/m^2 and to ≥ 40 kg/m^2 groups, respectively (all p<0.001). Percent weight loss was similar in each BMI category: 3.7%, 4.0%, 4.0% and 3.9%, respectively (p<0.001).

Conclusions: This service evaluation demonstrates that 12 week referral to a commercial organisation is as effective for people with high BMIs as for those who are moderately overweight.

Keywords: Obesity, Treatment, Weight management, Body mass index, Weight outcomes

Background

In a previous paper we have examined the rate and extent of weight loss in a primary care/commercial weight management organisation (CWMO) partnership scheme (called Slimming on Referral). In that paper 34,271 patients were referred by their health care professionals to a UK commercial weight management organisation, Slimming World, for 12 weekly sessions [1]. Data were reported for the whole population, for completers (those who attended 10 of 12 sessions) versus non-completers, and for men and women [1]. There is now a growing body of data suggesting that commercial diet and lifestyle programmes are effective in the general population [1-8]. However, it is not clear from current published studies whether lifestyle interventions are as effective in patients with higher BMIs than for those who are moderately overweight [1,2].

The purpose of the current analysis was to examine the effectiveness of a primary care/CWMO partnership scheme in patients of different BMI categories. Data were collected from participants in the slimming on referral scheme between May 2004 and November 2009, who had time to finish their full 12-week referral. This resulted in the inclusion of 38,614 patients who were referred from within 77 Primary care Trusts or NHS Trusts, for whom data on weight, height, age and gender were collected. Of these there were 2,625 cases where the data for one or

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Table 1 Patient characteristics at week 1 of the referral scheme and weight change by start BMI category

	BMI < 30 kg/m^2		BMI 30–34.9 kg/m^2		BMI 35–39.9 kg/m^2		BMI ≥ 40 kg/m^2			
	Total n=3697		Total n=11759		Total n=9902		Total n=8913			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	f-value	p-value
Height (m)	1.65	0.08	1.64	0.08	1.64	0.08	1.64	0.08	48.60	<0.001
Weight (kg)	76.8	8.0	88.0	9.6	100.8	10.9	122.3	18.6	19885.38	<0.001
Age (years)	48.1	15.0	48.1	14.8	47.2	14.6	45.8	13.4	64.43	<0.001
Weight change (kg)	−2.9	2.8	−3.6	3.2	−4.1	3.7	−4.8	4.4	346.58	<0.001
Percent weight change	−3.7	3.6	−4.0	3.6	−4.0	3.6	−3.9	3.5	7.06	<0.001
Weeks attended	8.7	3.6	8.9	3.5	8.8	3.6	8.9	3.5	0.19	0.905
Start BMI (kg/m^2)	28.2	1.4	32.5	1.4	37.3	1.4	45.4	5.2	44536.13	<0.001
End BMI (kg/m^2)	27.2	1.7	31.2	1.8	35.8	1.9	43.6	5.3	37989.02	<0.001
BMI change (kg/m^2)	−1.1	1.0	−1.3	1.2	−1.5	1.3	−1.8	1.6	387.75	<0.001
Proportion achieving 5% Weight loss	33.4%		36.6%		36.4%		35.8%		4.10	0.006
Proportion achieving 10% Weight loss	5.5%		6.1%		6.2%		5.4%		3.69	0.011

more of the 12 referral vouchers issued per participant was unclear or could not be resolved (spoiled vouchers, illegible writing etc.) and 1,718 cases where the participant completed the scheme outside of the 14 (12 plus 2) week time window, due to circumstances such as bereavement or illness. This left 34,271 in the present study. 80 participants were included in the database but there was no data for their date of birth. Age data are reported excluding these subjects. Some participants went on to self-fund further attendance following the initial 12-week referral and others were offered subsequent 12-week referral packages from their health care team. Results for the latter are reported elsewhere [9]. The data in this analysis covers the initial 12-week sessions of the referral scheme.

Data for this service evaluation was collected as part of routine data collection within the referral programme. At the point of referral patients' gender, date of birth and height were recorded by the health professional. When the patient enrolled at the weight management group (week 1 of the referral), their start weight and date were recorded. Each week the patient returned to group their weight change was recorded along with date of attendance. The same calibrated scales were used each week at a given group to record weight and weight change. The collected data were sent to the research team for input into the referral database.

This work is categorised as a service evaluation under the Ad Hoc Advisory Group on the Operation of NHS Research Ethics Committees, guidelines (2006). Existing data were anonymised and analysed as an intervention in use only to ask the question "What standard does this service achieve?"

Data were extracted from the referral database, and subjected to a number of parameter checks for outliers, and anomalous data entry. Anomalies were checked against the raw source data to resolve any issues that arose. From the raw data collected, start BMI, end BMI, BMI change, weight change and percent weight change were calculated. There was considerable variability in the number of sessions attended, ranging from 1–12 weeks. Mean attendance was 8.9 of 12 sessions.

The end weight was calculated based on the members' last attendance at group during the referral period using the Last Observation Carried Forward approach [10].

For the current analysis weight loss outcomes were analysed by the BMI categories <30 kg/m^2, 30–34.9 kg/m^2, 35–39.9 kg/m^2 and ≥40 kg/m^2. The effects of different factors on weight loss between BMI categories were assessed, by fitting linear models and examining the significance of fitted terms in these models, through regression and analysis of variance. All analysis was performed using the GENSTAT 5 statistical program (Genstat 5 Rothampstead Experimental Station, Harpenden, UK). Results are expressed as mean (SD).

Findings

The physical characteristics and weight outcomes by BMI category are given in Table 1. Eleven percent had a start BMI <30 kg/m^2, 34% between 30–34.9 kg/m^2, 29% between 35–39.9 kg/m^2 and 26% had a start BMI ≥40 kg/m^2. Weight, end BMI, BMI change and absolute weight loss all increased with increasing BMI category (all p<0.001). Absolute weight losses over the 12 week study period were 2.9, 3.6, 4.1, and 4.8 kg for the BMI categories <30 kg/m^2, 30–34.9 kg/m^2, 35–39.9 kg/m^2 and ≥40 kg/m^2, respectively. Regression analysis showed that after adjusting for age and gender, relative to the <30 kg/m^2 group, absolute weight losses were 0.8, 1.4 and 2.4 kg more for the 30–34.9 kg/m^2, 35–39.9 kg/m^2 and ≥40 kg/m^2, groups, respectively (all p<0.001). Percent weight loss was similar in each BMI category at 3.7, 4.0, 4.0 and 3.9% for BMI categories <30 kg/m^2, 30–34.9 kg/m^2, 35–39.9 kg/m^2 and ≥40 kg/m^2. Regression analysis showed that after adjusting for age and gender, relative to the <30 kg/m^2 group, percent weight losses were 0.3, 0.3 and 0.2% greater for the 30–34.9 kg/m^2, 35–39.9 kg/m^2 and ≥40 kg/m^2 groups, respectively (all p<0.001). For each BMI category those achieving 5% weight loss were 33, 37, 36 and 36%, respectively (main effect, p=0.006). Regression analysis showed that significant differences occurred between the BMI categories <30 kg/m^2 and 30–34.9 kg/m^2 (p=0.028). The percentage of those losing 10% in their first 12 sessions by BMI category were 6, 6, 6 and 5% respectively (main effect, p=0.011). Specific group differences were not significant in regression comparisons. There was no significant difference in the number of weeks attended as a function of BMI category (p=0.905).

The current analysis illustrates that percent weight loss was consistent across the BMI range and that those with BMIs ≥40 (who represented 26% of participants referred from primary care) lost a similar percentage of their initial body weight as other participants at a lower BMI. In the present service evaluation, participants followed a group support programme and dietary plan, which is structured around *ad libitum* intake of low energy dense foods, principles of energy balance and appetite regulation to reduce energy intake, with additional guidance to ensure a balanced diet [11]. The present data set suggests that participants with a BMI ≥40 can achieve higher absolute and similar percent weight losses to their counterparts at lower BMIs when following a low energy density dietary plan, *ad libitum*.

Average start BMI of the study population was in the range that would be recommended for more intensive interventions such as pharmacotherapy and for a significant percentage, bariatric surgery [12,13]. Start BMI averaged 36.8 kg/m^2 and 26% of this referral population had a BMI ≥40 kg/m^2. This suggests that lifestyle interventions can work in populations with BMIs that are normally recommended to receive secondary or tertiary care.

As this was a service evaluation, it was limited by the absence of a control group and the fact that the results were based upon those people who joined a group, rather than intention to treat. The study only observed weight changes over 12 weekly sessions and there was no longer-term follow up. Key strengths were that the referral programme evaluation assessed the effectiveness of the programme as it runs in real life, the sample size was large and conducted in members of the general public aiming to control their weight in their everyday lives.

Conclusion

Referral to a commercial organisation is as effective for people with high BMIs as for those who are less overweight and attendances were similar between BMI categories.

Abbreviations

CWMO: Commercial weight management organisation; SD: Standard Deviation; BMI: Body Mass Index; NHS: National Health Service.

Competing interests

RJS, DJB, JB, CP, AA and JL work for Slimming World. SW was supported by Slimming World for the analysis and preparation of this manuscript.

Authors' contributions

JS, DB, JB, CP and SW collated the data, JS, CP, AA and JL were involved in the design of the study, JS and SW were involved in the statistical analysis, JS, CP and DB drafted the manuscript. All authors read and approved the final manuscript.

Acknowledgement

We are grateful to GW Horgan of Biomathematics and Statistics Scotland, for conducting an independent statistical analysis of the data. We would like to thank the Slimming World on Referral team for entry of the raw data and their general support to all primary care/commercial partnerships.

Funding

The analysis of the data was funded by Slimming World.

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Received: 16 October 2012 Accepted: 22 April 2013
Published: 24 April 2013

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Cite this article as: Stubbs *et al.*: Service evaluation of weight outcomes as a function of initial BMI in 34,271 adults referred to a primary care/commercial weight management partnership scheme. *BMC Research Notes* 2013 **6**:161.

Paper 9

Jewell, K., **Avery, A**., Barber, J., Simpson, S.A. (**2014**). **The healthy eating and lifestyle in pregnancy (HELP) feasibility study**. *British Journal of Midwifery* 22(10) 625-634.

The healthy eating and lifestyle in pregnancy (HELP) feasibility study

Abstract

Obesity and excess gestational weight gain (GWG) are linked to increased complications during pregnancy, birth and postpartum.

This study aimed to explore the feasibility of group-based weight management for obese pregnant women. At booking, pregnant women with a body mass index (BMI) >30kg/m^2 were invited to weekly weight management groups, facilitated by a midwife and Slimming World consultant, providing diet and lifestyle, goal setting and general pregnancy advice. Attendance was until 6 weeks postpartum. 148 women with a mean age of 32 years (5.3 SD) and BMI of 37.4kg/m^2 (5.5 SD) attended. 85% (n=126) went to >3 and 65% (n=96) >6 sessions. The mean birth weight for 132 newborns was 3.53kg (0.49 SD) and for the 39 women losing weight, 3.59kg (0.35 SD). Of the 132 births, 48% were spontaneous vaginal delivery; 89% (115) initiated breastfeeding; 70% were still breastfeeding 28 days post-delivery.

The healthy eating and lifestyle in pregnancy (HELP) group proved to be an acceptable intervention providing women with the ability to control weight gain during pregnancy, as well as maintaining a healthy lifestyle postpartum. Although the study was underpowered and exploratory, restricting GWG did not have a negative impact on the birth weights or other birth outcomes. Indeed, more babies were born in the healthy weight range to those women who lost weight during pregnancy.

Keywords: Maternal obesity, Gestational weight gain, Weight management, feasibility, Group support

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The prevalence of obesity in pregnancy is increasing: around 1 in 5 women attending antenatal care in the UK are obese and in the current obesogenic environment, with a rise in the number of obese teenagers reaching child-bearing age, this figure is likely to fluctuate (Kanagalingam et al, 2005; Shah et al, 2006; Heselhurst et al, 2010). Pregnancy is also a significant causative factor in the development of obesity; women with high weight gain during pregnancy tend to retain more weight at 15 year follow-up (Linné et al, 2004). Thus women who have had a high gestational weight gain (GWG) are more likely to commence their next pregnancy with a higher starting body mass index (BMI).

Obesity and excess GWG have both been linked to an increased risk of complications during pregnancy and birth (Cedergren, 2004; Heslehurst et al, 2008). Complications include: gestational diabetes mellitus, pregnancy-induced hypertension, venous thromboembolism, postpartum haemorrhage and caesarean section (Sebire et al, 2001; Usha Kiran et al, 2005; Bhattacharya et al, 2007). Obesity is also known to increase the risks of shoulder dystocia, birth defects, fetal and neonatal death and stillbirth (Robinson et al, 2003; Chu et al, 2007; Rasmussen and Yaktine, 2009; Stothard et al, 2009). Some of the birth risks are directly related to the increase in large for gestational age (LGA) infant. Antenatal care costs may be 5–16 fold higher in overweight and obese women (Heselhurst et al, 2007).

Scott-Pillai et al (2013) in their retrospective study of 30 298 women giving birth in Belfast identified that for women with a BMI at booking of between 35 and 40 kg/m^2 there was a 6.0 times greater risk of developing gestational diabetes, a 1.8 increased odds ratio of requiring a caesarean section, a 2.0 times greater risk of the baby suffering shoulder dystocia and a 2.2 times greater risk of the baby being stillborn. A healthy BMI of 20-25 kg/m^2 was used as the standard for comparison.

Obesity and excess GWG are the most probable independent risk factors for the associated increase in maternity complications, but there is limited evidence available to determine what a healthy weight gain should be for the already obese woman. In Kiel et al's (2007) study of 120 251 women, outcomes for pre-eclampsia, caesarean section and LGA babies were much improved in women with a baseline BMI ≥40kg/m^2 if the they lost between 2-9lbs or even ≥10lbs. Only in the case of small for gestational age (SGA) babies was there a slightly impaired outcome with gestational weight losses greater than 10lbs. Collectively, the data showed minimal risks for all four of their outcomes, for example where the risk of LGA and SGA births lines intersect, equated to a weight gain of 10–25lbs for class 1 (BMI≥30) obese women, a gain of 0-9lbs for class 2 (BMI≥35) obese women and a loss of 0-9lbs for class 3 (BMI≥40) obese women.

Health professionals are often uncomfortable raising the issue of maternal obesity (Smith et al, 2012), referral options and evidence-based interventions to tackle obesity during pregnancy are limited (Dodd et al, 2008). UK guidelines on appropriate weight gain during pregnancy are also lacking but the American Institute of Medicine (IOM) guidance is often used with the BMI specific recommended weight gains of 7.0-11.5 kg for women who are overweight and 5.0-9.0 kg for women who are obese at the start of pregnancy (IOM, 2009). There is no separate guidance for women who commence the pregnancy morbidly obese with a BMI ≥40 kg/m²

The National Institute for Health and Care Excellence (NICE) 2010 guidance on weight management before, during and after pregnancy is clear that restrictive diets and weight-loss during pregnancy should be avoided. There is some evidence suggesting that inadequate gestational weight gain may be a risk factor for intrauterine growth restriction, preterm birth, low birth weight and perinatal mortality. However, none of these studies examine the effects in an already obese pregnant population (Carmichael and Abrams, 1997; Rasmussen and Yaktine, 2009). Similarly, none of these studies considered dietary or lifestyle habits which may have influenced the amount of gestational weight gain.

Advice from NICE and the government has suggested free or subsidised attendance at commercial weight management groups for obese (non-pregnant) patients with a growing evidence base to support this treatment option (NICE, 2006; Jolly et al, 2011)

The healthy eating and lifestyle in pregnancy (HELP) intervention was developed by a senior midwife as an intervention for obese pregnant women given the lack of NHS resources available to support women to manage their weight during the antenatal period. The intervention aimed to equip women with the knowledge, skills and confidence to control weight-gain during pregnancy, as well as maintaining a healthy lifestyle postpartum, through healthy eating and increases in physical activity. The intervention was delivered through a weekly group held at the antenatal clinic, jointly facilitated by an experienced midwife and Slimming World (SW), a commercial weight management organisation who were invited to provide the lifestyle component of the intervention by the midwife.

The main aim of the HELP study was to assess the feasibility and acceptability of referring pregnant women with a BMI ≥30kg/m² into the weekly group. The secondary objective was to determine the impact of the intervention on weight status across pregnancy and link this to obstetric and neonatal outcomes. Thus secondary outcome measures include maternal gestational weight change, postpartum maternal weight, baby birth weights, mode of birth, birth complications including postpartum haemorrhage, shoulder dystocia, LGA and SGA and method of feeding.

Methods

Design

This study is a non-randomised single arm feasibility trial, following the Medical Research Council (MRC) framework for complex interventions (Craig et al, 2008) to inform the need, design, processes and outcomes for a future definitive randomised controlled trial. The intervention and approaches are to be underpinned by NICE guidance on principles for effective interventions to support behaviour change and motivational support (NICE, 2014), which underpins SW weight management programmes.

Recruitment

Recruitment took place between May 2008 and September 2010. All pregnant women were screened by the midwife at booking (usually between 10 and 12 weeks gestation) and women with a BMI ≥30kg/m² were given an invitation to attend the weekly group support and a study information leaflet. The only inclusion criteria were that the women were over 18 years old, had a BMI ≥30kg/m² and that they understood English sufficiently to participate in the intervention groups. All midwives, who would be raising the issue of weight management at booking were provided with training. At the first visit to the intervention group, the women were screened by the study midwife for any pregnancy complications or medical factors such as pre-existing diabetes or twin pregnancy, which may effect attendance at the group. Information was given about the study and informed consent taken. An initial weight, height and BMI were recorded.

Intervention

The intervention groups were held weekly within the hospital antenatal clinic, during the early evening to promote access for women who were working or who had no childcare during the day. There was no charge for attendance at the group and all resources were free. The weekly sessions were facilitated by a midwife and SW consultant. All women attending the groups were given a new member pack including the SW pregnancy and breastfeeding leaflet, which details the current recommendations for healthy eating and food safety during pregnancy plus advice on extra energy and nutrient needs during breastfeeding, and a Body Magic leaflet (which promotes increases in individuals physical activity levels). Women were encouraged to follow SW's Food

Optimising healthy eating plan with regular healthy meals and snacks. This plan is based on current healthy eating guidelines with guidance by experienced dietitians; it encourages a varied and balanced diet with particular attention to calcium- and fibre-rich foods. It helps limit the intake of sugary and fatty foods and provides a healthy balance of all major food groups without the need for a severe calorie restriction or avoidance of key food groups or nutrients.

The weekly group sessions were led by a midwife whose remit was to discuss all specific pregnancy-related issues and a SW consultant facilitating healthy eating and lifestyle behaviour change. Sessions were structured to allow all components of the intervention to be delivered: social support, motivation, self-monitoring, goal setting, supporting self-efficacy and midwifery support. The format of group sessions included:

- Weighing (using Seca Ltd scales, Birmingham, England); however, women could opt out of the weekly weigh-ins. There was an opportunity for informal social support at this time. The emphasis was to maintain weight in pregnancy but if weight reduction was observed, a detailed monitoring of dietary intake was taken and referral to an obstetrician sought if there were concerns.
- One-to-one confidential midwifery advice
- Healthy eating/lifestyle change and behaviour advice
- Goal setting and motivational goals
- A discussion topic: examples included breastfeeding, meals on the go, eating out, labour, these were dependant on needs of the group.

If women did not attend the group, the SW consultant contacted them (via telephone message) to encourage continued attendance. This is normal SW practice in standard groups. Women were able to attend the group sessions immediately following acceptance of the invitation and for up to 6 weeks post-delivery. They were then encouraged to join a community-based SW group at a locality of their choice but at this point were required to pay the weekly group fee.

Outcomes and follow up

Women were followed up until 6 weeks postpartum. Data on session attendance and weights during pregnancy were collected on a weekly basis. Weight and height data recorded at booking were taken as baseline values. The weight data was verified using the Slimming World record cards to ensure accuracy and collect any missing data.

The woman's date of birth, parity, antenatal and labour complications, mode of birth, gestation at delivery, birth weights and feeding method were obtained from the maternity computer system. Data were analysed descriptively and mean values are presented with standard deviations in brackets unless otherwise stated.

Study participants were invited to a small focus group following the feasibility study to inform the main study design. The group was facilitated by SS and KJ and was semi-structured and covered the topics; recruitment, motivation to attend, group content, barriers to attending and general practicalities. This group was audio recorded and later transcribed and analysed using a thematic analytic approach.

Ethical approval

Ethical approval was granted by Cardiff and Vale NHS Trust research department.

Results

Recruitment

There were 148 women recruited to the study (*Figure 1*); the feasibility study did not collect data on numbers who declined.

The mean pregnancy length at initial group attendance was 12 weeks (2.5) but with a range of 7 to 26 weeks. The mean age of group attendants was 32 years (5.3 SD; range 19-48). Parity mean value was 0.8 (1.0) indicating that most women were on their first pregnancy. A BMI at booking was available for 95 women with a mean value of 37.4kg/m² (5.5 SD; range 30-58.7).

Figure 1. Showing attendance at different monitoring points

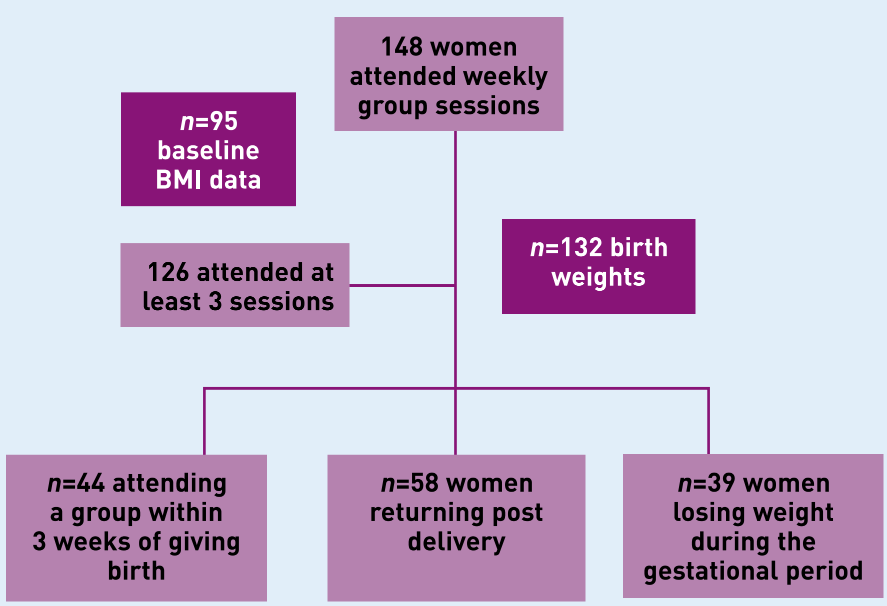


Figure 2. Total group attendances, including pre- and post-delivery

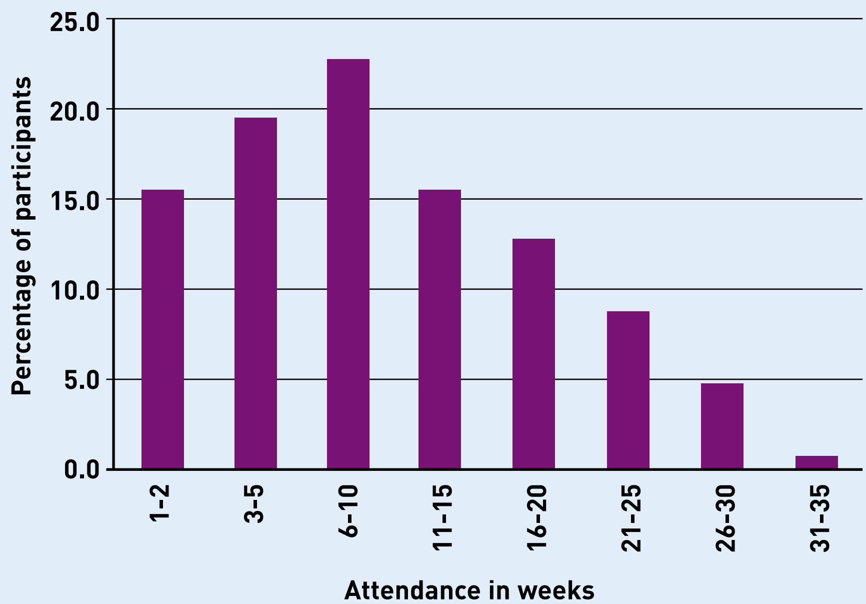


Figure 3. Weight change at last pre-delivery group attendance

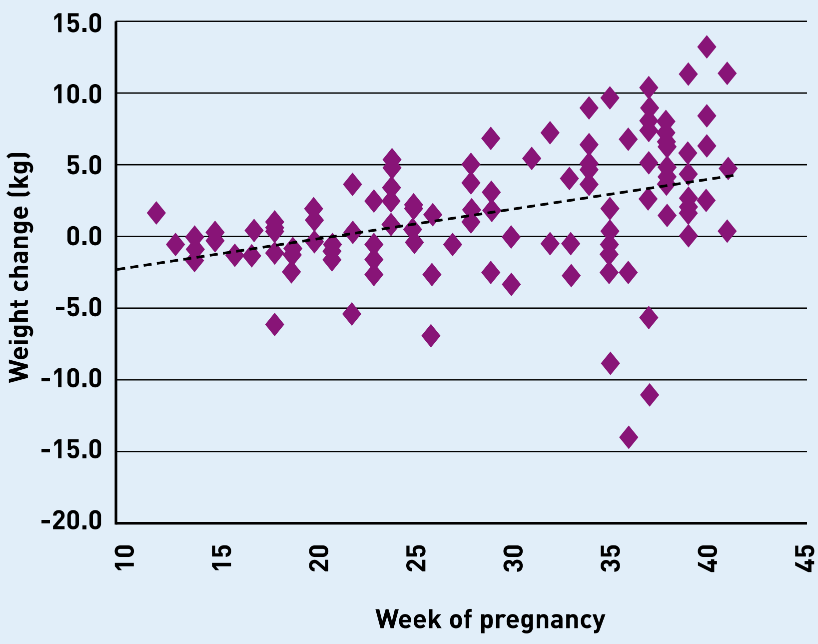


Table 1. Weight change for those women who returned after giving birth (*n*=58)

	Mean weight change (SD)	Maximum weight change	Minimum weight change
Weight change before giving birth	+7.2 lb. (1.5) +3.3 kg (0.7)	+29 lb +13.2 kg	-24.5 lb -11.1 kg
Total weight change since joining group	-12.4 lb. (1.5) -5.6 kg (0.7)	+16 lb +7.3 kg	-37.5 lb -17 kg

Attendance

The mean attendance at the group was 10 weeks (7.7 SD; range 2-35). Of a possible 33-35 sessions, 85% of the pregnant women (*n*=126) attended at least 3 group sessions and 65% (n=96) at least 6 group sessions (*Figure 2*). Of the 126 women who attended at least 3 group sessions there was a reduced attendance 3 weeks before giving birth but with re-engagement with the group sessions after delivery. Parity did not appear to influence attendance.

Maternal weight change

For the 44 women who attended the group within 3 weeks before delivery, a mean gestational weight gain of 4.3kg (0.7 SD) was recorded. For the whole study sample, *figure 3* shows the overall weight change recorded at the last pre-delivery attendance, showing the full range (-14.1 to +13.2kg). Of the sample population, 24 women gained weight within the IOM guidelines, 96 gained less than or lost weight and 7 gained more than the IOM guidelines during the gestational period. For the 39 participants who lost weight, the mean weight loss was 2.5kg (2.9 SD).

For those 58 women who returned to the group after having had their baby, the mean weight gain during pregnancy was 3.2kg with a maximum weight gain of 13.2kg recorded.

Table 1 outlines the data for the weight change post-delivery for the 58 women who returned to the group after giving birth showing a mean weight -loss since booking in pregnancy of 5.6kg (0.7 SD) and range of -17 to +7.3kg.

Mode of birth

The mean length of gestation was 39.7 weeks (2.0 SD). Of 132 births where mode of birth was recorded, 48% were spontaneous vaginal births, 5% ventouse, 9% forceps, 18% elective caesarean section and 19% emergency caesarean section. Postpartum haemorrhage was recorded for 48 women with a mean blood loss of 958 ml.

Birth weights

Birth weights were available for 132 of the births with the mean birth weight of 3.53kg (0.49 SD). One baby was born prematurely at 33.7 weeks. There were 16 cases of macrosomia with birth weights >4000g. *Figure 4* illustrates the range of birth weights in the total study sample. For those women who lost weight during pregnancy (*n*=39), the mean birth weight for their babies was 3.59kg (0.35 SD). No babies in this study sample were born with a weight below 2500g, but two were born with a below 3000g. Five of these babies had a birth weight >4000g. *Figure 5* illustrates the birth weights of those babies born to women who lost weight during pregnancy.

Baby feeding method

Of those who attended the HELP group, 89% of women (n=115) chose to breastfeed following birth. At 28 days post-birth 70% were still breastfeeding.

Adverse events

Of the 128 infants for whom Apgar scores were available, the mean score was 8.4(9.5). Only two infants had a score below four at 1 minute and no infants had a score of five or less at 5 minutes.

There were no cases of shoulder dystocia in any of the deliveries. One baby was stillborn. The woman chose to return to the group immediately after giving birth for support and subsequently achieved a healthier BMI before conceiving again.

Focus group analysis

Two study participants attended a small focus group, numbers limited by the fluidity of the study sample/timing The main themes discussed are described below.

Recruitment

Participant 1 stated that the initial approach regarding joining the group was 'uncomfortable'. She was told by an obstetrician:

> ***'your BMI is off the scale and you will be attending this group'***

but was later told not to attend as she should not be dieting in pregnancy. Participant 2 had already lost weight prior to pregnancy and had heard about the study from a midwife, but when she went to the hospital no information was given. Later at home she noticed a letter inviting her had been put inside the notes,

> ***'it was as if they were embarrassed to mention it.'***

When asked about the terminology that was used when they were approached, they both were uncomfortable with the terms 'obese' or 'morbidly obese'. Participant 1 suggested:

> ***'don't use obese or morbidly obese, use BMI and a visual chart is good because you can see where you are'.***

Motivation to attend the group

Participant 1 indicated her concerns about keeping her baby healthy and to be healthy

Figure 4. Baby birth weights for 134 deliveries with available birth weight data

mean birth weight 3.53kg

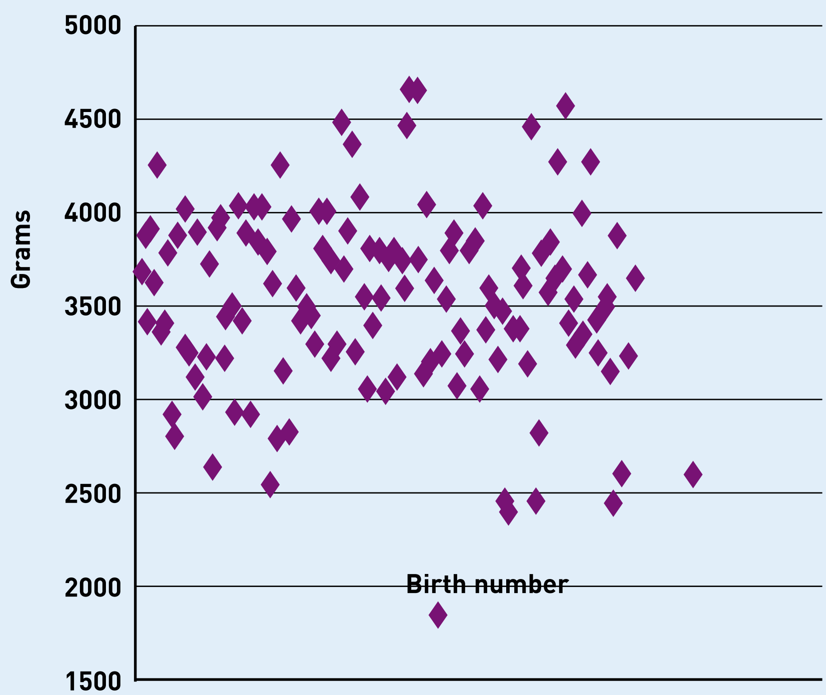
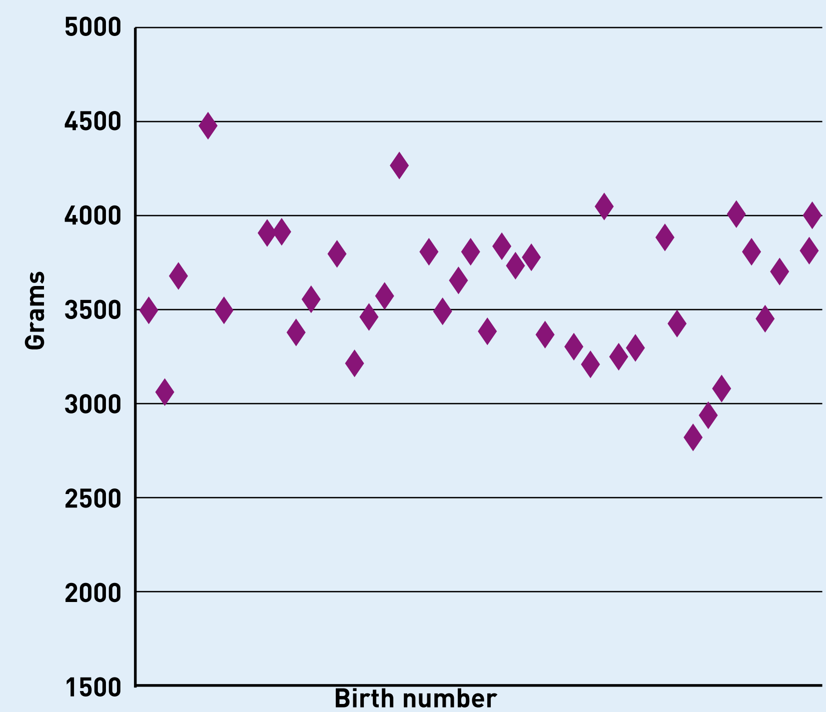


Figure 5. Baby weights for women who lost weight during pregnancy (n=39)

mean baby weight 3.59kg



herself for the future:

'I wanted to keep myself and my baby healthy...also to change things in the future on my next baby, little things like some in the group talking about water births and things that you can't have unless you are below a certain BMI.'

Participant 2 indicated that she wanted things to be different this time compared to previous pregnancies.

'I didn't want to put on as much as last time and get diabetes again.'

Group content

When asked what they saw as the purpose of the groups, participant 1 stated:

'it was never about weight loss it was all about how you felt and your weight journey.'

Participant 2 stated:

'weight loss aside it was actually being in a room with people in similar situations in terms of weight and pregnancy.'

The women were asked if having both a SW consultant and midwife was important. Participant 2 stated:

'you need both absolutely...together it married so you felt that it's like somebody was almost looking after you and somebody was looking after your baby.'

The subject of continuous recruitment to groups was also discussed, women were at different stages, the women were asked whether this had an impact. Participant 1 stated:

'I never found that an issue, no, because I mean it was interesting to see the people at the end of their pregnancies having their babies and seeing the results and thinking ooh I could be like them.'

Barriers to attending the group

The issue of barriers to attendance was discussed as sessions had been held within the hospital in the evening, participant 1 stated:

'I think that sometimes people drop out, its not possibly the pregnancy thing it's more about...what's happening in their life...well I think you've got more chance if somebody coming home on their way home from work popping in than not at all.'

Participant 2 stated:

'It's because you're so tired as well that's the difficulty and because you were working. In winter when you know it's dark at 4 o'clock I know for a fact that I hated coming here in the dark.'

Group practicalities

One participant liked the fact it was in the hospital as a venue. She said,

'I think it also homes it in that it's related to the fact that you are pregnant as well being in the hospital and it brings it all together doesn't it, and also there is that care from the midwife.'

The subject of attending postnatally was discussed, participant 1 stated:

'Oh yes M was born on the Wednesday if I could've come down to the group on the Thursday after I would've been there.'

The women were also asked what they felt was the optimum size of the group, participant 1 thought that the group should have a minimum of four or five, and participant 2, six.

Discussion

It is widely acknowledged that having a higher BMI at the start of a pregnancy and excessive weight gain during pregnancy will increase the health risks to both the woman and infant (Bhattacharya et al, 2007: Siega-Riz et al, 2009; Centre for Maternal and Child Enquires and the Royal College of Obstetricians and Gynaecologists, 2010). However, it is unclear what constitutes a healthy gestational weight gain. NICE (2010) do not recommend BMI-specific weight changes during pregnancy.

In 2007, Kiel et al convincingly demonstrated the benefits of restricting GWG in obese women. More recently, in their meta-analysis of evidence from 44 randomised controlled trails, including 7278 women, Thangaratinam et al (2012) concluded that dietary and lifestyle interventions can both reduce maternal weight gain and improve outcomes for both woman and baby. However, the overall evidence rating was low to very low for important outcomes, such as pre-eclampsia, gestational diabetes, gestational hypertension and preterm delivery.

The LIMIT study (Dodd et al, 2014), where healthy eating and exercise advice was offered to pregnant women who are overweight or obese showed a significant reduction in the number of babies born over 4kg in weight. While the relatively intensive advice and assistance to adopt a healthy diet and regular exercise during pregnancy led to an 18% reduction in the chance of a baby being born over 4kg, there was no significant difference in the maternal weight change between the intervention and control groups. Also, the antenatal lifestyle advice used in the LIMIT study did not reduce the risk of having a baby who weighs above the 90th centile for gestational age and sex or improve other maternal pregnancy and birth outcomes measured.

Regardless of the limited guidance and evidence of best practice, given the prevalence of obesity among women of child-bearing age, there is a need for scalable interventions which support obese pregnant women to prevent excessive GWG and encourage healthy lifestyles and postpartum weight loss.

This study examined feasibility, acceptability, recruitment and retention as well as other key outcomes. Recruitment was slow initially with members of the maternal health care team finding it difficult to raise the issue of obesity during pregnancy and to discuss the associated increased health risks. In some cases, it took time for the team members to recognise the benefits of referring to the HELP group. An experienced midwife-led the pathway and passionately encouraged referral into the group and after the first 6 months the referrals gathered momentum. When the group closed there was general widespread disappointment with few other options available locally to provide the same level of support.

It is suggested that the women who were supported by the group felt very positive about the experience, 'I felt I had no choices when they told me I was too big, but coming to group and keeping control of my weight has given me my confidence back' and 'last time I put on 4 stone and had diabetes, this time I am in control'. It is likely that not only the dietary and lifestyle changes contributed to the outcomes observed but also the social support which a group, well facilitated, provides.

The study was not powered to detect an effect on weight or other secondary outcomes. However, in this small feasibility study of 148 women, with an average start BMI at booking of 37.4kg/m², 39 women did lose some weight during pregnancy. This did not appear to increase the likelihood of them having a SGA baby; indeed it may have reduced the risk, given no babies were born to this group of women with a birth weight below 2500g. They also appeared to be less likely to have a LGA or macrosomic baby weighing greater than 4000g.

For those women attending the group within 3 weeks of giving birth, the mean GWG of 4.3kg was just slightly less than the 5.0-9.0kg recommended by the IOM for obese women. For those women who returned to the group after having their baby (mean 1.8 SD 0.31 weeks post partum), the mean GWG was 3.3kg with a maximum GWG of 13.2kg recorded. In these small sub groups there does not seem to have been any adverse effects to either the woman or the baby through what may be described as an 'inadequate' weight gain.

For this feasibility study no data were collected about actual dietary changes made as a result of the intervention. However, as per the SW pregnancy policy, any woman losing above a certain amount of weight at any time point during the pregnancy is required to complete a food diary. Thus there is some anecdotal information available with many of the women changing their previous high-fat, energy-dense, nutrient-poor eating habits for less energy-dense but plentiful amounts of nutrient-rich food choices.

The intervention aimed to help the pregnant women believe that they possessed the necessary skills to change their eating and activity behaviours and that their actions would help to improve both their health and that of their unborn child. This was to be achieved through information sharing, supporting self-efficacy, modelling of behaviours and social support. In the non-pregnant population social support is associated with improved weight loss as well as increases in people completing treatment and maintaining weight loss (Wing and Jeffery, 1999; Elfhag and Rossner, 2005). The social support was perceived as particularly valuable by the woman who had the stillborn baby who returned to the group for both the support and also to prepare for her next pregnancy.

It is hypothesised that the social support may have been one explanation for the particularly

Key points

- Obesity and excess gestational weight gain are both linked to an increased risk of complications during pregnancy and birth
- High gestational weight gains contribute to the development of postnatal obesity and long-term weight retention
- Scalable referral options and evidence-based interventions to tackle obesity during pregnancy are limited
- Ante natal group weight management interventions may also improve breastfeeding rates
- Collaborative working between a NHS midwife and a commercial slimming organisation received positive comments a very small focus group of women participating in the intervention
- Fewer small and large for gestational age infants were born to the women losing weight (mean 2.5kg) during pregnancy although weight loss was not encouraged

successful breastfeeding rates, both at birth and 28 days post-delivery, in those women attending the HELP group. At the time when the data were collected, the breastfeeding rates were 52% at birth and 44% at the 5-6 day screening data compared to the respective figures of 89% and 70% for the HELP study group—with the latter figure of 70% being recorded 28 days post-delivery. Besides the social support, the increased self-confidence may also have contributed to these high rates of breastfeeding, as may the improvements in BMI since obese women may find it more difficult to breastfeed (Anstey and Jevitt, 2011). SW's pregnancy literature does encourage breastfeeding and there is additional dietary advice included to support successful breastfeeding and to ensure that the additional nutritional demands are met. Improving breastfeeding rates continues to be high on the public health agenda, to ensure that each child gets the best start in life (Department of Health, 2010) and breastfeeding for longer may also reduce the subsequent risk of childhood obesity (Armstrong and Reilly, 2002; Harder et al, 2005; Lefebvre and John, 2014).

The HELP pilot study group ran every week for over 2 years with two midwives and two SW consultants were involved to ensure holiday cover and continuity. Across the UK there are over 4000 trained SW consultants and 11000 community groups running each week, so there is a very sound infrastructure and robust supporting resources were this intervention to be proven effective in a large trial and subsequently rolled out. Hence it would be relatively easy to replicate the HELP group either in a hospital or community setting with midwife support. Women, when they were no longer able to access the hospital group, were able to go to a local community group.

Limitations

The study has a number of limitations, including the small sample size, the limited outcome and process measures, the small focus group sample size as well as the lack of a control group. These will be addressed in a follow-up randomised controlled trial.

Conclusion

The results of this feasibility study appear quite promising. Referring pregnant women with a BMI above 30kg/m^2 at the booking clinic into the HELP pilot group was found to be feasible and acceptable although the referrals were slow at the start. Women were positive about the group attendance. After attendance at the group, women who both were followed up within 3 weeks of giving birth and those who attended post-delivery recorded mean weight gains below that recommended by the IOM. Thirty-nine women lost weight during the gestational period but the mean baby birth weight was no different than for those women not losing weight. Indeed the extremes of birth weight were reduced in those women losing weight with fewer small and large for gestational age in this small group of women. Further research is required to determine whether either minimal gestational weight gain or weight loss in the clinically obese woman is desirable providing the restricted weight change is achieved through healthy dietary changes and increase in physical activity levels.

A number of women were lighter post-delivery than when joining the group and besides the usual health benefits this will have the added value of allowing them to start their next pregnancy with a healthier BMI providing lifestyle changes are maintained. The other significant finding from this feasibility study is that the antenatal group support appeared to have an impact on breastfeeding rates with more women attending the group going on to breastfeed their infants. If this is due to the intervention, this is an important finding given the many health benefits associated with breastfeeding.

Given that one in five women are now starting their pregnancy with a BMI in the obese category there is a need for effective, scalable interventions. Further research is needed to develop interventions which limit GWG and encourage post-partum weight loss and test these in rigorously designed randomised controlled trials. Some of the findings from this feasibility study were used to inform the development of a large randomised multicentred trial which recruited (ISRCTN25260464) across twenty UK hospital sites. BJM

HELP study acknowledgements: *Funding was obtained from a Cardiff and Vale NHS research grant and Slimming World provided the SW literature and Consultant expenses.*

Conflicts of interest: *AA receives a salary form SW for dietetic consultancy work and for contribution to the research portfolio.*

Acknowledgements: *Liam Morris at SW for statistical support*

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Paper 10

John, E., Cassidy, D. M. Playle, R. Jewell, K., Cohen, D., Duncan, D., Newcombe, R.G., Busse, M., Owen-jones, E. Williams, N. Longo, M. **Avery, A**., Simpson, S. A. (2014) **Healthy eating and lifestyle in pregnancy (HELP): a protocol for a cluster randomised trial to evaluate the effectiveness of a weight management intervention in pregnancy.** *BMC Public Health* 14:439.

John et al. BMC Public Health 2014, **14**:439
http://www.biomedcentral.com/1471-2458/14/439

BMC Public Health

STUDY PROTOCOL **Open Access**

Healthy eating and lifestyle in pregnancy (HELP): a protocol for a cluster randomised trial to evaluate the effectiveness of a weight management intervention in pregnancy

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Abstract

Background: Approximately 1 in 5 pregnant women in the United Kingdom are obese. In addition to being associated generally with poor health, obesity is known to be a contributing factor to pregnancy and birth complications and the retention of gestational weight can lead to long term obesity.
This paper describes the protocol for a cluster randomised trial to evaluate whether a weight management intervention for obese pregnant women is effective in reducing women's Body Mass Index at 12 months following birth.

Methods/design: The study is a cluster randomised controlled trial involving 20 maternity units across England and Wales. The units will be randomised, 10 to the intervention group and 10 to the control group. 570 pregnant women aged 18 years or over, with a Body Mass Index of +/=30 (kg/m^2) and between 12 and 20 weeks gestation will be recruited. Women allocated to the control group will receive usual care and two leaflets giving advice on diet and physical activity. In addition to their usual care and the leaflets, women allocated to the intervention group will be offered to attend a weekly 1.5 hour weight management group, which combines expertise from Slimming World with clinical advice and supervision from National Health Service midwives, until 6 weeks postpartum. Participants will be followed up at 36 weeks gestation and at 6 weeks, 6 months and 12 months postpartum. Body Mass Index at 12 months postpartum is the primary outcome. Secondary outcomes include pregnancy weight gain, quality of life, mental health, waist-hip ratio, child weight centile, admission to neonatal unit, diet, physical activity levels, pregnancy and birth complications, social support, self-regulation and self-efficacy. A cost effectiveness analysis and process evaluation will also be conducted.

Discussion: This study will evaluate the effectiveness of a theory-based intervention developed for obese pregnant women. If successful the intervention will equip women with the necessary knowledge and skills to enable them to make healthier choices for themselves and their unborn child.

Trial registration: Current Controlled Trials: ISRCTN25260464
Date of registration: 16th April 2010.

Keywords: Study protocol, Pregnancy, Obesity, Complex intervention, Randomised controlled trial, Diet, Physical activity

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Background

Obesity: the problem

The Foresight Report (2007) estimates by 2050, 50% of women could be obese and National Health Service (NHS) costs associated with obesity could be £10 billion per annum [1]. Approximately 1 in 5 women attending antenatal care in the United Kingdom (UK) are obese [2,3] and this figure is likely to increase. In Europe and the United States of America (US) between 20 and 40% of women gain more weight during pregnancy than is routinely advised [4]. Pregnancy is a significant factor in the development of obesity in women. Many women retain cumulative weight gained over several pregnancies and women with high weight gain during pregnancy retain more weight at follow-up [5-7]. Excess maternal weight gain during pregnancy is also associated with child obesity at 3 years and in adolescence [8,9]. This suggests there is potential for influencing the mother's lifestyle and weight as well as the child's weight.

Obesity has been linked to an increased risk of complications during pregnancy and birth including pregnancy-induced hypertension [2,10], gestational diabetes mellitus [2,11], increased emergency and elective caesarean section rates [2,10], increased induction of labour rates [2,11], venous thromboembolism [12] and increased postpartum haemorrhage [2,13]. There are also increased risks for the child including pre-term birth [2,11], shoulder dystocia [14], admission to a neonatal unit [2,13], birth defects (e.g. spina bifida, omphalocele) [14], still birth [2,13], macrosomia [2,15], fetal and neo-natal death and poor Apgar scores [16]. Consequently, the NHS costs are significantly higher in overweight and obese pregnant women compared to women in the normal weight range. Antenatal care costs may be 5–16 times higher in overweight and obese women [2,17].

Obesity interventions

Clinicians are often uncomfortable dealing with their patients' obesity [18,19], referral options are limited and few evidence based interventions to tackle obesity during pregnancy exist. In addition, although the Institute of Medicine (IOM) in the US has produced guidance on appropriate pregnancy weight gain for obese or overweight women this remains somewhat controversial as research evidence is limited and the guidance is based on observational data [20,21]. UK guidance is also lacking [22].

In the wider population there is evidence that lifestyle or behavioural interventions including modifications of diet and/or physical activity can help with weight loss even in the longer term [23-27]. However, interventions often have limited effectiveness, are costly and weight regain is common [23,27,28]. In the UK, the National Institute for Health and Care Excellence (NICE) has suggested that commercial weight management groups are a treatment option for obese patients [29]. Trials of commercial weight management groups have shown these approaches to be effective in the short term [30,31]. However, evidence for longer term effectiveness is lacking.

With regard to pregnant obese or overweight women, a recent large randomised controlled trial (RCT) found no impact of a lifestyle intervention on gestational weight gain (GWG) or on the proportion of women whose weight gain was below or within IOM guidance [32]. The intervention did not reduce the risk of large for gestational age infants nor did it improve maternal outcomes. However, the intervention was associated with a reduction in the risk of birth weight above 4000 g. A recent high quality meta-analysis of RCTs of interventions of diet and physical activity, alone or in combination, which included studies where women were obese, overweight and normal weight, found an overall 1.42 kg difference between intervention and control participants in GWG (in favour of the intervention group) [33]. For diet alone the difference was 3.84 kg. For interventions targeting obese or overweight women only the reduction in GWG was 2.1 kg. This review also found that reductions in pregnancy weight gain were not associated with an increased rate of small for gestational age babies. Interventions were associated with a lower risk of pre-eclampsia and shoulder dystocia and there was a trend towards a reduction in gestational diabetes, gestational hypertension and pre-term birth. However, the quality of the evidence was low for clinical outcomes as there was evidence of significant heterogeneity in the effect size, study level biases including issues with randomisation, incomplete outcome data, blinding, as well as risk of publication bias [33]. Other systematic reviews and meta-analyses have also found lower GWG from diet and physical activity interventions, but included studies often had methodological limitations including high loss to follow-up, small sample sizes and problems with blinding [34-38]. A Cochrane review of interventions to prevent excessive weight gain during pregnancy concluded that due to small effect sizes and methodological limitations of studies no intervention could be recommended for limiting excessive GWG [39].

With regards to postpartum weight loss, a recent systematic review including 12 trials indicated that a combination of diet and exercise or diet alone can help women lose weight in the postpartum period [40]. In addition, women in intervention groups were more likely to achieve a healthy weight. The authors did not find a difference between the amount of weight lost between the diet alone or diet and physical activity together. They caution that weight loss was moderate and that there were a number of methodological shortcomings in some trials. They also noted that there was much variation in the type, intensity and duration of interventions. Another systematic review also found that diet and supervised physical activity based interventions could lead to greater postpartum weight loss of 1.5 kg in the intervention compared to control group [41].

Diet and physical activity changes are key to weight loss but trials usually include other behavioural components as part of the intervention. The NICE guidance on obesity [29] and the new draft guidance on behaviour change [42,43] recommend self-monitoring and feedback, goal setting, planning and social support. Self-monitoring is important for successful behaviour change for weight loss [44]. In a meta-analysis of behaviour change interventions of physical activity and healthy eating, more effective interventions were shown to combine self-monitoring with at least one other technique derived from Control Theory (e.g. intention formation, specific goal setting) [45]. Social support is associated with improved weight loss as well as an increase in people completing treatment and maintaining weight loss [46,47]. Social support may offer benefits such as encouragement, feedback, and role modelling or peer pressure for healthy behaviours.

With regards to interventions to limit GWG, a recent meta-analysis identified that behavioural intervention components including providing information, motivational approaches, self-monitoring and rewards contingent on success were important, and using these alongside dietary interventions could be more effective [48]. Authors of this review suggest that further research is needed to identify the most effective behavioural components for limiting GWG. Another systematic review exploring lifestyle interventions which utilised goal setting approaches found that successful interventions included personalised goal setting for diet and physical activity, self-monitoring and feedback [49]. However, the authors highlighted a lack of theory in the design and evaluation and methodological problems with many studies including issues around blinding, high drop out and lack of information on intervention fidelity. Finally, a meta-analysis examining characteristics of successful interventions to reduce GWG found that diet and physical activity interventions were effective in limiting GWG. However, the authors identified that developing an understanding of the processes that lead to behaviour change and determining key behaviour change techniques is difficult because of poor reporting of the content of interventions, alongside lack of measurement of psychological determinants or behavioural outcomes. They suggest that better description of theory and the behavioural components of interventions, as well as assessing behavioural outcomes and theorised mechanisms of the effect of interventions is required [50].

The intervention being tested in this trial is a complex intervention which includes many of the effective components described above [51]. The proposed intervention is based on Social Cognitive Theory [52] and Control Theory [53] and includes techniques associated with these theories that have shown to be efficacious in changing weight related behaviours in systematic reviews and meta-analyses [26,44,45,54,55]. These include boosting self-efficacy, goal setting, modelling, encouragement, feedback and self-monitoring. Other elements of effective behaviour change such as action planning, problem solving, tailoring and social support are also central to the intervention.

Rationale

Pregnancy is a time of change in women's lives and is a potentially important point at which to influence women's health behaviours as well as those of other family members [56]. Weight loss interventions with one individual can have spin-off effects on other family members [57]. Therefore, intervening with pregnant women and equipping them with the skills, knowledge and support necessary to manage their weight effectively, both during their pregnancy as well as after (thereby preventing excessive weight gain during pregnancy and retention of weight), is an important step in tackling obesity in this group.

An effective intervention would decrease obesity-related health risks for the women, reduce the risk of complications for mother and baby during childbirth and reduce health service costs. This could have a long term impact on not only the mother, but the child and other family members, resulting in far reaching public health benefits [56,57]. Although trials targeting GWG or weight loss postpartum by using advice on diet and/or physical activity have had some success [58,59], many studies have methodological problems including issues with randomisation and blinding, poor retention, incomplete follow-up data, small sample sizes, issues relating to intervention fidelity, poor description of the intervention and lack of a theoretical basis [58,60]. As such, more evidence is required. This trial seeks to address some of these methodological shortcomings, in that: it is adequately powered; it is theory-based; moderators of intervention effect are being measured; there are a number of different strategies in place to retain participants; there is a detailed process evaluation assessing issues like fidelity; and, there is a cost effectiveness analysis. As far as we are aware no RCTs of pregnancy or postpartum interventions have included an assessment of cost effectiveness. This trial will test a theory-based intervention targeting longer term postpartum weight control as well as weight gain during pregnancy.

Aim of the study

The primary aim is to assess whether a weight management intervention for obese pregnant women is effective in reducing the women's Body Mass Index (BMI) 12 months after giving birth.

Secondary aims include:

- to examine whether the intervention leads to lower weight gain during pregnancy;
- to assess whether the intervention leads to fewer complications during pregnancy, at birth and postnatally;
- to examine the impact of the intervention on diet, physical activity levels, health related quality of life, mental health, self-efficacy, social support and breast feeding;
- to examine the child's weight gain;
- to examine mediators and moderators of change;
- to conduct a cost effectiveness analysis;
- to conduct a process evaluation to examine participant views, drop out, fidelity, duration of participation in the intervention and associated factors.

Methods/design

Ethical approval

The study will be conducted in accordance with the recommendations for physicians involved in research on human participants adopted by the 18th World Medical Assembly, Helsinki 1964 and later revisions. The study has been approved by the Research Ethics Committee for Wales (Reference number 09/MRE09/58).

Design

The study is a cluster randomised controlled trial; the maternity units, rather than individual participants, are the units of randomisation. This is to minimise risk of contamination of control participants through two potential mechanisms. Firstly, the use of aspects of the intervention with control participants by site midwives who have been trained in study procedures and secondly, the passage of information regarding the intervention between intervention and control participants who are acquainted and attend the same maternity unit.

In addition to receiving usual NHS care, all study participants will be provided with 2 study leaflets: 1) a Food Standards Association eating during pregnancy leaflet detailing foods which should be avoided during pregnancy and 2) an exercise during pregnancy leaflet detailing recommended physical activity during pregnancy and warning signs for when to stop exercise and seek medical attention. Participants attending intervention sites will also receive the HELP Study intervention which is described below. Participants attending control sites will only receive usual care and the leaflets.

Study intervention

A logic model (shown in Figure 1) describing the theory of the intervention was developed. This illustrates the key inputs, outputs/behaviours and outcomes of the intervention. Participants attending intervention sites will have the opportunity to attend free, weekly, 1.5 hour weight management group sessions from the point of recruitment (between 12 and 20 weeks gestation) up until 6 weeks postpartum. At this time point they will receive one voucher for a free Slimming World session at a 'normal' community group. They will also receive two intervention phone calls from the Intervention Midwife at 3 and 6 months postpartum in order to provide longer term support and encouragement. Long term intervention contact helps sustain weight loss [61] and telephone support can be effective in weight loss interventions [62]. Assuming normal gestation of between 37 and 42 weeks and depending on when women were recruited, the intervention period will be up to 56 weeks in total.

The intervention sessions will be held in NHS Antenatal Clinics and will be run jointly by an NHS midwife and a Slimming World consultant. There are four main components of the intervention group sessions: 1) healthy eating, 2) physical activity, 3) midwifery advice and 4) behavioural component.

1) The healthy eating component

Slimming World, a major UK based commercial slimming organisation has developed a flexible weight management and healthy eating programme called "Extra Easy", which follows current UK government recommendations for a healthy diet including the "Eat Well Plate". The diet consists of a combination of different food types: approximately 80% combined from fruit, vegetables, carbohydrates and protein; a smaller section for milk and dairy; and an allowance for foods high in fat or sugar. Other than limiting the intake of high fat or high sugar foods, it is not a 'restrictive' diet. Pregnant women are offered advice to encourage them to eat additional healthy extras to ensure they have adequate calcium and fibre intake. The programme utilises a "food optimising system" to encourage adherence to the healthy eating plan by considering and modifying energy density and satiety, complemented by flexibility of food options.

2) The physical activity component

An individualised physical activity programme for obese pregnant women was developed, based on The Royal College of Obstetricians and Gynaecologists guidelines for exercise in pregnancy [63]. Due to its flexibility, ease and cost effectiveness, walking is the primary focus of the programme. Women will be provided

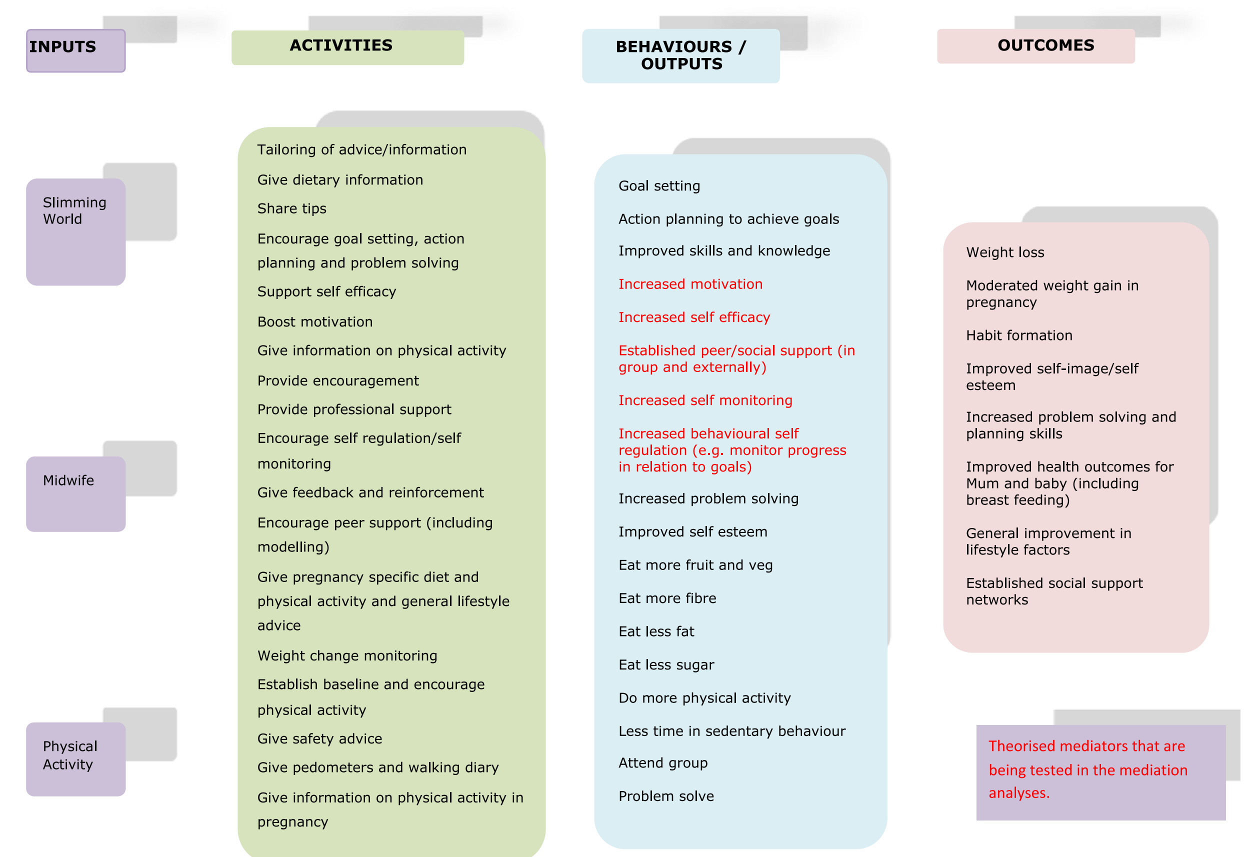

Figure 1 HELP Intervention Logic Model mapping the theory of the intervention.

with a pedometer and walking diary in order to record daily step counts for up to seven consecutive days at various time points (baseline, 36 weeks gestation, 6 weeks postpartum, 6 months postpartum and 12 months postpartum). Women's physical activity tends to decline as pregnancy progresses and therefore the use of pedometers is intended to act both as a motivational tool to encourage physical activity but also as a device to facilitate self-monitoring of physical activity [64]. Step count targets will be individually agreed as part of the walking intervention based on the following four study recommendations and taking into consideration government recommendations of 30 minutes of physical activity five days a week which equates to 10000 steps per day [65]. All women will be encouraged to increase their step counts gradually and as they feel able, as follows:

1 If previously sedentary, women will be advised to aim to walk for 15 minutes, three times per week, gradually increasing to 30 minutes, five times per week.
2 If previously moderately physically active, a maintenance activity plan will be negotiated based on current step counts.
3 If current step counts are greater than 10000 per day, women will be advised to continue as able within limits of comfort but not to start new modalities of physical activity.
4 Following birth, women will be encouraged to restart walking by gradually increasing daily step counts as soon as they feel able. If delivery was complicated, consultation with the women's general practitioner (GP) or midwife will be advised prior to restarting the walking programme.

Women who are unable to complete the walking programme will be encouraged to undertake alternative recommended physical activity including swimming, aquanatal and prenatal exercise classes, as appropriate.

In order to prevent over-exertion, women will be advised to only partake in moderate physical activity and they will be asked to utilise the Borg Scale of Perceived Exertion [66] each time they do any physical activity to monitor levels of exertion. The Borg scale runs from 6 (no exertion) to 20 (maximum exertion), women will be asked to engage in activity that is 'somewhat hard' (around 12-14 on the scale). Information regarding warning signs to terminate exercise and when medical advice should be sought will be provided. However, for the majority of women, exercise is safe for both mother and foetus throughout pregnancy and initiating moderate exercise or continuing exercise is recommended in most pregnancies [63].

3) The Midwife component

In addition to the usual NHS midwifery care, the Intervention Midwife will be available to provide advice regarding pregnancy and lifestyle, as well as provide additional support in topics that women may be anxious about like labour choices and breast feeding. Evidence indicates that obese women are less likely than their non-obese counterparts to breast feed [67] and breast feeding is associated with reduced postpartum weight retention [68]. The study is recommending a healthy, balanced and unrestricted diet in pregnancy and therefore foetal weight should not be impaired. Any woman in the intervention group who loses a cumulative 3 kg over the pregnancy will be reviewed by the Intervention Midwife and asked to complete a 7-day food diary to confirm that she is eating a healthy amount of food. If necessary, the Intervention Midwife will refer the participant to their obstetrician. Participant safety will be the responsibility of the Intervention Midwife and any concerns will be referred to an appropriate medical practitioner as per normal protocol within the health care service.

Each session will include the following:

- The weighing session where each woman attending will be weighed.
- New members will be welcomed and achievements of the group reviewed.
- Nutritional advice will be given and the group will discuss topics such as foods to avoid in pregnancy, sharing ideas, recipes, eating out ideas. The women will also be given access to Slimming World resources such as recipe books and magazines.
- Physical activity advice will be given and the group will review progress, share experiences, hints and tips, and discuss local activities like aquanatal. All participants will have their step targets reviewed monthly.
- Advice will be given on ailments during pregnancy such as symphysis pubis dysfunction and sciatica.
- Discussion of a 'Topic of the week' such as 'eating for two', nausea and breast feeding.
- Opportunities for one-to-one advice with the Intervention Midwife or Slimming World consultant.

4) Behavioural component

Practical skills and strategies for managing behaviour change will be discussed in the groups. The Slimming World approach (http://www.slimmingworld.com/health/how-sw-works/image-therapy.aspx) provides motivational support and aims to raise self-esteem and empower members. It involves aspects of Transactional Analysis [69], Motivational Interviewing [70] and Compassionate Mind Theory [71]. The approach taken within the groups is similar to Motivational Interviewing, as it is collaborative and seeks to strengthen motivation for change, while avoiding judgment or criticism. It uses empathy, acceptance and compassion to help individuals to overcome barriers and identify goals and their own reasons or motivators to change.

In the groups there will be a level of tailoring to individuals in terms of the diet and physical activity advice and as described above, the participants will have the opportunity to discuss these as well as plans and goals individually with the Slimming World consultant or Intervention Midwife, as well as within the wider group. A number of behavioural strategies will be discussed and encouraged during the group sessions these include; self-monitoring, self-regulation, goal setting, problem solving and action planning. Within the groups different behaviours will be modelled both by the intervention staff but also by other women in the group e.g. where they have started aquanatal classes or started cooking with fresh vegetables. The intervention staff will give encouragement and feedback to the women not only on their weight but also diet and physical activity and other issues.

The key aims of the groups are to encourage goal setting, self-monitoring and behavioural self-regulation, improve motivation and boost self-efficacy and social support. These are addressed directly by the Slimming World approach. Intervention staff will also be trained by the study team on the importance of encouraging and supporting women with respect to these aims. Women will be encouraged to weigh at least weekly and to monitor and, if necessary, alter their eating and physical activity behaviours in relation to their goals. The groups seek to enhance women's motivation by providing positive feedback and by helping them set realistic goals, problem solve and manage lapses or setbacks appropriately. It is intended that the groups will improve women's self-efficacy by providing them with useful information and by helping them develop the necessary skills for a healthy lifestyle, but also by helping them build on success and by giving them opportunities for observing similar others succeeding (modelling) as well as providing positive feedback on progress [72]. Social support will be provided by other women within the groups as the setting facilitates sharing experiences and information, giving feedback, empathy and encouragement as well as reinforcement of behaviours which may help increase motivation. It also provides opportunities for role modelling, improved self-efficacy, instrumental support (help), appraisal (e.g. affirmation) and peer pressure for healthy behaviours.

Regular attendance at the groups will be encouraged and participants will be contacted if they miss two or more consecutive intervention group sessions, to try to foster future attendance. Intervention group sessions will be held at a convenient time to enhance attendance, usually early evening.

The Intervention Midwives and Slimming World consultants will attend a one day training workshop delivered by the study team and will receive a study manual detailing all aspects of the intervention, in order to ensure consistency in the delivery of the intervention across all sites. In addition, intervention group sessions will be observed by study team members to examine intervention fidelity across sites.

Sample size

At the time we were developing the study we could find no systematic reviews of lifestyle interventions in pregnant women, so we based our sample size on a systematic review of interventions with obese adults, which found a mean weight loss of 7.9 kg (8.5%) during the first 6 months of interventions involving diet and exercise, after which weight was gradually regained, by 48 months a mean weight loss of 3.9 kg (4%) was maintained [28]. Results for trials which included only obese women (mean BMI+/=30 at baseline) demonstrated weight loss of a similar magnitude at 12 months [28]. In order for an individually randomised trial to have 80% power to detect a moderate effect size of 0.333 for a difference in BMI at 12 month follow-up of 1.5 kg/m^2 (SD = 4.5), at a 5% significance level, 143 women per group would be required. Little pertinent data are available for the estimation of the intra-cluster correlation coefficient (ICC). Assuming an ICC of 0.02, if 20 maternity units were recruited across England and Wales, a variance inflation factor of 1.4 would result, so the total sample size is therefore inflated to 400 to detect the difference stated above and we would require an average of 20 women per unit. This would allow for a variance inflation factor of 1.4 (ICC = 0.02) [73]. In trials investigating weight management interventions in pregnant women, losses to follow-up range considerably from 5% to 38% [58,59,74-76], therefore we have allowed for a drop out of 30% and intend to recruit 570 women.

Centre recruitment

Twenty maternity units across England and Wales will be recruited, ensuring a spread of different demographic areas, e.g. areas of high minority populations and low socio-economic status. All units will use electronic maternity information systems, in order to facilitate collection of outcome data and will have at least 1500 births per year. We will exclude any centre currently running a service similar to the HELP intervention.

Participant recruitment

570 pregnant women with a Body Mass Index (BMI) of +/=30 aged 18 years or older and between 12 and 20 weeks gestation will be recruited. Potentially eligible participants will be approached at their earliest antenatal appointment by NHS midwives or researchers, who will provide an information sheet and briefly describe the study. The decision to approach women will not be made by the midwife delivering the intervention. If women are eligible and interested in participating, they will be contacted by the research midwife (local Principal Investigator (PI)) to discuss the study in greater detail and arrange a baseline home visit where informed consent and baseline measures will be taken.

The approaching midwife/researcher will provide the women with a comprehensive information sheet prior to the baseline visit and adequate time will be given for them to read the material and to ask any questions they have about the study. Women will be reminded that they retain the right to withdraw consent for participation in any aspect of the trial at any time without their routinely available NHS care being affected. Midwives/researchers will be trained in Good Clinical Practice and all study procedures. The participant's GP, named midwife and obstetrician, if applicable, will be informed that she is taking part in the study.

A screening form will be completed to record the number of women approached about the study, eligibility, and at what stage women declined to take part in the study (e.g. when first approached or at the consent stage).

Exclusion criteria

Women will be excluded from being recruited into the study if they:

1) are unable to understand the intervention, e.g. have insufficient understanding of spoken English;
2) have any detected pregnancy related complications e.g. multiple pregnancy, foetal anomaly, current antenatal, maternal or foetal complications, recurrent miscarriage (three or more) or previous pre-eclampsia;
3) have any previous medical complications e.g. cardiac disease, serious respiratory disease including severe asthma, diabetes mellitus, serious mental illness/ psychological illness, epilepsy requiring anticonvulsant therapy or hypertension requiring treatment;
4) have nutritional complications e.g. serious physical or psychological disorders (eating disorders) or previous surgery for weight problems;

5) are involved in any other research that may affect any of the outcome measures that are being investigated in this study.

This list is not considered exhaustive. If the midwife considers that the woman has other serious complications that would affect her suitability to participate in the study, the midwife may at her discretion exclude the woman from recruitment noting on the recruitment form the reason why the woman has been excluded. If medical or obstetric complications arise while a participant is involved in the study advice will be taken from the woman's lead obstetrician on whether she should withdraw from the intervention. If a woman is withdrawn on clinical grounds the study team will still complete follow-up if the woman is willing.

Site randomisation

Sites will be randomised when all necessary approvals are obtained. Randomisation will be completed to give optimal balance for geographic region, maternity unit size, ethnic mix and the proportion of the maternity unit pregnant patient population with a BMI +/=30 [77-81]. A process of optimal allocation will be undertaken [79-81]. This will involve calculation of all possible allocations and a balance statistic for each one. A proportion of all allocations with the greatest degree of balance will be identified and passed to the independent statistician on the Trial Steering Committee (TSC) blinded to unit. He will randomly select a single allocation. This will then be returned to the trial statistician. The process of optimal allocation will be carried out in two blocks of ten sites with each block allocation being chosen by the independent statistician from the 25% most optimal allocations in each case. A statistician independent of the study but within the South East Wales Trials Unit will create random numbers for intervention/control arm allocation. The rest of the trial team and the clinics themselves will be informed of allocation after site recruitment.

In the event of delayed approvals for the maternity units such that it is not possible to randomise the second block of 10 sites together, minimisation will be used. A random component will be added to the minimisation algorithm using an 80% weighted randomisation. The allocations of the first block will be used to balance the remaining sites [77,78].

Outcomes

All outcome measures are listed in Table 1 and mediator measures in Table 2. Measures were selected following a comprehensive literature search and consultation with experts in diet and physical activity. Evidence of reliability, validity and sensitivity to change were considered in the selection process. An important issue was completion time to avoid excessive respondent burden as this could affect follow-up rates. For most of the outcomes and for the mediators there was a limited choice of measures and the final choice was inevitably a compromise between evidence of good psychometric properties and the resources and time available to complete the assessments.

The primary outcome is maternal BMI at 12 months postpartum. Secondary outcomes will include investigation into the impact of the intervention on gestational weight gain, the child's weight gain, complications during pregnancy, at birth and postnatally, diet, physical activity levels, health related quality of life, mental health and breast feeding intentions. All staff collecting data will be trained in administering the different outcome measures as well as accurately measuring weight, height and waist and hip circumference. Height will be measured once at baseline and used for all BMI calculations.

Information on both adverse events (AE) and serious adverse events (SAE) will be collected in the study. Trial sites, participants' GPs and intervention staff are responsible for reporting AEs and SAEs. They may also be reported by participants and by staff completing follow-up. In this trial cohort the following are expected to occur: hospitalisation for normal birth or any antenatal, perinatal or postnatal complications, termination of pregnancy for foetal anomaly and hospitalisation for postnatal depression. Rates of AEs and SAEs are likely to be higher in this group of obese women than the normal population of pregnant women. There are no SAEs expected to be related to the study intervention.

Follow-up & drop out

Baseline data will be collected by local PIs. Follow-up data will be collected by local PIs or research staff in each centre, or network research staff. For units in Wales this will be the Clinical Studies Officers employed by National Institute for Social Care and Health Research Clinical Research Collaboration (NISCHR CRC), in England the research nurses employed by the Comprehensive Local Research Networks (CLRN). The follow-up visits will be completed in the participants' home or at a location of the participants' choice. The follow-up appointments are timed to occur at important milestones both pre and postnatally: 36 weeks gestation, 6 weeks postpartum, 6 months postpartum and 12 months postpartum.

Every effort will be made to reduce loss to follow-up: women will be visited at a convenient location of their choice for all follow-up appointments. In order to improve response rates, participants will be contacted to rearrange any missed follow-up appointments, participant-nominated contacts will be collected at baseline in order to facilitate contact at follow-up appointments, participants will be posted study updates in the form of newsletters and follow-up calendars, and each participant will be provided with a

Table 1 Measurement of Outcomes

Outcomes	Measure	When*
Primary outcome		
Maternal weight expressed as BMI relative to height measured at baseline	Calibrated adult scales & stadiometer	B, 36w, 6p, 6 m, 12 m
Secondary outcomes		
Antenatal and birth complications**	Routinely collected data held in patient records	Birth
Pregnancy weight gain	Calibrated adult scales	B, 36w
Waist circumference and waist-hip ratio	Measuring tape	12 m
Child weight centile (adjusted for birth weight and age)	Calibrated baby scales and measuring tape	Birth, 6p, 6 m, 12 m
Admission to neonatal unit	Patient records	Birth
General mental health	General Health Questionnaire (GHQ) 12 [82]	B, 36w, 6p, 6 m, 12 m
Breast feeding intentions	Study-developed questions	36w
Breast feeding behaviour and weaning	Study-developed questions	6p, 6 m, 12 m
Self-reported physical activity	7 Day Physical Activity Recall (7 Day PAR) [83-85]	B, 36w, 6p, 6 m, 12 m
Diet	Dietary Instrument for Nutrition Education (DINE) [86] (plus additional questions on fruit and vegetables, sugar, sweets)	B, 36w, 6p, 6 m, 12 m
Alcohol	Alcohol Use Disorders Identification Test-Consumption (AUDIT-C) [87]	B, 36w, 6p, 6 m, 12 m
Smoking	Study-developed questions	B, 36w, 6p, 6 m, 12 m
Costs	Participant resource use	B, 36w, 6p, 6 m, 12 m
Health related quality of life	EQ-5D (including visual analogue scale) [88]	B, 36w, 6p, 6 m, 12 m

*B = baseline; 36w = 36 weeks gestation; 6p = 6 weeks postpartum; 6 m = 6 months postpartum; 12 m =12 months postpartum.
**gestational diabetes; pre-eclampsia; thrombosis; proportion staying within IOM guidance on weight gain in pregnancy [20]; form of pain relief; birth delivery mode; gestation at delivery; induction of labour; shoulder dystocia, $3^{rd}/4^{th}$ degree perineal tear; postpartum bleeding or thrombosis; Apgar scores.

£10 high street voucher as a thank you for completing each follow-up. A HELP study website will be used to provide study updates (http://medicine.cf.ac.uk/help-study/), and a minimum dataset will be developed to collect follow-up data by telephone for those participants who are unwilling or unable to meet with the researcher.

In order to prevent resentful demoralisation in the control group, each of these women will be offered 12 weeks normal community-based Slimming World sessions free of charge after her 12 month follow-up is complete. Any woman who undergoes a miscarriage, stillbirth, neonatal death or termination of pregnancy will be given an open option whether or not they wish to continue participation in the study.

All site study staff including the Intervention Midwife and Slimming World consultant will be visited by the research team and updated via regular contact and newsletters in order to encourage continued enthusiasm. In addition, to prevent disappointment following randomisation in the control sites, if results from the study prove positive units allocated to the control group will then be offered training for their midwives in the intervention.

Process evaluation

A process evaluation will be conducted in line with the framework suggested by Steckler and Linnan [95]. This evaluation will utilise both qualitative and quantitative data including data taken from focus groups, interviews, site intervention group observations, session summaries. The process evaluation model will include assessment of eight components; these are context, reach, exposure, fidelity, recruitment, retention, contamination and theory testing. The definition of some of these elements is less

Table 2 Measurement of Mediators

Mediators	Measure	When
Social support	Social Support Exercise and Eating Habits Scales [89] (plus intervention specific social support questions)	B, 36w, 6 m, 12 m
Self-efficacy	Weight Efficacy Lifestyle Scale [90] and Multidimensional Self efficacy for Exercise Scale [91,92]	B, 36w, 6 m, 12 m
Self-regulation	Shortened Self-Regulation Questionnaire [93]	B, 36w, 6 m, 12 m
Motivation	Treatment Self-Regulation Questionnaire (for diet and physical activity) [94]	B, 36w, 6 m, 12 m

(B = baseline; 36w = 36 weeks gestation; 6 m = 6 months postpartum; 12 m =12 months postpartum).

clear than others and there is some overlap between concepts, so these are defined here as used in this study. “Context” includes information relating to different aspects of the context that the intervention was delivered in. This was explored by addressing who delivered the intervention and where it was delivered. The broader context was considered in the qualitative work and includes data on circumstances, skills, resources and attitudes that may influence intervention effectiveness. “Reach” is defined as the extent to which the target audience is reached by the intervention as well as whether the intervention had ‘spillover’ effects on other people not recruited in the trial. We were interested in exploring whether it had any impact on the family and friends of the participants. “Exposure” is defined as whether the participants received the different elements of the intervention and whether the participants implemented the different elements as intended. “Fidelity” is defined as the degree to which the Intervention Midwives and Slimming World consultants delivered the intervention as intended.

We will assess study attrition by intervention or control group as well as by site. We will compare those dropping out with those remaining in the trial in terms of demographics. We will attempt to obtain reasons for dropout where possible and record these. Finally, we will assess potential contamination between groups through the interviews and focus groups as well as by obtaining details of all other services or interventions that control group participants accessed. Table 3 shows the key sources of information used to explore the eight components of the process evaluation.

A key method for assessing these components is via the qualitative data collection i.e. qualitative interviews with participants and focus groups with the staff delivering the intervention. Semi-structured interviews will be completed with approximately 30 participants from the intervention group, purposively sampled across sites according to attendance levels at the intervention group sessions and whether they lost weight or not. The interviews will be carried out at the end of the intervention period (at approximately 6 months postpartum) and at the end of the study (at approximately 12 months postpartum). We will explore the participants’ views of the intervention, barriers and facilitators, the impact of life events on adherence to the intervention, importance of social support, strategies, coping mechanisms and responses to relapses. We will interview a small sample of participants who drop out of the intervention but who are willing to be interviewed, to establish their views of the intervention and reasons for discontinuing. We will also conduct brief interviews with a sample of around 15 women from the control group about taking part in the study and any lifestyle changes they made both during and after pregnancy. The interviews will continue until data saturation is reached.

Three intervention staff focus groups will be completed and will explore the intervention components, the delivery of the intervention, intervention fidelity, participant adherence to the intervention, the recruitment process, perceived challenges or barriers in implementing the intervention and potential improvements to the intervention or the training.

With regards to theory testing we developed a logic model (this is shown in Figure 1) to explain the processes by which the intervention brings about change and we plan to test the theory of our intervention via mediation analyses as well as through other aspects of the process evaluation including participant interviews. Potential mediators including self-regulation, intrinsic motivation, self-efficacy and social support will be assessed. The analyses will identify both the extent to which the intervention was successful at changing these mediators and the extent to which mediator change was associated with change in BMI. Potential moderators of intervention effect will be examined including demographics, ethnicity, parity, mental health (also an outcome), smoking status and weight loss history.

Economic evaluation

The main evaluation will be a cost utility analysis assessing between group differences in total costs against differences in Quality Adjusted Life Years (QALY) derived from the EQ-5D quality of life instrument [88]. This approach is preferred by the National Institute for Health and Care Excellence (NICE) for the economic evaluation of NHS interventions as resulting cost utility estimates can be compared across unrelated health care interventions (www.NICE.org.uk). However, as a generic measure, EQ-5D may not be sufficiently sensitive to capture small changes in health-related quality of life in essentially healthy participants. A secondary cost effectiveness analysis will therefore be undertaken with BMI as the effectiveness measure. Both analyses will be done from an NHS perspective but as the HELP intervention might substitute for other weight control interventions, patient borne costs will also be assessed but will be reported separately.

Resources for training intervention midwives and delivery of the intervention will be recorded prospectively in relevant units and valued using standard methods [96]. Participants’ use of NHS resources will be collected by questionnaire from women in both arms of the trial at baseline and all follow-up points specified above and similarly valued. The questionnaire will also record payments for non-NHS weight loss/maintenance activities and will include the EQ-5D questionnaire [88].

Table 3 Process Evaluation Elements

Process evaluation component	Assessment
Context	• Data collected on a site proforma detailing site demographics, ethnicity, size, services delivered etc.
	• Data on those delivering the intervention
	• Data from two site observations completed at different time points in the intervention delivery period using a structured observation guide.
	• Contextual issues explored in the staff focus groups and participant interviews
Reach	• Attendance at the group sessions
	• Comparison of characteristics of those attending the intervention with those not attending
	• Reach explored in the staff focus groups and participant interviews
Exposure	• Number of group sessions delivered
	• Data from group session summary forms which describe those attending and the content/timings of sessions
	• Data from site observations (two per site)
	• Attendance at group sessions
	• Exposure and attendance explored in the staff focus groups and participant interviews
	• Data gathered on use of pedometers, step targets and walking diary completion
Fidelity	• Data from site observations (two per site)
	• Data from group session summary forms which describes how the intervention was implemented at each session
	• Fidelity explored in the staff focus groups and participant interviews
Recruitment	• Comparison of demographics of sites recruited
	• Recruitment rates compared across sites in terms of how many recruited, who is recruited and also how quickly people are recruited
	• Comparison of potentially eligible women with those recruited using data from case report forms and screening forms
	• Recruitment issues explored in the staff focus groups and participant interviews
Retention	• Dropout by trial arm
	• Dropout by site
	• Comparison of demographics of those dropping out with those remaining
Contamination	• Participants asked what other services control group utilised in case report forms
	• Contamination explored in the staff focus groups and participant interviews
Theory testing	• Mediation analyses using questionnaire data
	• Theoretical mediators explored in the staff focus groups and participant interviews

Analysis

Quantitative analysis

The main analysis will be by intention to treat and will compare the primary outcome of BMI at 12 months postpartum in the intervention and control groups. Multilevel modelling will be used to account for clustering within antenatal unit and individual effects. A two level linear regression model will include baseline BMI (measured at recruitment) as a covariate. Both levels will be considered 'random effects' i.e. patients and units are drawn randomly from a larger population of patients and units. Cluster level variables include those used to balance the randomisation: antenatal unit size; proportion of women with BMI +/=30, geographic location and ethnic mix.

For the BMI data, positively skew distributed form is anticipated and will be checked prior to analysis. Log transformation will be considered, not only to deal with the non-normality but to allow interpretation of differences between arms in percentage terms. To further aid clinical interpretation of the intervention effect, analysis of log transformed weight at 12 months postpartum will also be considered, with baseline log weight and log height as covariates. The results can then be expressed in terms of BMI or weight along with a 95% confidence interval. The intra-cluster correlation (ICC) for the primary outcome will be calculated and reported.

Intention to treat analysis will be used for all secondary outcomes. Analysis of secondary outcomes will also use multilevel modelling incorporating baseline scores as covariates where appropriate. Two level linear regression models will be used for outcomes such as pregnancy weight gain and waist-to hip ratio and validated questionnaire scores, while logistic models will be used for clinical event outcomes. 95% confidence intervals for the intervention effect will be calculated. The ICC for each secondary outcome will be calculated and reported.

The impact of individual demographic factors as well as theoretical mediators (self-efficacy, social support, intrinsic motivation and self-regulation) on the intervention effect using interaction terms included in the main analysis models will be examined. Individual demographic variables include age, ethnicity, smoking status, previous weight loss history, psychological wellbeing and social class. We also intend to carry out tests for mediator variables [97].

As well as examining number of sessions attended, patterns of missed sessions and compliance with the intervention will also be explored. A complier average causal effect (CACE) analysis will be carried out for the primary outcome to assess the effect of the intervention in those who complied [97,98]. An investigation of required minimum dose of intervention will be carried out. A per- protocol analysis will include only those participants in each arm that received treatment as randomised excluding those in the control arm attending weight loss groups.

No formal subgroup analyses are planned. However, exploratory analyses of the impact of social class, parity, ethnicity (if numbers permit), smoking status and initial BMI on the effect of the intervention will be carried out. This will be achieved by fitting a subgroup by randomised group interaction term to the multilevel model.

If the proportion of missing primary data is substantial (more than 10%) a series of sensitivity analyses will be carried out to determine the likely effects of missing data [99-101]. The intention is to use multiple imputation to generate complete datasets for analysis. Imputation models will include those variables in the analytic model plus any additional variables associated with missingness and outcome. Self-reported weight (from the minimum dataset) and Slimming World session weight data may be used to replace missing weights where appropriate in secondary analyses. Further sensitivity analyses may be carried out to examine the effects of removing women who are known to be pregnant at the 12 month postpartum follow-up, as well as those who have recently given birth to a second baby. The assumptions of all models used for primary and secondary analysis will be checked.

Short and long term effects of the intervention can be examined using repeated measures analysis of intermediate weight measurements. The difference in weight at 6 months postpartum will also be examined. The proportion of participants who lost 5% of their weight (weight at 6 months postpartum compared to baseline) will be calculated for each arm. The difference between groups will be examined to identify if they maintained that loss. The association between subsets of clinical outcomes will also be investigated and a total count of all clinical outcome events will be calculated and compared between trial arms. Individuals lost to follow-up will be compared to those who complete follow-up to identify potential sample bias.

Qualitative analysis

Interviews and focus groups will be audio recorded, transcribed and checked by the researcher. Standard thematic analysis techniques will be employed. Transcripts will be closely examined to identify themes and categories [102]. Codes will be applied to these broad themes which will then be broken down further into sub-codes. Agreement on concepts and coding will be sought between members of the research team to ensure reliability. Commonly expressed themes will be identified as well as unusual cases. 20% of the data will be coded separately by two team members to check reliability of the coding process. Interviewing will be iterative; where new themes emerge they will be incorporated into the interviews and focus groups. Thematic analysis will be supported by qualitative analysis software (NVIVO).

Economic analysis

As training can be regarded as an investment producing a flow of benefits over time, training costs will be amortised and expressed in equivalent annual cost terms. Costs of delivering the intervention, including an element for training, will be apportioned to the intervention group. Mean differential costs between intervention and control groups will be estimated. As cost data are often skewed, tests for normality will be carried out and if data are not normally distributed non-parametric analyses will be used to carry out the comparison of costs between the two arms of the trial. Economic comparisons between the two study arms will take account of the cluster nature of the data.

Results of the cost utility analysis will be reported in the form of an incremental cost utility ratio (incremental cost/QALY). A series of one-way sensitivity analyses will assess how sensitive results are to changes in key assumptions. Probabilistic sensitivity analyses will be used to quantify uncertainty around the estimates and cost effectiveness acceptability curves will show the probability of the intervention having an incremental cost utility ratio below a range of acceptability thresholds [103].

In the secondary analysis, cost effectiveness will be assessed using BMI as the effectiveness measure. Unless the intervention is shown to be dominant (lower costs greater effect) the resulting incremental cost effectiveness ratio (incremental cost per unit difference in BMI) can be compared with that of other weight management programmes delivered to pregnant women.

Exploratory work will be carried out to model the medium term effect of the intervention bearing in mind the high degree of uncertainty in long term weight patterns particularly among the obese [104].

Discussion

This trial will evaluate the effectiveness of a theory-based intervention for obese pregnant women, which combines dietary expertise from Slimming World, physical activity, and clinical advice and supervision from midwives. The intervention aims to provide support to enhance motivation and equip women with the necessary knowledge and skills to enable them to make healthier choices and control their weight gain during pregnancy as well as maintain a healthy lifestyle postpartum through healthy eating and physical activity.

The study is novel as, to our knowledge, no RCTs of pregnancy or postpartum weight control interventions have included an assessment of cost effectiveness and there are no published trials of diet and physical activity interventions that run through pregnancy and into the postpartum period [34]. In addition, few trials have explicitly described the theoretical basis of the intervention or measured the psychological mediators of the effect.

The cluster design was chosen to avoid the risk of contamination, because midwives trained in the use of the intervention could potentially use aspects with control participants and pregnant women resident in the same area often know one other and could share study information. Also in order to run effective groups the cluster design is superior in terms of recruiting sufficient numbers to ensure sessions can be delivered locally.

The study incorporates economic and process evaluations as well as explicit testing of the theory of the intervention. The process evaluation will allow us to explore the impact of different aspects of the intervention and if the trial does not show an effect it will allow us to explore possible reasons for this.

Protecting against bias

Staff in maternity units who volunteer for the study are likely to be motivated in favour of the intervention, which may result in disappointment in those subsequently allocated to the control group. In order to avoid differential dropout between the experimental and control groups, we will offer the maternity units in the control group the opportunity to complete the training programme after the follow-up period, should the intervention prove to be successful. Careful characterisation of the participating sites, clinicians and patients will be undertaken to judge the external validity of the study findings.

Outcome data will be collected by PIs or trained researchers allied to the project. Due to the nature of the study, it will be difficult for researchers collecting outcome data to be blinded to the allocation of the women; however no staff involved in delivering the intervention will collect follow-up data.

The findings of this study will advance current knowledge in this field, both in terms of weight management interventions for obese pregnant women as well as behaviour change theory. If the trial is successful, this could alter the management of obese pregnant women within the NHS. Potential outcomes of the intervention may include fewer complications in pregnancy and postpartum for both mother and baby as well as less traumatic deliveries. Improvements in the women's physical and psychological health and self-esteem may also result from attendance at the intervention group sessions, and from the physical activity aspect of the intervention, independent of any weight loss. Benefits to the women may be long lasting. There is evidence that many women retain weight gained during pregnancy. If this intervention is successful this may impact on cumulative obesity developing over several pregnancies. Women will also benefit from expanded healthcare choices (e.g. midwife as opposed to consultant led care) in subsequent pregnancies, if a healthy lifestyle leads to a BMI within normal limits.

Conclusions

Obesity in pregnancy is linked to poor health and increased NHS costs. This intervention could potentially have an impact on the women taking part during their current pregnancy but it could also equip them with weight management and healthy lifestyle skills they can use in the future. Benefits to public health could be far reaching; pregnancy is a time of significant change within a family at which women who could benefit from weight control are accessible and may be readily motivated, and any change to lifestyle could influence families' behaviour in the longer term.

Abbreviations

AE: Adverse event; BMI: Body mass index; CACE: Complier average causal effect; CLRN: Comprehensive local research networks; DINE: Dietary instrument for nutrition education; GP: General practitioner; GHQ: General Health questionnaire; GWG: Gestational weight gain; HELP: Healthy eating and lifestyle in pregnancy; ICC: Intra-cluster correlation; IOM: Institute of medicine; NHS: National Health service; NICE: National Institute for Health and Care Excellence; NISCHR CRC: National Institute for Social Care and Health Research Clinical Research Collaboration; 7 Day PAR: 7 Day Physical Activity Recall; PI: Principal investigator; QALY: Quality adjusted life years; RCT: Randomised controlled trial; SAE: Serious adverse event; TSC: Trial steering committee; UK: United Kingdom; US: United States of America.

Competing interests

Amanda Avery has an academic post at the University of Nottingham but also works part-time for Slimming World. Slimming World have provided some of the intervention costs for the study, however neither Amanda Avery or Slimming World will have access to the study data or will be involved in the data collection or analyses of the study. The other authors declare that they have no competing interests in relation to this study.

Authors' contributions

Dr. EJ led the writing of this manuscript, contributed to the protocol and intervention development and managed the trial. Dr SAS is the Chief Investigator she led the study design, wrote the original protocol and led the trial implementation. DMC completed the qualitative aspects of the trial as well as the data management. KJ led the pilot study, assisted with study design and advised on the clinical aspects of the study. Professor DC contributed to study design and led the health economics component and Dr ML assisted with the health economics component. DD assisted with study design and advised on the dietary component of the intervention. Dr RP assisted with study design and led the statistical component of the study. Professor RN assisted with study design and advised on the statistical component of the study. Dr MB assisted with study design and the design of the physical activity component of the intervention. Dr EO-J assisted with study design and advised on trial management procedures of the study. Dr NW advised on the clinical and scientific aspects of the study design. AA contributed to intervention design and advised on different aspects of the protocol. All authors contributed to and commented on the different versions of this paper. All authors read and approved the final manuscript.

Acknowledgements

The authors would like to thank the other members of the HELP Study team for their contribution to the design and development of this study, Mandy Iles (Administrator) and Dawn Harries who is the lay representative and advised on study design.

Funding
The study is funded by the National Prevention Research Initiative (NPRI), Medical Research Council (MRC). The South East Wales Trials Unit (SEWTU) is funded by the National Institute of Social Care and Health Research (NISCHR). Slimming World provided some of the intervention delivery costs which included staff time at Slimming World Head Office and materials for participants.

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Received: 28 April 2014 Accepted: 1 May 2014
Published: 10 May 2014

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doi:10.1186/1471-2458-14-439
Cite this article as: John *et al.*: Healthy eating and lifestyle in pregnancy (HELP): a protocol for a cluster randomised trial to evaluate the effectiveness of a weight management intervention in pregnancy. *BMC Public Health* 2014 **14**:439.

Paper 11

Avery, A., Bostock, L., McCullough, F. (2015). **A systematic review investigating interventions that can help reduce consumption of sugar-sweetened beverages in children leading to changes in body fatness**. *Journal of Human Nutrition and Dietetics* 28 (Suppl. 1): 52–64 DOI: 10.1111/jhn.12267

BDA The Association of UK Dietitians
THE OFFICIAL JOURNAL OF THE BRITISH DIETETIC ASSOCIATION
Journal of Human Nutrition and Dietetics

REVIEW

A systematic review investigating interventions that can help reduce consumption of sugar-sweetened beverages in children leading to changes in body fatness

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Keywords
childhood obesity, sugar sweetened beverages, dietary intervention, public health, systematic review.

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How to cite this article
Avery A., Bostock L., McCullough F. (2015) A systematic review investigating interventions that can help reduce consumption of sugar-sweetened beverages in children leading to changes in body fatness. *J Hum Nutr Diet*. **28** (Suppl. 1): 52–64
10.1111/jhn.12267

Abstract

Background: Both the prevalence of childhood obesity and the consumption of sugar-sweetened beverages (SSBs) have increased globally. The present review describes interventions that reduce the consumption of SSBs in children and determines whether this leads to subsequent changes in body fatness.
Methods: Three databases were searched from 2000 to August 2013. Only intervention control trials, ≥6 months in duration, which aimed to reduce the consumption of SSBs in >100 children aged 2–18 years, and reporting changes in body fatness, were included. The quality of selected papers was assessed.
Results: Eight studies met inclusion criteria. Six interventions achieved significant ($P < 0.05$) reductions in SSB intake, although this was not always sustained. In the two interventions providing replacement drinks, significant differences in body mass index (12- or 18-month follow-up) were reported ($P = 0.001$ and 0.045). The risk of being overweight/obesity was reduced ($P < 0.05$) in three of the five education programmes but in one programme only for girls who were overweight at baseline and in one programme only for pupils perceived to be at greater risk at baseline. In the one study that included both provision of water and education, the risk of being overweight was reduced by 31% ($P = 0.04$) in the intervention group.
Conclusions: The evidence suggests that school-based education programmes focusing on reducing SSB consumption, but including follow-up modules, offer opportunities for implementing effective, sustainable interventions. Peer support and changing the school environment (e.g. providing water or replacement drinks) to support educational programmes could improve their effectiveness. Home delivery of more suitable drinks has a big impact on reducing SSB consumption, with associated reductions in body weight.

Introduction

Childhood obesity is a major public health problem in many countries across the world. Dietary interventions that could prevent excess weight gain in childhood are required.

There has been a growing trend globally in the consumption of sugar-sweetened beverages (SSBs) amongst children. A recent large US study of trend and cross-sectional analyses (Han & Powell, 2013) drawn from National Health and Nutrition Examination Survey (NHANES) data between 1999–2008 showed that the prevalence of heavy total SSB consumption ≥ 2092 kJ day^{-1} [≥ 500 kcal day^{-1}] had increased amongst children (4–5%). Low-income children had higher odds [odds ratio = 1.93; 95% confidence interval (CI) = 1.05–3.56] of heavy consumption than high-income ones, thus highlighting a potential targeting strategy for public health interventions.

A large cross-sectional study of European adolescents (Duffey *et al.*, 2012) highlighted how SSBs provide more daily energy intake (30.4% of total beverage intake) than any other beverages. Amongst British children, energy from drinks accounts for 14% of energy intake in children aged between 4 and 18 years, with sugary drinks accounting for the bulk of that energy and SSB intake being particularly high amongst adolescents (Ng *et al.*, 2012). Although a comparison between 1983 and 1997 SSB intake by UK children aged 10–11 years and 14–15 years showed a significant increase, this did not reflect in an increase in total sugar intake (115 g day^{-1} in 1983 and 113 g day^{-1} in 1997) (Gibson, 2010).

There is ongoing current debate around whether there is sufficient scientific evidence that decreasing consumption of sugar-sweetened beverages (SSBs) reduces obesity (Hu, 2013; Kaiser *et al.*, 2013). The World Health Organization recently carried out a meta-analysis of cohort studies in children which found that a higher intake of SSBs was associated with a 55% (95% CI = 32–82%) higher risk of being overweight or obese (Morenga *et al.*, 2013).

Putting this debate to one side, SSBs are nutrient poor and provide 'empty' energy to children's diets.

This systematic review aims to clarify which interventions aimed at children help to reduce the consumption of SSBs and whether these interventions lead to subsequent changes in body fatness. The methods of delivery of these interventions will be considered to help practitioners plan future interventions in this area.

For the purposes of the present review, the definition of SSBs includes carbonated and noncarbonated drinks sweetened with sugar, including fruit juices and milk drinks.

Materials and methods

The systematic review followed the relevant criteria of the PRISMA statement (Preferred Reporting Items for Systematic reviews and Meta-Analysis) (Liberati *et al.*, 2009).

Study selection

Trials, published in English from 2000 onwards, were included in this review if they met certain criteria: (i) the trial involves ≥100 healthy children, including healthy weight, overweight and obese participants, aged between 2–18 years; (ii) the intervention includes a focus on reducing consumption of sugary drinks; (iii) control data are available for comparison; (iv) the results report on the change in consumption of SSBs AND changes in body fatness; and (v) the study comprises an intervention study period of ≥6 months in duration.

The primary outcome measure of interest was the reduction in consumption of sugary drinks compared to control data. The secondary outcome measure was any change in body composition indicative of body fatness [e.g. change in body mass index (BMI) from baseline, percentage overweight or obese, risk of being overweight, skinfold thickness or waist circumference].

To be included in the review, any multi-component education programme needed to list the reduction of SSBs as the number one priority.

Search strategy

Searches were undertaken using the following electronic databases: Web of Science, Medline and EMBASE. The search centred on identifying intervention studies amongst populations of children (aged between 2–18 years) that reduced their consumption of SSBs from January 2000 to August 2013. Two searches were undertaken. First, the search terms used were [fruit juice or soft drink or sugar-sweetened beverage or nutritively sweetened beverage or soda or liquid calories or chocolate milk] AND [children or kids or adolescents] AND [energy]. A further search was undertaken using [sugar free drink or diet drinks or diet sodas] AND [children or kids or adolescents] AND [energy].

Data collection and extraction

Titles and abstracts of studies were identified by the database searches using the search strategy outlined. Nonhuman trials and non-English language studies were eliminated at this stage using database filters. Studies were then screened against the inclusion criteria using title screening, abstract screening and full paper screening. Title screening was carried out by one reviewer, with a second reviewer consulted at the abstract screening stage, and a third reviewer in the full paper screening process. The screening process, including the number of studies excluded at each stage in the process, was documented and is shown in Fig. 1.

Data from each of the final eight studies identified by the search process was extracted using a data extraction form adapted for this systematic review. The headings used in the form include: author, country of origin, number of subjects, mean age, weight status of subjects, where study is based, length of intervention and any follow-ups, details of the intervention, change in consumption of SSBs, change in body fatness compared to control group and overall study conclusion.

For ease of comparison of changes in SSB consumption between studies, raw data from studies were converted into percentage change from baseline for both the intervention and control arms where possible.

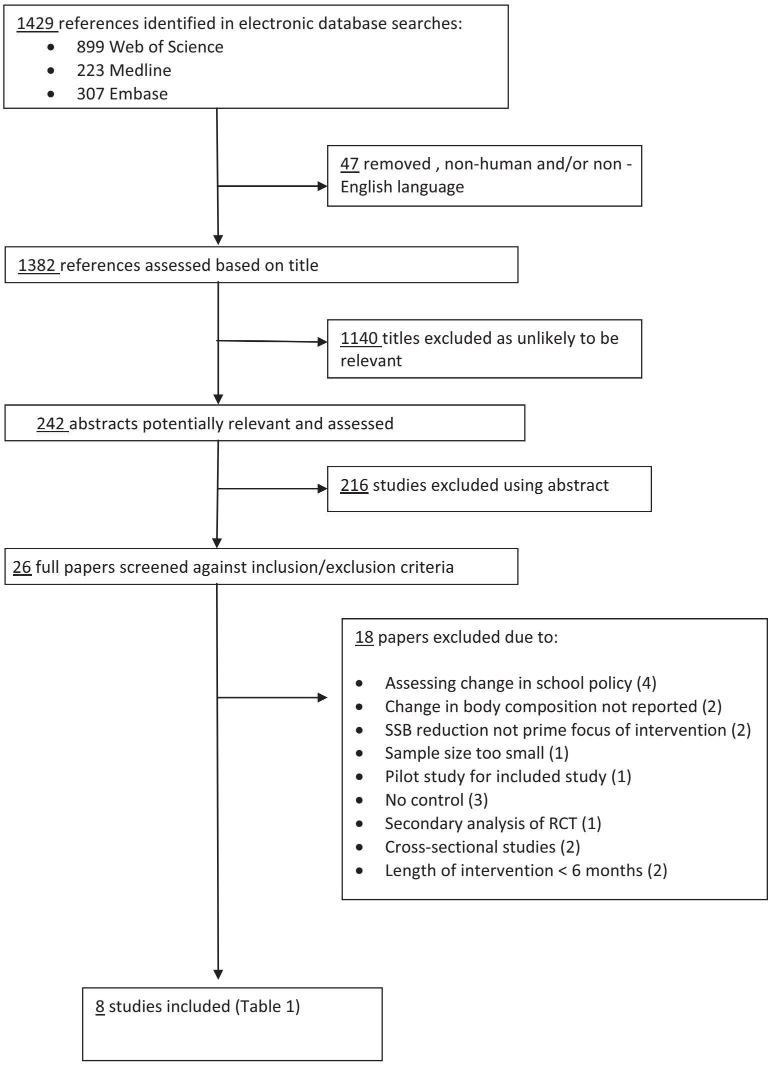

Figure 1 Flow diagram for database search results. RCT, randomised controlled trial; SSB, sugar-sweetened beverage.

Quality assessment

The quality of the final eight studies was critically assessed using the Jadad scale for reporting randomised controlled trials (Jadad *et al.*, 1996). The quality scores ranged between 1 and 5 with higher scores indicating higher study quality.

Results

Interventions targeting the consumption of sugar-sweetened beverages

The present review identified eight studies which met the strict inclusion criteria (Fig. 1) and included interventions focused on reducing the consumption of SSBs with data on changes in body fatness reported (Table 1). A follow-up study to James *et al.* (2004) was carried out by the same group in 2007 and the results of these studies have been considered and reported together.

Of the eight studies selected, five were undertaken in Europe (one in England, one in Germany, three in the Netherlands), one in the USA, and two in Brazil. For one of the studies based in Brazil, schools from a particularly poor region were targeted for the intervention. Seven of the studies involved ‘normal’ weight children with one undertaken amongst overweight and obese children. Seven of the studies were conducted through schools, whereas one was home based. The children in the studies ranged in mean age between 8 and 15 years. The length of the interventions ranged between 4 and 18 months and the time of follow-up between 7 and 36 months, with a follow-up conducted at the end of the intervention in four of the studies. Sample sizes ranged from 224 to 2950 children.

Table 1 Controlled studies with interventions that can lead to reduced consumption of SSBs leading to changes in body fatness

First author (year), country	Total number of subjects, mean age, weight status of subjects, where study based	Length of intervention (months), timing of follow-up (months)	Intervention	Change in consumption from sugary drinks (intervention versus control)	Change in BMI (kg m $^{-2}$ (intervention versus control)	Overall study conclusion
Cunha (2013), Brazil (area of high social deprivation)	559, 11, Normal, school	9	9 nutritional education sessions delivered by trained nutritionists	Variation in daily frequency: Intervention / Control; Sodas (P = 0.02) −0.2 / −0.08; Juices (P = 0.66) −0.16 / 0.01	No difference between intervention and control groups	Encouraging adoption of healthy eating promoted a reduction in SSBs but did not lead to BMI reduction. Possible substitution of SSBs with sugar-containing juices
De Ruyter (2012), Netherlands	641, 8, Normal, school	18	Provision of masked (non-energy and sugar-sweetened) canned drinks daily whilst in school	Mean (SD) baseline consumption of 1.02 (0.20) during school break and 1.50 (1.40_ per weekend day. [Each sugar-sweetened drink provided 435KJ/ 104kcal]	Change in BMI *Z*-score; intervention 0.02. Control group 0.15 (P = 0.001) Weight increase; 6.35 versus 7.37 kg	Masked replacement of sugar-containing beverages with non-energy beverages reduced weight gain and fat accumulation in normal weight children
Ebbeling (2012), United States	224, 15, Overweight and obese, home	12, 24	2 weekly home delivery of non-energy beverages with written intervention messages, monthly telephone calls with parents, three check-in visits with participants	Servings day^{-1} (P < 0.001): At 12 months – 88% decrease; At 24 months – 76% decrease; kJ day^{-1} (P < 0.001): At 12 months – 88% decrease; At 24 months – 79% decrease	12 months: Significant effect of −0.57 (P = 0.045) 24 months: Nonsignificant effect of –0.30 (P = 0.46)	In overweight and obese adolescents, the increase in BMI was smaller in the intervention group after 1 year but not at 2-year follow-up
Ezendam (2012), Netherlands	883, 13, Normal, Web-based and school	4, 24	8 computer modules on weight management and energy balance-related behaviours	Lower odds (0.54) of consuming >400 mL day^{-1} of SSB in intervention group. No significant differences at 24-month follow-up	No difference in BMI or waist circumference at 4 months or 24 months Those perceived to be at greater risk at baseline show differences in BMI change of 1.5 versus 3.7	Intervention associated with positive short-term effects on SSB consumption but a reduced BMI only in those children perceived to be at greater risk at baseline

Table 1 (*Continued*)

First author (year), country	Total number of subjects, mean age, weight status of subjects, where study based	Length of intervention (months), timing of follow-up (months)	Intervention	Change in consumption from sugary drinks (intervention versus control)	Change in BMI (kg m $^{-2}$ (intervention versus control)	Overall study conclusion
James (2004, 2007), England	644, 9, Normal, school	12, 36	Nutritional education programme, 'Ditch The Fizz', delivered (by research investigator) through school. 1 × 1-h session each term (four sessions in total)	No of glasses/3 days: 32% ($P = 0.02$) reduction in carbonated drinks. Nonsignificant reduction in carbonated drinks with sugar of 25% ($P = 0.2$) Change in consumption at 3-year follow-up not recorded	% overweight/obese: 12 months: Intervention –0.2% decrease Control – 7.5% increase 36 months: No difference between intervention and control	A targeted, school-based education programme produced a modest reduction in the number of carbonated drinks consumed that was associated with a reduction in the number of overweight and obese children Difference in overweight prevalence no longer seen at 3 years
Muckelbauer (2009), Germany	2950, 8, Normal, school	11	Water fountains and water bottles provided in schools plus educational programme of 4 × 45-min lessons on water delivered by teachers via the curriculum	Number of glasses day^{-1}: Soft drinks – No significant effect ($P = 0.406$) [Juice – No significant effect ($P = 0.500$)] Water – 1.1 ($P < 0.001$)	Change in BMI SD score did not differ between groups Risk of being overweight was reduced by 31% ($P = 0.04$) in the intervention group	An environmental and educational, school-based intervention proved effective in the prevention of overweight among children in elementary school, even in populations from socially deprived areas
Sichieri (2008), Brazil	1140, 11, Normal, school	7	Healthy lifestyle education programme (10 × 1-h sessions delivered by research assistants) emphasising water consumption instead of sugar-sweetened carbonated beverages	Mean daily intake (mL day^{-1}) Intervention group: Carbonated drinks – 23% decrease ($P = 0.03$) Juice – Nonsignificant increase of 3% ($P = 0.08$) Control group: Carbonated drinks – 4% decrease ($P = 0.03$) [Juice – Nonsignificant increase of 12% ($P = 0.08$)]	Not statistically significant between groups. Among those overweight at baseline, a reduction in BMI in the intervention group, statistically significant among girls	Decreasing SSBs intake significantly reduced BMI among overweight girls Efforts to reduce energy intake through liquids need to emphasise overall sweetened beverages and juices

Table 1 (*Continued*)

First author (year), country	Total number of subjects, mean age, weight status of subjects, where study based	Length of intervention (months), timing of follow-up (months)	Intervention	Change in consumption from sugary drinks (intervention versus control)	Change in BMI (kg m^{-2}) (intervention versus control)	Overall study conclusion
Singh (2009) Netherlands	1108, 13, Normal, School	8, 12 and 20	School-based, multi component, health promotion, 11 lessons	mL day^{-1} (*P*-value not reported) 8 months Girls: 23.9% decrease Boys: 25.5% decrease 12 months Girls: 26% decrease Boys: 20.7% decrease No sig differences at 20 months	No significant differences in BMI between groups. (Significant difference in sum of skinfold thickness in girls at 8 and 12 months)	Beneficial effects on sum of skinfold thickness in girls and consumption of SSBs in girls and boys in short and long term

BMI, body mass index; SSB, sugar-sweetened beverage.

No studies were identified amongst children aged less than 8 years.

These interventions can be considered under four headings: school-based educational programmes, school-based educational programme combined with environmental change, school-distributed drinks and home-delivered drinks.

School-based educational programmes

The primary school-based educational intervention ('Ditch the Fizz' delivered as part of CHOPPS, the Christchurch Obesity Prevention Programme in Schools), undertaken by James *et al.* (2004), resulted in a 25% ($P = 0.2$) reduction in the number of glasses of carbonated drinks containing sugar consumed over a 3-day period in the intervention group, compared to the control group, and reported a mean difference of 7.7% (95% CI = 2.2–13.1%) in the percentage of being overweight or obese following the intervention at 12-month follow-up. Although there was an increase of 7.5% in the number of children who were overweight or obese in the control group, there was a 0.2% decrease in the intervention group over the initial 12-month follow-up period.

In terms of limitations, it is highlighted that the data on drink consumption was obtained for a short period (3 days) and relied on self-reported diaries, which may have been subject to under-reporting (Campbell *et al.*, 2001). Furthermore, only 36% of baseline and follow-up drink diaries were returned. Two years after the end of the intervention, a follow-up study (James *et al.*, 2007) found no difference in childhood overweight or obesity between the intervention and control group.

The school-based, healthy lifestyle education programme by Sichieri *et al.* (2008) encouraged water consumption in place of SSBs and resulted in a significant decrease of 23% ($P = 0.03$) in the mean daily intake (mL day^{-1}) of carbonated drinks in the intervention group. This decrease was four times as big in the intervention group compared to the control group. There was no significant difference in BMI between the intervention and control groups but, amongst intervention girls who were overweight at baseline, a significant ($P = 0.009$) reduction in BMI was found at the end of the school year. It should be noted that, during the intervention, subjects reported increasing their consumption of fruit juices, which may have compensated for any energy reduction from SSB reduction. This led to the conclusion that any efforts to reduce energy consumption through liquids should emphasise overall sweetened beverages including sugar added juices rather than just sodas. It was also concluded that the switch from sugary drinks to plain water was potentially too large and that, in future interventions, a switch from high to low-sugar beverages might be more successful. One limitation of this study was that data was based on only one self-reported 24-h recall at baseline and a further 24-h recall after the intervention. However, an attempt was made to validate the baseline data by using an additional beverage frequency questionnaire.

Singh *et al.* (2009) found that SSB consumption in both boys and girls of secondary school age had significantly decreased (25.5% and 23.9%, respectively; *P*-value not reported) by the end of this 8-month, educational and environmental, health promotion intervention, and that this was largely maintained at 12 months but had disappeared by 20 months. By the end of the intervention, there was no significant difference in BMI between intervention and control groups, although the sum of skinfold thickness was lower in girls in the intervention group at 8 months (−2.3 mm; 95% CI = −4.3 to −0.3 mm) and 20 months (−2.0 mm; 95% CI = −3.9 to −0.1 mm). It is worth noting that the limitations of the present study include nonblinding of key research assistants, self-selection of participating schools and the use of self-report questionnaires.

Cunha *et al.* (2013) delivered nine nutritional education sessions by trained nutritionists as part of their PAPPAS ('parents, students and teachers for healthy eating') intervention. Parents and teachers received information on the same subjects, the positive messages related to the intake of water, fruits, rice and beans and an emphasis on reducing SSBs and cookies.

The 9-month intervention led to a significant variation in the daily frequency of consumption of SSBs, specifically sodas (−0.2 in the intervention group compared to −0.08 in the control; $P = 0.02$) amongst the 11-year-olds but did not result in a reduction in BMI gain. However, the two groups were not well matched at baseline, with a higher prevalence of being overweight and obesity and a slightly higher intake of SSBs amongst participants in the control group. Cunha *et al.* (2013) commented on the additional difficulties of trying to make changes in low socioeconomic groups in developing countries such as Brazil. Furthermore, it was suggested that the lack of an effect on BMI despite the major reduction in SSB and cookie consumption may be the result of a concurrent increase in fruit consumption.

The web-based computer-tailored intervention (FATaintPHAT) described by Ezendam *et al.* (2012) included a focus on reducing the consumption of SSBs and high-energy snacks. The objective of the intervention was to prevent excessive weight gain among adolescents aged 12–13 years through the delivery of eight 15-min modules over a 10-week school term. Although the intervention was associated with 0.54 lower odds of a high daily intake (>400 mL day^{-1}) of SSBs compared to the control group at the end of the intervention (4 months), there was no significant difference at 24-month follow-up and no difference in anthropometric measures. The students perceived to be at greater risk, as determined by their baseline behaviours, did appear to benefit from the intervention to a greater extent (1.5 BMI change compared to 3.7 in the control group) at 24-month follow-up but the limitations of the study were the marked differences in the student characteristics at baseline.

School-based educational programmes combined with environmental change

The large study by Muckelbauer *et al.* (2009) introduced environmental and educational interventions into schools to promote the increased water consumption amongst primary school-aged children in socially deprived areas of two German cities. It combined the provision of water fountains and water bottles with educational sessions on water delivered by teachers as part of the school curriculum. This intervention did not have a significant effect on soft drink or juice consumption but significantly increased water consumption (1.1 glasses day^{-1} or more; 95% CI = 0.7–1.4 glasses day^{-1}; $P < 0.001$) compared to the control group. Although the change in BMI SD (i.e. standard deviation) score did not differ between the intervention and control group, the risk of being overweight was reduced by 31% ($P = 0.04$) in the intervention group. Measurement of the water flow of the drinking fountains during the intervention indicated that issuing new water bottles during the intervention led to increased water flow, suggesting that bottles may be an effective incentive in primary school-aged children. One limitation of this particular study is that other changes in dietary behaviours possibly resulting from this intervention were not recorded. Within the current review, this was the only one of the final selection of studies that attempted to estimate the costs of implementing the intervention. The costs associated with the environmental changes needed for this intervention were estimated as €2500 per water fountain and annual costs per child of €13 with no added costs for the educational component as it was delivered by the teachers.

School-delivered drinks

The school-based intervention (DRINK) by de Ruyter *et al.* (2012) involved the masked replacement of SSBs with non-energy drinks for an 18-month period in primary school-aged children. This double-blinded randomised controlled trial (RCT) provided participating children with one can each day of either a non-carbonated, non-energy, artificially sweetened drink or a 435 kJ (104 kcal), noncarbonated, sugar-containing alternative. After 18 months, the intervention group had significant reductions in BMI *Z*-score of −0.13 ($P = 0.001$), mean weight gain (significant mean difference of 1.01 kg; $P < 0.001$) and body fat measurements compared to the control group. One of the strengths of this trial was the measurement of urinary sucralose as an additional compliance marker from randomly selected children who completed the study. These measurements suggested a high degree of adherence amongst participants. A limitation of the study is that 26% of participants in the intervention group did not complete the study and, when their data were included in the analysis, the effect of the study beverage became smaller and was no longer significant. It was concluded that this was likely a result of those children returning to regularly having sugary drinks again once they had withdrawn from the trial.

Home-delivered drinks

Ebbeling *et al.* (2012) delivered water or diet drinks to the homes of randomly assigned overweight and obese secondary-aged children over a 12-month period. After 12 months, consumption of SSBs by the intervention group was almost non-existent (88% reduction in servings/week; $P < 0.001$) and remained very low at 2 years (76% reduction; $P < 0.001$) despite no active intervention in the intervening 12 months. This trial was the only one selected that also reported the energy and sugar intake from SSBs. Both the energy and sugar intake decreased significantly in the intervention group compared to the control group and these significant differences still existed at the 2-year mark. With respect to BMI, the net intervention effect in the experimental group at the end of 12 months was a significant reduction (−0.57; $P = 0.045$), although this was not significantly different at 2 years (−0.30; $P = 0.46$).

Quality assessment

Each of the selected papers were scored according to randomisation, the appropriateness of the method of randomisation, whether blinding was included in the methodology and the robustness of the process, and also whether those children who dropped out of the intervention/control were described and accounted for in the data analysis. Thus, the maximum number that could be scored was 5 (Table 2).

Using this scoring system, the study by Cunha *et al.* (2013) received the lowest score of 2 because, although participating schools were randomised to either intervention or control, the randomisation process did not allow for the significant differences in the baseline characteristics of the participating children. Similarly, the study by Ezendam *et al.* (2012) scored 2 for similar reasons with the intervention group consisting of more vocational schools, more boys and more non-Western students than the control group.

Three studies (Muckelbauer *et al.* (2009); Sichieri *et al.* (2008); Singh *et al.* (2009) scored 3. The studies by de Ruyter *et al.* (2012); Ebbeling *et al.* (2012) and James *et al.* (2004) had the highest possible quality score of 5. Although receiving high scores, these studies still have limitations as described individually.

Discussion

The aim of this systematic review was to identify interventions that can help to reduce the consumption of SSBs in children resulting in changes in body fatness so that conclusions can be drawn about how future effective interventions may be designed and used by relevant health professionals to address the increasing prevalence of childhood obesity.

Eight studies met the inclusion criteria. Six interventions achieved significant reductions in SSB intake but

Table 2 Quality assessment criteria used to assess the final eight intervention studies identified in the systematic review

	Randomisation	Method of randomisation described and appropriate	Blinding mentioned	Method of blinding described and appropriate	Withdrawal and dropout of subjects described	Total
Cunha *et al.* (2013)	1	0	0	0	1	2
De Ruyter *et al.* (2012)	1	1	1	1	1	5
Ebbeling *et al.* (2012)	1	1	1	1	1	5
Ezendam *et al.* (2012)	1	0	0	0	1	2
James *et al.* (2004, 2007)	1	1	1	1	1	5
Muckelbauer *et al.* (2009)	1	1	0	0	1	3
Sichieri *et al.* (2008)	1	1	0	0	1	3
Singh *et al.* (2009)	1	1	0	0	1	3

Total quality assessment score for which scores range between 1 and 5: with 1 being the lowest quality and 5 being the highest quality.

this was not always sustained over a longer period of time.

The interventions can be considered under four headings: school-based educational programmes, school-based educational programme combined with environmental change, school-distributed drinks and home-delivered drinks.

School-based educational programmes

Educational programmes delivered via the school curriculum focussing solely on consumption of drinks can be effective in reducing the intake of SSBs (James *et al.*, 2004; Sichieri *et al.*, 2008; Singh *et al.*, 2009; Ezendam *et al.*,2012; Cunha *et al.*, 2013) and can have an impact on percentage overweight or obese (James *et al.*, 2004) and reduction in BMI amongst those who are overweight, particularly in girls (Sichieri *et al.*, 2008; Singh *et al.*, 2009) and those who were perceived to be at greater risk at baseline (Ezendam *et al.*, 2012).

In the nutritional education programme delivered by James *et al.* (2004), although only a 25% reduction in carbonated drinks containing sugars was achieved at 12-month follow-up, there was a 7.7% difference in percentage overweight or obese, with those in the intervention group being less at risk. This effect, however, was not sustained at 36-month follow-up and, unfortunately, the level of consumption of SSBs at 3 years was not reported. In the other education-based programmes, the risk of being overweight/obesity was reduced following the web-based computer-tailored intervention reported by Ezendam *et al.* (2012) but only in those children perceived to be at a greater risk at baseline. It was predicted that those engaging in more 'risky' health behaviours at baseline might benefit more from the intervention and, indeed, this was the case. However, in contrast, although the nutrition education sessions delivered in Brazil (Cunha *et al.*, 2013) did lead to differences in soda ($P = 0.02$) consumption between the intervention and control groups, this did not lead to any significant differences in levels of body fatness. These children were from a relatively poor area of Brazil and it is proposed that the reduced intake of SSBs may have led to alternative sugar-containing beverages being consumed, which may not have been included in the analysis, or more fruit, which did not lead to a displacement of other less healthy items, as has been found in a number of systematic reviews of fruit intake and obesity (Rolls *et al.*, 2004; Ledoux *et al.*, 2011). A poor level of physical activity was also noted as a result of poor access to and inadequate facilities.

Generally, it is apparent that, although differences are seen for a certain length of time, either when the intervention is ongoing or after the intervention, behaviours are no different after a longer time interval.

Although not meeting the reviews inclusion criteria, Lo *et al.* (2008) demonstrated the effectiveness of the use of peers in changing behaviour in adolescents. The impact of peer leaders in school-based nutrition interventions in adolescents has been reported previously (Story *et al.*, 2002). In the study by Lo *et al.* (2008), both the single and multiple peer groups maintained a decrease in SSB consumption at 3-month follow-up but returned to their baseline behaviour at 1 year. This return to baseline behaviour has been found in other studies of teenagers (Lytle *et al.*, 2004) and it was suggested that this supports the potential need for maintenance sessions to remind children to maintain any new behaviours.

An evaluation of the multi-component Portuguese study (Program Obesity Zero), estimated to cost €373 per child, carried out by Rito *et al.* (2013) included a combination of health centre-based, family-centred and school-based education activities amongst overweight and obese primary school-aged children of low socio-economic status. Following the 6-month intervention, SSB consumption was reduced by 78% from baseline. BMI was 0.4 kg m^{-2} ($P < 0.001$), which is significantly lower after the intervention with a waist circumference of $\leq$2 cm ($P < 0.001$), whereas vigorous physical activity had increased, screen viewing time decreased and intake of total energy was less. However, the study data are not reported in such a way as to make it possible to identify the impact of the reduced consumption of SSBs on the anthropometric measurements (BMI and waist circumference). The study limitations include the fact that 55.1% of families with overweight children chose nonparticipation and it is possible that children may have biased their 24-h recalls of dietary intake following the intervention. These limitations will be equally applicable to some of the studies included in the review.

School-based educational programme combined with environmental change

The only study of this type from the final studies selected is Muckelbauer *et al.* (2009). The increased water consumption found in this trial in two poorer areas in Germany mirrors that found in a similar intervention amongst secondary school-aged children undertaken by Loughridge & Barratt (2005) and reinforces the impact of modifying the environment to support behavioural changes (Summerbell *et al.*, 2005; Sharma, 2007). Environmental changes to schools and communities may well play a key role in altering SSB intake in children.

Cradock *et al.* (2011) undertook a quasi-experimental evaluation of consumption data before and after policy changes regarding the sale of SSBs in vending and a la carte settings in US high schools and found that a significant reduction in SSB consumption coincided with a policy change to restrict their sale in high schools. A study by Kubik *et al.* (2011) highlighted the potential for school and district wellness councils to impact on the availability of less healthy vending machine fare in schools.

School-distributed drinks

The study by de Ruyter *et al.* (2012) demonstrates the impact of providing non-energy drinks to children in the school environment. This high quality, rigorously conducted study overcomes many of the shortcomings of previous RCTs and provides strong evidence that the reduced consumption of SSBs can decrease weight gain and obesity in children. As highlighted by the study, the evidence from observational studies suggests that consuming artificially sweetened drinks is associated with weight gain not weight loss (Fowler *et al.*, 2008; Foreyt *et al.*, 2012). However, the findings of this randomised control intervention study would support a move to discourage children from consuming sugary drinks as one potential way of reducing the high incidence of overweight in children. It may offer a workable intervention that can be replicated cost effectively in school settings.

Home-delivered drinks

The only study involving the home delivery of drinks to children is reported by Ebbeling *et al.* (2012). The study was designed to demonstrate the effects of reducing SSB consumption on body weight rather than as an intervention that could feasibly be rolled out on a wider scale. It was suggest that the lack of effect on BMI at the 2-year mark could either be the result of an increase in energy intake from SSBs and fruit juices in the intervention group once the trial has discontinued, a decrease in intake in the control group, or a combination of both.

Relevance of research to practice and the public health agenda

The final studies selected in this review suggest that a medium intensity (between 4 and 10×1-h sessions delivered over a period ranging between 6 weeks and 12 months) nutrition education programme focussing on beverage choices and delivered by either peers, teachers or nutritionists could be an effective way of reducing consumption of sugary drinks in both primary and secondary school-aged children.

The use of computer or web-based nutrition education delivered via school and home may also offer an effective contemporary educational route in reducing SSB consumption in children. Ezendam *et al.* (2012) showed a reduced risk of high SSB consumption following a web-based secondary school intervention. Haerens *et al.* (2007) improved the fat intake of secondary school-aged girls using a computer-tailored intervention aimed at promoting healthy food, drink and physical activity choices. Computer-based interventions could be an effective tool in helping to reduce SSB consumption amongst this age group and possibly younger children too, although it must be acknowledged that computer-based interventions may not be appropriate for all international communities, particulary in developing countries in areas of socioeconomic deprivation.

A consistent strand running through a number of the final studies highlighted in this review is the suggestion that maintenance sessions are necessary to remind children to maintain any change in SSB consumption over time (James *et al.*, 2004, 2007; Singh *et al.*, 2009; Ebbeling *et al.*, 2012; Ezendam *et al.*,2012). The need for maintenance sessions to be factored into the development of future interventions aimed at reducing SSB consumption is likely to be key to their long-term effectiveness.

Interventions that encourage possible alternative drinks to SSBs for children (water, diet drinks, 100% fruit juice) can offer some effective and practical ideas for future dietetic practice. The naturally occurring sugars in 100% fruit juices do mean that they contain a relatively high amount of energy (albeit along with some vitamins and other nutrients) and may be associated with an increased risk of excess weight gain (Dennison *et al.*, 1997) particularly amongst children who are already overweight (Faith *et al.*, 2006). Consumption should therefore be moderate. For example, the UK Eat Well Plate guidelines suggest 150 mL day^{-1} of fruit juice counts as one portion of the daily recommendation to have at least five fruits and vegetables (Public Health England, 2013). Fruit juice should only count towards one portion of this daily five-a-day recommendation of fruit and vegetables. In the USA, one recommended strategy for preventing childhood obesity is to 'Increase access to free, safe drinking water in public places to encourage water consumption instead of SSBs' (Institute of Medicine of the National Academies, 2009).

The combination of an educational intervention allied with changes to a primary school environment (provision of water fountains and water bottles) in the study carried out by Muckelbauer *et al.* (2009) did not lead to significantly reduced consumption of SSBs but did significantly increase water consumption and the risk of being overweight was reduced in the intervention group. The school-based educational study by Siega-Riz *et al.* (2011) aimed at improving a range of energy related behaviours also had no effect on SSB consumption but did significantly increase water consumption amongst secondary school-aged children.

Regarding switching from sugary drinks to plain water, it is worth noting that this may be potentially too large a leap for some children (Sichieri *et al.*, 2008) and consideration should be given to the possible merit of switching to a low-sugar alternative instead.

The studies by Ebbeling *et al.* (2012) and de Ruyter *et al.* (2012) both involve providing either water or diet drinks to children as an alternative to SSBs. Both interventions resulted in significant reductions in SSB intake and significant reductions in BMI in the intervention groups. However, these studies were designed to demonstrate the effects of reducing SSB consumption on body weight rather than as interventions that could feasibly be rolled out on a wider scale. Ebbeling *et al.* (2012) suggest that further work is needed to develop practical interventions for reducing SSB consumption that can be implemented on a large scale, possibly involving altering the school and community environments (availability, pricing and marketing of SSBs and non-SSBs).

These studies highlight the potential role that health professionals can play in working with schools to ensure that school environments encourage children to make healthier drink choices. Hu *et al.* (2013) suggest that public policies can play a key role in changing SSB consumption amongst children. Policies that could be considered include public health campaigns, higher taxation on SSBs and restricting access to SSBs, especially large serving sizes.

It is worth noting that a number of studies were effective amongst children in low socioeconomic groups and therefore could offer an opportunity for helping to reduce current health inequalities amongst children. The study by Muckelbauer *et al.* (2009) prevented the prevalence of being overweight amongst primary school-aged children in socially deprived areas and the intervention delivered by Ezendam *et al.* (2012) produced a reduced increase in BMI in the intervention group over the 2-year follow-up period for those perceived to be at greatest risk of unhealthy behaviours. This benefit was seen despite the intervention group consisting of more vocational schools and vocational-level students than the control group.

One possible way forward may be to adopt a modular approach to developing interventions by initially focusing on reducing SSB consumption followed by efforts to then alter other energy balance related behaviours in turn. This would give participants the opportunity to focus their efforts on one element at a time, without having to make too many stretching lifestyle changes at once. The maintenance of newly learned behaviours could also be built into the latter stages of an intervention to reinforce them. This may be a future area of research worth pursuing.

Strengths and limitations

Strict inclusion criteria was identified in advance of the search process and used accurately to identify relevant studies. The studies were quality assessed against a validated quality assessment tool designed to assess the quality of RCTs (Jadad *et al.*, 1996).

One limitation of this review is the small number of studies selected for comparison. This highlights the current small available pool of evidence in this area from which to draw meaningful conclusions about effective future interventions. The final studies are heterogeneous in nature and any overall conclusions must be drawn with care. Additionally, unpublished data and studies were not included within this review.

No studies were identified where an intervention targeted children under the age of 8 years.

Conclusions

The number of RCTs undertaken to date that are designed to reduce the consumption of SSBs and reduce body fatness in children is limited. No studies have been published to date that investigate interventions aimed at preschool-aged children. Based on evidence from the studies that have been completed in this field, school-based education programmes focused on reducing SSB consumption and incorporating follow-up modules may offer health professionals the best opportunities for implementing effective and sustainable interventions that are effective in both children and adolescents. Changing the school environment to support such educational programmes could improve the effectiveness of these interventions. There is a lack of relevant reported interventions carried out outside of the school environment. It should be noted that the school-based evidence does, however, include certain aspects that may be reproducible and effective in other settings. More rigorously conducted, quality RCTs in this area are required to aid the design of effective interventions that can be implemented by health professionals as one strand in the strategy of addressing the childhood obesity epidemic.

Conflict of interests, source of funding and authorship

The authors declare that they have no conflicts of interest.
A small amount of funding was received from the British Dietetic Association to contribute towards this work.
LB carried out the initial extraction of data. AA undertook the revised data extraction following the comments received. All authors contributed to each of the stages involved in the review; the decision on the search terms to be used; the final selection of papers to be used in the review; discussion on the data to be extracted and their interpretation; and the writing and editing of the paper. The topic for review was selected by the specialist group of the British Dietetic Association, DOM UK for which LB was commissioned to undertake the research. All authors critically reviewed the manuscript and approved the final version submitted for publication.

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Paper 12

Stubbs, J., Hillier, S. Pallister, C., **Avery, A.,** McConnon, A., Lavin. (2015). **Changes in self-esteem in participants associated with weight loss and maintenance of commercial weight management programme**. *Obesity & Control Therapies* 2(1): 1-5.

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Changes in Self-esteem in Participants Associated with Weight-loss and Maintenance of Commercial Weight Management Programme

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Received: February 19, 2015; Accepted: May 22, 2015; Published: June 15, 2015

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Abstract

Introduction and methods: This study examined associations between weight loss, its maintenance and self-esteem in 292 members of a commercial weight management organisation, Slimming World. Self-esteem was measured with the Rosenberg self-esteem questionnaire adapted to 5-point Likert scales. Associations between dimensions of self-esteem and weight change were examined by correlation and regression using the GENSTAT 5 statistical program.

Results: Mean (SD) weight on joining the CWMO was 89.0 (20.0) kg; time taken to reach current weight was 16.3 (13.5) months. Mean (SD) weight change was -15.6 (11.4) kg and BMI change was -5.7 (4.0) (both $p < 0.001$), maintained for 11.7 (12.8) months. Percent variance in weight change associated with each component of self-esteem is given in parentheses. All weight changes were negative. Participants reported a decrease in sense of failure (3.9%) and an increase in self-respect (3.0%) and self-pride (2.4%). Self-satisfaction (12.8%), feelings of self-achievement (10.6%), positive attitudes towards themselves (9.9%), sense of self-worth (10.6%) and self-efficacy (7.3%) all significantly increased in association with reaching and maintaining their current weight (all $p < 0.001$). Multiple regression analysis showed that age, gender, height and start weight accounted for 35.4% of the variance in weight change. Self-esteem components of the model accounted for 50.4% of the variance in weight change.

Conclusion: Successful weight loss and maintenance was associated with significant reported improvements in self-esteem in members of a commercial weight management organisation.

Keywords: Weight maintenance; Self-esteem, Commercial weight management programme

Introduction

It is now well-documented that body weight is related to self-esteem, but the relationship is multifaceted, influenced by a number of mediators (factors contributing to the relationship between two conditions) and moderators (factors affecting the strength of the relationship between two conditions) and can be bi-directional: weight can influence self-esteem and vice versa [1]. High BMIs tend to be related to lower self-esteem in both adults and children as reported in many [2-6], but not in all studies [7-9]. The relationship between body weight and self-esteem is often moderated by culture, gender, age and ethnicity [1]. The relationship is mediated by a number of factors such as cultural norms [10], number of previous dieting attempts [11], intimate relationships [12], depression [13] and the degree of stigma that overweight people experience. Body weight is related to perceptions of body image and body dissatisfaction [7,14-16], whether those perceptions are directly related to weight or not [17]. In modern society, women tend to perceive themselves as more overweight and aspire to be leaner than they are, whereas men do not perceive themselves as overweight or obese [1]. This over-evaluation of body shape in women may well be influenced by self-criticism [3].

In their comprehensive meta-analysis review of the effects of weight loss on psychological well-being, *Blaine et al.* [2] compared the effects of bariatric surgery and drugs (a biomedical approach) with psychotherapeutic weight loss treatments (a psychosocial approach) in 117 studies. They found a tendency for these weight loss treatments to reduce depression and increase self-esteem. However, only treatments that produced actual weight loss increased self-esteem, while reductions in depression were independent of weight loss. Treatments using drugs/surgery were much better at reducing depression, but therapy-based treatments increased self-esteem much more than treatments using drugs/surgery [2]. These outcomes are interesting but do not address how more commonly used weight management programmes, such as community based lifestyle programmes, impact psychological outcomes such as self-esteem.

In recent years there is growing evidence of the effectiveness of commercial weight management programmes in the scientific community [18-23]. However, there are very few data on the impact of commercial weight management programmes on self-esteem among participants who have lost a significant amount of weight (i.e. ≥ 10%). This survey assessed self-reported self-esteem and its association with a decrease in weight and BMI in members of a commercial weight management programme who had lost a significant amount of weight.

Materials and Methods

Two samples were recruited for this study. The first sample included subjects who were classified as Weight Loss Maintainers (WLM) attending a Commercial Weight Management Organisation (CWMO) and were contacted using the members' website. WLM were defined as members having reached and maintained their personally chosen target weight for at least 3 months. The invitation to complete the survey remained on the website for 1 month. A second sample included subjects who had participated in the Slimming World arm of the Diogenes study [24]. Both sample groups completed a short questionnaire and were offered the same incentive (entry into a prize draw to win £100). With the exception that the second sample had previously answered psychological and behavioural questions, as part of the Diogenes study, there was no difference in the interactions the researchers had with each sample. Both samples had continued to participate as members of the CWMO during the time of the survey. Subjects registered informed consent to taking part in the study by clicking a link to the questionnaire.

The questionnaire was divided into two sections, the first collected data on age, height, date of birth, duration of membership, time taken to reach current weight and time at current weight. Duration of membership, time taken to reach current weight and time at current weight data, were computed by assuming linearity and taking the mid-point of each time category, (i.e. 6 months or less as 3 months, 6 - 12 months as 9 months, 12 - 18 months as 15 months, 18 months - 2 years as 21 months, 2 - 3 years as 30 months, More than 3 years as 48 months). On average both samples had been long-term members (29.1 ± 14.1 and 38.2 ± 13.3 months, respectively) and had lost a substantial amount of weight (16.0 ± 9.0 and 15.3 ± 13.7 kg, respectively), which they had maintained for a mean (SD) of 11.1 (12.7) and 12.4 (13.0) months, respectively.

The second section of the questionnaire comprised of 5-point Likert scales asking questions about sources of help/support and reasons for trying to lose weight, behavioural strategies believed to have helped achieve weight loss, previous attempts at weight loss, motivational factors important to achieving and maintaining weight loss and retrospective, self-reported assessments of eating/activity habits and self-esteem (using the Rosenberg self-esteem scale [25]) before and after the subjects lost weight. Data were collected at one time point and so questions relating to "before weight loss" were retrospective. Data relating to self-esteem are reported here. Data relating to behavioural and motivation factors associated with WLM are published elsewhere [26]. This study was reviewed and approved by the University of Surrey Ethics Committee (approval: EC/2006/86/Psych).

Weight, age and height were self-reported by the participants themselves, for when they joined and at the time of questionnaire completion. The questionnaire was constructed and administered using Checkbox v4.4-Web Survey Software 2007, Prezza Technologies, Inc.

Statistical Analysis

Using height, start weight and end weight; the start and end BMI, weight and percent weight change were calculated. Associations between changes in self-esteem and weight change were examined by Pearson correlation coefficients. Associations between age, gender, height and start weight, self-esteem and weight change were analysed by fitting linear models and examining the significance of fitted terms in these models, through regression analysis. All analyses were performed using Microsoft Excel (2007) and the GENSTAT 5 statistical program (Genstat 5 Rothampstead Experimental Station, Harpenden, UK). Results are expressed as mean (SD), mean (SE) or as percentages where relevant.

Results

Participants

292 participants (277 women and 15 men) completed the survey and were included in the analysis. Mean (SD) joining weight (prior to weight loss) was 89.0 (20.0) kg; BMI was 32.6 (6.6) kg/m^2; height was 1.65 (0.07) m; age was 47.0 (12.9) years; duration of membership was 29.1 (16.2) months. At the point of survey, weight and BMI (after weight loss) was 73.4 (16.3) kg and 26.9 (5.6) kg/m^2, respectively. Mean (SD) weight change was -15.6 (11.4) kg, BMI change was -5.7 (4.0) kg/m^2, (all $p < 0.001$), time to reach current weight was 16.3 (13.5) months and time at current weight, 11.7 (12.8) months.

Changes in how participants felt about themselves before and after achieving a sustained weight loss

Participants' responses to questions about their sense of self-worth, both before they joined the CWMO and after they had achieved their current weight are shown in Figure 1. All changes were significant at $p < 0.001$. Percent variance in weight change associated with each variable is given in parentheses. Self-reported lack of self-respect (3.0%), lack of self-pride (2.4%) and sense of failure all decreased (3.9%). Self-satisfaction (12.8%), feelings of self-achievement (10.6%), positive attitudes towards themselves (9.9%), sense of self-worth (10.6) and self-efficacy (7.3%) all significantly increased in association with reaching their current weight and maintaining it.

Associations between changes in self-esteem and change in weight

As all weight changes were negative (as all subjects were weight loss maintainers), a positive directional change in a component of the Rosenberg self-esteem questionnaire showing a negative correlation with weight, indicated that an increase in that variable was associated with weight loss. A negative directional change in a component of the Rosenberg self-esteem questionnaire showing a positive correlation with weight also indicated that the change in that behaviour was associated with weight loss.

The direction of self-esteem and rank order of correlations between these outcomes and change in weight after the initial weight loss are reported in Table 1. Unifactorial regressions report percentage the variance in weight change that was associated with each component of self-esteem. All measures of self-esteem showed significant correlations with weight change ($p < 0.001$). Multiple regression models were computed for change in weight and BMI. Age, gender, height and start weight accounted for 35.4% of the variance in weight change, with self-esteem components of the model explaining 50.4% of the variance in weight change. By adding all components into a multiple-regression analysis, the model shows that self-esteem explains a smaller percentage of the variance on aggregate compared to the sum of the variance explained by univariate regressions which indicates that there is some inter-dependence or overlap between some of the components i.e. some of the components explain part of the variance attributable to other components.

Discussion

Changes in self-worth and self-esteem associated with weight loss and maintenance

This study demonstrated that weight reduction (-15.6 kg over 16.3 months), which was maintained (for 11.7 months), was associated with significant improvements in self-esteem. The self-reported changes in this present study are consistent with previous evidence that suggests obese women report low self-esteem, which improves following weight loss [2,27]. This study demonstrates that these effects are apparent in the context of a self-selected population of participants who had lost a significant amount of weight in a commercial weight management programme, although the results of this specific

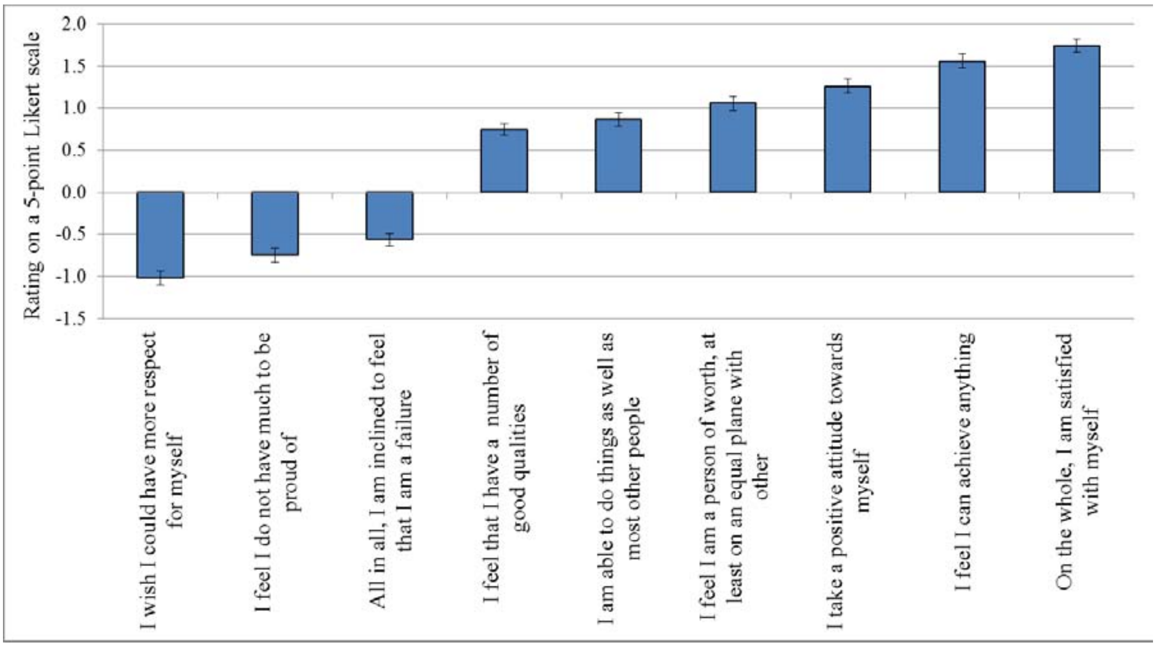

Figure 1: Mean (SE) difference in response to a 5-point Likert scale asking participants to describe how they felt about themselves before and after successful weight loss maintenance (n = 292). + denotes *p < 0.001*.

Table 1: Correlations between changes in eating behaviours activity behaviours, self-worth and self-esteem and weight change (n = 292).

Direction change	Self-worth and esteem	Weight Change	
		r	p
+	I felt I could achieve anything	-0.36	*< 0.01*
+	On the whole, I am satisfied with myself	-0.35	*< 0.01*
+	I feel I am a person of worth, at least on an equal plane with others	-0.34	*< 0.01*
+	I took a positive attitude towards myself	-0.34	*< 0.01*
+	I am able to do things as well as most other people	-0.33	*< 0.01*
+	I feel that I have a number of good qualities	-0.28	*< 0.01*
-	All in all, I am inclined to feel that I am a failure	0.24	*< 0.01*
-	I wish I could have more respect for myself	0.24	*< 0.01*
-	I feel I do not have much to be proud of	0.26	*< 0.01*

Citation: Stubbs J, Hillier S, Pallister C, Avery A, McConnon A, et al. (2015) Changes in Self-esteem in Participants Associated with Weight-loss and Maintenance of Commercial Weight Management Programme. Obes Control Ther 2(1): 1-5. DOI: http://dx.doi.org/10.15226/2374-8354/2/1/00115

study are perhaps constrained to this context.

Many obese women have low self-esteem and lack confidence, both of which may improve following weight loss; they also feel discriminated against, and stigmatised by their weight [2,27]. Modern western society can be punitive and discriminating towards overweight people for many reasons [28-31]. These considerations suggest that to have maximum benefit to participants, weight management programmes should consider addressing both the behavioural (diet and physical activity) and emotional dimensions of weight control by helping people improve their self-criticism, self-esteem, self-worth, mental-wellbeing and coping-strategies through social support [1,32].

The results of the current study are however unable to disaggregate weight loss and weight loss maintenance. Improved self-esteem may therefore facilitate coping with lapses and so promote weight loss maintenance *Turner et al* [33]. Emphasise the importance of low self-esteem as a trigger for relapse [34]. A survey of 3394 men and women found women in particular, rated depression, stress, low self-esteem and the need to avoid social or sexual situations, as the more important reasons for weight gain compared to men and that women were also more likely to feel bad and regain weight as response to a relapse [35]. Similarly *Byrne et al.* [36] identified characteristics such as failure to achieve weight goals and dissatisfaction with weight achieved, tendency to evaluate worth in terms of weight and shape, a lack of vigilance with regards to weight control, dichotomous thinking and a tendency to use food to regulate mood are associated with weight regain but not maintenance [37]. Feelings of failure, stigma, self-criticism and shame may be key factors underlying relapse in people who have a tendency to do so and therefore should be investigated in future studies [32,36].

Limitations of the current study

Many individuals who attend peer-support groups tend to be characterised by a common trait – they have a tendency to relapse [38-41]. Hence they seek the on-going support and stability that the safe environment of a peer-support, self-help group provides [32,33]. This suggests that there is both strength and a limitation to studies such as the current analyses. It is likely that this sample is a specific, self-selected sub-group, who represent individuals that successfully lose weight in a CWMO and maintain the loss, and may therefore not represent all individuals attempting to lose weight or the general population as a whole.

The current study is unable to determine if changes in self-esteem occurred before, during or as a consequence of weight loss. A weakness of the study lies in the implementation of retrospective questionnaires to compare the responses of the same subjects before and after their weight loss. However the use of this method has to be balanced against the difficulty of identifying successful weight loss maintainers prior to their weight loss.

In addition, the current study recruited predominantly female participants and as such future investigations should determine the differences between male and female responses to the psychological and behavioural aspects of weight loss and weight maintenance. Indeed depressions, degree of stigmatisation and self-criticism have close links with measures of self-esteem and were also not measured. Future research should therefore measure changes in these symptoms during both weight loss and weight maintenance.

Conclusions

Improvements in self-esteem were associated with long-term weight loss and maintenance in members of a CWMO. Future investigations should focus on developing the evidence base to determine the impact and relationship of weight loss through weight management programmes on the psychological and emotional aspects of well-being and weight control.

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Paper 13

Avery, A., Langley-Evans, S., Harrington, M., Swift, J. (2016). **Setting targets leads to greater long-term weight losses and 'unrealistic' targets increase the effect in a large community based commercial weight management population**. *Journal of Human Nutrition and Dietetics.* DOI: 10.1111/jhn.12390

BDA The Association of UK Dietitians
THE OFFICIAL JOURNAL OF THE BRITISH DIETETIC ASSOCIATION
Journal of Human Nutrition and Dietetics

RESEARCH PAPER

Setting targets leads to greater long-term weight losses and 'unrealistic' targets increase the effect in a large community-based commercial weight management group

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Keywords
setting targets/goals, community weight loss.

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How to cite this article
Avery A., Langley-Evans S.C., Harrington M., Swift J.A. (2016) Setting targets leads to greater long-term weight losses and 'unrealistic' targets increase the effect in a large community-based commercial weight management group.
J Hum Nutr Diet.
doi: 10.1111/jhn.12390

Abstract

Background: Setting personal targets is an important behavioural component in weight management programmes. Normal practice is to encourage 'realistic' weight loss, although the underlying evidence base for this is limited and controversial. The present study investigates the effect of number and size of weight-loss targets on long-term weight loss in a large community sample of adults.
Methods: Weight change, attendance and target weight data for all new UK members, joining from January to March 2012, were extracted from a commercial slimming organisation's electronic database.
Results: Of the 35 380 members who had weight data available at 12 months after joining, 69.1% (n = 24 447) had a starting body mass index (BMI) ≥30 kg m^{-2}. Their mean (SD) weight loss was 12.9% (7.8%) and, for both sexes, weight loss at 12 months was greater for those who set targets ($P < 0.001$). Those that set ≥4 targets achieved the greatest loss ($P < 0.001$). The odds ratio for weight loss ≥10% at 12 months was 10.3 (95% confidence interval = 9.7–11.1, $P < 0.001$) where targets had been set compared to none. At the highest quintile of target size, the size of the first target explained 47.2% ($P < 0.001$) of the variance in weight loss achieved at 12 months. The mean (SD) BMI reduction in those with a target >25% was 7.6 (4.0) kg m^{-2}. A higher percentage of obese members did not set targets ($P < 0.001$) compared to those with a BMI <30 kg m^{-2}.
Conclusions: Much of the variance in weight loss achieved in this population was explained by the number of targets set and the size of the first target. Although obese people were less likely to set targets, doing so increased the likelihood of achieving clinically significant weight loss and, for some 'unrealistic' targets, improved the results.

Introduction

Behaviour change strategies are perceived as important components of the underlying treatment for obesity, namely lifestyle modification through diet and exercise (1). The setting of targets and goals is considered to be an important behavioural change technique (2). Both the Centers for Disease Control and Prevention (3) and the National Institute for Health and Care Excellence (4) recommend that an intervention should encourage individuals to set a weight-loss target of 5–10% of initial body weight. This has been associated with clinically significant health benefits (5,6) and is described as 'realistic' (4). More recent National Institute for Health and Care Excellence (NICE) guidance suggests that a 3% weight loss is desirable and should be the aim for a 12-week intervention (1). However, health improvement is only one reason for people wanting to lose weight and maintain weight loss.

Physical appearance, social factors such as social pressure and events, improving self-esteem, energy levels and work performance can also motivate individuals to lose weight and maintain a healthier weight [7,8].

Weight-loss targets, goals and expectations are all described as motivators for weight loss [4], although the terms are often confused and used interchangeably, both in practice and in the literature. A weight-loss target or goal may be defined as the total amount of weight an individual would like to lose [9], whereas expectations are more realistic than targets and should ideally be fluid and change as weight loss occurs [10]. Clients will inevitably come into a weight-loss programme with an idea of the amount of weight that they are aiming to lose. These weight-loss targets are important because they regulate behaviour by affecting attention, decisions, effort and task persistence [11]. They energise and direct behaviour [12], and create the framework through which the behaviour is perceived and evaluated [13].

Evidence suggests that effective diet and exercise modification interventions over a 12–24 week period can result in a weight loss of 5–10% of initial body weight [14] and yet this is unsatisfactory to many obese individuals [15]. Weight-loss targets are often much higher than recommended and influenced by many individual factors, including baseline body mass index (BMI) [16] and sex [17]. Weight-loss targets and expectations are also influenced by the environment, with higher targets in clinical compared to community settings [18].

Targets set by clients are often much higher than what is actually achieved[16], which has led to high targets being considered 'unrealistic' [4] and a cause for concern. The 'false hope' syndrome/hypothesis [19] suggests that very ambitious targets relating to weight loss are less likely to be met, and that the subsequent failure will to lead to disappointment, dissatisfaction, decreased effort and relapse. However, evidence demonstrates that non-attainment of goals does not necessarily stop successful weight losers from maintaining their weight loss [9,20]. With many individuals being more satisfied by smaller weight losses than they expected, it is suggested that weight-loss goals become less important in the long-term [14,21] and maintenance may become easier [22]. A recent meta-analysis concluded that there was no empirical evidence to suggest that setting realistic goals led to greater weight loss, or that unrealistic goals had any negative impact on weight loss [6]. Others have gone further and suggested that higher targets may be motivational to some participants who wish to avoid the feeling of disappointment [9]. A review looking at the effect of expectations on weight-loss outcomes concluded that higher targets may lead to higher weight loss at 6–12 months [14].

Indeed, Locke & Latham [11] suggest that goals act in an energising capacity and setting higher targets results in greater effort being made, resulting in a better performance than a lower set target. In addition, goals have an impact on the level of persistence, again with harder targets leading to prolonged effort. Setting realistic targets is claimed to be one of the seven myths about current obesity treatment with insufficient evidence to support the practice [23].

Thus, there is much debate as to the effect that weight-loss targets have on long-term weight loss. In the present study, their effect within a large community-based, commercial weight management group that positively encourages target weight setting was considered to provide further fuel for the debate. The aim was to consider whether self-imposed target setting predicts weight loss at 12 months in group members with an initial BMI $\geq$30 kg m^{-2}. Three aspects of targets were investigated as predictors: (i) whether target setting was reported by the group member or not; (ii) the number of targets set over the 12-month data collection period; and (iii) the size of the first target set. It was hypothesised that setting weight-loss targets leads to a greater amount of weight loss in the long-term (12-month period) and significantly more members reaching $\geq$10% weight loss. For those who do set targets, it was also hypothesised that larger targets and setting a greater number would lead to greater weight loss over 12 months.

Materials and methods

Slimming World (SW) is a UK-based commercial weight management programme meeting the NICE (2014) guidance for programme content and constant efforts are made to evaluate and thus improve the support offered to members. SW weekly groups are held throughout the UK and members are further supported by a magazine and website. At SW, weight-loss targets are referred to as personal achievement targets. Members are strongly encouraged to set their own weight-loss target, although it is not compulsory and the health benefits of losing 10% initial weight are emphasised. The trained group facilitator may offer advice if requested and will ensure that the target does not lead to a weight below the healthy range. Those who choose to do so have the freedom to set interim and final weight targets, which can be fluid, to suit their own requirements.

Data on new members aged $\geq$18 years and not pregnant, who joined between January 2012 and March 2012 inclusive, were extracted from the SW electronic database. Data were collected for all members up to either their leaving the group or, for members still attending, up to

September 2013. Data available in the SW database were electronically collected from registration forms and group meetings. Members were weighed at the group in light clothing without shoes using calibrated scales (Seca Ltd, Birmingham, UK) to the nearest 200 g. Personal information on each new member included date of recruitment, date of birth, region, sex, self-reported height, number of attendances, initial weight and weight at 12 months. In addition, any reported interim/final weight-loss targets and the date of target achievement were also recorded. Names and membership numbers were removed from the database to ensure the anonymity of participants. Ethical approval for the secondary data analysis was approved through the School of Sociology and Social Policy, University of Nottingham.

Data screening

Any non-UK members within the database were removed, as were any members who only attended the initial group meeting or for whom data on any variable were missing (Fig. 1). Age at baseline was calculated for each member based upon their date of birth and the date of recruitment. Initial BMI and BMI at 12 months, respectively, was calculated by dividing initial weight and weight at 12 months (converted to kg) by the square value of self-reported height (m). Initial BMI was categorised into normal weight (20–24.9 kg m^{-2}), overweight (25–29.9 kg m^{-2}), obese (30–39.9 kg m^{-2}) and morbidly obese (>40 kg m^{-2}). Weight change at 12 months is reported as a percentage of the start weight. The targets achieved are

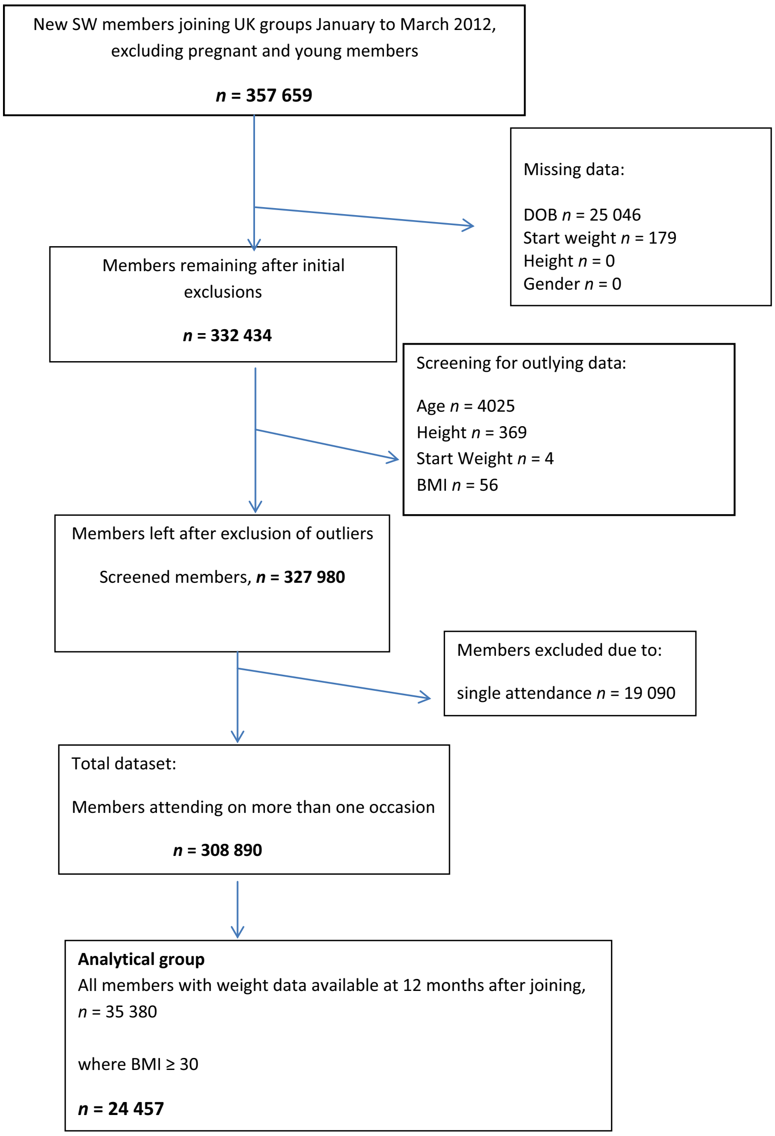

Figure 1 Flowchart of data screening process. SW, Slimming World; DOB, date of birth; BMI, body mass index.

reported as a percentage of the starting weight. Weeks to achieve the first target were calculated from the difference between date of achievement and date of recruitment. Participants were categorised as 'target set' and 'non-target set' members based upon whether they had target weights reported. Outliers were screened out using standard SW parameter checks: members were excluded if any of the following applied <18 and >80 years, height <1.35 and >2.1 m, start weight <36 and >273 kg or start BMI <20 and >90 kg m^{-2}. Finally, data were screened for any abnormal weight changes >70 kg or > 50% weight loss or >10% weight gain. The original dataset of 376 186 members extracted generated a useable dataset of 308 890 individuals (Fig. 1). An analytical group was then created comprising members from this dataset with 12-month weight data available and who had an initial BMI ≥30 kg m^{-2}. This resulted in an analytical sample of 24 447 individuals (Fig. 1) used to test the study hypotheses.

Statistical analysis

All statistical analysis was carried out in SPSS, version 22.0 (IBM Corp., Armonk, NY, USA). All continuous variables were tested for normality as determined by the level of skew and kurtosis. Unless stated otherwise, continuous data are Gaussian and are described using the mean (SD) and bivariate analyses were conducted using independent samples *t*-tests and Pearson's correlation coefficient. Binominal data were described using frequencies and bivariate analyses were conducted using a chi-squared test. Data are reported as the mean (SD).

To test the hypothesis that setting weight-loss targets leads to a greater amount of weight loss in the long-term (12-month period), 'target set' members and 'non-target set' members in the analytical group were analysed using one-way analysis of variance (with post-hoc Bonferroni correction). To test the hypothesis that the size of the first target leads to a greater amount of weight loss in the long-term (12-month period), the population was divided into quintiles based upon the size of the first target. To investigate the relative importance of the size of the first target and the number of targets as predictors of percentage weight change at 12 months, stepwise linear regression analysis was performed using adjusted r^2 values and standardised coefficients (β values) to determine the level of significance. Collinearity statistics were used to determine the level of tolerance. Finally, to determine the predictors of a ≥10% weight loss at 12 months, odds ratios (OR) and corresponding 95% confidence intervals (CI) were determined in the analytical sample as a whole, and within each quintile of the size of the first target.

Results

Characteristics of 'target set' and 'non-target set' members in the total data set

The mean (SD) initial BMI for the total data set (n = 308 890) was 33.1 (6.39) kg m^{-2} and the mean (SD) age at joining was 43.1 (13.6) years. Some 46.6% (n = 143 940) were 'target set' members and 53.4% (n = 164 950) were 'non-target set' members. The majority of members in the total data set were female: 95.2% in the 'target set' group and 95.9% in the 'non-target set' group. Members in the 'target set' group were significantly older than those in the 'non-target set' [mean (SD) age at joining of 43.4 (13.7) years versus 42.8 (13.5) years, $P < 0.05$]. Members in the 'target set' group had a significantly lower initial BMI [mean (SD) 32.1 (6.0) versus 33.8 (6.6) kg m^{-2}, $P < 0.05$] compared to members in the 'non-target set' group. A significantly higher percentage of members with normal weight and overweight initial BMI were in the 'target set' group (54.9% versus 45.1% in the non-target set group, $P < 0.001$), whereas a lower percentage of members with an obese or morbidly obese initial BMI (n = 197 271) were in the 'target set' group (58.1% versus 41.9%, $P < 0.001$). Members in the 'target set' group were significantly more likely to attend SW for a longer period [mean (SD) 21.0 (21.4) versus 12.7 (14.4) weeks, $P < 0.05$]. 11.5% (n = 35 380) of the total sample had weight data available at 12 months after joining. Significantly more 'target-set' members had a 12-month weight recorded than 'non-target set' members (18.5% versus 5.4%, $P < 0.05$).

Analytical group

Of the 35 380 members who had weight data available at 12 months after joining, 69.1% (n = 24 447) were obese on joining SW. For this analytical group, the mean initial BMI was 37.1 (5.9) kg m^{-2} and age at joining was 47.6 (13.7) years. Mean (SD) weight loss at 12 months was 12.9% (7.8%). 68.2% (n = 16 663) were 'target set' members and 31.8% (n = 7784) were 'non-target set' members (Table 1). Initial BMI, weight loss and BMI at 12 months were influenced by significant interactions of sex and target setting ($P < 0.001$). Both males and females in the 'target set' group had lower initial BMI compared to those in the 'non-target set' group, and men had significantly higher initial BMI in both the 'target set' and 'non-target set' group ($P < 0.001$). For both sexes, those in the 'target set' group were significantly older than those in the 'non-target set' group ($P < 0.01$). There was no significant difference in percentage weight loss at 12 months between men and women in either the 'target

Table 1 Characteristics of cohort: comparing target setters and non-target setters

	No target set		Targets set	
	Men	Women	Men	Women
n	474	7310	1383	15 280
Initial weight (kg)	128.3 (25.4)	103.7 (18.7)***	117.9 (20.5)†	96.9 (16.6)***†
Initial BMI (kg m^{-2})	40.5 (7.1)	38.7 (6.3)***	37.2 (0.7)†	36.3 (5.4)***†
12 month weight (kg)	114.1 (20.0)	92.9 (16.4)***	100.0 (17.3)†	82.9 (15.3)***†
12 month BMI	36.0 (5.6)	34.6 (5.6)***	31.5 (5.0)†	31.0 (5.1)***†
Weight loss (kg)	14.3 (12.2)	10.8 (8.1)***	17.9 (12.5)†	14.0 (8.7)***†
Weight loss (% initial weight)	10.5 (7.4)	10.0 (6.7)*	14.8 (8.6)†	14.2 (7.8)*†
Age	48.4 (13.2)	47.5 (13.6)	48.9 (13.3)	47.5 (13.8)**
Number of attendances	60.2 (16.2)	60.6 (15.5)	61.2 (16.0)†	62.5 (15.3)†

Significant effect of sex: *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.
†Indicates a significant effect of setting target ($P < 0.001$).
All data are shown as the mean (SD). Initial weight, initial body mass index (BMI), weight at 12 months and BMI at 12 months were influenced by significant interactions of sex and target setting ($P < 0.001$).

set' or 'non-target set' group. However, for both sexes, the percentage weight loss at 12 months was significantly greater for members in the 'target set' compared to the 'non-target set' group ($P < 0.001$). For both sexes, members in the 'target set' group attended more sessions than those who did not ($P < 0.001$) (n = 62.8% of 'target set' members set 1 target; n = 23.7% set 2 targets; n = 8.7% set 3 targets; and n = 4.8% set 4 or more targets over the 12-month study period). Those members that set more than four targets over the year achieved significantly greater weight loss ($P < 0.001$) (Fig. 2).

For the 16 663 'target set' members in the analytical group, the mean (SD) size of the first target was 19.4 (9.0)% weight loss (Table 2). To extend the analysis, the population was divided into quintiles on the basis of the size of first target (Q1: <10.41%; Q2: 10.42–16.35%; Q3: 16.36–20.86%; Q4: 20.87–26.48%; and Q5: >26.48%

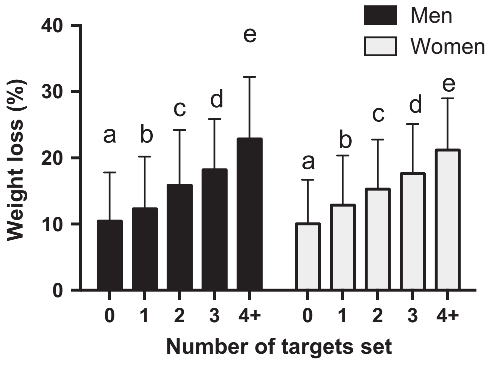

Figure 2 Impact of number of targets set on weight loss at 12 months.

of weight loss). Members setting the highest first targets were significantly younger than those setting lower first weight-loss targets. Members setting the highest first targets had significantly higher initial BMI [Q5 mean (SD) 39.4 (5.5) kg m^{-2}] than those setting targets in any other quintile [Q1: 36.9 (6.0); Q2: 34.9 (4.9); Q3: 34.8 (4.7); and Q4: 35.7 (4.8) kg m^{-2}, respectively, $P < 0.001$]. The mean weight loss at 12 months for all those setting targets was 14.3 (7.9) %. Members setting the highest first target achieved a significantly greater percentage weight loss at 12 months compared to members in other quintiles [13.9 (6.1), 16.1 (7.0) and 19.0% for all of the mean values and sds could we please have mean(sd) and then the unit eg % to be consistent with the other results presented (9.4) for the third, fourth and fifth quintiles, respectively, compared to 11.4 (7.6) and 11.1 (6.0) for the first and second quintiles, $P < 0.001$]. A mean (SD) BMI change of 36.3 (5.5) to 31.0 (5.1) kg m^{-2} was achieved by the group setting targets compared to 38.8 (6.4) to 34.7 (5.6) kg m^{-2} in the group with no targets reported, a difference of 1.1 kg m^{-2} ($P < 0.001$). The higher weight losses achieved at 12 months in those setting higher first weight-loss targets was reflected in greater BMI changes achieved (Table 2). Members setting higher first targets took significantly longer to achieve their target weight (Table 2). There was no significant difference in terms of the total number of attendances between the quintiles.

To identify predictors of percentage weight loss at 12 months, stepwise linear regression was used. Prior to analysis, the data set was screened for missing values and examined for fit between the variables and the assumptions of multivariate analysis. The dependent and independent variables were investigated using bivariate correlation analysis. All independent variables were

Table 2 Characteristics of the analytical group including quintiles of initial weight-loss target

	All subjects	No target set	All with target set	Size of first target 0–10.41% loss (Q1)	Size of first target 10.42–16.35% loss (Q2)	Size of first target 16.36–20.86% loss (Q3)	Size of first target 20.87–26.48% loss (Q4)	Size of first target >26.48% loss (Q5)
n	24 447	7784	16 663	3333	3329	3334	3318	3330
% Female	92.4	93.9	91.7	92.9	90.4	91.0	91.7	92.5
Age (years)	47.6 (13.7)	47.6 (13.6)	47.6 (13.8)	48.8 (13.8)	50.8 (13.9)	48.7 (13.7)	46.6 (13.4)	43.0 (12.9)*
Initial BMI (kg m^{-2})	37.1 (5.9)	38.8 (6.4)	36.3 (5.5)†	36.9 (6.0)	34.9 (4.9)**	34.8 (4.7)**	35.7 (4.8)	39.4 (5.5)*
Number of attendances	61.8 (15.5)	60.6 (15.5)	62.4 (15.4)†	61.4 (15.7)	60.5 (15.2)	62.1 (15.1)	63.2 (15.1)	65.0 (15.3)*
Number of targets set			1.6 (1.0)	2.2 (1.2)	1.6 (0.9)	1.5 (0.8)	1.4 (0.8)	1.3 (0.7)*
Weeks to achieve first target	32.9 (20.5)		28.3 (20.5)	18.4 (16.3)	21.5 (17.6)	28.9 (16.9)	34.7 (16.9)	38.2 (16.7)*
Size of first target achieved (% weight loss)	19.4 (9.0)		19.4 (9.0)	8.2 (2.2)	13.8 (1.6)	18.6 (1.3)	23.4 (1.6)	33.1 (5.9)*
Weight loss at 12 months (%)	12.9 (7.8)	10.1 (6.7)	14.3 (7.9)†	11.4 (7.6)**	11.1 (6.0)**	13.9 (6.1)	16.1 (7.0)	19.0 (9.4)*
BMI at 12 months (kg/m^2)		34.7 (5.6)	31.0 (5.1)†	32.6 (5.5)	30.9 (4.6)	29.9 (4.5)	29.9 (4.8)	31.8 (5.6)*
BMI reduction at 12 months (kg m^{-2})		4.1 (3.0)	5.3 (3.2)†	4.3 (3.2)**	4.0 (2.3)**	4.9 (2.3)	5.8 (2.7)	7.6 (4.0)*

A significant effect across quintiles (*$P < 0.001$, **$P < 0.005$) and between quintiles is indicated.
†A significant effect of setting target ($P < 0.001$).
Data are shown as the mean (SD). BMI, body mass index.

Table 3 Percentage weight loss at 12 months predictive variables using a stepwise linear regression model

Step	Predictors	Adjusted r^2	r^2 change	*F* change	*P*
1	Size of first target	0.441	0.441	7054.296	0.000
2	Size of first target and number of targets set	0.566	0.125	2570.171	0.000
3	Size of first target, number of targets set and weeks to achieve first target	0.608	0.042	960.075	0.000
4	Size of first target, number of targets set, weeks to achieve first target and total attendances	0.641	0.033	825.996	0.000
5	Size of first target, number of targets set, weeks to achieve first target, total attendances and starting BMI	0.657	0.016	413.126	0.000
6	Size of first target, number of targets set, weeks to achieve first target, total attendances, starting BMI and sex	0.659	0.002	40.372	0.000
7	Size of first target, number of targets set, weeks to achieve first target, total attendances, starting BMI, sex and age	0.659	0.000	8.997	0.003

BMI, body mass index.

associated with the dependent variable, although only the size of the first target demonstrated an effect that accounted for more than 30% of the variance ($r = 0.66$). Initial BMI, sex and age accounted for minimal variance (Table S5).

The stepwise linear regression analysis revealed that 65.9% of the variance in weight loss at 12 months was explained by variation in the size of the first weight-loss target (44.1%), the number of targets set (12.5%), weeks to achieve first target (4.2%) and the total number of attendances (3.3%). Initial BMI, sex and age predicted significant but small percentages of variance (Table 3). Greater weight loss at 12 months was therefore predicted by a greater first target weight loss, more targets being set and greater attendance. Additional stepwise linear regression analyses were conducted on members categorised by the size of the first target, divided into quintiles. Across each of the four lower quintiles, the number of targets set predicted the greatest amount of variance in percenatge weight loss at 12 months (Q1: 15.9%; Q2: 26.4%; Q3: 24.0%; and Q4: 18.8%, respectively, $P < 0.001$). Only at the highest quintile of first target was the size of the first target a significant predictive variable, predicting 47.2% of the variance, with the number of targets set predicting 3.5%. The odds of achieving ≥10% weight loss at 12 months were greater for the 'target set' group compared to the 'non-target set' group and were progressively greater with an increasing size of initial weight-loss target compared to a non-target set member (Table 4).

Table 4 Odds ratio (OR) with respecct to achieving ≥10% weight loss at 12 months compared to not setting a target weight

	OR value	95% CI	*P*
All setting a target	10.3	9.7–11.1	<0.001
Q1	1.3	0.9–1.4	<0.001
Q2	1.5	1.3–1.6	<0.001
Q3	3.4	3.1–3.7	<0.001
Q4	4.5	4.1–5.0	<0.001
Q5	4.5	4.1–4.9	<0.001

CI, confidence interval; Q, quintile.

Discussion

The maintenance of extensive records by a major commercial slimming organisation presents an opportunity to conduct an analysis of a large community sample. Our analysis of a predominantly female population shows that if people with a BMI ≥30 kg m^{-2} maintained attendance of a weight management group, then they were likely to achieve a clinically significant weight loss (≥10% weight loss) at 12 months irrespective of whether they set targets or not. This indicates that maintaining engagement through attendance is very important within this type of weight-loss setting. The mean weight loss achieved in the present study is very similar to that reported by Lavin *et al.* [24], where 45 395 'high-engagers' from a separate SW data set achieved a mean 13.2 (7.4)% weight loss at 12 months and thus this should be considered as a normal weight-loss outcome in slimmers accessing and engaging with community support programmes. In a randomised controlled trial where 377 adults were referred to community Weight Watchers groups, 33% achieved a weight loss greater than 10% at 12 months [25]. The reality is that, particularly for the morbidly obese patient, they will need to achieve a weight loss greater than 5–10% to maximise the clinical benefits gained from weight loss.

Although obese and younger people were less likely to set weight-loss targets, those that did were significantly more likely to achieve a greater weight loss at 12 months than those who did not. Among the obese population in this sample, those who set targets were 10 times more likely to be at least 10% lighter at 12 months. Setting a higher first weight-loss target, in the range of 20–30% of initial weight, was associated with further improvement in weight-loss outcomes, although the actual weight loss was nearer 20% at 12 months, equating to a BMI mean reduction of 7.6 kg m^{-2} in those with a target >25%. The combination of the number of targets set and the size of the first target predicted much of the variance seen in weight-loss outcomes at 12 months irrespective of age, sex, number of attendances and starting BMI, although relationships between all of the variables are seen to some extent. It was observed that, when initial BMI was ≥30 kg m^{-2}, those setting high first weight-loss targets (>26.5%) were younger and heavier at the time of joining the weight management group. This group were 4.5 times more likely to lose ≥10% of their starting weight than those not setting a target. The data suggests that obese people could either set a greater number of smaller weight-loss targets or choose a higher first weight-loss target achieved over a longer time, aiming to achieve a clinically beneficial weight loss and healthier BMI at 12 months. Although the findings of this analysis support the benefits of setting targets as part of a behavioural strategy to improve weight-loss outcomes, the reported data challenge the belief that these targets should be realistic as defined by a 5–10% weight loss. Four-fifths of those who set a target were aiming for a greater weight loss than this and were still engaged with the weight-loss programme at 12 months, with clinically beneficial weight losses.

The present study, with a larger study population, supports and builds on the findings of De Vet *et al.* [18], where, in a nonclinical sample, new year's weight-loss targets of 13.6% were reported, with approximately two-thirds of the 447 participants setting targets that exceeded 10%. It was suggested that not providing any moderating guidelines on setting weight-loss targets may yield positive attainment outcomes and that the amount of weight loss individuals strive for may lead to more effort. Casazza *et al.* [23] cited setting realistic targets to be one of the seven myths about current obesity treatment with insufficient evidence to support the practice. The present study further fuels this claim and suggests that national guidance on weight management needs to be reviewed with the emphasis on setting realistic targets being removed. For a number of people, setting ambitious weight-loss targets will be motivating and meaningful. Houser-Marko & Sheldon[26]cite higher-level targets as being more self-relevant and holistic, providing a sense of direction and purpose.

The present study adds to current knowledge by examining the association between the number of targets set and the size of the first weight-loss target and weight loss-outcomes at 12 months for both men and women. Undeniably, the group of participants setting the highest weight-loss targets (Q5) achieved the greatest weight loss at 12 months, although the data also suggest that, for both sexes, there will be some individuals who may benefit from setting a greater number of smaller weight-loss targets and the balance between the two approaches may need to be fluid according to personal circumstances [27]. Crawford & Glover[14], in their review, highlighted the lack of published evidence examining the fluidity of target setting in relation to weight-loss outcomes, with data particularly lacking for men.

One of the definitions for weight-loss maintenance described by Elfhag & Rossner[28] is 'achieving an intentional weight loss of at least 10% and maintaining this body weight for at least one year'. In their review, they identified successful weight maintenance being associated with, along with other factors, more initial weight loss, reaching a self-determined target weight and social support. One of the benefits of enrolling with a commercial slimming organisation is the social support offered to all members and this may facilitate the higher individual target weights to be set, leading to improved weight loss at 12 months [29].

The major strength of the present study is that it presents data from a large community sample of both men and women, albeit with a small percentage of men that is representative of enrolment and attendance at commercial slimming organisations [24,25]. However, the study size was sufficiently large to detect any outcome differences between the sexes. A limitation is that the data set was unfortunately incomplete, with 12-month weight being not recorded for a significant number of people in the original sample. This most likely arose because members may have had successful or unsuccessful weight-loss journeys and were longer attending the slimming group at 12 months. It is also possible that some people may have left and re-joined after a more than 4-week break and this is not captured in the data analysis.

With the finding that 12-month weight change is influenced by target setting, it would be of future interest to perform analyses that consider weight change over longer periods (24 or 36 months) aiming to determine whether the successful weight losses are maintained. The time-frame for data collection precludes such analysis at present. Other, smaller hospital-based studies suggest that achieving weight-loss targets is associated with the maintenance of weight loss over a 24-month period [29]. The present study did not consider the relationship between weight-loss expectations and target setting and no data were collected to establish whether the people in the sample were satisified with the weight losses that they achieved, or whether they hoped to achieve their targets in a shorter time period. It would be of benefit to know why the study population did or did not set targets, as well as what influenced this decision, because such information could be used to refine current guidance or programmes that assist in weight loss. In particular, it would be beneficial to know more about what influenced some people to set very high targets (>20% weight loss), which appeared to be a successful strategy for achieving greater weight loss over 12 months. Further studies are required to answer some of these unknowns.

To date, no study based in a community setting has investigated weight-loss targets on this scale and detail, with both the size of the target and the number of targets being reported. Obese people are less likely to self-impose targets but, if they do, the more targets they set, they more likely they are to achieve a greater weight loss at 12 months. Setting an ambitious first weight-loss target is going to further improve weight-loss outcomes. This contradicts current national guidance and it is proposed that the current approach to set 'realistic' weight-loss targets is indeed a myth and should be questioned and reviewed. The combination of the size of the first target and the number of targets set predicts much of the variance seen in weight-loss outcomes at 12 months, irrespective of baseline BMI, sex and age.

Acknowledgments

The research was undertaken as part of masters and doctoral studies. Conflict of interests, source of funding and authorshipThe authors declare that they have no conflict of interests.

Conflicts of interest, source of funding and authorship

AA, alongside her academic position at the University of Nottingham also holds a consultancy position at Slimming World.

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

AA, MH and JAS designed the study. AA, SLE and JAS completed the data analysis. AA, SLE and JAS prepared and critically reviewed the manuscript.

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Supporting information

Additional Supporting Information may be found online in the supporting information tab for this article:

Table S1. Means, SDs and bivariate (Pearson) correlations between the main variables of the study. Note all correlations are significant at the $P < 0.01$, except where indicated by an asterisk (*) where $P < 0.05$, and no correlation was observed between age and the total number of contacts$^{\$}$.

Table S2. The predictors of weight loss at 12 months for each size of first target quintile group using stepwise linear regression.

Paper 14

Avery, A., Anderson C., McCullough, F. (2017). **Associations between children's diet quality and watching television during meal or snack consumption: a systematic review.** Maternal and Child Nutrition (Accepted December 2016). e12428. https://doi.org/10.1111/mcn.12428

Received: 16 August 2016 | Revised: 7 December 2016 | Accepted: 9 December 2016
DOI 10.1111/mcn.12428

WILEY Maternal & Child Nutrition

REVIEW ARTICLE

Associations between children's diet quality and watching television during meal or snack consumption: A systematic review

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Abstract

Studies have identified an association between watching television (TV) and childhood obesity. This review adds context to existing research by examining the associations between TV viewing, whilst eating, and children's diet quality. Web of Science and PubMed databases were searched from January 2000 to June 2014. Cross-sectional trials of case control or cohort studies, which included baseline data, measuring the associations between eating whilst watching TV and children's food and drink intake. Quality of selected papers was assessed. Thirteen studies, representing 61,674 children aged 1–18 yrs, met inclusion criteria. Of six studies reporting overall food habits, all found a positive association between TV viewing and consumption of pizza, fried foods, sweets, and snacks. Of eight studies looking at fruit and vegetable consumption, seven identified a negative association with eating whilst watching TV ($p < .0001$). Four out of five studies identified a positive association between watching TV whilst eating and servings of sugar-sweetened beverages ($p < .0001$). Four studies identified an association between low socioeconomic status and increased likelihood of eating whilst watching TV ($p \le .01$). Family meals did not overcome the adverse impact on diet quality of having the TV on at mealtimes. Eating whilst watching television is associated with poorer diet quality among children, including more frequent consumption of sugar-sweetened beverages and high-fat, high-sugar foods and fewer fruits and vegetables. Although these differences in consumption are small, the cumulative effect may contribute to the positive association between eating whilst watching TV and childhood obesity.

KEYWORDS

child public health, childhood diet, childhood obesity, family influences, food consumption, systematic review

1 | INTRODUCTION

The increasing global prevalence of childhood obesity and the associated impact on physical and psychological health have been well documented (WHO, 2016). The foresight report (Government Office for Science, 2007) highlights the complex, multifactorial nature of obesity, with its many contributing factors.

The sedentary lifestyle of children has been implicated in the steady rise in the obesity epidemic (Health Survey for England, 2014), and television (TV) viewing has been positively associated with increased body mass index (BMI) in children (Braithwaite et al., 2013; Montoye et al., 2013). It has been commonly hypothesised that increased TV viewing replaces hours spent undertaking physical activity, thereby leading to reduced energy expenditure and subsequent weight gain (Dietz, 2001). Conversely, research has shown that this might not necessarily be the case and that the increased weight associated with higher rates of TV viewing are, in fact, unrelated to physical activity or lack thereof, but due to other factors (Biddle, Gorely, Marshall, Murdey, & Cameron, 2004).

Alternative ways in which TV viewing has been linked to increased weight in children is through the influence that it has on children's diet in terms of advertising energy-dense food (Andreyeve, Kelly, & Harris, 2011), promoting mindless eating during viewing, (Ogden et al., 2013) and increased snacking and "junk food" consumption, (Boulos, Vikra, Oppenheimer, Chang, & Kanarek, 2012), including higher consumption of sugary drinks (Carson & Janssen, 2012; Dubois, Farmer, Girard, & Peterson, 2008). The role of parents should be taken into account when considering these factors, because their influence shapes children's food habits from a young age (Francis, Lee, & Birch, 2003; Olafsdottir et al., 2014), and parents' ability to set rules regarding limits on time spent watching TV could prove of importance in influencing their child's diet quality (Anderson & Whitaker, 2010). Associations have previously been confirmed between socioeconomic status (SES) and childhood obesity (Stamatakis, Wardle, & Cole, 2010), but it is less clear how watching TV and diet quality are influenced by low SES.

Although many studies have examined associations between TV viewing and obesity in children, there are limited data investigating the associations between TV viewing and the foods and drinks, which are consumed during this time. This review examines the associations between watching TV during meal or snack consumption and children's diet quality. Despite living in an age of multiple electronic screen devices, this review focuses on the hardware TV, located in the home setting, but will include commercial and noncommercial TV, videos, and DVDs without differentiating between them.

2 | METHODS

2.1 | Search strategy and selection criteria

To ensure that no similar reviews had already been published, we conducted a preliminary computerised search of the Cochrane Library. One review (Wahi, Parkin, Beyenne, Uleryk, & Birken, 2011) was not specific to the effects of interventions on diet quality. A second search of Web of Science also returned one review, entitled ObesiTV: How TV is influencing the obesity epidemic (Boulos et al., 2012).

Results from cross-sectional studies dating from January 2000 to July 2014 were reviewed by performing further computerised searches of Web of Science and PubMed (MED-LINE) using the search terms "family or meal*," "tele* or TV," and "obesity or BMI or food choices or obese or overweight." Filters were used to eliminate nonhuman studies and those that were not in the English language, as well as studies based on adults. A title screen, followed by abstract screen, was performed in order to exclude nonrelevant studies. The remaining studies were then read and assessed against inclusion or exclusion criteria by all three researchers. A hand-search of included studies was performed, and relevant articles assessed in order to produce the final list of studies to be included. This final list was checked by two reviewers before data extraction. A PRISMA checklist was followed (Liberati et al., 2009).

Inclusion criteria:

- Study participants: children ≤18 years
- Studies examining the associations between watching TV whilst eating or drinking in developed countries and diet quality
- Articles in English language

Exclusion criteria:

- Data based on follow-up data from longitudinal studies where other variables may have influenced food and drink intake
- Reviews, rather than original data
- Studies including an intervention

The primary outcome was the association between eating during TV viewing and children's food and drink consumption. The secondary outcomes were the effect of eating during TV viewing on BMI and risk of overweight, role of parents, socioeconomic influences, and associated physical activity levels.

2.2 | Data collection and extraction

Data extraction included authors, year, and country; type of study; method of determining amount of TV viewing during food or drink consumption; method of determining dietary intake or patterns; outcomes reported; adjustment for confounding variables; and key findings.

2.3 | Quality assessment

The quality of the studies was assessed by two reviewers, independently, using an amended version of the Newcastle–Ottawa scale (Higgins & Green, 2011), in which stars were awarded for high quality characteristics, as shown in Table 1. This adapted version allowed a maximum score of two for each category. Given that multiple factors can influence food intake, high scores reflect that there has been adjustment for confounding factors—particularly SES.

3 | RESULTS

Forty-six studies were originally identified that measured the associations between watching TV on food intake and obesity in children.

Key Messages

- Eating whilst watching TV is associated with poorer diet quality among children.
- This reduced diet quality includes more frequent consumption of sugar-sweetened beverages, more high-fat/high-sugar foods and fewer vegetables and fruit.
- Although the differences in diet quality are small, the cumulative effect may contribute to the positive association between eating whilst watching TV and childhood obesity.
- An association between low-socioeconomic status and the increased likelihood of eating whilst watching TV was observed.

TABLE 1 Assessment of quality of a cohort study—Newcastle–Ottawa scale

Selection
1. Representativeness of the study population
a. Truly representative of the children in the contemporary western world
b. Somewhat representative of the children in the contemporary western world
c. Selected group of children (e.g., only certain socioeconomic groups or areas)
d. No description of the derivation of the cohort
2. Ascertainment of exposure
a. Measurement by trained health professional
b. Use of validator tool, for example, previously validated questionnaire
c. Written self-report
d. Other or no description
Comparability
1. Comparability of cohorts on the basis of the design or analysis
a. Study controls for socioeconomic status (or measure of)
b. Study controls for other factors, for example, maternal education, child's gender, age, and ethnicity
c. No control
Outcome
1. Assessment of outcome
a. Multiple regression analysis controlling for mediators
b. Self-report
c. Other or no description
2. Was period over which data was collected appropriate for outcomes to be measured?
a. Yes, if data was collected on >1 occasion, including one weekend day and one week day
b. No, if data was collected on a single occasion or did not include one weekend day and one week day.

Twenty-six studies were omitted because they included an intervention, were based on longitudinal study data, or were not presented in English language. Seven studies were excluded because they did not report associations between watching TV during food or drink consumption (Figure 1).

Table 2 presents the reported associations between watching TV during food consumption and children's food and drink intake (13 studies).

3.1 | Quality assessment

Results from the quality assessment are summarised in Table 3. Nine out of the thirteen papers achieved a score of 5 out of a maximum possible of 6.

3.2 | Study characteristics

Total number of children included in the 13 studies was 61,647, all of whom were aged between 1 and 18 years. Of these, 24,141 children were aged ≤11.5 years. The remaining 37,506 were aged 11–18. Some overlap occurred due to children being surveyed according to their school year, rather than age, and different studies targeted children according to different cutoff ages. Of the 24,141 children aged ≤11.5 years, 3,011 children could be considered of preschool age (≤6 years). Five thousand nine hundred eighty-six children were of primary school age (6–11.5 years). The study by Lissner et al. (2012) (not included in this figure) used data from the European funded identification and prevention of dietary- and lifestyle-induced health effects in childhood and infants study, which was based on children aged 2–9 years.

The total sample comprised 35,650 girls and 35,068 boys. A further 4,966 children were included in the study by Liang, Kuhle, and Veugelers (2009), which gave no details of gender. The study by Coon, Goldberg, Rogers, and Tucker (2001) only interviews 91 parent–child pairs; however, its results are consistent with the results of the larger studies.

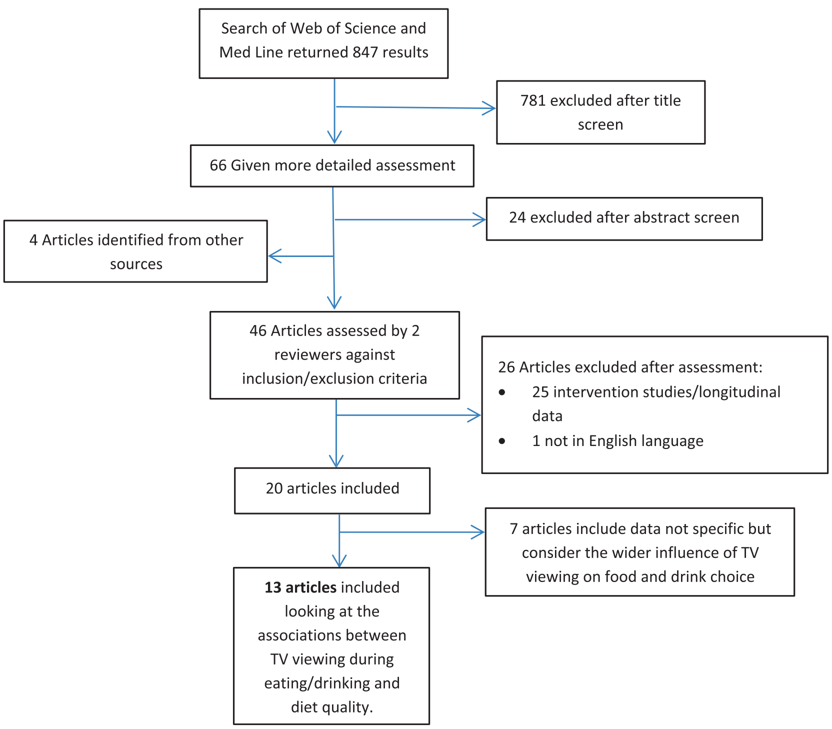

FIGURE 1 Flow diagram showing database search results

TABLE 2 Associations between children's diet quality and watching television during meals or snacks

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Carson and Janssen, 2012 Canada (11)	*N* = 15,973 Canadian children in grades 6–10 (12.8–15.3 years, mean age 14.4 years) who participated in the health behaviour in school-aged children survey. (*N* = 8242 females and 7731 males)	Analysis of Canadian only data collected from WHO-sponsored HSBC cross-sectional survey conducted in over 40 countries in 2009/2010.	Classroom-based questionnaire	Classroom-based questionnaire	Whether TV snacking and junk food consumption mediate the relationship between TV viewing and BMI.	Gender, age, race, family structure, and SES, whether currently dieting and whether dieting in the last 12 months.	Snacking and junk food consumption increased with increasing time spent viewing. By comparison with TV viewing quartile 1, frequency of TV snacking was 0.65 (95% CI [0.57, 0.74]) units higher in quartile 2, 0.92 (95% CI [0.84, 1.01]) units higher in quartile 3 and 1.35 (95% CI [1.26, 1.45]) units higher in quartile 4. Frequency of junk food consumption was higher in quartile 2 (0.19: 95% CI [0.13, 0.24]), quartile 3 (0.37: 95% CI [0.31, 0.42]), and quartile 4 (0.61: 95% CI 0.55, 0.67). BMI increased with increased time spent watching TV ($p \leq .05$). For every 1 unit increase in the 7 point TV snacking scale, the BMI z-scores decreased by 0.03 ($p < .05$)
Coon et al., 2001 USA (26)	*N* = 91 parent–child pairs, with children in the 4th, 5th or 6th grade. (9–12 yrs). Mean age was 10 years. (*N* = 53 females and 38 males)	Data collected from Maryland suburbs from 1993–1995 as part of a study on family behaviours and children's diets	Face-to-face interview, structured survey in family home. Qu re; whether TV on or off during each meal	three nonconsecutive 24-hr. recalls; school days	Energy intake: %energy CHO and % energy total fat snacking	Parents' nutritional knowledge, attitudes and norms, mother's education (years in school), hours per week mother works for pay, number of meals per day TV is on, number of nights per week parents prepare quick suppers, and parent's attitude toward meat.	TV is more likely to be on during meals in families with lower incomes ($p \leq .01$) and less-educated mothers ($p \leq .05$). Compared with children from families in which the TV is on for <2 meals per day, children from families where the TV is on for >2 meals per day

(*Continues*)

TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
							consumed 1. 16% fewer vegetables per day ($p \le .01$) 2. 15% more portions of soda per day ($p \le .05$) 3. 2% more of their total daily energy from meat ($p \le .05$), with 14% more red meat per day ($p \le .01$) 4. 3% more of their total daily energy from pizza, salty snacks, and sodas combined ($p \le .001$) 5. 2% less of their total daily energy intake from fruits, vegetables, and juices combined ($p \le .001$). 6. Twice as much caffeine ($p \le .05$).
Cox et al., 2012. Australia (23)	N = 135 preschool children aged 2–6 years (mean age: 4.5 years) from Melbourne (N = 81 females and 54 males)	Data collected form cross-sectional survey between Jun–Sep 2010.	3-day TV diary completed by mothers of pre-schoolers. Information collected on viewing time, content and food consumed whilst watching TV.	3-day TV diary completed by mothers of preschoolers. Information collected on viewing time, content and food consumed whilst watching TV.	Association between BMI and TV viewing time, TV content, energy intake whilst viewing and daily physical activity.		Moderate positive association between TV viewing and energy intake whilst viewing TV on weekdays and weekends (r = 0.61 and 0.50, p = .001). Weak positive associations were found between TV viewing and consumption of obesogenic foods (r = 0.23, p = .001) and frequency of consuming fast foods (r = 0.27, p = .001). Daily serves of vegetables was moderately negatively associated with TV viewing (r = −0.31, p = .001). Weak association between weekday and weekend TV viewing and number of minutes in

(*Continues*)

TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
							sedentary activities (r = 0.20 and 0.22, respectively, p = .05).
Del Mar Bibiloni et al., 2009 Spain (30)	N = 1,231. 12–17-year-old children living in the Balearic Islands (N = 657 females and 574 males)	Population-based cross-sectional nutritional survey carried out in the Balearic Islands between 2007 and 2008.	General questionnaire with question about distraction during meals—one option being watching TV, as well as questions regarding hours per day of TV viewing.	Two nonconsecutive 24-hr diet recalls General questionnaire with questions about frequency of eating specific foods and number of daily meals.	Prevalence of overweight, differences between genders, waist hip ratio and body fat measurements. Link between obesity, parental education and meals per day. Link between TV and SSB	Sociodemographic and lifestyle variables.	Positive correlation between watching TV and SSB consumption (r = 0.123, p < .001). Positive association between BMI and distraction at mealtimes (OR 1.52, 95% CI [0.81, 2.84]) but not significant. Inverse relationship between parental education and BMI (OR: 3.47 in boys, 95% CI [1.58, 7.62] and 3.29 in girls, 95% CI [1.38, 7.89], p < .01). Increasing risk of obesity with decreasing number of meals per day (adjusted OR: 2.60 in boys who ate 4 meals per day, 95% CI [1.13, 5.98], p < .05 and 4.99 in boys and 2.20 in girls who ate 1–3 meals per day, 95% CIs [2.1, 11.54] and [0.99, 4.89], respectively, p < .01) Risk of obesity linked to parental education (adjusted OR: 2.35 boys and 1.89 girls with parents of medium education level, 95% CIs [1.04, 5.34] and [0.73, 4.94], respectively p < .05 and 3.47 boys and 3.29 girls from parents with low educational level, 95% CIs [1.58, 7.62] and [1.38, 7.89], respectively, p < .01).

(*Continues*)

TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Dubois et al., 2008 Canada. (12)	*N* = 1,540 representative sample of children born in 1998 (aged 4–5 years) in Quebec, Canada. (*N* = 750 females and 790 males)	Analysis of baseline data from longitudinal study of child development in Quebec (1998–2002.	TV viewing questionnaire	24-hr recall, eating behaviour questionnaire	Association between eating meals and snacks in front of the TV and: • BMI • energy intake • macronutrient intake • consumption of fruit or veg • consumption of soft drinks • hours of viewing	Maternal characteristics (age, immigrant status, education, working status and self-perceived health). Mother and father's smoking status, and derived number of smoking parents in the household, family type, household annual income, SE status. Variables pertaining to the child including day care attendance and sex of the child.	Children who ate snacks whilst watching TV every day consumed more CHO and less energy from proteins compared with children who never ate snacks in front of the TV ($p \leq .05$). Eating meals during TV viewing once daily or more was associated with lower consumption of energy from protein ($p \leq .05$). Eating dinner or snacks daily whilst watching TV was associated with fewer servings of fruits & vegetables ($p \leq .05$). Eating meals whilst watching TV increased odds of drinking soft drinks daily (OR: 2.316, $p < .0001$). Having snacks whilst watching TV increased the odds of drinking soft drinks (OR: 2.294, $p < .0001$) & increased further for children who ate snacks whilst watching TV daily (OR: 3.568, $p < .0001$). Children who ate in front of the TV once daily had 70% increased odds of drinking soft drinks daily, which increased to 80% in children who ate in front of the TV twice daily. Children who ate snacks or dinner whilst watching TV once daily or more had higher BMI compared to those who did so less than once

(*Continues*)

TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
							daily ($p \leq .05$). Children from younger mothers, immigrants, smoking parents, and mothers whose self-perceived health was poor were more likely to eat meals and snacks in front of the TV, as well as those from low SE families and mothers with no high school diploma ($p \leq .05$). Watching TV for >3 hr/day was associated with meals or snacks in front of the TV ($p \leq .05$)
Feldman et al., 2007 USA (27)	*N* = 4064 ethnically and socioeconomically diverse adolescents from 31 public middle and high schools in Minneapolis-St. Paul metropolitan area. Mean age 14.9 years (range from 11 to 18) (*N* = 2,022 females and 2,042 males)	Cross-sectional study —data from project Eating Among Teens (EAT) collected in 1998–1999.	Project EAT survey	149-item youth or adolescent questionnaire	Intake of fruits, total vegetables, dark green or yellow vegetables, calcium-rich food, grains, soft drinks, fried food, snack food, calories, family meal frequency, and watching TV during meals.	Socio-demographics, weekly hours spent watching TV, and caloric intake	Boys and girls who ate family meals whilst watching TV ate fewer vegetables, including dark green or yellow vegetables, and calcium rich foods and more soft drinks than those who ate family meals without TV ($p < .001$) Fewer grains were consumed by children who ate family meals whilst watching TV compared with those who ate family meals without watching TV ($p < .001$ in boys and 0.020 in girls) Girls who ate family meals whilst watching TV ate more fried foods than girls who ate family meals without TV ($p < .001$). Not so significant effect for boys.

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Fitzpatrick et al., 2007 USA (22)	*N* = 1,336 parent–child pairs from low-income households. Children's ages ranged from 1.0 to 4.9 years; mean age was 2.8 years. Sample was evenly divided between males and females.	Cross-sectional study of care-givers participating in Women, Infants and Children (Food and Nutrition service) in New York state between May and Dec 2000.	Self-administered survey (available in English or Spanish)	Self-administered survey (available in English or Spanish)	Frequencies of serving fruits, vegetables, and milk	Race or ethnicity and parental education attainment	Number of days the TV was on during dinner was inversely associated with serving fruits (OR: 0.95, $p < .05$) and serving vegetables (OR: 0.94, $p < .01$). Number of days or week eating dinner as a family was positively associated with servings of fruit (OR: 1.14, $p < .001$) and vegetables (OR: 1.15, $p < .001$). However, having dinner as a family does not overcome the adverse effects of having the TV on during mealtimes.
Hare-Bruun et al., 2011 Denmark (25)	*N* = 697 8–10 year old (382 female and 315 male); *N* = 495 14–16 year old (275 female and 220 male) school children in Odense, Denmark.	Prospective cohort study with cross-sectional analysis (data from Danish part of European Youth Heart Study 1997–98 and 2003–2004)	Computer-based questionnaire developed for the EYHS	Computer-based questionnaire developed for the EYHS and 24-hour recall with qualitative food record completed at home, face-to-face.	Effect of TV viewing on healthy food preferences and healthy food habits.	Survey year, BMI z-score, physical activity, maternal BMI, paternal BMI, and SES.	More TV viewing was associated with lower healthy food preferences in all 8–10-year-old girls (OR: −0.61 for 1–2 hr/day and −1.06 for >2 hr/day, $p \leq .05$), and boys (OR −1.12 for 1–2 hr/day and −1.36 for >2 hr/day, $p \leq .001$) and in 14–16-year-old girls who watched >2 hr/day(OR: −0.94, $p \leq .05$) Boys aged 8–10 years who watched TV during meals every day or most days had less healthy food preferences than those who rarely watched TV during meals (OR: −0.83, $p \leq .05$). 8–10-year-old girls who watched TV during meals 1–2 times per week had higher healthy food

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
							preferences than those who rarely watched TV during meals (OR: .068, $p \le .05$). Watching TV during meals most days or every day was associated with less healthy food habits in 8–10-year-old girls (OR: −1.56, $p \le .001$), 14–16-year-old girls (OR −1.24, $p \le .001$), and boys age 14–16 years (OR −2.04, $p \le .0001$)
Liang et al., 2009 Canada. (21)	*N* = 4,966 grade 5 students (predominantly 10–11 years old). (no detail on gender)	Data taken from 2003 children's lifestyle and school performance study, a population-based study of grade 5 students and their parents in Nova Scotia.	Questionnaire completed at home by parents, which collected information on sociodemographic factors and contained validated questions on their child's activities.	Slightly modified version of the Harvard youth/adolescent food frequency questionnaire.	Effect of watching TV and of watching TV whilst eating supper on percentage of students concerning two or more servings of soft drinks weekly, percentage of energy from sugar out of CHO energy, percentage of energy from dietary fat, percentage of energy from snack foods and prevalence of overweight.	Energy intake, child's gender, and household income	Eating supper whilst watching TV is negatively associated with diet quality (OR: −3.46 in those who watched TV during supper ≥5 times or week, 95% CI [−4.32, −2.60]) and positively associated with overweight (OR: 1.43 in highest quartile, 95% CI [1.14, 1.78]). TV watching showed positive associations with consumption of ≥2 weekly servings of soft drinks (OR: 2.46 in highest quartile, 95% CI [1.54, 3.93]), percentage of energy from CHO sugar (OR 1.21 in highest quartile, 95% CI [0.52, 1.89]), percentage of energy from snacks (OR: 2.20 in highest quartile, 95% 7CI [0.29, 4.10]), and percentage of overweight (OR: 2.42 in highest quartile, 95% CI [1.54, 3.79]). TV watching showed

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TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
							negative associations with daily servings of fruits and vegetables (OR: −0.08 in highest quartile, 95% CI [−0.19, 0.03]) and diet quality index (OR: −1.73 in highest quartile, 95% CI [−3.35, −0.10]). Effects of watching TV on percentage of energy from fat (OR: 0.17) and on diet quality index (−1.73) were less pronounced than those of supper in front of the TV on these nutritional indices (OR: 0.97 and −3.46, respectively).
Lissner et al., 2012 Sweden (20) (IDEFICS data collected from: Italy, Estonia, Cyprus, Belgium, Sweden, Germany, Hungary, and Spain)	*N* = 15,144. IDEFICS data—children aged between 2 and 9, recruited via their daycare centres or schools. (*N* = 7436 females and 7708 males)	Baseline data collected between Sept 2007 and June 2008, taken from IDEFICS study (2-year intervention study)	Parent questionnaire about children's lifestyles, diets and family circumstances. Physical examination to characterise weight status and cardiometabolic health.	Children's eating habits questionnaire (CEHQ) comprising Food Frequency Questionnaire (FFQ) relating to previous 4 weeks	BMI, propensity to consume high fat or sugar foods, taste preference (sweet or fat)	Model 1: country, parental education (as a measure of SE status), age and sex Model 2: previous covariates, plus fat and sugar propensity ratios.	Eating whilst watching TV was associated with more high fat items (OR: 1.49 in highest quartile, CI: 1.34–1.65) and more high sugar items (OR: 1.93 in highest quartile, CI: 1.72–2.16) in proportion to total number of foods consumed. Eating whilst watching TV was significantly associated with overweight, with prevalence odds ratios of 1.20 for boys and 1.35 for girls (CI: 1.04–1.40 and 1.17–1.55, respectively). Watching 60 minutes or more of TV per day was associated with overweight with OR of 1.20 in boys (CI 1.05–1.38) and 1.21 in girls (CI: 1.06–1.38).

(*Continues*)

TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
Matheson et al., 2004. USA (24)	*N* = 90 third grade children aged 7.8–9.6 years (mean: 8.6 years) (*N* = 51 females and 39 males); *N* = 142 children aged 9.0 to 11.5 years (mean: 9.6 years) (*N* = 66 females and 76 males).	Baseline cross-sectional data collected in 1999–2000 from: Sample one: recruited from a school-based trial on reducing TV viewing. Sample two: drawn from a study of factors affecting children's dietary intake.	For each meal or snack children were asked whether they participated in any of the following activities whilst eating, watching TV, videotape, movie, played video games or on a computer, watched a movie at the theatre, did homework or reading or played inside or outside, were riding in a car van, bus or truck.	Three nonconsecutive dietary recalls, including two weekdays and one weekend day. The first recall was conducted face-to-face and the remaining two recalls were collected over the telephone.	Description of the amounts and types of foods that children consume whilst watching TV, compare those times with the types consumed at other times of the day, and examine association between BMI and amounts and types of foods consumed during TV viewing.	Two samples were analysed separately. Weekend and week day data calculated separately.	Amongst 3rd grade children who ate whilst watching TV on weekdays, 0.07 servings of soda were consumed with the TV on compared to 0.36 with the TV off, 0.05 servings of fast food were consumed with the TV on compared to 0.35 with the TV off and 0.09 servings of veg were consumed with the TV on compared to 0.73 with the TV off. Amongst 5th grade children who ate whilst watching TV on weekdays, 0.39 servings of veg were consumed with the TV on compared to 2.07 with the TV off and 0.15 servings of sweets and snacks were consumed with the TV on compared to 0.58 with the TV off. In the weekday 3rd grade data, the correlation between children's BMI and % energy from fat consumed during TV viewing was significant ($r = .025$, $p = .04$). In the 3rd grade sample, 59% of snacks were consumed during TV viewing on weekdays and 45% on weekends. In the 5th grade sample, 67% of snacks were consumed during TV viewing on weekdays and 45% on weekends. This was more frequent than meal consumption in front of

(*Continues*)

TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
							the TV. More than one third of the children's dinners were consumed in front of the TV.
Rey-López et al., 2011 (28)	*N* = 1,336 aged 12½ to 17½ years old. (*N* = 699 females and 637 males)	Data from HELENA cross-sectional study, collected Oct 2006–Dec 2007. Data selected that had valid information from the sedentary behaviour questionnaire and only data from Ghent, Heraklion, Pecs, and Zaragoza was included, because other cities that took part in the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) cross-sectional survey (CSS) did not examine food consumption during sedentary behaviours.	Self-reported sedentary behaviour questionnaire taken by the children at school, which included questions about habitual TV viewing time and concurrent food choices.	Self-reported sedentary behaviour questionnaire taken by the children at school, which included questions about habitual TV viewing time and concurrent food choices.		Family affluence, parental occupation, parental education	Energy dense dietary choices during TV viewing were more likely in boys who watched TV >2 hr/day (OR: 1.88, 95%CI [1.15, 3.08]) and in girls who watched TV >2 hr/day (OR: 1.58, 95% CI [1.15, 2.17]) Compared with boys who watched TV for ≤2 hr/day, boys who watched >2 hr/day had more frequent consumption of • soft drinks (p = .001) • pastry (p = .004) • sandwiches (p = .004) • savoury (p = .006) • sweets (p = .04) Compared with girls who watched TV for ≤2 hr/day, girls who watched >2 hr/d had more frequent consumption of • fruit juice (p = .02) • soft drinks (p = <0.001) • beer (p = .03) • coffee (p = .03) • pastry (p = .04) • sweets (p = <.001) • sandwiches (p = .002) Girls whose mothers achieved a low educational level had an increased risk of consumption of energy-dense drinks during TV viewing (OR: 3.22, 95% CI [1.81, 5.72]) compared with those whose mothers attained the

(*Continues*)

TABLE 2 (Continued)

Authors, year, and country (reference number)	Population size and age group of study population	Type of study	Method of determining amount of TV viewing during meals	Method of determining dietary intake or patterns	Outcomes reported	Adjustment for confounding variables	Key findings
							highest education. Girls with low family affluence status were more likely to consume energy-dense drinks during TV viewing; this association was less when paternal occupation and education were tested (OR: 2.03, 95% CI [1.19, 3.47]).
Verzeletti et al., 2009 Italy (29)	*N* = 14,407 adolescents between 11 and 16 years of age; *N* = 7,904 from Belgium (*N* = 3,991 females and 3,913 males); *N* = 6,503 from the Veneto region of Italy (*N* = 3253 females and 3250 males).	Cross-sectional study on data from the 2005–2006 HBSC survey.	Questionnaire with questions on family food rules and food-related family lifestyles.	Questionnaire with questions on family food rules and food-related family lifestyles.	Daily fruit and vegetable intake	SES	After controlling for variables, there was no association between having a daily meal whilst watching TV and daily fruit and vegetable intake. Findings suggest that heavy TV viewing behaviours may be associated with lower fruit and vegetable intake among adolescents but also that the hours of TV viewing are more important than the habit of watching TV during meals for these outcome variables.

Note. BMI = body mass index; EYHS = European Youth Heart Study; HSBC = health behaviour in school-aged children survey; IDIFECS = identification and prevention of dietary- and lifestyle-induced health effects In childhood and infants; OR = odds ratio; SE = socioeconomic; SES = socioeconomic status; SSB = sugar-sweetened beverages; TV = television.

TABLE 3 Quality assessment scores using the Newcastle–Ottawa scale

Reference	Selection (max. 2*)	Comparability (max. 2*)	Outcome (max. 2*)
Carson & Janssen, 2012	**	**	*
Coon et al., 2001	**	**	*
Cox et al., 2012	**		*
Del Mar Bibiloni et al., 2009	**	**	*
Dubois et al., 2008	**	**	*
Feldman et al., 2007	**	**	*
Fitzpatrick et al., 2007	*	*	*
Hare-Bruun et al., 2011	**	**	*
Liang et al., 2009	**	**	*
Lissner et al., 2012	**	**	*
Matheson et al., 2004	**		*
Rey-López et al., 2011	**	**	*
Verzeletti et al., 2009	**	*	*

Eight of the 13 studies in Table 2 have been submitted for publication since 2009. The data were all collected after 1993 from developed countries including the USA, Canada, Australia, Spain (and Balearic Islands), Denmark, Italy, Estonia, Cyprus, Sweden, Belgium, Greece, Germany, Hungary, and Portugal. Six studies are based on data collected since 2005.

One study reported outcomes specifically for children from families of low SES (Fitzpatrick, Edmunds, & Dennison, 2007); only two studies (Cox et al., 2012; Matheson, Killen, Wang, Varady, & Robinson, 2004) did not take SES or some measure of it (e.g., parental education level or household income) into consideration when performing the statistical analysis.

3.3 | Eating whilst watching TV and food and drink consumption

Note. Only significant results ($p \le .05$) are reported unless otherwise stated. All results are reported in chronological order, from preschool to adolescence

3.3.1 | Diet quality

Eight of the studies looked at aspects of diet quality. Cox et al. (2012) found a weak positive association between TV viewing and consumption of obesogenic (r = 0.23) and fast foods (r = 0.27) in preschool children. Children, (2–9 years), who ate whilst watching TV were found by Lissner et al. (2012) to have more high-fat and high-sugar items in the diet in proportion to total number of foods consumed, compared with children who did not eat whilst watching TV.

Two studies used a questionnaire to score the children's diets in order to determine an overall index of diet quality. Hare-Bruun et al. (2011) deduced scores based on tertiles of healthy eating according to consumption of foods containing fat, added sugar, and liquid sugar in order to score children on total healthy food preferences (ΣHFP) and total healthy food habits (ΣHFH). They found that boys aged 8–10 years who watched TV during meals every day or most days had less healthy food preferences than those who rarely watched TV during meals (ΣHFP: −0.84, 95% confidence interval (CI) [−1.52, −0.16]). Girls aged 8–10 years who watched TV during meals 1–2 times per week, however, had higher healthy food preferences than those who rarely watched TV during meals (ΣHFP: 0.68, 95% CI [0.06, 1.31]). Regardless of their preferences, watching TV during meals most days or every day was associated with less healthy food habits in 8–10-year-old boys (ΣHFH: −2.25, 95% CI [−3.11, −1.40]) and girls (ΣHFH: −1.56, 95% CI [−2.36, −0.76]) and 14–16-year-old boys (ΣHFH −2.04, 95% CI [−3.12, −0.96]) and girls (ΣHFH: −1.24, 95% CI [−2.16, −0.32]). The findings of Liang et al. (2009) in 10–11 year olds were based on a food frequency questionnaire, which created a scale of diet quality based on consumption of soft drinks, energy from sugar, fat and snack foods, and daily servings of fruits and vegetables. A diet quality index was created as a composite measure, which encompassed dietary variety, adequacy, moderation, and balance. These results concur with those of Hare-Bruun et al. (2011), in that eating supper whilst watching TV is negatively associated with diet quality index, which decreased from 63.08 in children who had supper in front of the TV less than once per week to 60.12 in children who had supper in front of the TV ≥5 times per week.

Other studies looked at more specific aspects of the diet. Coon et al. (2001) found that "middle school" children who ate >2 meals or snacks per day with the TV on obtained 3% more of their total daily energy from pizza, salty snacks, and sodas than children who ate meals with the TV on ≤2 meals per day. Feldman, Eisenberg, Neumark-Sztainer, and Story (2007) identified an increased consumption of fried foods by adolescents who ate family meals with the TV on compared with those who did not (1.3 servings per day compared to 1.1 in girls and 0.54 compared to 0.49 in boys). Carson and Janssen (2012) observed an increase in junk food consumption, as defined by sweets (candy and chocolate), coke or other soft drinks-containing sugar, cakes, pastries or doughnuts, potato chips, or French fries, associated with more time spent eating whilst watching TV.

These findings were reinforced by Rey-López et al. (2011), who ascertained that energy dense dietary intake during TV viewing, mainly in the form of snacks, including soft drinks, pastry, sandwiches, and sweets, were more likely in adolescents who watched TV >2 hr per day. Boys consumed savoury snacks more frequently, whereas girls consumed fruit juice and coffee more frequently compared with adolescents of the same gender who watched ≤2 hr per day.

3.3.2 | Consumption of fruits and vegetables

Of the eight studies, which reported on consumption of fruits and vegetables, seven identified a negative association between eating whilst watching TV and consumption of fruits and vegetables. Cox et al. (2012) found a moderate negative association between TV viewing and daily servings of vegetables (r = −.31) in preschool children. This was confirmed by both Dubois et al. (2008), where eating dinner or snacks daily whilst watching TV, and Fitzpatrick et al. (2007) where the number of days the TV was on during dinner was associated with fewer servings of fruits and vegetables in this age group. Matheson et al. (2004) found that on weekdays, 5th grade students ate 0.39 servings of vegetables when the TV was on compared with 2.07 servings eaten by their peers with the TV off. This finding was reinforced by Liang et al. (2009), in their study of 5th grade students. Coon et al.

(2001) found that children who ate ≥2 meals or snacks per day with the TV on consumed 16% less fruit and vegetables, which equated to 2% less of their total daily energy from fruits, vegetables, and juices. Daily consumption of dinner or snacks whilst watching TV was found to be associated with 0.23 fewer servings of fruits and vegetables per day (Dubois et al., 2008). Feldman et al. (2007) identified the importance of family meals but found that even if adolescents eat with the family, having the TV on during mealtimes was associated with a reduction in the number of daily servings of vegetables and particularly in the number of servings of dark green or yellow vegetables per day. Only Verzeletti, Maes, Santinello, Baldassari, and Vereecken (2009) found no association between watching TV during daily meals and fruit and vegetable intake in adolescence, but this study was of low quality.

3.3.3 | Consumption of sugar-sweetened beverages (SSBs)

Four out of five studies, which reported on SSB consumption found a positive association between watching TV whilst eating and servings of SSBs.

Dubois et al. (2008) found that eating whilst watching TV was associated with significantly increased odds of drinking soft drinks daily, which was more than double in those who ate snacks whilst watching TV sometimes (odds ratio [OR]: 2.294) and more than tripled in preschool children who ate snacks whilst watching TV every day (OR: 3.568). They also found significant associations between total daily eating whilst watching TV and consumption of soft drinks. There was a 70% (95% CI [1.2, 2.4]) greater chance of daily soft drink consumption in children who ate whilst watching TV once a day, and an 83% (95% CI [1.2, 2.7]) greater chance in children who ate in front of the TV twice a day compared with preschoolers who ate in front of the TV less than once a day.

Coon et al. (2001) identified a 15% increase in consumption of SSBs by "middle school" children where the TV is on during ≥2 meals per day. In contrast, children of a similar age, who ate whilst watching TV on weekdays, consumed 0.07 servings of soda with the TV on compared to 0.36 with the TV off but with no adjustment for confounding factors (Matheson et al., 2004).

Older children who ate family meals with the TV on were found to drink a further 0.2 servings of soft drinks than those who ate family meals without the TV on (Hare-Bruun et al., 2011). Rey-López et al. (2011) found that 21% of boys and 12% of girls who watched TV for ≤2 hr drank soft drinks during TV viewing, compared to 27% and 18% who watched TV for >2 hr per day.

3.3.4 | Consumption of caffeine

Only one study (Coon et al., 2001) looked specifically at caffeine consumption and found that children who ate ≥2 meals per day drank, on average, twice as much caffeine as those who ate <2 meals per day with the TV on. This may or may not be attributed to an increased intake of caffeine-containing SSBs. Although Rey-López et al. (2011) did not look at caffeine specifically, they found that 4% of adolescents who watched TV for >2 hr per day consumed coffee during TV viewing, compared to 3% of those who watched ≤2 hr per day. This figure, however, was only significant amongst girls.

3.3.5 | Consumption of carbohydrate and grains

Dubois et al. (2008) identified a slightly greater carbohydrate consumption by preschool children who ate snacks whilst watching TV every day compared with those who did not (213 g per day as opposed to 210 g per day), whereas Feldman et al. (2007) found that slightly fewer grains were consumed by adolescents who ate family meals whilst watching TV compared with those who ate family meals without TV (5.6 daily servings, as opposed to 5.9). This reduced number of grains in the diet of adolescents who ate family meals whilst watching TV may contribute to a diet with lower dietary fibre content.

3.3.6 | Consumption of protein

Three studies considered protein consumption. Preschool children who ate snacks whilst watching TV every day consumed less energy from protein compared with those who did not (14.4% vs. 15.1%; Dubois et al., 2008). This result is in contrast to the observation that 2% more energy from protein and 14% more meat was consumed by middle school children who frequently ate meals with TV on (Coon et al., 2001). Although eating meals in front of the TV leads to increased protein consumption with greater meat consumption in middle school children (Coon et al., 2001), adolescents who ate snacks whilst watching TV obtained less of their daily energy intake from protein (Feldman et al., 2007).

3.3.7 | Vitamins and minerals

Two studies examined vitamin and mineral intake. Coon et al. (2001) found no association between TV watching at mealtimes and vitamin or mineral intake, but Feldman et al. (2007) found that older children who ate family meals whilst watching ate fewer calcium-rich foods than children who ate family meals without TV. Although only the two studies report on micronutrients, the results suggest that micronutrient levels may reflect the lower diet quality of children who eat whilst watching TV.

3.3.8 | Secondary outcomes: Effects of eating whilst watching TV on BMI and obesity risk

Six studies reported on BMI. Four studies identified a significant positive association between eating whilst watching TV and children's BMI. Cox et al. (2012) identified a moderate positive association between TV viewing and energy intake whilst viewing (0.61 on weekdays and 0.50 at weekends) as well as a weak positive correlation between preschool children's BMI z-scores and energy intake whilst viewing (0.21 on weekdays and 0.22 at weekends). Dubois et al. (2008) found that preschoolers who ate dinner or snacks whilst watching TV at least once per day had a higher BMI (mean BMI 15.9) than children who ate dinner or snacks whilst watching TV less than once a day (mean BMI 15.7). Both Lissner et al. (2012) and Liang et al. (2009) identified positive associations between eating whilst watching TV and overweight. Lissner et al. (2012) calculated an OR for being overweight of 1.28 in 2–9 year olds who regularly ate food whilst watching TV (95% CI [1.16, 1.42]). This ratio was greater in girls (OR 1.35, 95% CI [1.17, 1.55]) than in boys (OR 1.20, 95%CI [1.04, 1.40]). Liang et al. (2009) found that 41.7% of 5th grade children who ate supper in front of the TV ≥5 times per week were overweight, compared with 30.6%

of children who ate supper in front of the TV less than once per week. Only one study found that TV snacking was negatively associated with BMI. For every 1 unit increase in the TV snacking scale, BMI z-scores decreased by 0.03 in this group of adolescents but BMI did increase with increased time spent watching TV (Carson & Janssen, 2012).

Although Del Mar Bibiloni et al. (2009) did report a positive association between adolescent BMI and distraction at mealtimes, the findings were not significantly different.

3.3.9 | Secondary outcomes: Role of parents

Fitzpatrick et al. (2007) found that the number of days that meals were eaten as a family was positively associated with servings of fruits and vegetables but that this does not overcome the adverse effects of having the TV on at mealtimes.

Adolescents who ate family meals whilst watching TV were noted to consume fewer vegetables including dark green or yellow vegetables, grains, and calcium-rich foods and more soft drinks than children who ate family meals without the TV on. Girls who ate family meals with the TV on also ate more fried foods than girls who did not.

3.3.10 | Secondary outcomes: Influence of SES

Likelihood of eating whilst watching TV was found by Dubois et al. (2008) to fall with increasing SES, with a significantly greater proportion of preschool children from low SES eating meals and snacks in front of the TV than children of parents with greater occupational prestige, education level, and financial situation. Of the children in quintile 1 (considered low SES), 19.8% ate their dinner (evening meal) in front of the TV every day, whereas only 5.2% of children from quintile 5 (considered high SES) ate dinner whilst watching TV on a daily basis. This difference was greater still when considering snacking, with 32% of children in quintile 1 eating snack foods in front of the TV every day, compared with 6.5% in quintile 5. Both breakfast and lunch followed the same trend, with likelihood of eating in front of the TV every day decreasing throughout the quintiles.

Coon et al. (2001) found that children were more likely to have the TV on if their parents had lower incomes. Single parent families and less-educated mothers were also more likely to have the TV on at mealtimes. They also found that the more knowledgeable parents were about nutrition, the less likely it was that the TV would be on at mealtimes.

Parental education was found by del Mar Bibiloni et al. (2009) to be a risk factor for obesity with an OR of 3.47 for adolescent boys of parents with low educational level, compared with those of parents with high educational level (95% CI [1.58, 7.62]). For girls, the OR was 3.29 (95% CI [1.38, 7.89]). Rey-López et al. (2011) also found that a low level of maternal education was associated with higher consumption of energy-dense drinks during TV viewing; however, this result was only apparent among adolescent girls, with an OR of 3.22 (95% CI [1.81, 5.72]) compared with girls whose parents achieved the highest level of education. The effect of family affluence also affected girls' consumption of energy-dense drinks during TV viewing, with children from families of low affluence more likely to consume energy-dense drinks than those from families of high affluence (OR 2.03, 95% CI [1.19, 3.47]).

3.3.11 | Secondary outcomes: Screen time and physical activity levels

Just the one study, Cox et al. (2012) identified weak but significant positive associations between both weekday and weekend TV viewing and number of minutes spent in sedentary activities in this preschool population (r = 0.20 and 0.22, respectively, p = .05).

4 | DISCUSSION

This review has concentrated on the influences of watching TV, including commercial and noncommercial TV, videos, and DVDs, without differentiating between them. Previous studies have found that energy intake is greater during TV watching than during use of computers or video games for homework or leisure (Lyons, Tate, & Ward, 2013; Marsh, Mhurchu, Jiang, & Maddison, 2014).

The primary outcomes of this review are the associations observed between eating, either meals or snacks, whilst watching TV and children's diet quality, and the secondary outcomes consider BMI, the role of parents, socioeconomic influences, and physical activity levels. Although previous reviews have considered the effectiveness of reducing screen time in children and the influence of TV on obesity (Boulos et al., 2012), none have looked at how eating whilst viewing TV affects children's diet quality. For the discussion, and to support the conclusions, only results from the studies with a high quality rating (≥5), and where there have been adjustments made for some measure of SES, will be considered. Related observations are used to add context to the findings.

There are many aspects that contribute to diets of poorer quality, including eating patterns, increased consumption of foods and beverages perceived to be bad for health, such as those high in fat and sugar, often referred to as junk food, as well as decreased consumption of foods perceived to be good for health, such as vegetables and fruits.

This review found evidence that eating whilst watching TV on most or every day does lead to a reduced quality of the diet consumed and that there is an association between watching TV during meals or snacks and a greater intake of energy dense high-fat, high-sugar foods including pizza, fried foods, savoury snacks, junk foods, and sweet foods.

Based on the quality and size of the studies, the data presented on unhealthy food habits appears to confirm that, even from as young as 2 years, children who eat whilst watching TV are more likely to consume high-fat, high-sugar foods.

The benefits of fruits and vegetables in the diet are well documented (Slavin & Lloyd, 2012), and exposure at an early age is important to prevent selective eating in later years (Coulthard, Harris, & Fogel, 2014). However, this review strongly suggests that there is a negative association between eating whilst watching TV and the consumption of fruits and vegetables (Coon et al., 2001; Feldman et al., 2007; Dubois et al., 2008). Children, of all ages, are clearly not choosing fruits as regular snack items to consume whilst watching TV. These findings are consistent with other reports, which have found total TV viewing time to be negatively associated with fruit and vegetable consumption (Ramos, Costa, Araujo, Severo, & Lopes, 2013). Based on these findings the authors suggest that the family food environment should include a fruit bowl or vegetable platter, full of attractive and varied fruits and vegetables, sited near to the TV.

The findings comparing carbohydrate and protein intakes suggest that TV "snackers" could represent a distinct population compared to those children who tend to eat meals in front of the TV, because many snacks are carbohydrate based compared to meals, which normally comprise a protein portion such as meat, but the age of the child may influence the results.

Previous research has focussed on the effects of TV on consumption of SSBs (Olafsdottir et al., 2014), and it was hypothesised that this review would support the existing evidence base that eating and drinking during TV increases consumption of SSBs, including sodas, fruit juices, and caffeine-containing SSBs. Indeed, the results are consistent with existing studies, and the findings add strength to the previously established association between screen time and SSBs by confirming a link between drinking SSBs, including fruit juice, during TV use and increased amount and/or frequency of consumption (Coon et al., 2001; Feldman et al., 2007; Dubois et al., 2008; Rey-López et al., 2011). Given that the consumption of SSBs in the USA has increased from 222 to 458 kcal per day over the past 3 decades (Duffey & Popkin, 2007), interventions, which aim to reduce the consumption of SSBs whilst watching TV, are important.

Overall, a positive correlation was seen between children's BMI z-scores and energy intake whilst viewing with the exception of some teenagers who may fill up on TV snacks with a lower energy content and then eat less at mealtimes. Although a secondary outcome, the general association between eating whilst watching TV and increased BMI adds context to the primary findings regarding children's diet quality. The size and quality of these studies adds to the previous evidence base linking TV with obesity.

The data reported confirm the important role of parents and the relevance of setting limits (Anderson & Whitaker, 2010), because increased energy intake and unhealthy eating or drinking habits are associated with increased screen time and eating whilst watching the TV. Parents are a strong influence on children's food choices in their early years of life, and it is known that girls are more likely to snack, including whilst watching TV, and to have increased screen viewing time if they come from overweight families (Falbe et al., 2013). Parents are responsible for setting a precedent for their children and are therefore influential in influencing screen-viewing habits and dietary choices. It appears that eating together as a family on a regular basis is associated with lower BMI and healthier food choices in children (Hammons & Fiese, 2011) but that, although family meals are important, they do not counteract the effects of watching TV whilst eating.

More children, of all age groups, from lower socioeconomic backgrounds consume snacks, energy dense drinks, and meals whilst watching TV compared with children from families with a higher level of income or educational attainment. This review implicates SES and measures of it as a major factor in children's TV eating and drinking habits. These secondary findings are supported by previous studies on the subject (Currie et al., 2012; Rollins, Belue, & Francis, 2010), highlighting the need for educational programmes aimed at parents, especially those with low socioeconomic backgrounds.

Previous studies have found that, although TV is associated with increased BMI, typically in a dose response manner, this relationship is not dependent upon physical activity (Brown, Nicholson, Broom, & Bittman, 2011; Laurson, Eisenmann, & Moore, 2008; Stamatakis et al., 2013). This review adds limited supporting evidence that the effects are not due to an increase in sedentary time replacing that which would otherwise be spent being physically active, but to changes in diet quality.

5 | STRENGTHS AND LIMITATIONS

All data is cross-sectional. Intervention trials would be necessary to confirm causality rather than the associations reported. However, the data are representative of the western world and collected from a wide range of developed, westernised countries. Some of the large sample sizes may have influenced the levels of significance reported although the high quality studies made adjustments for key confounders.

Although much research has been done to confirm that this association exists, this review is, to our knowledge, the first to collate evidence on the impact of eating whilst watching TV on children's diet quality, which clearly has an impact on weight status and health. We acknowledge that studies showing no association may not have been published. For us to further our understanding of this complex relationship between screen time and diet quality, future research should include interventions, which provide information about the possible underlying factors. For example, is there an element of convenience and eating food from packets rather than a plate or is it due to distraction and mindless eating, which affects diet quality if a child eats or drinks whilst watching TV? Such research would provide follow-up data to determine whether watching TV whilst eating as a child necessarily impacts on BMI and health in the long term and into adulthood.

Given the ever increasing number of "screens" being used by children, further research is required to determine the impact of different types of screen time, whilst eating, on diet quality.

Although the size of some of the associations may seem to be small, it is increasingly becoming recognised that the cumulative effect of small dietary changes may lead to significant nutritional improvements (Paineau et al., 2010), and a report prepared for a Joint Task Force including the American Society for Nutrition proposes that a small changes approach may help to address the obesity epidemic (Hill, 2009).

All dietary intake methodologies, for example, the use of food frequency questionnaires or dietary recall, have their limitations, which may lead to either incomplete or inaccurate reporting. Although the quality assessment did look for the use of validated tools, the limitations in the accuracy of dietary intake data may still be present even in high quality studies.

Overall, this review suggests that for children, from preschool age onwards, eating whilst watching TV reduces diet quality with more high-fat, high-sugar foods and fewer fruits and vegetables and increased consumption of sugar sweetened beverages. Although these differences in consumption tend to be small, the accumulative effect may be enough to cause the positive association between eating during TV use and prevalence of childhood obesity. It is recommended that parents are targeted in any intervention, because their influence is vital in setting and enforcing limits on screen time, particularly whilst eating, and encouraging family meals without the TV on. Given that children from lower socioeconomic backgrounds are more likely to eat whilst watching TV, a focus on supporting these families to make changes is required in order to reverse the greater trends seen in obesity levels in children from families of low SES.

SOURCE OF FUNDING

This work was supported by a summer studentship awarded to CA, by the University of Nottingham's Dean of Science, and supervised by AA and FM.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

AA, CA, and FM designed the study. CA led on the data extraction and data analysis with FM and AA agreeing on papers selected and data interpretation. CA prepared the first draft, and AA updated and prepared subsequent drafts, FM critically reviewed the manuscript.

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How to cite this article: Avery A, Anderson C, McCullough F. Associations between children's diet quality and watching television during meal or snack consumption: A systematic review. *Matern Child Nutr*. 2017;e12428. https://doi.org/10.1111/mcn.12428

Paper 15

Avery, A., Nagar, R., Hillier, S., Pallister, C., Lavin, J., Mellor, D. (2016). **Impact on weight and glycaemic control in people with diabetes attending a group-based commercial weight management organisation.** Practice Nursing 28(2): 468-473.

Studying the impact on weight and glycaemic control in adults with diabetes attending a group-based commercial weight management programme

Most NHS weight management and diabetes education is short term, so can the more sustained support provided by commercial weight loss programmes prove a useful ally in treating obesity and diabetes? Here the authors evaluate a survey that suggests it can

ABSTRACT

Healthcare professionals could work in partnership with commercial group weight management programmes (CGWMP) to help people with diabetes lose weight and improve their glycaemic control. The effect of ongoing CGWMP support on diabetes control has not previously been reported. This study evaluates weight loss and glycaemic control in people with diabetes attending a CGWMP.

Method: A cross-sectional online survey posted on a CGWMP's member's website. The survey asked for reported changes in HbA1c and physical activity and demographics including age, type of diabetes, medications taken and healthcare professional support. The dataset was linked to electronically reported weight and attendances. Data was statistically analysed to assess percentage of individuals meeting targets for weight reduction and HbA1c and outcome changes with variation between genders, type of diabetes and support.

Results: 620 respondents with mean weight loss of 10.0±8.0%; 157 reported a mean reduction in HbA1c of 18±21mmol/mol (1.6±1.9%). 58.2% lost >10% body weight after 24 weeks and 51.5% had achieved HbA1c of <48mmol/l (6.5%). Those with type 2 (n=547) had greater reduction in HbA1c ($p=0.034$) but not weight ($p=0.317$) compared to type 1 diabetes (n=73). An increase in physical activity was associated with advise from a healthcare professional ($p<0.001$) with increases in PA not associated with lower HbA1c ($p=0.654$). A >5% weight reduction was associated with diabetes medication reduction ($p=0.028$) and improved glycaemic control ($p=0.001$).

Conclusion: Support provided by the CGWMP resulted in clinically significant weight losses and improvements in HbA1c with reductions in diabetes medication. Attendance at CGWMPs may be an effective long-term strategy and a scalable option to help improve diabetes control.

Key words | glycaemic control | weight management | diabetes | hypoglycaemia | cost-effective

Sustainable, scalable and cost effective approaches reducing chronic health risks associated with diabetes and obesity are required. Group education, emphasising self-management and lifestyle change, is an accepted approach particularly for people with type 2 diabetes (T2DM). (NICE, NG28, 2015). Many people with type 1 diabetes (T1DM) also benefit from weight management and group education is also recommended (NICE, NG17, 2015). Currently most UK diabetes and weight management education is short-term with local variation but diabetes is a lifelong condition and people are likely to benefit from access to on-going support. There are few ongoing group based programmes for people with diabetes, which are scalable, with evidence of long-term

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Submitted 19 December 2016; accepted for publication after peer review 13 January 2017

effectiveness (Brown et al, 2015).

Commercial group weight management programme (CGWMP) provider organisations are well placed to work in partnership with healthcare professionals to help people with diabetes lose weight and improve their glycaemic control. However, the effect of ongoing membership of a CGWMP on diabetes control has not previously been described. Given that practice nurses are at the forefront of primary care led diabetes care, this research may offer opportunities to them to support this delivery.

This study evaluates the electronically reported weight changes in a subgroup of people with diabetes (both T1DM and T2DM) attending a CGWMP. The self-reported changes in glycaemic control (HbA1c) were compared against current clinical standards set by NICE (2015). Changes in levels of physical activity and diabetes medication were investigated.

Materials and methods

A combination of a cross-sectional online survey, posted on the members' only section of Slimming World's website between 21 July and 9 August 2013, and data collected through the CGWMP provider's electronic weight record system were linked and analysed. The survey consisted of questions exploring type of diabetes, duration of diabetes, and glycaemic control with reported HbA1c at the time of joining and current values. In addition demographics including age and gender were requested alongside self-reported changes in physical activity (PA) levels, information about changes in medications taken to improve glycaemic control and support received from healthcare professionals.

The survey was designed specifically for this study, with the intention of being easy to complete and in language with which the participants attending the programme would be familiar. The questionnaire was constructed and administered using Checkbox v4.4-Web Survey Software (Prezza Technologies, Inc, Watertown, MA, USA). Electronically recorded attendance and weight data (Seca scales, Birmingham, UK; calibrated to the nearest 200g) were collected and used to report weight changes over time.

Data were analysed using SPSS 22.0 (IBM, New York, NY, USA). Normality of continuous variables was assessed using the Kolmogorov-Smirnov test and appropriate parametric and nonparametric statistics were then used to describe the sample. Chi-squared and Kruskal-Wallis tests were used to investigate the relationship between variables. Data was analysed on a per protocol basis. An analysis of variance (ANOVA) was undertaken to assess the effect of length of membership on weight loss, post-hoc analysis was undertaken using a Bonferroni correction. A p-value of <0.05 was taken as significance.

Ethical permission to undertake the analysis was obtained from the University of Nottingham's research ethics committee (School of Biosciences ref SB1516/15).

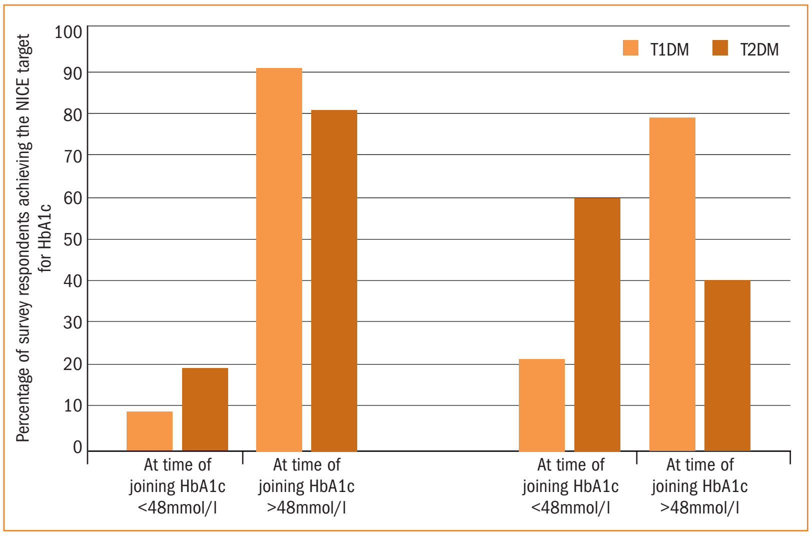

Figure 1. Percentage of survey respondents achieving the NICE target for HbA1c(<48mmol/l or <6.5%) . As data is cross-sectional, it is not possible to adjust for attendance; median attendance was 6 months. n=138 for respondents with T2DM and 39 for respondents with T1DM reporting a HbA1c at time of joining, and n=128 for respondents with T2DM and 33 for respondents with T1DM at the time of survey reported a HbA1c.

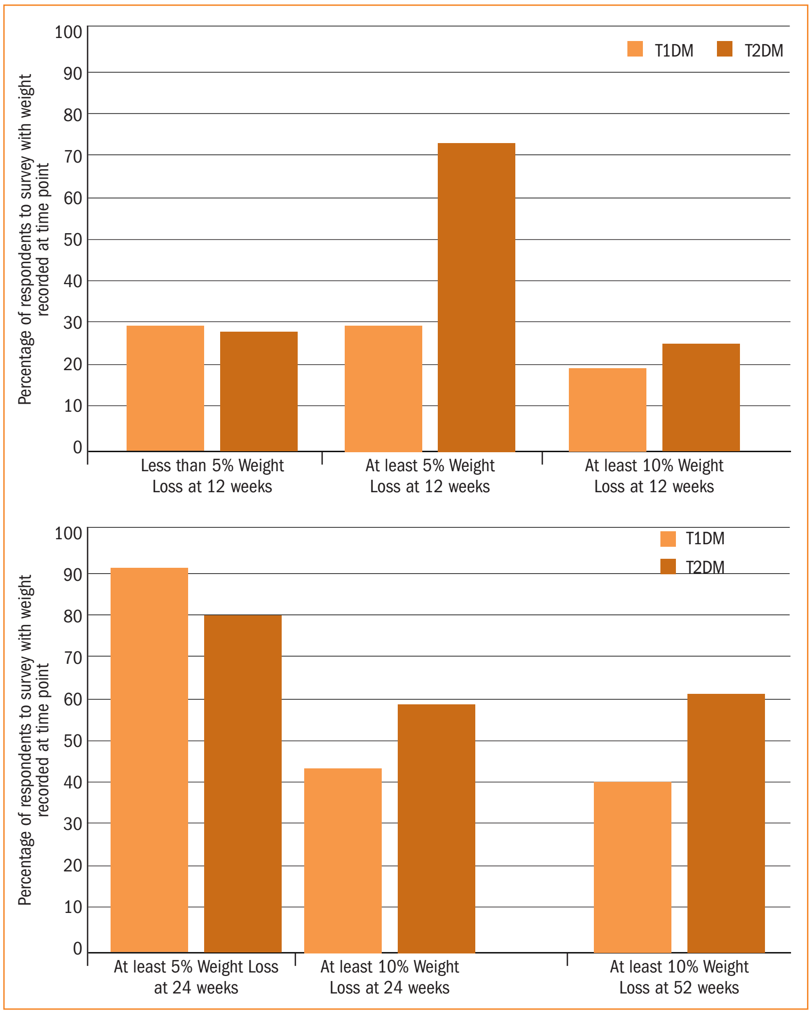

Figure 2a and 2b. Weight loss recorded by respondents to the survey at 12 and 24 weeks.

Table 1: Baseline demographics of the respondents to the survey. Data presented as means ± standard deviations, all data was found to be normally distributed (Kolgmorov-Smirnov p>0.05) and p values are for unpaired t-tests, significance taken at p<0.05 level.

	All Members	Members with T2DM	Members	P value T2DM vs T1DM
Total respondents	620	547	73	–
Age	51.1±12.5	52.7±11.7	38.0±11.9	<0.001
Gender (n) Total/Female/ Male	620/546/74	547/477/70	73/69/4	–
Gender (%)	88/12	87/13	95/5	–
Female/Male	(n=619)			
Duration diabetes (months)	(n=619) 101.4±100.0	(n=546) 81.9±69.6	(n=73) 246.1±156.9	<0.001
Recorded Body Mass Index (kg/m2) at joining	(n=419) 38.7±7.5	(n=373) 39.3±7.3	(n=46) 33.6±7.1	<0.001
Self-reported HbA1c at joining (mmol/ mol) %	(n=177) 68±21 8.4±1.9	(n=138) 67±22 8.3±2.0	(n=39) 8.5±1.6	0.50

Results

A total of 620 members responded to the questionnaire. Table 1 shows the baseline characteristics. Responding members had a median length of membership of 6.0 months at point of survey (Range 0-24 months; IQR 11.0 months; mean value12±9.8 months).

Respondents to the survey were 88% (n=546) female and 88% (n=547) reported having T2DM. On joining the CGWMP, there were differences between genders and those with T1DM and T2DM (*Table 1*). Members with T1DM were significantly younger, lighter with a lower Body Mass Index (BMI) and had a longer duration of diabetes (p<0.001). There were no significant differences in glycaemic control between genders (p=0.329), type of diabetes (p=0.501) or BMI (p=0.992). For all members who attended for 12-24 weeks (n=236) a mean weight loss of 12.2±7.0 kg was achieved. Members who attended for between 24-52 weeks (n=72) had a mean weight loss of 13.9±7.0kg and those attending for more than a year lost 15.4±15.6kg (n=99) (*Tables 2, 3*).

Of the survey respondents, 72.5% lost more than 5% of body weight in 12 weeks, with 24.4% losing more than 10% of their initial body weight (*Figure 2a*). At 24 weeks 58.2% of respondents had lost greater than 10% of their initial body weight (*Figure 2b*). Of the 93 respondents who had been a member for at least 52 weeks, a similar percentage, 40% of those with T1DM and 61% with T2DM, had lost at least 10% of their body weight (Figure 2b). Those who achieved >5% weight reduction were more likely to have their diabetes medication reduced (p=0.028) and improved glycaemic control (p=-0.001).

157 (28%) respondents reported changes in HbA1c levels. There were no significant differences in HbA1c between those with T1DM and those with T2DM at baseline (Table 1) (p=0.501). The numbers reporting an HbA1c of <48 mmol/mol (6.5%) increased from 16.4% (n=177) at joining to 51.5% (n=161) at the time of the survey (figures 1 and 2a and b). Members with T1DM reported a smaller reduction in HbA1c compared to members with T2DM (p=0.034). For respondents with T2DM, less weight was lost if treated with insulin (2.4kg, p<0.05). Despite a difference in weight loss, there were no differences between reductions in HbA1c (18±21mmol/mol (1.6±1.9%) for those managed with insulin, compared to 19±21 mmol/mol (1.7±1.9%) for those not managed with insulin, p=0.758). Members reporting the use of any diabetes medications lost significantly less weight, mean difference of weight loss 4.4kg (p<0.001, -13.9±11.8 versus -9.5±8.6kg), however there were no differences with respect to improvement in HbA1c (-19±22(-1.7±2.0%) compared to -16± 14mmol/mol(1.5±1.9%)).

Respondents who reported reducing their diabetes related medication reported a significantly greater reduction in HbA1c 24±22 mmol/mol (2.2±2.0%, n=83) compared to those who had not 13±18 mmol/mol (1.2±1.6%, n=73, p=0.001). When this was considered in terms of type of medication reduced there was no significant association with any type of medication (p=0.073). Respondents who reported reducing their diabetes medication lost a significantly greater percentage of their starting bodyweight, -10.9±7.2% (n=74) compared to -8.2±7.9% (n=74) for those who did not decrease their medication (p=0.028). The type of medication reduced did not affect the amount of weight loss (p=0.0249).

Reported change in physical activity was examined as a potential confounding variable, with 72.3% (n=448) of respondents reporting an increase in physical activity. Members who reported an increase in physical activity did not lose significantly more weight (11.9±10.5kg for those reporting increased physical activity, compared with 8.5±8.2kg; p=0.094). Reporting an increase in physical activity was associated with being advised to lose weight by a healthcare professional (p<0.001), with those with T2DM being more likely to report an increase in physical activity than those with T1DM (p=0.001). Change in medication dose and decreases in insulin were not associated with an increase in physical activity (p=0.272). Reported increases in physical activity were not associated with an improved HbA1c (p=0. 654).

Duration of membership significantly increased weight

Table 2: Baseline demographics of the respondents to the survey. Data presented as means ± standard deviations, all data was found to be normally distributed (Kolgmorov-Smirnov p>0.05) and p values are for unpaired t-tests, significance taken at p<0.05 level.

	All Members	Members with T2DM	Members with T1DM	P value T2DM vs T1DM	Females Members	Male Members	P value Female vs Male
Percentage weight loss (%)	-10.0±8.0	-9.9±8.0	-11.2±8.0	0.32	-9.7±7.8	-12.0±8.9	0.06
Self-reported HbA1c at time of survey (mmol/mol)	(n=161) 50±16	(n=128) 47±15	(n=33) 60±16	<0.001	(n=143) 50.2±15.3	(n=18) 47.9±21.1	0.58
Self-reported change in HbA1c joining to survey (mmol/mol) (%)	(n=157) -18±21 -1.6±1.9	(n=123) -20±22 1.8±2.0	(n=34) -12±16 1.1±1.5	0.034	(n=141) -18±20 -1.6±1.8	(n=16) -24±25 -2.2±2.3	0.21

loss (p<0.001), if greater than 12 weeks, and the loss was maintained for at least one year, but the effect of duration of membership on HbA1c was not significant (p=0.126).

Discussion

Slimming World (SW) is the largest CGWMP in the UK, currently running 16,000 group sessions each week, reaching 800,000 members. It is estimated that approximately 10% of this number may have diabetes. Groups meet in a variety of local community venues throughout the UK across a range of days and times, making them easily accessible. The group facilitators are supported by regularly updated resources and dietitians based at head office.

The majority of respondents had T2DM and with a starting BMI of over 39kg/m^2. This pragmatic evaluation, using an on-line survey, reports significant weight loss and improvements in glycaemic control, as measured by self-reported changes in HbA1c levels, in people with both T1 and T2DM attending the CGWMP. Reductions in

Table 3: Recorded weight loss and reported change in HbA1c according to length of membership at the time of survey. Data presented as means +/- standard deviations, all data was found to be normally distributed (Kolgmorov-Smirnov p>0.05) and p values are for ANOVA post-hoc test with Bonferroni correction, following p<0.05 ANOVA result as indicated. Significance taken at p<0.05 level. As the survey was open over a two-week period, the average weight for members over this period was used.

	Total	< 12 weeks membership	12-24 weeks membership	24-52 weeks membership	> 52 weeks membership	p-value ANOVA	Post-Hoc
Recorded weight change (kg)	(n=393) -11.0±10.0	(n=156) -6.5±4.4	(n=65) -12.2±7.0	(n=72) -13.9±7.0	(n=99) -15.4±15.6	<0.001	Less than 12 weeks vs other groups (p<0.001) No significant differences for duration of membership greater than 12 weeks
Self-reported change in HbA1c (mmol/mol) (%)	(n=156) -18 ±21 -1.6±1.9	(n=51) -18±20 -1.6±1.8	(n=24) -26±26 -2.4±2.4	(n=38) -13±23 -1.2±2.1	(n=43) -20±16 -1.8±1.5	0.126	Not Applicable

weight and improved glycaemic control were associated with reduced need for diabetes medication. Although a self-selecting sample, with a current median membership of 6 months, this study provides evidence that long term management can improve the key markers of weight and HbA1c whilst reducing medication requirements. Although length of membership does not increase reductions in HbA1c, it supports the suggestion that improvements in glycaemic control are maintained. This is concordant with the findings of Trento and colleagues (2010) that diabetes is not necessarily, with good self-management, a progressive condition.

Currently in the UK only orlistat is licensed for weight management and although caution needs to be exercised in comparing this evaluation with a randomized controlled trial, 72.5% of respondents lost at least 5% of body weight at 12 weeks which increased to 81.3% at 24 weeks. This compares to 51.3% at 1 year for orlistat (compared to 31.6% for placebo) in a population with T2DM (Hanefield & Sachse, 2002).

The respondents reported a mean decrease in HbA1c of 18mmol/mol (1.6%), which is comparable to the 22mmol/mol (2.0%) reported in the DCCT study (1993) for T1DM and almost double that reported in the UKPDS study (1998), associated with a 50% reduction in microvascular complications in T1DM5 and 10% reduction in diabetes related deaths in T2DM6. In addition, this level of reduction exceeds that reported for emerging therapies for diabetes management including the sodium-glucose cotransport 2 inhibitors, (Kadowaki et al, 2014), DPP-4 inhibitors, (Moses et al, 2014), and incretin mimetics and analogues, (Moretto et al, 2008).

There are few ongoing group NHS-based programmes for obese people with diabetes, which are scalable, with evidence of long-term effectiveness. The data reported in this study can be compared with that from the subset of 142 patients with diabetes who completed the SLiM 6-month programme facilitated by trained dietetic assistants. The mean weight loss reported for the SLiM programme was 5.7±6.9kg (p=0.001) with 30% of patients with diabetes achieving ≥5% and 11% achieving ≥10% weight loss over the 6 months, with those who lost weight achieving a mean weight loss of 4.0±4.6%. A mean reduction in HbA1c of 4.0±14.8mmol/l was reported, representing a change from 64.0±18.2mmol/l at base-line to 60.1±15.5mmol/l at the end of the programme (Brown et al, 2015).

Comparing data suggests that membership of weight management groups can provide valuable long term support for people with diabetes wishing to lose weight and improve their health. It should be recognized that improvements in health might not be entirely dependent on weight loss but might also be related to associated changes in dietary behaviours, not reported here, or increased physical activity levels. The group and peer support may also contribute to the weight loss maintenance reported and is an area requiring further exploration (MacLean et al, 2015). The findings may be of relevance to the quest to find scalable cost-effective solutions to reduce HbA1c levels in people presenting with prediabetes. A CGWMP offers a non-clinical support option, and as diabetes is a long-term condition requiring self-management, this in itself might explain some of its benefits and value. Diabetes UK (2015) has suggested that people with diabetes only spend a maximum of three hours a year with their healthcare team. This means that other sources of ongoing support, such as weight management group membership could support improved self-management without increasing NHS resource burden.

Future work should look to enhance partnership working between CGWMPs and diabetes teams (either in primary or secondary care) to better support people with diabetes. Adjusting medication is important not only to reduce risks associated with hypoglycaemia, but also to facilitate weight loss. Hypoglycaemia and over treatment with insulin and sulphonylureas have been associated with weight gain, linked to the need to consume additional food energy as carbohydrate to treat hypoglycaemia (DCCT, 2001). It is clear that both people with T1DM and T2DM can benefit from membership of a weight management programme, and more research needs to be undertaken on the best way of monitoring and reducing the potential risks including hypoglycaemia. Effective teamwork between the person with diabetes, their diabetes care team and the weight management organisation is vital to optimize safe and desired outcomes. Research is currently on-going evaluating a range of clinical outcomes following the referral from a diabetes specialist nurse in primary care to a CGWMP.

Limitations

This cross sectional survey represents a fluid sample of around 1% of the total number of people with diabetes attending SW groups. All were still attending the groups having been members for variable lengths of time. Thus, the results may not reflect the overall impact of the intervention.

The use of self-reported retrospective information, apart from weight and attendance, is a potential limiting factor. The overall nature of self-reported studies of this type; means that the data may represent a self-selection bias, in that those who chose to participate may be those who achieve better outcomes in terms of weight and improvement in glycaemic control and therefore may be more likely to respond positively to survey requests. Although this is possible, it is considered that online surveys are no more prone to this than paper based surveys (Weigold et al, 2013). Therefore, a main limitation is the self-reported HbA1c which unlike the weight data could not be verified in this study, and should be an area of focus for future work.

Adverse event reporting, especially the incidence of hypoglycaemia related to changes in dietary patterns and doses of insulin and sulphonylureas was not reported within the scope of this study.

KEY POINTS

- Role of ongoing support for people with diabetes can improve glycaemic control with results seen comparable to treatment with expensive pharmacological agents
- Weight management groups can offer this support, and help obese people with diabetes manage their weight and glycaemic control
- Healthcare encouragement increases physical activity levels which may further enhance weight management and glycaemic control.
- Accessible group support external to traditional healthcare models should be considered as part of diabetes care and education.

Although there are a number of methodological limitations to consider, the results suggest that attending a CGWMP is beneficial to people with diabetes. Although weight loss is known to improve HbA1c and reduce medication usage, it is also significant that these are not necessarily interdependent, and improved lifestyle behaviours associated with group attendance may explain the results. This observation has been supported by other lifestyle interventions in groups with diabetes and warrants further investigation.

Conclusion

People with both T1DM and T2DM, who attend a CGWMP can achieve clinically significant weight loss and glycaemic control as measured by changes in HbA1c levels. Improvements in physical activity levels and decreases in diabetes medication can also be achieved. The data supports the role of healthcare professionals encouraging the person with diabetes to lose weight, with these individuals apparently experiencing better glycaemic control, and this partnership approach warrants further emphasis and exploration. It is important for prospective research to fully assess the role of CGWMPs in supporting the self-management of people with diabetes. The mean length of attendance suggests that CGWMPs may offer long-term support to both long-term conditions (diabetes and obesity) and given the infrastructure of these organisations, this may offer a scalable solution to the associated public health burden. **PN**

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Paper 16

Avery, A., Hillier, S., Pallister, C., Barber, J., Lavin. J (2016). **Factors influencing engagement in postnatal weight management and subsequent weight and well-being outcomes.** *British Journal of Midwifery 24(11):2-8.*

Factors influencing engagement in postnatal weight management and weight and wellbeing outcomes

Abstract

Background: Many women exceed gestational weight gain recommendations. Successful postnatal weight management decreases the risk of entering further pregnancies obese.
Aims: This service evaluation investigates women's motivations to lose weight postnatally, the weight loss achieved and the impact on the women's self-esteem.
Methods: An online survey was used, with quantitative questions to determine motivation and lifestyle behaviours related to postnatal weight management in women attending a commercial weight management organisation. Weekly weights were confirmed from digitally recorded data.
Findings: A total of 1015 women responded. Mean body mass index at joining was $33.3\,kg/m^2 \pm 5.85$ and, when surveyed, $30.5\,kg/m^2 \pm 5.86$, a change of $-2.8 \pm 0.1\,kg/m^2$ ($P<0.01$, 95% CI 2.76–3.11). 463 women (45.6%) joined the groups between 6–26 weeks postnatal. The main motivators to lose weight were to 'improve how I feel about my body size and shape' (85.2%) and 'improve self-confidence' (76.6%); however, only 'to improve my health' (65.6%) correlated with actual weight loss (0.114, $P<0.01$). Health professionals' recommendation was less of a reason (6.5%). Improvements in self-confidence (77.6%), self-esteem (78.6%), wellbeing (85.2%) and body size/shape (70.0%) were reported.
Conclusions: Women chose to engage in the weight management service to improve their self-confidence, feelings about their body shape, and health. There is an opportunity for health professionals to encourage women early after giving birth to engage in weight loss, which may improve outcomes.

Keywords: Obesity, Weight management, Pregnant, Postnatal

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Of the four million women who give birth in the USA each year, almost 30% gain more weight than recommended by the Institute of Medicine guidelines (Rasmussen and Yaktine, 2009). It has been established for many years that pregnancy may lead to subsequent weight problems. In the Stockholm Pregnancy and Women's Nutrition (SPAWN) longitudinal study, weight retention at the end of the first year postpartum was the main predictor of being overweight 15 years later (Linné et al, 2004).

In the UK, 24% of women of reproductive age are now obese, and the prevalence is predicted to increase (Butland et al, 2007). Maternal obesity increases health risks for the woman and child, both during and after pregnancy, including hypertensive disorders, thromboembolism, gestational diabetes mellitus, induction of labour, prolonged birth, caesarean section, postpartum haemorrhage and either low birth weight or macrosomia in the infant (Scott-Pillai et al, 2013). The more weight the woman gains during pregnancy, the more likely it is that the weight may be retained postpartum (Johnson et al, 2013). Women who enter a subsequent pregnancy overweight or obese have a higher risk of adverse outcomes for themselves and/or their infants.

Given that the antenatal period involves regular contact with health professionals, pregnancy may be considered an opportune time to encourage weight management and prevent excess weight gain, thus preventing the vicious circle of weight accumulation across successive pregnancies and associated health risks. However, a 2011 study reported that the majority of obese women taking part in either semi-structured interviews or focus groups in London felt that pregnancy was not the best time to address weight, as general concerns about pregnancy and complications were felt to be the priority (Khazaezadeh et al, 2011). Instead, those interviewed reported that the motivation for weight management efforts would be higher following childbirth, or prior to conception (Khazaezadeh et al, 2011). This finding is reinforced by Hodgkinson et al (2014), who concluded that the postpartum period is a time when women need more support.

UK National Institute for Health and Care Excellence (NICE, 2015) public health guidance for supporting women after childbirth currently recommends that health professionals use the 6–8 week postnatal check, or a follow-up appointment within the next 6 months, as an opportunity to discuss a woman's weight and offer support and up-to-date advice about how to lose weight safely after childbirth. The NICE guidance recommends that during follow-up appointments, breastfeeding should be encouraged along with a healthy diet and building moderate-intensity physical activity into daily life. Women with a body mass index (BMI) $>30\,kg/m^2$ should be made aware of the increased risks that being obese poses to them and encouraged to lose weight via a structured weight-loss programme.

Successful weight management in the period following childbirth not only decreases the risk of entering further pregnancies overweight or obese, but also has the potential to reduce long-term health risks such as heart disease, obesity, cancer, cardiovascular disease and type 2 diabetes (Scott-Pillai et al, 2013).

It is widely accepted that new mothers experience huge changes in lifestyle once they have given birth, and there is a tendency for women to put their own health second to their child's health. Previous evidence has identified a number of barriers that prevent women from successfully engaging in postnatal weight management, including lack of time, changes in body image, depression, lack of motivation and lack of support (Montgomery et al, 2011), but there is little knowledge available as to what might increase motivation levels.

Previous trials have assessed different approaches to weight management in the postnatal period, but evidence regarding the most effective method is still lacking; there is uncertainty surrounding the optimal method and recruitment stage (van der Pligt et al, 2013).

Group-based commercial weight management (CWM) interventions are successful when implemented in the general population (Stubbs et al, 2011) and are currently recommended in the UK (NICE, 2014). The CWM organisation Slimming World (SW) has worked in partnership with the Royal College of Midwives to develop a policy to support women to manage their weight through all stages of pregnancy and postpartum, including whilst breastfeeding. The multi-component group-based programme, including behavioural change strategies, emphasises the importance of maintaining a healthy diet that is varied and flexible and being physically active, detailing the benefits to both the woman and baby.

ADOBE/DOMFORSTOCK

The aim of this service evaluation is to investigate, through an online survey, members' motivations to lose weight postnatally, to consider the barriers and to determine the weight loss achieved and impact on women's wellbeing, confidence, self-esteem and body image, in order to continually improve the support offered.

Materials and methods

An online survey was hosted on the group-members-only section of the SW website during September 2013. It was advertised to current members who had given birth in the previous 2 years. The survey was specifically developed for this service evaluation, with the intention being that it was easy to complete and written in language with which the participants in the SW programme were familiar.

The survey consisted of 36 questions. Participants were asked to select from a drop-down menu to describe age, height, date of birth, parity, breastfeeding status, duration of membership and the amount of weight gained during the most recent pregnancy. Weight at the time of survey and on joining the programme was confirmed from the weekly weight data electronically recorded during group sessions as part of each participant's membership. The same calibrated scales were used each week at a given group to record weight and weight change. Weight data were screened for outlying data and BMI changes were calculated using the confirmed weight data and self-reported heights.

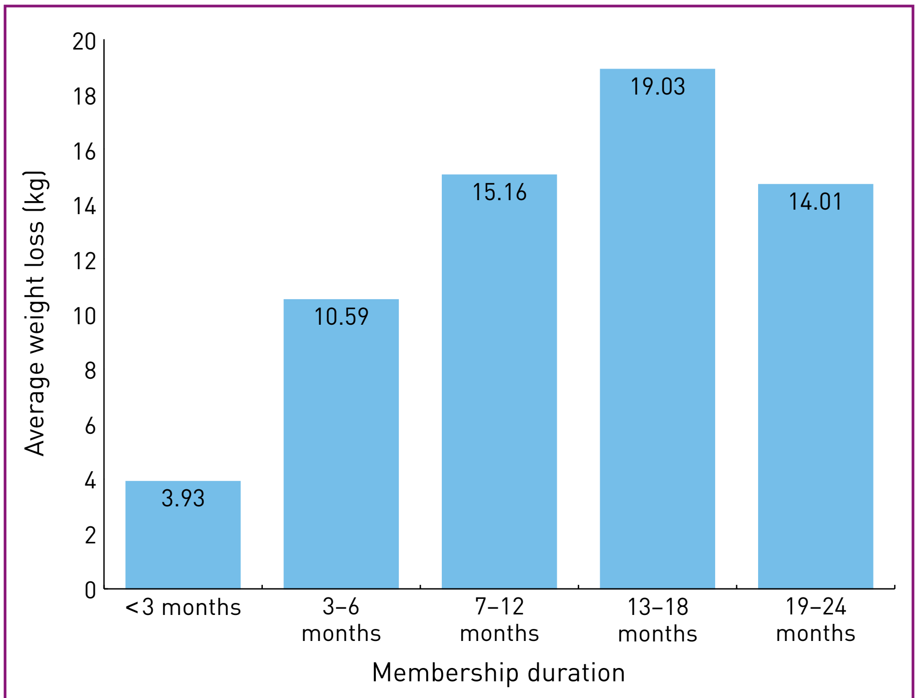

Figure 1. Weight loss by membership duration of the commercial weight management programme at time of survey

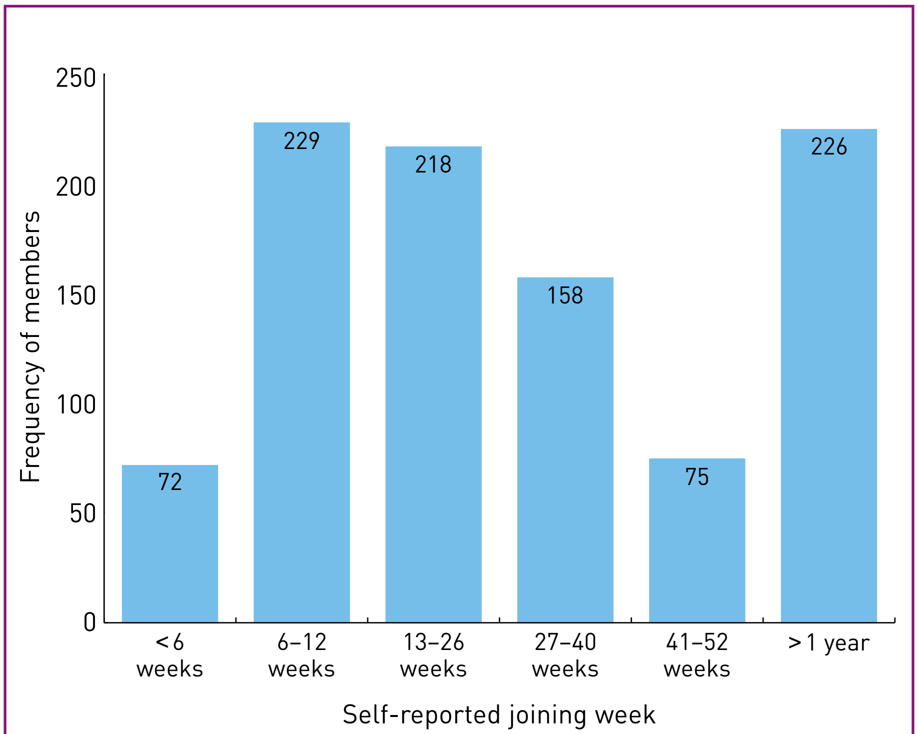

Figure 2. Self-reported joining week of all participants attending the weight management programme postnatally

The remainder of the questionnaire took the form of 5-point Likert scales, checkboxes or multiple choice where one or more options could be ticked as appropriate, to determine motivation and lifestyle behaviours. The survey asked questions on: motivations to join SW; changes in self-confidence, self-esteem, wellbeing, body shape and image before and since joining SW; how long after giving birth participants joined and whether having a baby contributed to the decision to join; whether they were breastfeeding; barriers to attending the group; how easy it was to attend the group; and benefits from attending. The questionnaire was constructed and administered using Checkbox v4.4-Web Survey Software © 2007, Prezza Technologies, Inc.

Participants

Group members, irrespective of their starting BMI, were only invited to complete the survey if they had given birth in the last 2 years and they had joined SW after having their baby (i.e. were not attending before becoming pregnant or while pregnant). Women who were currently pregnant were excluded from the study. Members were provided with online information about the study before participating and were informed that, by completing the survey, they were voluntarily consenting to participate in the study. As part of the membership contract, it is clear that unidentifiable personal weight data may be used for service evaluation purposes.

Statistical analysis

Data analysis was performed using SPSS for Windows (version 21) and Microsoft Excel. Descriptive data are summarised as frequency, mean + standard deviation and percentages of participants responding to each question or sub-question where indicated. Data were analysed using paired *t*-tests to determine significant differences between weight reported at baseline and at the time of survey. Pearson's *r*-correlation, following adjustment for length of membership, was used to determine the relationship between motivations for weight loss and actual weight loss as a result of attending the weight management programme.

Ethics

The work was carried out in accordance with the principles set out in the Code of Ethics according to the Declaration of Helsinki 1964.

Results

Participant characteristics

A total of 1015 women responded. Mean age was 32.2 ± 5.1 (range 18–45) years. Mean parity was 1.8 ± 0.9, with a range between 1 and 5+ children.

Mean BMI on joining ($n = 971$ owing to missing height data for some participants) was $33.3 \pm 5.8\,kg/m^2$ and at the time of the survey was $30.5 \pm 5.9\,kg/m^2$, representing a BMI change of

$-2.8 \pm 0.2\,kg/m^2$ ($P < 0.01$, 95% CI 2.76–3.11). Weight change was significantly different between joining weight (baseline) and weight at time of survey, with an 8.6% mean weight loss reported ($-7.9 \pm 0.05\,kg$) ($P < 0.01$). *Figure 1* shows the absolute weight changes dependent on the length of time the women were attending the weekly groups.

At the time of survey, current duration of membership varied between participants, 52.5% ($n = 533$) reported being members for less than 3 months, 22.4% ($n = 227$) were members for 3–6 months, 15.7% ($n = 159$) for 7–12 months, 6.2% ($n = 63$) for 13–18 months and 3.3% (n=33) for 19 months to 2 years. *Figure 1* illustrates a positive association between duration of attendance at the groups and mean amount of weight loss achieved up to 19–24 months' group membership.

Participants reported joining the weight management programme at a variety of time points after having their baby (*Figure 2*). Almost half the participants (45.6%, $n = 463$) started attending the weight management programme between 6–26 weeks postnatal, and 23.4% ($n = 238$) commenced >1 year postnatal.

More than three quarters of participants (76.8%, $n = 780$) stated they had retained more than 1 stone (6.4 kg), and 61.0% ($n = 619$) agreed that having a baby contributed to their decision to join SW, with 51.3% ($n = 521$) reporting that gaining weight during their pregnancy affected their self-esteem.

More than half of the participants who responded (62.8%, $n = 626$) reported breastfeeding their most recent child, with the length of breastfeeding varying between respondents:

- 0–1 week: 10.4% ($n = 66$)
- 1–3 weeks: 14.9% ($n = 93$)
- 4–6 weeks: 16.9% ($n = 106$)
- 7–12 weeks: 11.5% ($n = 71$)
- 3–4 months: 7.6% ($n = 47$)
- 4–5 months: 4.9% ($n = 31$)
- 5–6 months: 9.5% ($n = 59$)
- 7–12 months: 15.1% ($n = 96$)
- 12 months: 8.9% ($n = 57$).

A sub-analysis was performed to compare current weight loss (recorded from electronic records) with start date of joining the CWM programme (when adjusted for membership length), to identify whether time of commencing a weight management programme affected weight-loss outcomes. This analysis indicates that participants who engaged in the weight

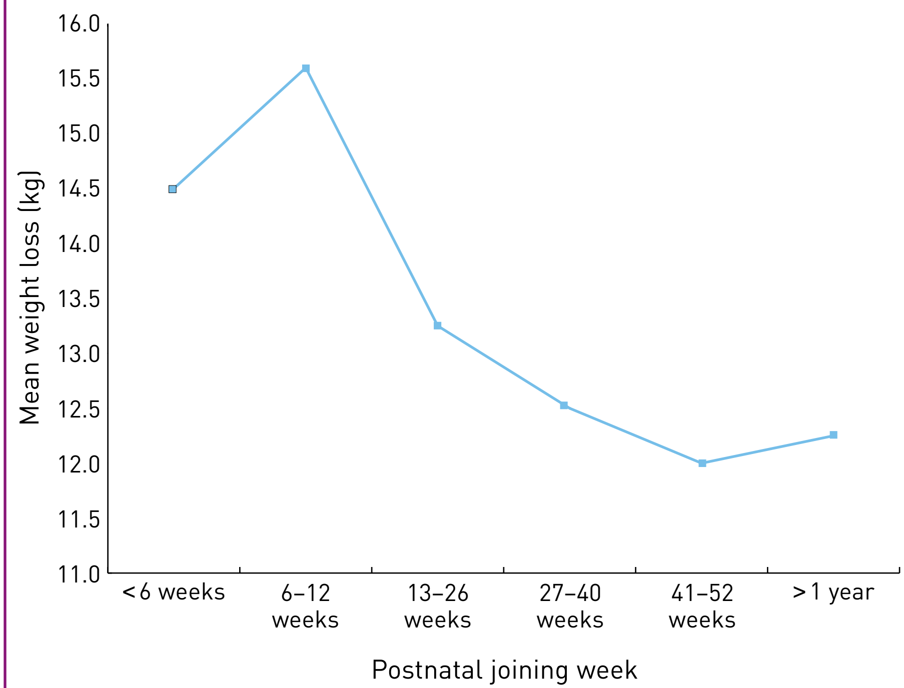

Figure 3. Participant start date and recorded weight loss adjusted for membership duration at time of survey

Table 1. Reasons for wanting to lose weight and correlations with actual weight loss

Reason	Frequency ($n = 1015$)	Percentage %	Correlation with weight loss	*P*-value
To improve how I feel about my body size and shape	865	85.22	0.031	0.336
To improve my self confidence	777	76.55	–0.016	0.620
To lose the weight I gained during my pregnancy	675	66.50	0.002	0.940
To improve my health	666	65.62	0.114*	0.000
It felt like the right time to lose weight	654	64.43	0.056	0.078
To lose baby weight before having another baby	181	17.83	–0.095*	0.003
Social pressure made me feel I was expected to lose weight	87	8.57	–0.004	0.889
A health professional recommendation	66	6.50	0.063	0.050
Media pressure and celebrity culture made me want to lose weight	40	3.94	–0.008	0.812

*Correlation is significant at the 0.01 level (two-tailed)

Table 2: Wellbeing, confidence, self-esteem and body image since joining Slimming Worl

Statement	Strongly agree		Slightly agree		Neither agree nor disagree		Slightly disagree		Strongly disagree	
	n=1015	%	n=1015	%	n=1015	%	n=1015	%	n=1015	%
I have improved self-confidence	402	39.61	386	38.03	202	19.90	18	1.77	7	0.69
I have improved self-esteem	402	39.61	396	39.01	193	19.01	15	1.48	9	0.89
I have an improved sense of wellbeing	490	48.28	375	36.95	131	12.91	12	1.18	7	0.69
I have confidence in my body size and shape	408	40.20	303	29.85	234	23.05	42	4.14	28	2.76
I feel under social/ media pressure to lose my baby weight	127	12.51	188	18.52	298	29.40	156	15.37	246	24.24

management service between 6–12 weeks postnatal recorded greater weight losses than those who engaged 41–52 weeks or >1 year postnatal ($P<0.05$) (*Figure 3*).

Motivations for weight loss

Participants were asked to select from a series of statements all applicable reasons why they decided to lose weight. The results indicate the main motivations were 'to improve how I feel about my body size and shape' (85.2%, n=865), 'to improve my self-confidence' (76.6%, n=777), and 'to lose the weight I gained during my pregnancy' (66.5%, n=675). Social pressure (8.6%, n=87), media pressure and celebrity culture (3.9%, n=40) were reported less frequently as a contributing factor to wanting to lose weight postnatally (*Table 1*). Reasons for deciding to lose weight were correlated with actual weight loss to determine whether initial intentions to lose weight transferred into reported weight loss: only 'to improve health' was positively correlated, with 'to lose baby weight before having another baby' negatively correlated to weight loss.

Wellbeing, self-esteem, confidence and body image

Just over half the participants (51.3%, n=521) reported that weight gain during pregnancy had affected their self-esteem, rising to 82.27% (n=835) when retaining weight after pregnancy. Participants also reported how they felt their self-esteem, self-confidence, general wellbeing, and confidence in body weight and size had been affected since joining the CWM group, and whether they felt under social or media pressure to be an 'ideal' weight following their pregnancy (*Table 2*). Participants reported improved self-confidence (77.6%, n=788), improved self-esteem (78.6%, n=798), improved sense of wellbeing (85.2%, n=865) and felt more confident in their body shape and size (70.0%, n=711). In response to the statement that they felt under social or media pressure to be an ideal weight following their pregnancy, 39.6% (n=402) disagreed, 31.0% (n=315) agreed and 29.4% (n=298) neither agreed nor disagreed.

Practicalities of taking part in the weight management programme

Participants were asked to report on the practicalities of attending the CWM group as a member after having a baby. Participants reported their group location (n=896, 88.3% agree quite a lot or very much) and time (n=846, 83.3% agree quite a lot or very much) was convenient for them. In addition, of those who took their children (n=737) and or buggies (n=743) to a SW group, almost three quarters reported their group to be child-friendly (76.5%, n=564) and buggy-friendly (73.4%, n=545).

Discussion

The aim of the current investigation was to determine women's motivations for losing weight in the postnatal period, investigate the impact of social pressure and explore the effect that the weight management programme had on women's health, confidence, self-esteem and body image, wellbeing and weight.

Almost half of the respondents had been members of the CWM group for more than 3 months and significant mean weight losses were achieved. The results indicate that obese women engage in weight management programmes at various times in the postnatal period, from as early as 6 weeks to more than 1 year after giving birth. The findings suggest women want to lose weight and engage in the programme to improve how they feel about their body shape and size, their health, and their self-confidence, and to lose the weight gained during their pregnancy. While body shape and size, improving self-confidence and losing the weight gained during pregnancy were the strongest motivators reported, improving health was the only motivator that was significantly positively correlated to actual weight loss.

The results also indicate that recommendation from health professionals currently plays a minimal role in motivating women to lose weight. This could be a result of health professionals not fully understanding the importance of postnatal weight management, or there being few opportunities where a health professional is able to raise the issue and encourage postnatal women to lose weight. Currently, the emphasis in the postnatal period tends to be on the health and wellbeing of the infant (Montgomery et al, 2011). The low response rate to this statement highlights a need to further develop the role that health professionals play in influencing the health of postnatal women. Only 17.8% (n=181) of the study participants claimed their motivation was to lose weight before having another baby.

The present survey reported 64.4% (n=654) of members felt that joining a weight loss group at the right time was a motivator to lose weight postnatally. This suggests there may be an opportune time to initiate a weight management intervention in postnatal women. Current UK guidelines (NICE, 2010) recommend the 6–8 week postnatal check as an ideal time to raise the issue of excess weight retained post-pregnancy and offer support about how to lose weight. The findings from this evaluation support this recommendation.

Very few of the women cited media or social pressure as reasons for wanting to lose weight. This indicates that although celebrity pressure may be one factor in making women feel they need to lose weight after birth, it does not actually have a major influence on engagement in a weight loss programme.

It might be assumed (particularly by media or critics) that engaging in a weight loss programme may add to the pressures faced by postnatal women, inducing feelings of low self-esteem or guilt that they 'need' to lose weight. However, the responses provided in the current survey demonstrate that the participants actually had low self-esteem before they joined a SW group—which may have been related to excess weight gain during and weight retention after pregnancy—and that their attendance and weight loss was associated with increased self-esteem, self-confidence and wellbeing.

The reported breastfeeding rates at 6 weeks and beyond are higher than current reported UK rates, at 58.5% *vs* 55% (NHS England, 2015), which may reflect the additional benefits of social support and improved self-esteem.

Previous evidence has identified time and childcare as potential barriers to engaging in weight management services (Montgomery et al, 2011). However, responses from participants in the current survey suggest that the weight management group location and time were convenient, and child- and buggy-friendly.

Limitations

The survey relied on retrospective self-reporting to establish the motivations for losing weight up to 2 years post-birth, and the survey only provides a snapshot of the potential motivators.

The self-reported increases in self-esteem and self-confidence may have been the result of reasons other than weight loss.

Despite the high number of respondents reported in this survey, it is likely that this sample is a specific, self-selected sub-group, representing individuals who successfully engage in a commercial weight management organisation. As such, the responses may not represent all postnatal women attempting to lose weight, or the general population as a whole. The results, therefore, should be considered in the context in which they were obtained and the population in which they represent.

In addition, a number of key distinguishable participant characteristics were not collected, including ethnicity and sociodemographic status. This information is of importance as social deprivation is highly associated with obesity in pregnancy (Heslehurst et al, 2010), and motivators and barriers to losing weight postnatally may differ in these populations. The authors were unable to adjust for the magnitude of weight gained during pregnancy in the statistical analyses.

Implications for practice

Health professionals need to seek every opportunity possible to encourage women in the early postnatal period to lose weight, particularly if the woman is likely to become pregnant again. They should not be concerned about increasing anxiety levels, as encouraging women to engage in certain CWM programmes in the postnatal period

Key points

- A total of 1015 postnatal women participated in an online survey
- A significant mean weight reduction was achieved though attendance at community weight management groups
- Women joined the weight management groups at various times during the postnatal period; 45.62% joined between 6–26 weeks after giving birth, while 23.45% waited until 1 year after giving birth
- The main motivations to lose weight were 'to improve how I feel about my body size and shape' and 'to improve my self-confidence'
- Early engagement in the weight management intervention improved weight-loss outcomes, which suggests there is an opportunity for midwives to discuss postnatal weight management

may increase levels of self-confidence and self-esteem. Encouraging women as early as 6 weeks after giving birth may help to improve weight loss outcomes in the postnatal period.

Conclusions

This survey indicates that postnatal women with an overweight or obese BMI engage in a group-based weight management programme because of personal reasons around improving body shape and size, health and self-confidence, rather than as a result of media or celebrity pressure. Participants reported concerns around retention of excess pregnancy weight gain affecting their self-esteem. However, engaging in a CWM programme, using a multi-component behavioural approach, resulted in significant weight loss and increases in self-esteem, self-confidence, wellbeing and body image. The groups were reported to be very accessible in terms of location and time, and were considered child-friendly. These results could have significant public health implications for promoting suitable weight management interventions for postnatal women. BJM

Funding: *The study was funded by departmental resources. AA, JB, CP and JL designed the study. AA and SH completed the data analysis. AA and SH prepared and CP and JL critically reviewed the manuscript.*

Conflict of interest*: AA, alongside her academic position at the University of Nottingham, also holds a consultancy position at Slimming World. The survey was hosted by Slimming World. All authors received some level of salaried payment by the organisation.*

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STATEMENT OF AUTHORSHIP OF PUBLICATIONS

On behalf of Amanda Jayne Avery

By Dr Sharon Simpson, Senior research fellow, Social and Public Health Sciences Unit, University of Glasgow.

This statement confirms the contribution made by Amanda Jayne Avery to jointly authored work;

Jewell, K., **Avery, A.**, Barber, J. & Simpson, S. (2014). The healthy eating and lifestyle in pregnancy (HELP) feasibility study. *Br. J. of Midwifery* 22(10) 727-738

I confirm that Amanda Avery contributed **50%** to the above publication. She was involved in the study design, data extraction, analysis, interpretation and manuscript preparation.

John, E., Cassidy, D.M., Playle, R., Jewell, K., Cohen, D., Duncan, D., Newcombe, R.G., Busse, M., Owen-Jones, E., Williams N., Longo, M., **Avery, A.** and Simpson, S. A. (2014). Healthy eating and lifestyle in pregnancy (HELP):a protocol for a cluster randomised trial to evaluate the effectiveness of a weight management intervention in pregnancy. BMC Public Health, 14:439-455

I confirm that Amanda Avery contributed 10**%** to the above publication. She was involved in the intervention design, development and delivery and advised at various stages.

Signature; S A Simpson

Date; 24/3/15

STATEMENT OF AUTHORSHIP OF PUBLICATIONS

On behalf of Amanda Jayne Avery

By Dr Jacquie Lavin, Head of Nutrition and Research, Slimming World

This statement confirms the contribution made by Amanda Jayne Avery to jointly authored work;

Bye. C., Avery. A. and Lavin. J. (2005). Tackling obesity in men: a preliminary evaluation of men only groups within a commercial slimming organisation. *Journal of Human Nutrition and Dietetics*, 18(5): 391-394.

(Appendix 1)

I confirm that Amanda Avery contributed 35% to the above publication. She initiated the research, extracting the initial data before supporting C. Pallister in the data analysis and interpretation, manuscript preparation and making amends to the manuscript following reviewer's recommendations

Lavin, J.H., Avery. A., Whitehead. S.M., Rees. E., Parsons. J., Bagnall. T., Barth. J.H. & Ruxton. C.H.S. (2006). Feasibility and benefits of implementing a Slimming on Referral service in primary care using a commercial weight management partner. *Public Health*, 120(9): 872-881

I confirm that Amanda Avery contributed 60% to the above publication. She was involved from the beginning of the project design, ethics, recruitment, data inputting, data analysis and interpretation and first draft of manuscript preparation.

Pallister, C., Avery, A., Stubbs, J. and Lavin, J. (2009). Influence of Slimming World's lifestyle programme on diet, activity behaviour and health of participants and their families. *Journal of Human Nutrition and Dietetics*, 24(4): 351-358.

I confirm that Amanda Avery contributed 35% to the above publication. She initiated the research, extracting the initial data before supporting C. Pallister in the data analysis and interpretation, manuscript preparation and making amends to the manuscript following reviewer's recommendations.

Avery, A., Allan, J., Lavin, J. and Pallister, C. (2010). Supporting post-natal women to lose weight. *Journal of Human Nutrition and Dietetics*. 23(4): 439

I confirm that Amanda Avery contributed 50% to the above abstract (Appendix 2). She initiated the research, extracting the initial data before supporting J. Allan in the data analysis and interpretation, abstract preparation, review and presentation.

Avery, A., Pallister, C., Allan, J., Stubbs, J. and Lavin, J. (2012). An initial evaluation of a family-based approach to weight management in adolescents attending a community weight management group. *Journal of Human Nutrition and Dietetics*, 25(5):469-76. doi: 10.1111/j.1365-277X.2012.01277.x (open access)

I confirm that Amanda Avery contributed 75% to the above publication. She was involved from the beginning of the project design, recruitment, data inputting, data analysis and interpretation and manuscript preparation.

Stubbs, J., Pallister, C., Avery, A., Allan, J. and Lavin, J. (2012). Weight, body mass index and behaviour change in a commercially run lifestyle programme for young people. *Journal of Human Nutrition and Dietetics*, 25(2): 161-166

I confirm that Amanda Avery contributed 20% to the above publication. She was involved in study design, manuscript preparation, review and wider dissemination of findings.

Stubbs, J., Brogelli, D., Allan, J., Pallister, C., Whybrow, S., Avery, A. and Lavin, J. (2013) Service evaluation of weight outcomes as a function of initial BMI in 34,271 adults referred to a primary care/commercial weight management partnership scheme. *BMC Research Notes*, 6:161 doi:10.1186/1756-0500-6-161 (open access).

I confirm that Amanda Avery contributed 15% to the above manuscript and related abstract (Appendix 2). She was involved in study rationale (further evaluation of Slimming on Referral), study design, manuscript preparation and review.

Stubbs, R.J., Brogelli, D., Pallister, C., Avery, A., McConnon, A. and Lavin, J.H. (2012). Behavioural and motivational factors associated with weight loss and maintenance in a commercial weight management programme. The Open Obesity Journal. 4, 35-43.

I confirm that Amanda Avery contributed 15% to the above publication. She was involved in study design, manuscript preparation, review and wider dissemination of findings.

Stubbs, R.J., Brogelli, D.J., Allan, J., Pallister, C., Whybrow, S., Avery, A. and Lavin, J. (2013). Service evaluation of weight outcomes as a function of initial BMI in 34,271 adults referred to a primary care/commercial weight management partnership scheme. *BMC Research Notes*, 6:161 doi:10.1186/1756-0500-6-161

I confirm that Amanda Avery contributed 15% to the above publication. She was involved in study design, manuscript preparation, review and wider dissemination of findings.

Stubbs, J., Hillier, S. Pallister, C., Avery, A., McConnon, A., Lavin. (2015). Changes in self-esteem in participants associated with weight loss and maintenance of commercial weight management programme. *Obesity & Control Therapies* 2(1): 1-5.

I confirm that Amanda Avery contributed 20% to the above publication and related abstract (Appendix 2). She was involved in study design, manuscript/abstract preparation, review and wider dissemination of findings.

Investigating motivations for weight loss and benefits of attending a commercial weight management organisation in postnatal women (submitted, 2015).

I confirm that Amanda Avery contributed 20% to the above publication. She was involved in study design and manuscript preparation.

Avery, A., Nagar, R., Hillier, S., Pallister, C., Lavin, J., Mellor, D. (2017). Impact on weight and glycaemic control in people with diabetes attending a group- based commercial weight management organisation. *Practice Nursing* 28(2): 468-473.

I confirm that Amanda Avery contributed 50% to the above publication. She was involved from the beginning of the project design, recruitment, data analysis and interpretation and manuscript preparation.

Avery, A., Hillier, S., Pallister, C., Barber, J., Lavin. J. (2016). Factors influencing engagement in postnatal weight management and subsequent weight and well-being outcomes. *British Journal of Midwifery 24(11):2-8.*

I confirm that Amanda Avery contributed 40% to the above publication. She was involved from the beginning of the project design, recruitment, data analysis and interpretation and manuscript preparation.

Signature; ______Jacquie Lavin______

Date; ____08/08/16____________

STATEMENT OF AUTHORSHIP OF PUBLICATIONS

On behalf of Amanda Jayne Avery

By Dr Fiona McCullough, Associate Professor, Division of Nutritional Sciences, University of Nottingham

This statement confirms the contribution made by Amanda Jayne Avery to jointly authored work;

Avery A., Bostock L., McCullough F. (2015). A systematic review investigating interventions that can help reduce consumption of sugar-sweetened beverages in children leading to changes in body fatness. J Hum Nutr Diet. 28 (Suppl. 1): 52–64 [10.1111/jhn.12267](https://doi.org/10.1111/jhn.12267)

I confirm that Amanda Avery contributed 50% to the above publication. She initiated the research, re-extracting data and supporting L. Bostock in the data analysis and interpretation, manuscript preparation and made amends to the manuscript following reviewer's recommendations.

Avery, A., Anderson C., McCullough, F. (2016). Associations between children's diet quality and watching television during meal or snack consumption: a systematic review. Maternal and Child Nutrition (under review).

I confirm that Amanda Avery contributed 50% to the above publication. She initiated the research, re-extracting data and supporting C. Anderson in the data analysis and interpretation, manuscript preparation and made amends to the manuscript following reviewer's recommendations.

Signature __________________________

Date ___8/8/16______________

STATEMENT OF AUTHORSHIP OF PUBLICATIONS

On behalf of Amanda Jayne Avery

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This statement confirms the contribution made by Amanda Jayne Avery to jointly authored work;

Avery, A., Langley-Evans, S., Harrington, M., Swift, J. (2016). Setting targets leads to greater long-term weight losses and 'unrealistic' targets increase the effect in a large community based commercial weight management population. *Journal of Human Nutrition and Dietetics.* DOI: 10.1111/jhn.12390

I confirm that Amanda Avery contributed **60%** to the above publication. She was involved from the beginning of the project design, data inputting, data cleaning, analysis and interpretation and manuscript preparation and amends following peer review.

Simon Langley Evans

Signature: ___________________________

Date: 16th August 2016

Appendix 1. Associated papers

Tackling obesity in men – preliminary evaluation of men-only groups within a commercial slimming organization

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Keywords
commercial slimming organization, men, obesity, weight loss

Abstract

Background Over Slimming World's 36-year history men have always made up a small percentage of the slimming organization's membership. Past company research suggested that men would feel more comfortable in men-only groups rather than mixed. In 2002, Slimming World set a target to raise the awareness among men about the dangers of being overweight and made practical weight-management solutions more accessible through a national network of men's groups.

Aim To evaluate men's weight loss within these 'men-only' groups.

Methods Data analysed included those men having attended a group for at least 8 weeks.

Results At the point of data collection average BMI had decreased from 35.9 to 32.5 kg m^{-2}. At least 5% weight loss was achieved in 90% of the sample. In those who had been members for 24 weeks 69% achieved a 10% weight loss. Shift working did not affect weight loss success.

Conclusion This data shows that overweight and obese men attending Slimming World are successful at losing weight in this environment and can achieve recommended health-related weight loss targets. There should be a move to get away from the misperception that slimming groups are only for women and raise awareness of the commercial option to men.

Introduction

Obesity is an ever-increasing problem for both men and women (National Audit Office, 2001). Throughout their lives men's health compares poorly to that of women and men have a life expectancy of 5 years less (Office for National Statistics, 2001). Overweight men are more likely to carry excess body fat around their waist and upper abdomen, which is associated with an increased risk of many health problems (Royal College of Physicians, 2004).

Although there are clear benefits to treating obesity and even modest weight loss can improve health and reduce need for medication (Goldstein, 1992), the recent public health white paper emphasizes a current lack of structured weight management provision (Department of Health, 2004). Partnership with commercial slimming groups has been suggested as one option to expanding current public health services (National Audit Office, 2001).

Men are less likely to use dieting to lose weight (Henderson *et al.*, 2002). In a study by Wardle & Johnson (2002) the majority of obese or overweight women questioned had attempted to lose weight in the last 3 years while only around half of the men had done so. When looking at ways to lose weight 18.1% of women had attended a slimming club compared with only 1.6% of men. Slimming World is a commercial slimming organization with 250 000 members attending 5500 weekly group sessions. The majority of members are female. In 2002, the average male attendance was just 3%. Recognizing that men need more appropriate weight management options, Slimming World set a target to open more men-only groups. Since increasing the total number of men-only groups to 13 nationwide, more recent data from December 2003 shows the number of males attending has now risen to 5% (Slimming World company data). The aim of this preliminary analysis was to investigate weight loss success of men attending commercial men-only slimming groups.

Methods

Data was collected from seven of the 13 Slimming World men-only groups running throughout the UK at the time. These groups were newly established, having opened between 6 and 9 months prior to the time of data collection. All men-only groups run on the same basis as mixed groups, with weekly meetings providing support and advice to help members reach personal weight goals. Nutrition advice is in line with the Balance of Good Health and the group setting is also used to inspire and support members in becoming more active. Membership to the groups is open and continues indefinitely.

The data collected comprised of weight records for members currently attending the seven groups ($n = 125$). These provided weight history of the members since joining to the time of data collection. As membership to the groups was open, data were only analysed for men having attended for at least 8 weeks ($n = 67$).

The data set was used to investigate current weight loss, joining BMI and current BMI. Percentage weight loss in those who had joined at least 12 and 24 weeks prior to data collection was calculated for 53 and 16 of the men, respectively. The impact of being a shift worker on members' weight loss success was investigated in 13 members.

Results

Where age data were available ($n = 27$), the age range of the study sample was 29–71 years, the mean age being 49.4 and the median 47 years.

With respect to socio-economic profiling, Index of Multiple Deprivation analysis proves that for the 47 members living in England, whilst the study population was weighted slightly towards the less deprived areas (55%), there was equal representation of men living in the most and the least quintiles of deprivation (19%).

Body Mass Index

Height data were available to calculate BMI for 45 members. BMI was calculated from initial weight when joining Slimming World and current weight when records were collected. This data showed a decrease in average BMI from 35.9 to 32.5 kg m^{-2}. Initial BMI ranged from 27.9 to 53.6 kg m^{-2}, and current BMI ranged from 22.8 to 49.5 kg m^{-2}.

Figure 1 shows that when joining Slimming World the majority of members were in the obese and morbidly obese categories. At the point of data collection (at least 8 weeks after joining) more members were in the overweight category and one in the healthy range.

Weight loss

Average weight loss was calculated at 8, 12 and 24 weeks (Table 1). In those who had been members for at least 12 weeks prior to data collection

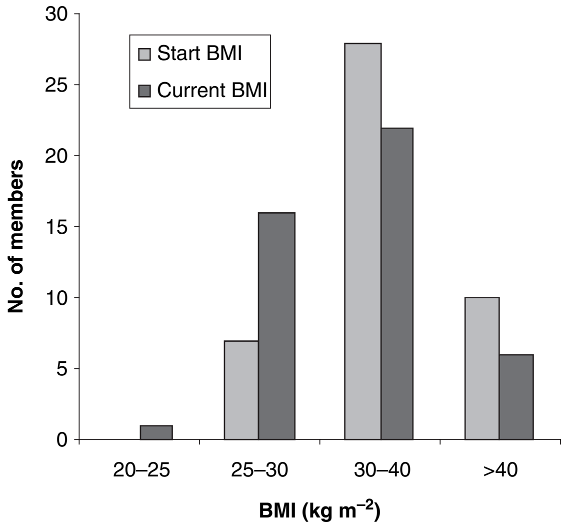

Figure 1 Body Mass Index of members on joining (start) and at point of data collection (current).

($n = 53$), mean weight loss at week 12 was 9.2% (range 0.2 to 21.1%). 91% achieved at least 5% weight loss, of which 34% achieved 10% weight loss.

Those who had been members for at least 24 weeks prior to data collection ($n = 16$) lost on average at week 24, 11.4% (range 5.0 to 17.9%). 69% achieved a 10% weight loss and the remaining 31% achieved at least 5% weight loss.

Shift workers

Thirteen members were shift workers. The shift workers' average start BMI was 35 kg m^{-2}, slightly less than the average start BMI of the non-shift workers which was 36.1 kg m^{-2}. The average percentage weight loss for the shift workers at week 8 was 7.2%, similar to that of the non-shift workers (7.3%). The percentage weight loss by week 12 was 9.4%, just higher than the non-shift workers (9.1%).

Discussion

The aim of this work was to conduct a preliminary evaluation of newly established men-only slimming groups. Weight loss and resulting changes in BMI in the groups analysed was encouraging. During their attendance at Slimming World the number of men in the morbidly obese and obese categories was greatly reduced and many progressed into the overweight or healthy category. This was a positive result, as the health risks for those men will have been significantly reduced.

Obesity treatment guidelines suggest moderate weight loss of 5–10% within 3–6 months as a suitable initial target (National Obesity Forum, 2004). Considering the whole data set ($n = 67$), 90% achieved this target. Of those who had been attending for 12 weeks ($n = 53$), 91% had reduced their weight by at least 5%, 34% of whom had lost at least 10%. Of those who had been members for 24 weeks ($n = 16$), all had lost 5% of their body weight and the majority (69%) had lost 10% or more. This moderate weight loss is beneficial, being associated with clinically useful improvements in a number of health parameters (Goldstein, 1992).

Previous research suggests obesity is more common in shift workers. In their sample, Di Lorenzo *et al.* (2003) found that 20% of shift workers were obese compared with only 9.7% of day workers. This was not the case in the current study, with joining BMI and importantly weight loss success being similar between shift and non-shift workers. However, solid conclusions cannot

Table 1 Body Mass Index and weight change

Baseline weight (kg)	114.7; 19.9; 79.6 to 210.7
Baseline BMI (kg m^{-2}) ($n = 45$)	35.9; 6.1; 27.9 to 53.6
Current BMI (kg m^{-2}) ($n = 45$)	32.5; 6.0; 22.8 to 49.5
Weight change by week 8 (kg) ($n = 67$)	−8.3; 3.8; −0.7 to −21.5
Weight change by week 12 (kg) ($n = 53$)	−10.7; 4.1; −0.2 to −30.8
Percentage weight change by week 12 ($n = 53$)	−9.2; 3.9; −0.2 to −21.1
Weight change by week 24 (kg) ($n = 16$)	−13.2; 3.6; −5.4 to −22.7
Percentage weight change by week 24 ($n = 16$)	−11.4; 4.2; −5.0 to −17.9

Values are given as mean; SD; range.

be drawn as the sample of shift workers was limited ($n = 13$).

Commercial slimming groups are not highly attended by males, however this preliminary data shows that overweight and obese men who do attend are successful at losing weight in this environment and can therefore reduce their health risk. The results compare favourably with the weight loss observed in a recent study in which patients were referred to Slimming World from primary care. The mean weight loss of males in this study was 7.8% at 12 weeks. Furthermore, once enrolled there was no difference in attrition rate between men and women (Greater Derby PCT, Central Derby PCT & Slimming World, 2004).

Further studies should attempt to look at larger cohorts of male attendees and assess weight loss over a longer period. Understanding the barriers to enrolment for men and rates of attrition from commercial groups would also be useful. However, this small observational study suggests that men who attend Slimming World do lose a meaningful amount of weight in a realistic time frame. There should be a move to get away from the mis-perception that slimming groups are only for women and raise awareness of the commercial option to men.

Acknowledgements

We wish to thank the East Midlands Public Health Observatory for assistance in analysing the Indices of Multiple Deprivation data.

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Obesity Facts
The European Journal of Obesity

Original Article

Obes Facts 2011;4:113–120
DOI: 10.1159/000327249

Published online: March 28, 2011

Weight Outcomes Audit for 34,271 Adults Referred to a Primary Care/Commercial Weight Management Partnership Scheme

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Keywords
Obesity · Treatment · Commercial slimming organisation · Effectiveness · Audit

Summary
Objective: This project audited rate and extent of weight loss in a primary care/commercial weight management organisation partnership scheme. **Methods:** 34,271 patients were referred to Slimming World for 12 weekly sessions. Data were analysed using individual weekly weight records. **Results:** Average (SD) BMI change was –1.5 kg/m^2 (1.3), weight change –4.0 kg (3.7), percent weight change –4.0% (3.6), rate of weight change –0.3 kg/week, and number of sessions attended 8.9 (3.6) of 12. For patients attending at least 10 of 12 sessions (n = 19,907 or 58.1%), average (SD) BMI change was –2.0 kg/m^2 (1.3), weight change –5.5 kg (3.8), percent weight change –5.5% (3.5), rate of weight change –0.4 kg/week, and average number of sessions attended was 11.5 (0.7) ($p < 0.001$, compared to all patients). Weight loss was greater in men (n = 3,651) than in women (n = 30,620) ($p < 0.001$). 35.8% of all patients enrolled and 54.7% in patients attending 10 or more sessions achieved at least 5% weight loss. Weight gain was prevented in 92.1% of all patients referred. Attendance explained 29.6% and percent weight lost in week 1 explained 18.4% of the variance in weight loss. **Conclusions:** Referral to a commercial organisation is a practical option for National Health Service (NHS) weight management strategies, which achieves clinically safe and effective weight loss.

Introduction

Despite a series of government reviews, documents, and action targets to halt the rising tide in obesity prevalence in the UK, the problem continues unabated. In England nearly a quarter of the men and women are now obese [1–3]. Projected trends for children paint an even more dismal picture [4]. Recent Foresight predictions suggest that if current trends continue, some 60% of the UK population will be obese by 2050 [1].

Obesity is now recognised as being at the forefront of current 'lifestyle diseases' creating a future of rising disease and chronic long-term ill health [1, 2, 4, 5]. Tackling the obesity epidemic will impact on other lifestyle diseases such as heart disease, stroke, cancer, and diabetes. This in turn will reduce the growing burden on health care resources that currently threatens the quality of care that national health care systems can provide [1, 6]. The Foresight projections estimate that the health burden of obesity will add an additional GBP 45.5 billion per year to UK national health care expenditure by 2050 [1, 6].

The UK Foresight Commission and other reports note that tackling obesity needs whole societal change with cross-government action and long-term commitment to make changes at all levels of society [1, 6]. The Foresight mapping exercise highlights the complexity of the obesity problem [1]. However, many therapists have emphasised that while much of the cause of obesity is due to a complex interplay between genetic susceptibility and environmental factors, its prevention and treatment need simple behavioural and lifestyle solutions that are accessible and accommodating to people living their normal lives in the community [5–12]. In this way people can realistically navigate towards a sustainable healthier body weight.

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With these considerations in mind it is pertinent to note that in their obesity guidance, the UK National Institute for Health and Clinical Excellence (NICE) recognises the importance of providing regular and ongoing support for behavioural change, to prevent weight gain, promote weight loss and its maintenance [4]. NICE recognises the role of commercial weight management organisations (CWMOs) which follow guidance criteria for best practice. Most recently the UK cross-departmental government report 'Healthy Weight, Healthy Lives' recognised the vital role played by the commercial sector and other providers in ensuring that more people can access effective services in order to increase cost-effective provision of health service capacity [13].

In 2006, the results of a feasibility study were published, examining the benefits of working in partnership with the UK National Health Service (NHS) by implementing a slimming on referral service in primary care, with Greater and Central Derby Primary Care Trusts. In that study, 91 out of 107 patients were offered free attendance at a CWMO for 12 sessions enrolled at a group, and 62 completed at least 10 out of the 12 weekly sessions, producing an average weight loss of 6.4% of baseline weight. 34 of those who completed 12 weeks went on to self-fund a further 12 weeks and achieved an average decrease in baseline weight of 11.3% [14].

Since the feasibility study, the referral scheme has been offered nationally to NHS Trusts and enables equal access to local group support for all adults seeking behaviour change solutions to their weight problems. The organisation has been working in partnership with Primary Care Trusts (PCTs) and NHS Trusts offering a subsidised scheme in order to provide free participation for 12 weeks to patients referred by their health professional. The purpose of this paper is to provide the largest audit of a UK slimming on referral service operated between the NHS and a commercial partner in terms of rate and extent of weight loss, attendance, comparison of the outcomes for men and women, and to briefly assess basic predictors of weight loss in this study population.

Methods

Referral Process

Patients were referred by a health care professional in primary or secondary care. Each participating PCT/NHS Trust set their own referral criteria, which varied between areas, depending on their local weight management care pathways. All areas incorporated in this analysis excluded patients under 16 years and pregnant women. At the point of referral, patients were issued a 12-week voucher pack to be completed in the space of 14 weeks (funded by the PCT/NHS Trust and subsidised by the CWMO). This voucher pack could be used by the patient to attend a local group of their choice, run by the CWMO, for 12 consecutive weeks. Extensions for up to 2 weeks were permitted for planned holidays or illness. The vouchers thus covered the patients' membership and weekly fees for a 12–14 week period. On referral, participants were treated exactly as any other group member, receiving the usual programme and support provided by the CWMO. The CWMO, Slimming World, meets the NICE best practice criteria to help adults develop the lifestyle changes needed to reduce weight, prevent weight gain, and support long-term weight maintenance. The organisation has an extensive community-based infrastructure of around 6,700 support groups held each week across the UK. Groups are located in a variety of local venues at different times and days of the week, making the groups easily accessible for all members of the community.

Dataset

This report analyses data collected from participants in the slimming on referral scheme between May 2004 and November 2009, who had time to finish their full 12-week referral. This resulted in the inclusion of 38,614 patients who were referred from within 77 PCTs or NHS Trusts, for whom data on weight, height, age, and gender were collected. Among these were 2,625 cases where the data for one or more of the 12 referral vouchers issued per participant was unclear or could not be resolved (spoiled vouchers, illegible writing etc.) and 1,718 cases where the participant completed the scheme outside of the 14 (12 plus 2) week time window, due to circumstances such as bereavement or illness. This left 34,271 in the present audit. 80 participants were included in the database but there was no data for their date of birth. Age data are reported excluding these subjects. Some of the participants went on to self-fund further attendance following the initial 12-week referral and others were offered subsequent 12-week referral packages from their health care team (9,852 in total). The data in this analysis covers the initial 12-week sessions of the referral scheme.

Data Collection

Data for this audit was collected as part of routine data collection within the referral programme. At the point of referral the patients' gender, date of birth, and height were recorded by the health professional. When the patient enrolled at the weight management group (week 1 of the referral), their start weight and date were recorded. Each week the patient returned to group their weekly weight change was recorded along with date of attendance. The same calibrated scales were used each week at a given group to record weight and weight change. The collected data were sent to the research team for input into the referral database.

This work is categorised as a service evaluation under the Ad Hoc Advisory Group on the Operation of NHS Research Ethics Committees guidelines (2006). Existing data were anonymised and analysed as an intervention in use only to ask the question 'What standard does this service achieve?'.

Data Analysis

Data were extracted from the referral database and subjected to a number of parameter checks for outliers as well as anomalous data entry. Anomalies were checked against the raw source data to resolve any issues that arose. From the raw data collected, start BMI, end BMI, BMI change, weight change, and percent weight change were calculated. The end weight was calculated based on the members' last attendance at group during the referral period using the Last Observation Carried Forward approach [15]. Patients were classified as 'completers' if they attended at least 10 out of the 12 sessions. Those who completed 9 or fewer sessions were defined as 'non-completers'.

The effects of different factors on weight loss were assessed by fitting linear models and examining the significance of fitted terms in these models through regression and analysis of variance (ANOVA). Where binary outcomes (e.g. achieving 5% weight loss or not) are reported, the effects of factors were tested by Pearson's Chi-square tests. Associations between weight losses in different weeks were examined by Pearson's correlation coefficients. All analysis was performed using the GENSTAT 5 statistical programme (Genstat 5 Rothampstead Experimental Station, Harpenden, UK). Results are expressed as mean (SD) or percents with standard error (SE) where relevant. Where data are presented for men and women and completers and non-completers, the absolute means are given with statistics adjusted for potential confounding factors such as age and height in the regression analyses.

Table 1. The characteristics and weight loss outcomes for completers and non-completers (completers are defined as those who attended for 10 or more of the 12 sessions of the referral period; non-completers are those who attended 9 or fewer sessions)

	Completers, n = 19,907		Non-completers, n = 14,364		t-value	p-value
	average	SD	average	SD		
Height, m	1.65	0.09	1.65	0.09	–1.46	0.144
Weight, kg	99.7	20.1	99.0	19.8	–5.32	<0.001
Age, years	49.3	14.4	44.5	14.1	–28.12	<0.001
Weight change, kg	–5.5	3.8	–1.8	2.3	95.09	<0.001
Percent weight change	–5.5	3.5	–1.8	2.3	99.94	<0.001
Weeks attended	11.5	0.7	5.3	2.6	–292.13	<0.001
Start BMI, kg/m^2	36.9	6.5	36.6	6.5	–5.05	<0.001
End BMI, kg/m^2	34.9	6.3	36.0	6.4	12.75	<0.001
BMI change, kg/m^2	–2.0	1.3	–0.7	0.9	97.81	<0.001

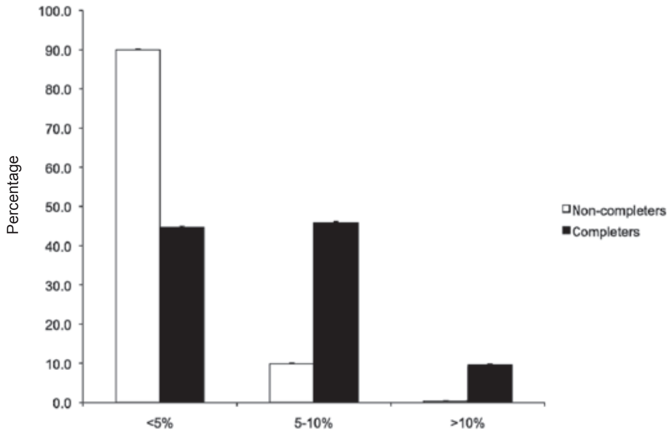

Fig. 1. Percent of completers and non-completers achieving less than 5%, between 5–10%, and >10% weight loss by the end of the referral scheme (n = 34,271).

Results

Subjects

Characteristics of the 34,271 subjects (3,651 men; 30,620 women) were as follows: The mean (SD) age was 47.3 (14.4) years, height 1.65 (0.09) m, and weight was 99.4 (20.0) kg. Mean start BMI was 36.8 (6.5) kg/m^2 and 25.4% of the referred population had a starting BMI in excess of 40 kg/m^2.

Weight Change and Attendance

Mean (SD) weight change of all participants was –4.0 (3.7) kg, percent weight change was –4.0 (3.6), end BMI was 35.3 (6.4) kg/m^2, and mean BMI change was –1.5 (1.3) kg/m^2. Average (SD) attendance was 8.9 (3.6) sessions. 19,907 (58.1%) of the patients attended at least 10 of the 12 sessions (completers) and 14,364 (41.9%) were classed as non-completers (i.e. those who attended fewer than 10 of the 12 sessions). The characteristics and outcomes for completers and non-completers are given in table 1. Average (SD) attendance of completers was 11.5 (0.7) sessions and that of non-completers was 5.3 (2.6) sessions. 35.8% of the whole population and 54.7% of the completers lost at least 5% and 5.8% of the whole population lost equal to or more than 10% of their body weight over the 12 sessions. In the present audit, 92.1% of all participants lost weight or remained weight stable, using the assumption of the Last Observation Carried Forward Model [15].

Completers and Non-Completers

Table 1 shows that completers lost significantly more weight than non-completers (–5.5 vs. –1.8 kg, respectively; t = 95.09; $p < 0.001$) during the 12-session referral period. The same patterns were evident for percent weight loss (–5.5 vs. –1.8%, respectively; t = 99.94; $p < 0.001$). Thus, while completers and non-completers did not differ significantly in terms of initial height or much in weight or BMI, the completers lost a greater weight, percent weight, and had a greater change in BMI (table 1). Non-completers were on average 4.8 years younger than completers (t = –28.12; $p < 0.001$).

Figure 1 shows the percentage of completers and non-completers who achieved less than 5%, between 5–10%, and >10% weight loss by week 12. 54.7% of completers and 9.7% of non-completers achieved at least 5% weight loss ($p < 0.001$). 9.7% of completers and 0.3% of non-completers lost at least 10% of their initial body weight by the end of the referral period ($p < 0.001$).

Men and Women

Table 2 compares the characteristics and weight loss outcomes for men and women. Men were on average taller, older, heavier, and had a higher BMI on enrolment than women (all $p < 0.001$). Men tended to lose more weight than women both in absolute kg and as a percent of baseline body weight (both $p < 0.001$). Thus, while they did not, on average, attend to a greater degree than women, they had a greater BMI change than women for the 12 sessions of the referral scheme ($p < 0.001$). There was, however, a significant difference in the percentage of men and women classed as completers (men = 63.8%; women = 57.4%) ($p < 0.001$). Male completers and non-completers were significantly older than their female counterparts ($p < 0.001$). A significantly higher

Table 2. Characteristics and weight loss outcomes for men and women

	Men, n = 3,651		Women, n = 30,620		t-value	p-value
	average	SD	average	SD		
Height, m	1.77	0.08	1.63	0.08	93.37	<0.001
Weight, kg	117.9	22.4	97.2	18.5	52.27	<0.001
Age, years	51.4	13.8	46.8	14.4	14.66	<0.001
Weight change, kg	–5.8	4.9	–3.8	3.5	–33.28	<0.001
Percent weight change	–4.9	4.0	–3.9	3.5	–14.65	<0.001
Weeks attended	9.2	3.6	8.8	3.5	0.78	0.438
Start BMI, kg/m^2	37.8	6.6	36.7	6.5	8.88	<0.001
End BMI, kg/m^2	36.0	6.5	35.3	6.4	5.85	<0.001
BMI change, kg/m^2	–1.8	1.6	–1.4	1.3	–17.48	<0.001

Table 3. Regression coefficients for percent weight loss at the end of the referral period for age, height, gender, starting BMI, attendances, and percent weight lost in the first week, together with t-statistics and probability values (n = 34,271)

	Estimate	Standard error	t (n = 34,184)	p-value
Constant	1.285	0.353	3.64	<0.001
Age, years	–0.006	0.001	–6.12	<0.001
Height, m	0.149	0.199	0.75	0.453
Gender, male	–0.612	0.053	–11.61	<0.001
Start BMI, kg/m^2	0.008	0.002	3.92	<0.001
Attendances	–0.438	0.004	–108.55	<0.001
% lost in week 1	1.429	0.013	112.02	<0.001

percentage of men than women lost 5% (46.3 vs. 34.6%) and 10% (10.6 vs. 5.2%, respectively) of their baseline weight by the 12th session ($p < 0.001$).

Rates of Weight Loss

The average rate of weight loss over the 12 sessions (when completed over the 14-week time window) for the total population was 0.3 kg/week. ANOVA showed that men lost weight at a significantly faster rate (0.4 vs. 0.3 kg/week) than women, both in absolute and percent terms (both $p < 0.001$). Completers lost weight at a significantly faster rate than did non-completers (0.4 vs. 0.1 kg/week). These patterns were also apparent for percent weight loss (both $p < 0.001$). Analysing only subjects who completed within a 12-week time window increased the slope for rate of weight loss by approximately 6–8%, depending on the group (men or women, completer or non-completer).

The rate of weight loss decreased as the process of weight reduction proceeded from the start to the end of the scheme. Thus the slope for the rate of weight loss was steeper during weeks 1–6 than weeks 7–12 for the whole population and for men compared to women. The rate of deceleration of weight loss was not significantly different between completers and non-completers.

Prediction of Weight Loss

Table 3 gives the regression coefficients for percent weight loss at the end of the referral period for age, height, gender, starting BMI, attendances, and percent weight lost in the first week, together with t-statistics and probability values. It is clear that the greatest predictor of percent weight loss was the number of attendances (table 4). On average men lost more weight than women over the referral period ($t = –11.61$; $p < 0.001$). For every unit increase in start BMI subjects tended to lose an additional 0.01% weight by the end of the referral period ($t = 3.92$; $p < 0.001$). Age, but not height, significantly predicted percent weight lost by the end of the referral period; as with BMI the effect was small ($t = –6.12$; $p < 0.001$). Table 4 shows the accumulated ANOVA for the predictors of weight loss, giving the factors, percent of variance explained, F-ratios, and probability statistics for main effects. It is clear from table 4 that age, height, gender, and starting BMI all explained a very small amount of the variance in percent weight lost. Attendance accounted for 29.6% of the total variance in percent weight lost at the end of the referral period. Percent weight lost during the first week of referral was also an important predictor of total weight lost, accounting for 18.4% of the variance. 50.1% of the variance in weight lost was unaccounted for by this model.

Figure 2 shows the regression of attendance against weight loss over the 12 sessions of the scheme for the whole audit population. The model including attendance and percent weight lost during week 1 accounted for 49.9% of the variability in percent weight loss. As can be seen from table 4, the two key predictors of percent weight loss by the end of the referral period were percent weight lost in the first week and attendance throughout the 12 weekly sessions. However, week 1 weight loss was also related to attendance, since adding week 1 weight loss into the stepwise model first increased the percent variance explained by the first week's weight loss to

Table 4. Accumulated ANOVA for the predictors of weight loss, giving the factors, percent of variance explained, F-ratios, and probability statistics for main effects (n = 34,271)

Change	Degrees of freedom	% variance	F-ratio	p-value
Age, years	1	1.3	859.21	<0.001
Height, m	1	0.3	167.07	<0.001
Gender	1	0.3	233.55	<0.001
Start BMI, kg/m^2	1	0.0	0.11	0.743
Attendances, weeks	1	29.6	20,202.28	<0.001
% weight lost in week 1	1	18.4	12,547.73	<0.001
Residual	34,184	50.1		
Total	34,190			

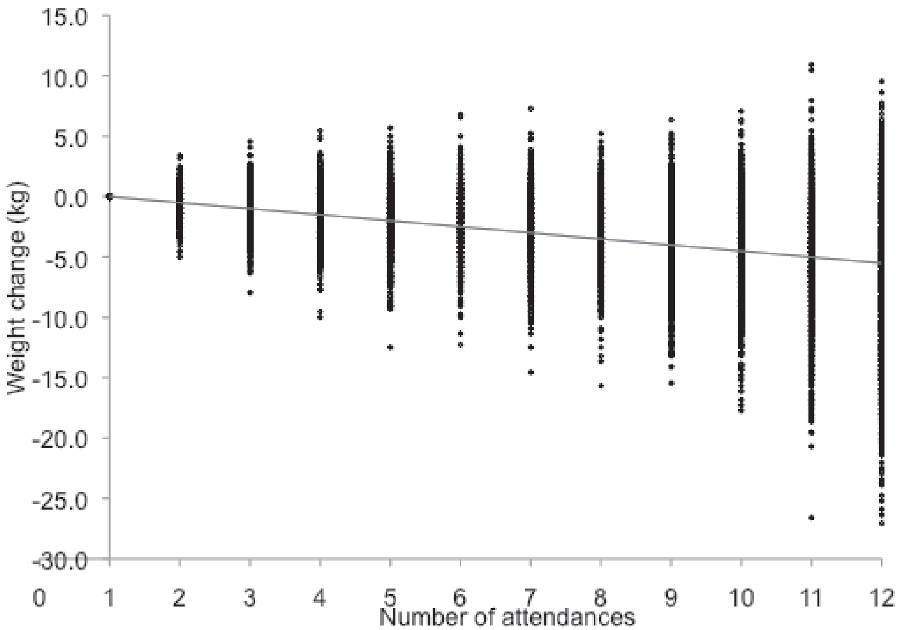

Fig. 2. Regression of attendance against weight loss over the 12 sessions for the whole audit population (n = 34,271).

31.3% and decreased the percent of the variance due to attendance to 17.3%. Those who lost more weight in week 1 tended to attend longer. Both cumulative stepwise regression models explained the similar total amounts of variance in percent weight lost.

Discussion

Weight management treatment in primary care is an important first stage of any stepped care model for weight control [4]. Reductions in at least 5% baseline weight can improve health outcomes as well as reduce the need for medication and use of health care resources [16–18]. Modest weight losses are an important component in prevention, since most Western adults appear to gain between 0.2–2.0 kg per annum [19, 20]. The most effective first line of prevention and treatment of obesity is dietary and lifestyle change [1, 8, 10, 12]. Partnership with CWMO has been recommended by various bodies as one means of expanding provision of obesity services in primary care [3, 4, 13]. Commercial organisations have the benefit of resource, infrastructure, and scale, which enables them to offer the regular support that is difficult to achieve within current NHS resources. However, there is a lack of consensus, due to a lack of evidence, as to how effective commercial partnerships are. A comprehensive review of major commercial weight loss programmes in the US noted that there needs to be more evidence to support the use of the major commercial and self-help programmes [21]. Since then evidence is emerging as to how effective commercial behaviour change programmes can be in helping people control their weight [14, 22–26]. The present dataset provides important components of the audit evidence base for the UK.

Rate and Extent of Weight Loss

The current audit is the largest examination of the impact of referral to commercial weight management support conducted in the UK to date. The results are similar to our initial feasibility trial of this scheme [14]. 58.1% of the audit population completed at least 10 of the 12 sessions of the programme, which is similar to previous work by ourselves [14] and others [25]. 35.8% of this whole population and 54.7% of the completers lost at least 5% of their body weight in about 3 months, which is the current recommended initial target weight loss (within 3–6 months), according to the NICE guidelines and the Department of Health [4, 13]. 92.1% of all participants lost weight or remained weight stable if we use the assumptions of the Last Observation Carried Forward Model [15]. It is possible that some of those who dropped out early gained more weight during the 12-session referral period. Nevertheless, these data are encouraging from a preventative perspective, since most adults tend to gain small amounts of weight over this time period [19, 20].

Average start BMI of the audit population was in the range that would be recommended for pharmacotherapy and many for surgery in the UK [4]. Start BMI averaged at 36.8 kg/m^2 and 25.4% of this referral population had a BMI > 40 kg/m^2. This suggests that lifestyle interventions can work in populations with BMIs that are normally recommended to receive secondary or tertiary care.

Length of Attendance

The data presented in this audit clearly emphasise how important it is for patients to attend or comply with their weight loss programme. In all outcomes, completers fared far better than non-completers. The trajectory of weight loss for the completer and non-completer groups is curvilinear, which is typical for obesity treatments in general [21, 27]. Weight loss begins rapidly and starts to slow as weight loss proceeds. It is clear from this report and a number of other studies in the literature [for review see 12] that attendance is a major correlate of weight lost. The exact mechanisms by which attendance translates into weight loss is not clear and may well differ for different people. For some the group support will be important while for others having their weight monitored by a third party will help with motivation [28]. Further studies are needed to assess which components of group support are important in different people and why some people drop out of the programme prematurely.

Men and Women

Weight losses (absolute and percent) appeared to be higher in men compared to women, although men did not attend a great deal more than did women. The percent of the audit population who were men was about two times greater than is seen among the general group membership (11 vs. about 6%). NHS referral may be an effective means of recruiting more men to attend weight management groups.

Comparison with Other Approaches to Weight Management

People treated with a comprehensive group behavioural approach lose approximately 9% of initial weight in 20–26 weeks of treatment [21]. Although the present dataset only gives a time window of approximately 3 months, results of previous work suggests that if patients continue to attend after the 12-session referral period these losses persist. When the period of audit is extended to 24 sessions, average weight losses of 11.3% have been seen for those still attending the group [14] and also 11.4% in 24 sessions (approximately 24 weeks) in self-referred male members of the CWMO [22]. We are currently developing further trials, with longer-term follow-up as an important adjunct to the present audit.

The present results show a mean weight loss of 4.0% (5.5% for completers) in 12 sessions. These data compare very favourably to pharmacological treatments for obesity [29–31]. Recent reviews and meta-analyses suggest that obesity drugs do not produce more than 5% weight loss on average in 12 months [29–31]. The average weekly net cost of referral to this organisation equates to GBP 3.95 per week, and average weekly weight loss was 0.3 kg. Taking into account the additional costs of health care staff and PCT resources [14], this is a very favourable cost compared to the equivalent prescription costs for obesity drugs, which cost approximately GBP 1.00 per day on a net basis according to the British National Formulary 2009 [32]. Even if we assume that both referral schemes and drugs produced the same weight loss in 3 months the referral scheme would cost GBP 47.39 for about 12 weeks compared to about GBP 84.00 for the net cost of obesity drugs. It can therefore be reasonably concluded that NHS referral schemes for weight loss are a cost-effective option.

Prediction of Weight Loss

The percent of weight lost was not strongly related to initial body weight and so those with more weight to lose did not achieve a greater percent weight loss. However, percent weight lost in the first week was almost as great a predictor of percent weight loss at the end of the referral period as was attendance throughout the referral period. This effect has been found in previous studies [12, 27]. Attendance is discussed above. The relationship between percent weight lost in the first week and end weight loss is less clear. It may be that those who lose a greater percent of baseline weight in the first week are more motivated (either before they attend or as a consequence of their experiences in the first week), so they may have familiarised themselves with the eating and activity programme to a greater extent and are simply on a consistent trajectory of greater weight loss or a combination of these variables. We have previously observed in our commercial weight management groups that those who lose most weight in the first week do go on to lose more weight [33]. Exactly how this relates to motivation and the prevention of lapses and relapses warrants further detailed investigation [7–9].

50.1% of the variance in weight loss was not explained by the simple predictive model, suggesting that much of the variability on weight loss is due to other psychological, behavioural, or even physiological traits of different individuals participating in the scheme. We are currently analysing studies collecting psychological and behavioural determinants of longer-term weight loss success.

Strengths and Limitations of the Study

As this was a service audit, limitations to this study include the absence of a control group and the fact that results were based upon those people who joined a group, rather than intention to treat. There were no comparable and consistent in-house options available in the NHS Trusts to provide a control group. However, the purpose of the study was not to compare the efficacy of this CWMO's programme with other treatments. It was to audit the effectiveness of NHS referral to the programme in terms of rate and extent of weight loss and attrition rates. This study only observed weight changes over 12 weekly sessions and there was no longer-term follow-up after referral. Additional studies are examining longer-term weight trajectories over 1–2 years. Key strengths were that the referral programme audit assessed the effectiveness of the programme as it runs in real life, the large sample size, and the fact that the subjects were real consumers aiming to control their weight in their everyday lives.

Conclusion

In the present audit, 58.1% of enrolled participants completed at least 10 out of 12 sessions of the programme (completers). A total of 35.8% of all patients enrolled and 54.7% of completers lost at least 5% initial body weight. Weight gain was prevented in 92.1% of patients, using the assumptions of the Last Observation Carried Forward Model. This analysis has demonstrated that partnership working for weight management is effective, benefits patients, and (as previously reported [14]) can be less expensive than other in-house options and pharmacotherapy. It confirms that referral to commercial organisations can be a useful way of extending currently limited NHS resources to tackle the obesity epidemic. Although the initial referral period is limited to about 12 weeks, the partnership opens the door to long-term weight control through self-referral or continued NHS referral. Finally, these data have confirmed that there are two simple basic predictors (attendance and weight loss in the first week) of weight loss that together account for 48.0% of the variability in weight lost by the end of the referral period, which would be valuable indicators of the likelihood a person will lose approximately 5% of their initial body weight in about 12 weeks. In other words, regardless of age, gender, or starting weight, if a person is able to attend 10 or more of the 12 sessions and is supported and encouraged to achieve good weight losses in their first week, they are likely to be successful in beginning their weight loss journey.

Acknowledgement

We are grateful to GW Horgan of Biomathematics and Statistics Scotland, for conducting an independent statistical analysis of the data. We would like to thank the Slimming World on Referral team for entry of the raw data and their general support to all primary care/commercial partnerships.

Disclosure Statement

R.J. Stubbs, C. Pallister, A. Avery, and J. Lavin work for Slimming World. The analysis of the data was funded by Slimming World.

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doi: 10.1111/j.1758-8111.2012.00040.x

Attendance and weight outcomes in 4754 adults referred over 6 months to a primary care/commercial weight management partnership scheme

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What is already known on this subject

- There is growing evidence of the effectiveness of commercial weight management programmes in the community. A recent randomized controlled trial has shown commercial providers to be more effective than NHS providers for weight management solutions in primary care. Some commercial weight management providers have established national slimming on referral schemes for weight management, which result on average in weight losses of 4–5% over a 12-week referral period. A recent randomized controlled trial of a similar scheme over 12 months yielded similar weight loses. Another RCT comparing commercial providers over 6 months showed average weight losses of ~6.6% across providers.

What this study adds

- The present study shows that when local primary care practitioners target resources to where they, as health professionals, felt they would have the most beneficial effect in their local communities, greater weight losses can be achieved.
- Different NHS Trusts extended 12-week referrals by an additional 12 weeks in a total of 4754 patients.
- Mean weight losses of 8.6% were achieved suggesting that local targeting of primary care resources can maximize returns for NHS investments in commissioning the services of commercial weight management organizations.

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Received 12 March 2012; revised 3 May 2012; accepted 10 May 2012

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Funding: The analysis of the data was funded by Slimming World.

Summary

This project audited attendance and weight loss in a primary care/commercial weight management partnership scheme in patients who participated over 6 months. 4754 adult patients (575 men, 4179 women) were referred to Slimming World for 24 weekly sessions. Data were analysed using individual weekly weight records. Mean (standard deviation, SD) body mass index (BMI) change was –3.3 kg m^{-2} (2.2), weight change –8.9 kg (6.0), percent weight change –8.6% (5.3) and number of sessions attended 21.3 (3.2) of 24. For patients attending at least 20 of 24 sessions ($n = 3626$ or 76.3%), mean (SD) BMI change was –3.6 kg m^{-2} (2.2), weight change –9.6 kg (6.1), percent weight change –9.3% (5.3). Weight loss was greater in men than women ($P < 0.001$). 74.5% of all patients enrolled, and 79.3% of patients attending 20 or more sessions achieved at least 5% weight loss. 37.3% of the whole population lost ≥10% of their weight. Weight gain was prevented in 96.3% of all patients referred. Referral to a commercial organization for community-based lifestyle intervention is a practical option for longer-term National Health Service weight management strategies.

Keywords: Commercial weight management organization, effectiveness, obesity.

Introduction

The Healthy Lives, Healthy People white paper sets out a vision for the health of the nation focussed more on the proactive prevention of avoidable disease rather than the reactive treatment of existing morbidity and mortality (1). Behaviour change is central to this vision. The most difficult aspect of achieving these goals lies in engaging the general population to participate in modifying their behaviour. Encouraging people to partake in healthier choices would create the foundation of healthy habits that lead to greater well-being, quality of life and reduced healthcare expenditure for the nation (1). The report also identifies the need for localized and flexible, individualized solutions and evidence-based innovative approaches to behaviour change. This should be supported by community, workplace and National Health Service (NHS)/local authority initiatives, in partnership with commercial providers (1).

At the individual patient level, obesity prevention and treatment need behavioural and lifestyle solutions that are accessible and accommodating to people living their normal lives (2). A critical feature missing in many attempts at promoting lifestyle change is the implementation of solutions that are amenable and practical for consumers, which entail continuing support, so that they can effectively adopt and maintain new and healthier patterns of behaviour over a period of months (3–7). There has been growing interest in how to more effectively encourage the majority of adults who are overweight and obese to engage with the now widely disseminated information about healthy lifestyles. In this way, knowledge can translate into the behaviours that lead to a sustained alteration of energy balance and weight reduction (8–10).

Turning principles into practice and healthy choices into habits requires expertise in engaging, motivating and guiding consumers in weight control practices, and in coping with lapses to support behaviour change until it becomes the basis of a healthy lifestyle. There is growing evidence of the effectiveness of commercial weight management programmes in the community (11–18). Some commercial weight management providers have established national slimming on referral schemes that enable access to local group support for adults seeking behaviour change solutions for weight management (11,16,17). Slimming World has been working in partnership with NHS Trusts offering a subsidized scheme to provide free participation for 12 weeks to patients referred by their health professional. An audit of this scheme was recently published, in which 34 271 patients were referred for 12 weekly sessions (11). Mean percent weight change was –4.0% (3.6). For patients attending at least 10 of 12 sessions mean percent weight change was −5.5% (3.5), ($P < 0.001$, compared to all patients) (11). Some of the NHS Trusts involved offered a second, consecutive, referral giving a 24-session referral period. These second referrals were made for patients, at the discretion of the individual referring NHS Trusts.

This paper audited weight outcomes over this 6-month referral period in terms of attendance and weight loss, comparisons of the outcomes for men and women and assessed basic predictors of weight loss in this study population.

Methods

The referral process

Patients were referred by a healthcare professional in primary or secondary care. Each participating NHS Trust set their own referral criteria, which varied between areas, depending on their local weight management care pathways. All areas incorporated in this analysis excluded patients under 16 years and pregnant women. At the point of referral, patients were issued a 12-week voucher pack to be completed in the space of 14 weeks (funded by the NHS Trust and subsidized by the commercial weight management organization [CWMO]). This voucher pack could be used by the patient to attend a local group of their choice, run by the CWMO, for 12 consecutive weeks. Extensions for up to 2 weeks were permitted for planned holidays or illness. Participants were treated exactly as any other group member, receiving the usual programme and support provided by the CWMO. The CWMO, Slimming World, has around 9000 support groups held each week across the UK and Ireland. 4754 participants were offered subsequent 12-week referral packages from their referring healthcare team. Participants were offered the subsequent referral at the discretion of the referrer. Criteria for this varied between NHS Trusts but included selection of those who were deemed motivated with higher starting body mass index (BMIs), those making gradual progress towards their treatment objectives, presence of comorbidities which would be improved by further weight loss and those deemed unable to self-fund further attendance.

The dataset

This report analyses data collected from participants in the Slimming World on referral scheme between May 2004 and November 2009. There were 5802 patients referred from the 45 primary care or NHS Trusts with two consecutive referrals of 12 sessions. Of these, 565 used their vouchers outside the 2×14-week time windows allowed for holidays (i.e. 12 + 2 weeks). A remaining 483 had incomplete weight records, missing height or date of birth. This left a sample size of 4754.

Data collection

Data for this audit were collected as part of routine data collection within the referral programme. At the point of referral, the patients' gender, date of birth and height were recorded by the health professional. When the patient enrolled at the weight management group (week 1 of the referral), their start weight and date were recorded. Each week, the patient returned to group their weekly weight change was recorded along with date of attendance. Weight was recorded in light clothes, without shoes. Weight was recorded at the same time every week of attendance over the 24-week referral period, as the subjects' groups were held at the same time of the week. Weighing subjects in light clothes may add some slight variability to the data, compared to weights that were corrected to nude, but it would lead to no systematic bias in the estimate of weight change as the referral period progressed. The same calibrated scales were used each week at a given group to record weight and weight change to the nearest 200 g (Seca, Ltd, Birmingham, England).

The collected data were sent to the research team for input into the referral database.

This work is categorized as a service evaluation under the Ad Hoc Advisory Group on the Operation of NHS Research Ethics Committees, guidelines (2006). Existing data were anonymized and analysed as an intervention in use only to ask the question 'What standard does this service achieve'?

Data analysis

Data were extracted from the referral database, and subjected to a number of parameter checks for outliers and anomalous data entry. Anomalies were checked against the raw source data to resolve any issues that arose. From the raw data collected, start BMI, end BMI, BMI change, weight change, percent weight change and attendance were calculated. The end weight was calculated based on the members' last attendance at group during the referral period using the Last Observation Carried Forward approach (19). Patients were classified as 'completers' if they attended 20 or more out of the 24 sessions. Those who completed 19 or fewer sessions were defined as 'non-completers'. For analysis by BMI group, patients were grouped into those who had a BMI <30 kg m^{-2}, between 30 and 34.9 kg m^{-2}, between 35 and 39.9 kg m^{-2}, and with a BMI ≥40 kg m^{-2}.

The effects of different factors on weight loss were assessed by fitting linear models and examining the significance of fitted terms in these models through regression and analysis of variance (ANOVA). Where binary outcomes (e.g. achieving 5% weight loss or not) are reported, the effects of factors were tested by Pearson chi-squared tests. All analysis was performed using the GENSTAT 5 statistical program (Genstat 5, Rothampstead Experimental Station, Harpenden, UK). Results are expressed as mean (standard deviation, SD) or percents where relevant. Where data are presented for men and women and completers and non-completers, the absolute means are given with statistics adjusted for potential confounding factors such as age and height, in the regression analyses.

Results

Subjects

Characteristics of the 4754 subjects (575 men; 4179 women) were as follows: the mean (SD) age was 49.8 (14.3) years, height 1.64 m (0.08) and weight was 102.8 kg (20.7). Mean start BMI was 37.9 kg m^{-2} (6.7) and 31.5% of the referred population had a starting BMI of 40 kg m^{-2} or above.

Weight change and attendance

Mean (SD) weight change of all participants was −8.9 kg (6.0), percent weight change −8.6 (5.3), end BMI was 34.7 kg m^{-2} (6.4) and mean BMI change was −3.3 kg m^{-2} (2.2). Mean (SD) attendance was 21.3 (3.2) sessions. 3626 (76.3%) of patients attended at least 20 of the 24 sessions (completers) and 1128 (23.7%) were classed as non-completers (i.e. those who attended 19 or fewer of the 24 sessions). The characteristics and outcomes for completers and non-completers are given in Table 1. Mean (SD) attendance of completers was 22.9 (1.3) sessions and

Table 1 The characteristics and weight loss outcomes for completers and non-completers. Completers are defined as those who attended for 20 or more of the 24 sessions of the referral period. Non-completers are those who attended 19 or fewer sessions

	Completers (3,626)		Non-completers (1,128)		*t*-value	*P*-value
	Average	SD	Average	SD		
Height (m)	1.64	0.08	1.65	0.08	0.00	0.997
Weight (kg)	102.9	20.8	102.3	20.5	−2.30	0.021
Age (years)	50.8	14.1	46.5	14.3	−7.98	<0.001
Weight change (kg)	−9.6	6.1	−6.3	4.8	16.07	<0.001
Percent weight change	−9.3	5.3	−6.2	4.5	16.67	<0.001
Weeks attended	22.9	1.3	16.4	2.2	−114.28	<0.001
Start BMI (kg m^{-2})	38.0	6.8	37.7	6.6	−2.46	0.014
End BMI (kg m^{-2})	34.4	6.4	35.3	6.5	2.85	0.004
BMI change (kg m^{-2})	−3.6	2.2	−2.3	1.7	16.59	<0.001

BMI, body mass index; SD, standard deviation.

non-completers' was 16.4 (2.2) sessions. 74.5% of the whole population and 79.3% of the completers lost at least 5% and 43.1% of completers and 37.3% of the whole population lost equal to or more than 10% of their body weight over the 24 sessions. 96.3% of all participants lost weight or remained weight stable, using the assumption of the Last Observation Carried Forward Model (19).

Completers and non-completers

Table 1 shows that completers lost significantly more weight than non-completers (–9.6 vs. –6.3 kg, respectively), $t = 16.07$; $P < 0.001$, during the 24-session referral period. The same patterns were evident for percent weight loss (–9.3 vs. –6.2%, respectively, $t = 16.67$; $P < 0.001$). Thus, while completers and non-completers did not differ much in terms of initial height, weight or BMI, the completers lost a greater weight, percent weight and had a greater change in BMI (Table 1). Non-completers were on average 4.3 years younger than completers ($t = -7.98$; $P < 0.001$). The majority (76.3%) of participants were classed as completers.

Figure 1 shows the percentage of completers and non-completers who achieved less than 5%, between 5% and 10%, and ≥10% weight loss by week 24. 79.3% of completers and 59.2% of non-completers achieved at least 5% weight loss ($P < 0.001$). 43.1% of completers lost at least 10% of their initial body weight by the end of the referral period compared to 18.9% of non-completers ($P < 0.001$).

Men and women

Table 2 compares the characteristics and weight loss outcomes for men and women. Men were on average taller, older and heavier (all $P < 0.001$) and had a higher BMI on enrolment than women ($P = 0.032$). Men tended to lose more weight than women both in absolute kg and as a percent of baseline body weight (both $P < 0.001$). While

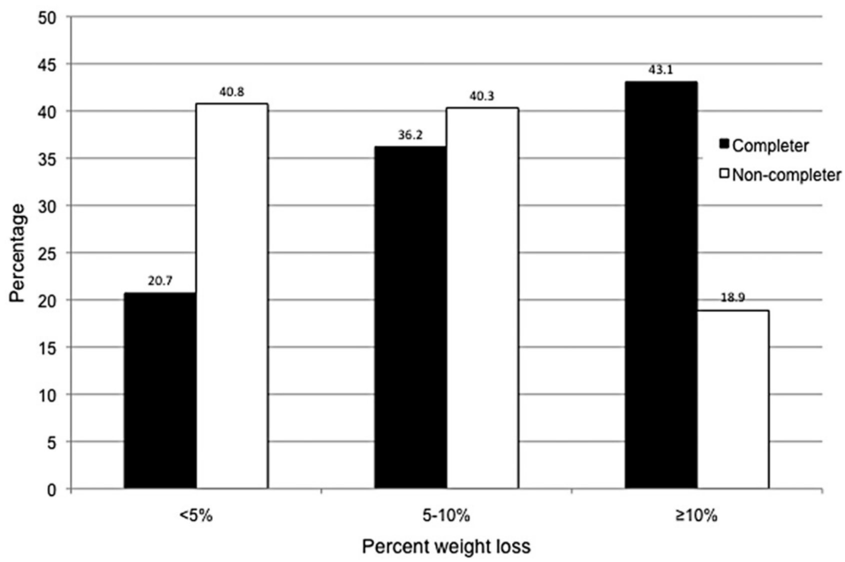

Figure 1 Percent of completers and non-completers achieving less than 5%, between 5% and 10%, and >10% weight loss by the end of the 24-session referral period ($n = 4754$).

Table 2 The characteristics and weight loss outcomes for men and women

	Men (575)		Women (4,179)		*t*-value	*P*-value
	Average	SD	Average	SD		
Height (m)	1.77	0.07	1.63	0.07	42.04	<0.001
Weight (kg)	119.9	21.8	100.4	19.4	21.17	<0.001
Age (years)	53.9	13.1	49.2	14.4	6.76	<0.001
Weight change (kg)	–11.5	7.2	–8.5	5.7	–10.30	<0.001
Percent weight change	–9.5	5.6	–8.5	5.3	–3.42	<0.001
Weeks attended	21.6	3.0	21.3	3.2	1.31	0.189
Start BMI (kg m^{-2})	38.4	6.3	37.9	6.8	2.14	0.032
End BMI (kg m^{-2})	34.7	6.1	34.7	6.5	0.95	0.341
BMI change (kg m^{-2})	–3.7	2.3	–3.2	2.1	–3.91	<0.001

BMI, body mass index; SD, standard deviation.

they did not, on average, attend to a greater degree than women, they had a greater BMI change than women for the 24 sessions of the referral scheme ($P < 0.001$). There was no significant difference in the percentage of men and women classed as completers (men = 82.6%; women = 75.8%; $P = 0.054$). Male completers and non-completers were significantly older than their female counterparts ($P < 0.001$). A significantly higher percentage of men than women lost 5% (79.5 vs. 73.8%) and 10% (44.3 vs. 36.4%, respectively) of their baseline weight by the 24th session ($P < 0.003$).

Rates of weight loss

Mean rate of weight loss, over the 24 sessions (when completed over the 28-week time window), in kg week^{-1} for the total population was 0.3 kg week^{-1}. ANOVA showed that men lost weight at a significantly faster rate (0.5 vs. 0.3 kg week^{-1}) than women, both in absolute and percent terms. Completers lost weight at a significantly faster rate than non-completers (0.3 vs. 0.2 kg week^{-1}) (both $P < 0.001$). These patterns were also apparent for percent weight loss (both $P < 0.001$). The rate of weight loss decreased as the process of weight reduction proceeded from the start to end of the referral period. Thus, the slope for the rate of weight loss was steeper during weeks 1 to 12 than weeks 12 to 24 for the whole population and for men compared to women. The rate of deceleration of weight loss was significantly different between completers and non-completers ($P < 0.001$).

Weight loss in different BMI groups

6.5% of participants had a BMI <30 kg m^{-2}, 31.5% between 30 and 34.9 kg m^{-2}, 30.5% between 35 and 39.9 kg m^{-2}, and 31.5% had a start BMI ≥40 kg m^{-2}. Weight, end BMI, BMI change and absolute weight loss all increased with increasing BMI category (all $P < 0.001$). Absolute weight changes were −5.8, −7.5, −9.0 and 10.7 kg for the BMI categories <30 kg m^{-2}, 30–34.9 kg m^{-2}, 35–39.9 kg m^{-2} and ≥40 kg m^{-2}, respectively. Regression analysis showed that after adjusting for age and gender, relative to the <30 kg m^{-2} group, absolute weight losses were 1.6, 3.1 and 4.9 kg more for the 30–34.9 kg m^{-2}, 35–39.9 kg m^{-2} and ≥40 kg m^{-2} groups, respectively (all $P < 0.001$). Percent weight change was similar in each BMI category at −7.6, −8.5, −8.9 and −8.6% for BMI categories <30 kg m^{-2}, 30–34.9 kg m^{-2}, 35–39.9 kg m^{-2} and ≥40 kg m^{-2}, respectively. Regression analysis showed that after adjusting for age and gender, relative to the <30 kg m^{-2} group, percent weight losses were 0.9%, 1.3% and 1.0% greater for the 30–34.9 kg m^{-2}, 35–39.9 kg m^{-2} and ≥40 kg m^{-2} groups, respectively (all $P < 0.03$).

Prediction of weight loss

Table 3 gives the regression coefficients for percent weight loss at the end of the referral period for age, height, gender, starting BMI, attendances and percent weight lost in the first week, together with *t*-statistics and probability values. The greatest predictor of percent weight loss was the percent weight lost in the first week, followed by gender and number of attendances (Table 3). Table 4 shows the accumulated ANOVA for the predictors of weight loss, giving the factors, percent of variance explained, *F*-ratios and probability statistics for main effects. It is clear from Table 4 that age, height, gender and starting BMI all explained a very small amount of the variance in percent weight lost. Percent weight lost during the first week of referral accounted for 13.2% of the total variance in percent weight lost at the end of the referral period. Attendance was also an important predictor of total weight lost, accounting for 8.9% of the variance. However, only 22.7% of the variance in weight lost was accounted for by this model. Adding week 1 weight loss into the stepwise model first slightly increased the percent variance explained by the first week's weight loss to 14.4% and decreased the percent

Table 3 Regression coefficients for percent weight loss at the end of the referral period for age, height, gender, starting BMI, attendances and percent weight lost in the first week, together with *t*-statistics and probability values ($n = 4754$)

	Estimate	SE	*t* (4608)	*P*-value
Constant	5.340	1.860	2.88	0.004
Age (years)	0.005	0.005	0.95	0.341
Height (m)	0.003	0.010	0.32	0.749
Gender (male)	0.637	0.256	2.49	0.013
Start BMI (kg m^{-2})	0.011	0.010	1.05	0.292
Attendances	0.472	0.022	21.84	<.001
% lost in week 1	1.844	0.065	28.48	<.001

BMI, body mass index; SE, standard error.

Table 4 The accumulated analysis of variance for the predictors of weight loss, giving the factors, percent of variance explained, *F*-ratios and probability statistics for main effects ($n = 4754$)

Change	d.f.	% variance	*F*-ratio	*P*-value
Age (years)	1	0.1	8.21	0.004
Height (m)	1	0.1	6.60	0.010
Gender	1	0.3	17.16	<0.001
Start BMI (kg m^{-2})	1	0.1	5.53	0.019
Attendances (weeks)	1	8.9	546.75	<0.001
% weight lost in week 1	1	13.2	811.36	<0.001
Residual	4747	77.3		
Total	4753			

BMI, body mass index; d.f., degrees of freedom.

of the variance due to attendance to 7.8%. Both cumulative stepwise regression models explained the similar total amounts of variance in percent weight lost.

Discussion

There have recently been a number of publications of 12-session referral schemes from primary care to CWMOs (11,12,16,17,20). These studies are remarkably consistent in showing that weight losses over 12 weeks are around 4–5% (11,12,16,17). The recent Lighten Up intervention suggested that 12-week referral to weight management schemes, using either primary care programmes or commercial providers, produced a main effect of greater weight loss at 12 months follow-up, for those who participated in the commercially run weight management schemes (20). A randomized controlled trial (RCT) has compared weight outcomes across four CWMOs, over periods of 6 months showing mean weight losses of ~6.6% across providers (13). Two RCTs have examined 12-month outcomes in one commercial provider and weight losses were 4.6% and 5.1%, respectively (15,21). A non-commercial primary care programme has also been formally evaluated, which produced a mean weight loss of 3.0% over 12 months (14). The present audit took a different approach by examining the weight outcomes for a group of referral patients, who had been selected by the PCTs to longer periods of referral in order to target resources to where they as practitioners felt they would have the most beneficial effect in their local communities. Local practitioners used their discretion to extend a 12-session referral scheme by a further 12 sessions in those chosen patients. The CWMO had no role to play in this selection process but provided the weight management solution. Thus, while this was not a test of efficacy as conducted in a RCT, it was a test of the real-world effectiveness of local primary care professionals working in partnership with a CWMO to provide longer-term weight management solutions to patients.

74.5% of participants in this audit achieved 5%, 37.2% attained 5–10% and 37.3% reached ≥10% weight loss in the 6-month referral period. These outcomes are in line with current recommended weight loss within 3–6 months, according to the Department of Health and the National Institute for Health and Clinical Excellence guidelines (2,22). These results add to the growing evidence base on partnerships between primary care providers and CWMOs by suggesting that local targeting of resources at the level of primary care can maximize returns for NHS investments made.

Predictors and associations with weight loss

Average start BMI of the audit population was in the range that would be recommended for pharmacotherapy and/or surgery in the UK (22). Start BMI averaged at 37.9 kg m^{-2}, 62% had a BMI ≥ 35 kg m^{-2} and 31.5% of this referral population had a BMI ≥ 40 kg m^{-2}. There is some debate in the literature as to whether initial BMI is associated with rate and extent of weight loss (6,12,23–25). The current dataset suggests that much of this debate can be resolved by considering both absolute and percentage weight losses. Absolute weight losses increased with start BMI but percentage weight losses were similar across BMI categories. This suggests that lifestyle interventions can work in populations with BMIs that are normally recommended to receive secondary or tertiary care (11,22).

While men only comprised a minority of the audit population, their weight outcomes (absolute loss and as a percentage of initial weight) exceed those of women. This is the case in some (11,12,16) but not all studies (14,15,21). Men are usually larger than women and have a higher percentage of fat free mass. There is a general trend in the literature for men to lose more weight than women, when compared in the same studies. See (26), p. 127 for a detailed discussion. In this and our previous audit of referral schemes, while fewer men attend the programme, those who do so attend as much as do women and tend to lose a greater absolute and percentage of their original body weight.

The current dataset and the majority of evaluations of diet and lifestyle programmes for weight management (including those of CWMOs) show that attendance is a key correlate of weight loss (6,12,14,16,21,26). This clearly emphasizes how important it is for patients to attend or comply with their weight loss programme. The trajectory of weight loss for the completer and non-completer groups was curvilinear, which is typical for obesity treatments in general (27–29). However, there were interesting differences in the regression and cumulative ANOVA models constructed from this dataset and the same models constructed for 34 271 patients who were referred for an initial 12 weekly sessions, under the same conditions (of whom these were a part) (11). In the previous study, attendance accounted for 29.6% of the total variance in percent weight lost at the end of the referral period. Percent weight lost during the first week of referral was also an important predictor of total weight lost, accounting for 18.4% of the variance. Age, gender, height and start BMI explained little of the variance (11). In the current study over a period of 24 sessions, percent weight loss in the first week was a greater predictor than attendance and both factors explained less of the variance in weight loss than in the 12-session study. This model explained over 49.9% of the variance in weight loss over 12 weeks in 34 271 patients compared to 22.7% in the current dataset. The big drop in the percentage of the variance due to attendance is likely to be due to the greater variability in attendance in the 12-session audit in a much larger sample. It could also be that attendance becomes less clearly associated with successful weight loss in the longer term as participants adopt the intrinsic habits and behaviours required to lose weight over a period of months (6). In the cumulative stepwise regression described in this paper, attendance was added into the model before percent lost in the first week of attendance. Adding week 1 weight loss into the stepwise model first slightly increased the percent variance explained by the first week's weight loss and decreased the percent of the variance due to attendance. Both cumulative stepwise regression models explained similar total amounts of variance in percent weight lost. Thus, there was some (relatively weak evidence) that the two factors were associated in this dataset and that initial weight loss had a (relatively small) effect on subsequent attendance. These effects were not as strong in a 12-week dataset of 34 271 patients, where there was greater interdependence of week 1 weight loss and attendance. It has previously been observed that those who lose most weight in the first week go on to lose more weight (11,30). Exactly how this relates to motivation, continued attendance and longer-term weight outcomes warrants further detailed investigation (6). It would be useful for weight management programmes to explore the practical issue of how to achieve greater weight loss in the first week of attendance and how to influence the relationship between early weight loss, attendance (or engagement with the programme) and weight outcomes.

Previous work has recorded that age, gender and baseline BMI/weight are significant predictors of weight outcomes (11,12). See (31) for a detailed discussion of pre-treatment predictors of weight outcomes. This was the case in our previous 12-session audit (11) and the current dataset. However, in both cases, the percentage of the variance in weight outcomes, associated with these variables was very low. It is important to distinguish between statistical significance and effect sizes.

Comparison with other approaches to weight management

It has previously been reported that people treated with a comprehensive group behavioural approach lose approximately 9% of initial weight in 20 to 26 weeks of treatment (28,32). The data presented in this audit are directly in line with those estimates and supported by a previous RCT of four commercial providers conducted over the same time window of 6 months (~6.7% on average, ~9% for completers) (13). Results of previous work suggest that weight outcomes of a shorter referral period (i.e. 12 weeks), which are followed up at 12 months (20), or longer-term referral over 12 months (15) produce more modest weight outcomes. Explaining exactly why weight outcomes seem better at 6 than 12 months in the literature would perhaps provide new insights to enhance weight maintenance strategies. It is now well recognized that weight loss trajectories slow as time progresses (26–29), but the exact mechanisms that oppose further weight loss and often promote weight regain are multiple, complex, individually subtle and difficult to quantify specifically (3,33–35). The fact that weight loss trajectories are curvilinear is reproducible across a range of treatments (27,29). This illustrates the importance of weight loss maintenance strategies and continued support as an adjunct to initial weight loss solutions (6).

The present results show a mean weight loss of 8.6% (9.3% for completers) in 24 sessions. These data compare very favourably to pharmacological treatments for obesity (36–38) and with recent published data from evaluating CWMOs (11–13,15,16,20). Recent reviews and meta-analyses suggest that obesity drugs do not produce more than 5% weight loss on average in 12 months (36–38). The average weekly net cost of referral to this organization equates to £3.95 per patient per week and average weekly weight loss was 0.3 kg. Taking into account the additional costs of healthcare staff and NHS resource (17), this compares favourably to the equivalent prescription costs for obesity drugs, which cost approximately £1 per day on a net basis according to the British National Formulary 2009 (39). The referral scheme would cost ~£95 for 24 weeks compared to ~£168 for the net cost of obesity drugs.

Strengths and limitations of the study

As this was a service audit, limitations to this study include the absence of a control group and the fact that results were based on those people who joined a group, rather than intention to treat. There were no comparable and consistent in-house options available in the NHS Trusts to provide a control group. However, the purpose of the study was not to compare the efficacy of this CWMO's programme with other treatments. It was to audit the effectiveness of longer-term NHS referral to the programme in terms of rate and extent of weight loss and attrition rates. This study observed weight changes over 24 weekly sessions and there was no longer-term follow-up after the referral period. Key strengths were that the audit assessed the effectiveness of the programme as it runs in real life, the large sample size, data were objective and not self-reported, predictive analyses controlled for confounding effects (age, sex, height, start BMI/weight) and the fact that the subjects were real consumers aiming to control their weight in their everyday lives. Both a strength and limitation of this study is that the sample was not randomly selected. Those who received a second referral were selected by the referring NHS or Health Trust themselves in an attempt to target resources where they felt they were most needed and would provide the best return for NHS investment.

Conclusion

In the present audit, the majority (76.3%) of enrolled participants completed at least 20 sessions of the 24-session programme (completers) indicating that NHS-referred patients are willing to engage in CMWO programmes. 74.5% of all patients enrolled, and 79.3% of completers lost at least 5% initial body weight. Weight gain was prevented in 96.3% of patients, using the assumptions of the Last Observation Carried Forward Model (19). Mean weight loss was 8.9 kg or 8.6%, which is in the range that will have clear benefits to health, well-being and quality of life. This analysis has demonstrated that partnership working for weight management is effective, benefits patients and (as previously reported) (11,17) can be less expensive than other in-house options and pharmacotherapy. These results add to the growing evidence base on partnerships between primary care providers and CWMOs by suggesting that local targeting of resources at the level of primary care can maximize returns for NHS investments made.

Conflict of Interest Statement

RJ Stubbs, DJ Brogelli, CJ Pallister, AJ Avery and JH Lavin work for Slimming World.

Acknowledgements

We are grateful to GW Horgan of Biomathematics and Statistics Scotland, for conducting an independent statistical analysis of the data. We would like to thank the Slimming World on Referral team for entry of the raw data and their general support to all primary care/commercial partnerships.

RJ Stubbs, CJ Pallister and S Whybrow conceived and conducted the audit and analysed data. All authors were involved in writing the paper and final approval of the submitted version.

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Appendix 2. Associated Abstracts

Ethical approval was applied for with the conclusion this was an audit.

Results: Mean protein intake was adequate [71 g day^{-1} (SD 24)], while energy intake was inadequate [8095 kJ day^{-1} (SD 2241)].

Table 1 Summary of micronutrient intake.

Nutrient	Mean recorded intake (SD)	Number of patients with intake below RNI (%)	Number of patients with intake below RRI (%)
Thiamin (mg)	1.6 (1.1)	0 (0)	15 (67)
Riboflavin (mg)	1.4 (0.6)	7 (29)	20 (83)
Niacin (mg)	31.3 (11.0)	0 (0)	3 (13)
Biotin (μg)	23.5 (5.7)	0 (0)	No RRI
Pantothenic acid (mg)	4.3 (2.3)	4 (17)	19 (79)
Pyridoxine (mg)	1.5 (0.6)	5 (21)	24 (100)
Folate (μg)	205.9 (68.3)	13 (54)	24 (100)
Cobalamin (μg)	3.9 (2.1)	2 (8)	8 (33)
Vitamin C (mg)	62.7 (57.5)	9 (38)	19 (79)
Iron (mg)	10.4 (3.5)	9 (38)	12 (50)
Selenium (μg)	66.1 (26.8)	9 (38)	No RRI
Zinc (mg)	7.7 (3.2)	13 (54)	23 (96)
Vitamin E (mg)	5.6 (2.2)	2 (8)	22 (92)

There were no significant relationships between nutrient intake and age, gender or marital status. Those who had been on dialysis longer had significantly reduced intakes of protein, niacin, pyridoxine and selenium ($P < 0.05$) as shown in Table 1. There was no significant difference between intake on dialysis and non-dialysis days.

Discussion: The intake of many micronutrients in a substantial proportion of patients appeared poor, which may exacerbate relative deficiencies due to altered metabolism. No patients attained the requirements for folate and pyridoxine; recommendations are 400% and 733% above the reference nutrient intake (Fouque, 2003). Patients who have been on dialysis for longer appeared to have poorer intakes of some micronutrients.

Conclusions: Micronutrient intake in this sample was poor; requirements appear unachievable by diet alone. Supplementation may be beneficial but further study is required with assessment of blood levels.

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Is Slimming World on Referral an effective option to help people with learning difficulties manage their weight?

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Background: Since piloting the Slimming World on Referral service in 2001 (Lavin *et al.*, 2006), the scheme has been made available nationally. This subsidised partnership scheme enables primary care to refer patients to a local Slimming World group for weekly weight management at no cost to the patient themselves. To date, over 30 schemes have been set up with the NHS, mainly focusing on people with general medical conditions. Obesity levels are greater in adults with learning difficulties than in the general population and have been shown to contribute to reduced life expectancy and increased health needs (Royal College of Nursing, 2006). In 2007, a Primary Care Trust (PCT) & Slimming World trialled the use of Slimming World on Referral, specifically for members with learning difficulties. This study aimed to evaluate its feasibility.

Methods: Twenty members were referred to a specially set up Slimming World group and given the opportunity to attend free of charge for 24 weeks. The group was run by a local Slimming World consultant with support from Berkshire East PCT's learning difficulties care staff. A simplified version of Slimming World's healthy eating plan was promoted. Visuals were used to encourage the intake of low energy dense foods and healthier meal options, for instance, options for a healthy lunch box. Weight change, body mass index (BMI) change and rates of attendance were analysed using weekly weight records. Data were analysed by *t*-tests (paired and unpaired) using SPSS version 11.

Results: Average attendance was 19 weeks (2.9). Average percentage weight change was −4.4% (3.7) and 11 out of the 20 (55%) participants lost 5% or more of their body weight within the 24 weeks.

Table 1 Effect of attendance at Slimming World group on weight and BMI.

	Baseline, mean (SD)	Follow up, mean (SD)	*P* value
Weight (kg)	96.0 (12.1)	91.7 (12.8)	<0.001
BMI (kg m^{-2})	36.7 (6.9)	35.1 (7.0)	<0.001

For those who attended at least 20 of the 24 sessions ($n = 12/60\%$), data improved further: mean BMI change −1.9 kg m^{-2} (1.6, $P = 0.002$), weight change −5.4 kg (4.3, $P = 0.002$), percentage weight change −5.8% (4.5, $P = 0.002$).

Discussion: It has previously been shown that referral partnership between the NHS and Slimming World offers a practical weight management option in terms of efficacy, attrition and cost (Lavin *et al.*, 2006). This audit data shows that the referral service can be used to achieve clinically effective weight losses in a specific patient group which has high levels of obesity.

Conclusion: Slimming World on Referral offers a feasible option to help adults with learning difficulties manage their weight.

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Dietary intake, body composition and physical activity levels in women with polycystic ovary syndrome compared with healthy controls

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Background: Polycystic ovary syndrome (PCOS) affects up to 10% of women of reproductive age in the UK. Obesity is a common feature of PCOS with approximately 33% of UK women with PCOS (wPCOS) being obese (Barr *et al.*, 2007) compared with 20% of women in the general population (Ruston *et al.*, 2004). This research aims to compare the diet and lifestyle of wPCOS (normal and overweight) with matched controls.

Methods: A 7-day food and activity diary, and medical questionnaire were completed by 37 wPCOS and 31 age and weight matched controls. A pedometer was also provided to on the same 7 days. Anthropometric measurements (body mass index, percentage body fat, and waist-to-hip ratio), and dietary intakes were compared. Percentage body fat measurements were taken using Bodystat tetrapolar bio-impedance (BodyStat, UK). Ethical approval was obtained from Roehampton University Ethics Board and the Huntingdon Research Ethics Committee.

Results: There were no significant differences for anthropometric measurements or mean energy intake between wPCOS and controls. However, percentage energy (%E) from fat, and absolute and percentage saturated fat intakes were all significantly higher for wPCOS compared with controls (Table 1) and further from the recommendations for health. Percentage energy intake from carbohydrate for wPCOS was significantly lower than controls ($P = 0.003$) with no significant differences in the contribution from protein.

Table 1 Subject characteristics and nutrient intake (mean ± SD).

Values	Total (n = 68)	wPCOS (n = 37)	Control (n = 31)	Significance
Body mass index (kg m^{-2})	24.3 (4.3)	24.4 (4.1)	24.2 (4.5)	NS
Waist: Hip ratio	0.77 (0.07)	0.77 (0.07)	0.77 (0.06)	NS
Body fat (%)	29.5 (7.1)	30 (7)	29 (7)	NS
Energy intake (kcal day^{-1})	1867 (388)	1906 (362)	1821 (418)	NS
Carbohydrate (% intake day^{-1})	43 (7)	41 (8)	46 (5)	0.003
Protein (% intake day^{-1})	16 (4)	16 (4)	16 (3)	NS
Total fat (% intake day^{-1})	38 (6)	40 (6)	35 (5)	0.007
Saturated fat (% intake day^{-1})	12.9 (3)	15 (3)	12 (3)	0.023
Saturated fat (g day^{-1})	26.9 (9.1)	29 (8)	25 (10)	0.002
Steps per day (n = 42)	9318 (2636)	9369 (2430)	9251 (2960)	NS

Stratification by BMI identified a significant difference in %E from carbohydrate between lean wPCOS (41 ± 6%) and lean controls ($P = 0.042$) and conversely a higher %E intake from fat in lean wPCOS versus lean controls ($P = 0.039$).

Discussion: Results indicate both qualitative and quantitative differences in the dietary intakes of wPCOS compared to age and weight matched controls. However, no significant differences in activity levels or body composition were identified. Analysis is ongoing and will help to further elucidate the relationship between behaviour, weight and risk factor profile in women with PCOS allowing for the development of more effective management strategies.

Conclusions: This is the first study to report the habitual dietary intake of UK wPCOS compared with matched controls, and results are similar to US findings (Wright *et al.*, 2004). Identification of sub-optimal dietary patterns in wPCOS in the UK will allow dietary information for this population to be more effectively tailored to help maximise the success of lifestyle interventions.

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THE OFFICIAL JOURNAL OF THE BRITISH DIETETIC ASSOCIATION
Journal of Human Nutrition and Dietetics

Selected abstracts from the British Dietetic Association Conference: Aviemore, Scotland 22–24 June 2010

Supporting post-natal women to lose weight

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Background: Women find it difficult to lose excess weight gained during pregnancy. As they have more children, weight can increase progressively, which is difficult to manage and increases risk of complications in future pregnancies (Villamor and Cnattingius, 2006). Therefore, the post-natal period is a key time to support women in managing their weight. The aims of this study were to both determine the time at which women sought to access support from a structured weight management programme post-delivery and the ease of access.

In addition, the aim was to report on changes in lifestyle and health status achieved as a result of the support.

Methods: An online survey of members attending Slimming World (SW) up to 2 years post-natally was hosted on the member's website for 2 weeks. Questions investigated what influenced the person to join; when, post-delivery, they accessed the support; breastfeeding; and ease of attendance at group. Data on self-reported weight and heights were collected for various time points. Respondents were asked about changes in eating and activity habits and general well-being subsequent to joining SW. Likert five-point scales were used to assess changes in behaviour. A positive result indicates an increase in the behaviour.

Results: Five hundred and ninety members responded. Eighty-four (14.2%) had joined SW either before they became, or when, pregnant. The remainder (506) joined after having a baby; 85.7% said having a baby influenced their decision to join. The majority joined at <26 weeks (47.8%) or at >1 year (28.3%) after giving birth The majority found it very easy (48%) or quite easy (32%) to attend group. The mean pre-pregnancy body mass index (BMI) of respondents (576) was 30.1 kg m^{-2} (SD 6.1). Of those who joined SW post-natal (504), the mean BMI on joining was 33.6 kg m^{-2} (SD 6.9). Of those already attending when they became pregnant (67), mean BMI on joining was 33.5 kg m^{-2} (SD 7.4).Mean BMI at time of survey (582) (i.e. since attending SW) was 30.7 kg m^{-2} (SD 6.5). Some 42.5% of respondents said they had reached their pre-pregnancy weight and 41.5% said they are now lighter than before becoming pregnant. Of those who had been members for over 6 months (152), 56.5% had reached their pre-pregnancy weight and 55.3% were lighter than before becoming pregnant. Of those who had had previous pregnancies (309), 72% stated being unable to lose previous pregnancy weight. Respondents reported eating more regularly, cooking more meals from fresh ingredients, eating more fruit and vegetables and consuming fewer unhealthy snacks since joining. Seventy-six percent reported being more active since joining, with appropriate shifts in lifestyle behaviour observed; going for more walks and watching television less. These post-natal women also reported improvements in self-esteem, self-confidence and general well-being. 74.2% breastfed their babies, and of these, 57.4% breastfed for more than 6 weeks.

Discussion: Women accessed group support at different time intervals, suggesting that support needs to be available for when individuals feel ready to address weight management rather than at a defined time post-delivery. A mean BMI change of –2.9 was observed at the time of survey, indicating this programme is helping women lose weight post-natally. At the time of the survey, many women had already reached their pre-pregnancy weight and were in fact lighter than before becoming pregnant. This contrasts with many respondents' previous experience of being unable to lose weight gained during pregnancy. The changes in eating habits reported (e.g. increased fruit and vegetable consumption and reduction in unhealthy snacks) would serve to improve the nutritional quality of the diet. Alongside an increase in activity levels, this is in line with evidence-based practice for weight management (NICE, 2006). Given the vulnerability of post-natal women, it is important that weight management support does not impair their mental well-being. This study actually shows the reverse, with women reporting feeling less down-hearted and more peaceful since losing weight. Some 42.6% of all respondents were still breastfeeding at 6 weeks, suggesting that accessing weight management support had not compromised the ability to breastfeed.

Conclusion: Holding over 6000 weekly groups across the UK, Slimming World is well placed to support women to manage their weight post-natally The data suggest that the programme does help post-natal women to adopt healthy lifestyle habits, lose weight and also to feel better about themselves, all of which may have a positive impact on subsequent pregnancies.

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An intervention to improve the content of packed lunches in primary school children

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Background: 'Packing a Healthy Lunch' (PAHL) is an ongoing initiative that was launched in 2007 with the aim of improving the content of packed lunches within The Royal Borough of Kensington and Chelsea primary schools. The school environment is well-recognised as being an excellent setting in which to influence children's attitudes and knowledge with regards to health (Department of Health, 2004), and the initiative's whole-school approach incorporates a range of individualised interventions targeting parents, pupils and teachers. An evaluation of its impact was achieved by surveying packed lunches before and immediately after the initiative, and again 1 year later.

Methods: Primary schools were recruited directly through contact from an NHS Kensington & Chelsea dietitian. Once engaged, the nutrition team carried out a packed lunch survey during one lunch service in order to provide baseline data. The contents of each packed lunch is recorded by food type (including protein, fruit, salted snacks, confectionery and drinks with added sugar) during a brief chat with each pupil; their year group and gender was noted. A range of specially-developed interventions were discussed during a follow-up meeting with the school, and the most suitable ones are run over the course of a week. A second packed lunch survey

THE OFFICIAL JOURNAL OF THE BRITISH DIETETIC ASSOCIATION
Journal of Human Nutrition and Dietetics

Discussion: A similar previous study has investigated the practical aspects of a gluten-free diet and found that this is typically more restrictive than its alternatives (Lee *et al.*, 2007). The findings from the present study provide further evidence that specialist diets are generally more expensive and less available than an unrestricted diet. This could present a barrier to people trying to follow a special diet and might be addressed by increasing awareness of the need for milk-free products by manufacturers and retailers. Dietitians have a role to play in this and in producing CMPA resources and providing education that takes account of barriers like cost and availability.
Conclusions: It can be concluded from this study that, overall, a milk-free diet is less accessible and more expensive than an unrestricted milk-containing diet.

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An investigation into how satiety and hunger they influence food choice in slimmers and nonslimmers

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Background: Satiety is defined as either a feeling of fullness or the cessation of physical hunger sensations following the ingestion of food (Murray & Vickers, 2009). How the satiating value of foods and their overall satiating effect can be used as a strategy for promoting weight loss has become an area of increasing interest in terms of weight management. This qualitative study investigated the attitudes of individuals who were 'slimmers' versus 'nonslimmers' about hunger and the different sensations of hunger, satiety and measures taken to stay satisfied and how feeling of hunger influences food choices.
Methods: Participants were recruited via community weight management groups (slimmers) and the local community (nonslimmers, screened as not actively losing weight). Four focus groups were held. Participants were asked questions that explored their feelings related to hunger and satiety; whether they perceived there to be different types of hunger; how hunger influences subsequent food choice and whether they considered it important to avoid feeling hungry. The focus group followed a semi-structured format and data were collected until saturation was achieved. The session was recorded and later transcribed verbatim. To ensure consistency, the same moderator facilitated each session. The transcripts were thematically analysed using N-vivo.
Results: Sixteen participants; nine slimmers, actively losing weight, and seven nonslimmers were recruited. All subjects considered hunger as a physical sensation that elicits a behavioural response. Common responses included consuming larger volumes of food and selecting convenience food options. For slimmers, these actions were perceived to be detrimental to their efforts. For slimmers, hunger sensations had the potential to initiate a spiral of emotions causing them to perceive their weight loss attempts are futile. Consequently, slimmers felt hunger was something to be avoided and they took active measures to achieve this. Most commonly slimmers incorporate planned 'snacks' between meals to curb hunger. Satiety was considered across all groups to be beneficial because it offers increased eating control and, for slimmers, enables them to manage hedonic desires to eat. Another core theme identified was that foods considered to offer increased satiety were 'carbohydrate-based foods'.
Discussion: Avoiding hunger would appear to be an important strategy for slimmers to achieve weight loss success and the strategy of regular snacking may be a beneficial behaviour to support weight loss. The evidence base is mixed, although there is research to suggest snacking can aide slimming success (Waller *et al.*, 2004). Satiating foods have been shown to impact upon reducing intake. What this study shows is the perceived importance of satiety on eating behaviour and the role it can play in controlling eating behaviour for consumers. This indicates that satiety is also an important factor in achieving weight loss success.
Conclusions: A dietary approach that emphasises the satiating power of foods alongside a calorie deficit may facilitate more successful weight loss. The insight this study offers into the mentality of a slimmer could also be useful in clinical practice when building rapport and establishing empathy between dietitians and patients.

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Food and nutrition policy: an intervention to improve nutrition in lunch clubs for older people

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Background: A review of the nutrition services offered to older people in the Royal Borough of Kensington and Chelsea,

Winner of the Yakult Prize for Public Health Nutrition

PH3

Evaluating the potential role of a commercial weight management organisation (CWMO) in type-2 diabetes management

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Background: Type-2 diabetes (T2D) is a major public health problem closely linked to being overweight and obese[1]. Management of T2D includes a number of lifestyle changes in order to reduce the risk of life-threatening macro- and micro -vascular complications. Weight management is highlighted as the principal strategy for managing blood glucose levels in T2D[2]. This research aimed to evaluate the impact of attending a CWMO on outcome measures in members with T2D.

Methods: Subjects completed a self-reported 31-point questionnaire, consisting of quantitative and qualitative questions about blood glucose levels, Body mass index (BMI), HbA1c, diet, activity patterns and the impact of weight on quality of life were assessed using a questionnaire which was published on the CWMO website for 2-weeks. Respondents were categorized by length of membership and weight, BMI, blood glucose and HbA1c results were analysed using paired *t*-tests to assess changes with attendance of the CWMO. 5-point Likert scales were used to determine changes in quality of life and activity habits since joining the CWMO. These questions were taken

from the validated Impact of Weight on Quality of Life (IWQOL) questionnaire[3].

Results: Of the 2812 respondents with T2D, 552 successfully completed the questionnaire. Mean age was 53.1 (±SD 11.1) years, mean attendance 12.2 (±SD 20.6) months. For this analysis only respondents who had been members for >3 months (n = 394) were included.

	Joining CWMO (±SD)	Current Weight (±SD)	% Difference	P Value
Weight (kg)	107.21 (23.40)	95.56 (21.72)	−10.87	$P < 0.001$
BMI(kg m^{-2})	39.33 (7.96)	33.90 (6.89)	−13.79	$P < 0.001$
Blood Glucose (mmol L^{-1})	11.29 (5.03)	6.52 (2.01)	−42.32	$P < 0.001$
HbA1c %	8.65 (2.15)	6.55 (1.32)	−24.36	$P < 0.001$

Summary Statistics for mean weight, HbA1c, blood glucose and HbA1c change, for respondents with T2D who had been members for more than >3 months.

Respondents reported significant improvement in their physical activity levels, physical functionality scores, measures of self-esteem, sexual life, public distress/weight stigma and working experiences ($P < 0.001$ for all changes). The longer respondents had been members, the more likely they were to report an increased participation in physical activity ($P = 0.02$).

Discussion: In this evaluation, CWMO members with T2D lost weight, reported improved blood glucose and HbA1c levels irrespective of how long they had been a member. Improvements in quality of life measures support previous research of CWMO having beneficial outcomes on weight and diabetes management[4]. The reported improved glycaemic control warrants further investigation using medical records to determine if CWMO could support weight management in type 2 diabetes.

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Investigating motivations for weight loss and benefits of attending a commercial weight management organisation post-natally

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Previous reports have indicated that women feel pressure from celebrity culture and wider society to lose weight swiftly after having a baby (Netmums and The Royal College of Midwives, 2010). The aim of this study was to investigate women's motivations to lose weight postnatally, weight loss achieved and impact on self-esteem. A survey of women attending Slimming World (SW) who had given birth in the last 2 years was hosted on SW web-site during September 2013. The survey used quantitative and qualitative questions to determine motivation and lifestyle behaviours and asked for self-reported weight and height. 1015 women responded. The majority of participants ($n = 533$, 52.5%) had been members for <3months; mean joining BMI was 33.3 kg/m^2 (SD 5.85) and mean BMI at time of survey 30.5 kg/m^2 (SD 5.86). The main reasons for wanting to lose weight were 'to improve how I feel about my body size and shape' (22%), 'to improve my confidence' (19%) and 'to lose weight I gained during pregnancy' (17%). A combined 3% cited media/social pressure as a reason to lose weight and 31% agreed to feeling under social/media pressure to be an ideal weight post-natally. A range of weight gains in pregnancy were reported, the most common being between 1 and 2 stone. 71% ($n = 611$) of those who already had children reported having retained weight from a previous pregnancy. 82% said retaining weight postnatally affected their self-esteem. After losing weight with SW, 38% were lighter than their pre-pregnancy weight and 78.6% expressed improvements in self-esteem since joining SW. Social/media pressure plays a minimal role in a woman's decision to lose weight post-natally. Motivation is more personal. Attendance at SW resulted in weight loss and improved self-esteem in post-natal women.

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http://dx.doi.org/10.1016/j.appet.2014.12.141

energy restriction, we tracked levels of hedonic hunger and reactivity to food cues in a sample of obese participants engaged in a weight management trial. Participants completed measures of attentional bias to food items, hedonic hunger and other related appetitive constructs at the beginning of a weight loss intervention and after three months of energy restriction. Preliminary baseline data from the first 20 participants studied, collected at the start of the weight management period, suggest that scores on a measure of hedonic hunger are associated with attentional bias to food cues in this obese sample. Greater hedonic hunger is associated with greater food cue reactivity. Data collection is ongoing and how this suggested relationship may be related to weight managemen success after three months of dieting is under investigation. Establishing the role of hedonic hunger in weight loss success will enabl us to identify those vulnerable to the effects of environmental foo cues.

http://dx.doi.org/10.1016/j.appet.2014.12.142

Childhood obesity and educational attainment. Evidence fron prospective cohort studies

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Currently, 200 million school-aged children are classified as overweight or obese worldwide. Cross-sectional evidence indicates that childhood obesity is associated with lower attainment at school. The objective of this study was to assess the prospective relationship between childhood obesity and educational attainment. In April 2014 prospective cohort studies (in English only) were identified from Medline, Embase, PsycINFO, Education Resource Information Centre (ERIC), and SportDiscus. Title and abstracts were screened, full-text articles of relevant studies obtained, data extracted and methodological quality assessed. Eleven studies from six cohorts from North America, Europe, Asia, and Australia were identified (Nrange = 409–14,000 children; baseline age range = 4–11 years). After controlling for confounding and mediating variables, six studies reported that children who became overweight or obese and children who were persistently obese during the follow up duration of two to six years obtained significantly lower educational attainment scores than children who were never overweight or obese. Based on two studies this inverse association was more apparent

The challenge of setting up and evaluating a primary care based Tier 3 adult weight management service; bridging the gap between service delivery and research

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The department of health recommended widespread introduction of Tier 3 multidisciplinary weight management services but currently few are available. In Rotherham and Norfolk these services have been provided successfully in primary care for several years. The intervention at both sites is based on NICE guidelines and current evidence, and the core outcomes are weight loss targets defined by the commissioners, but may not reflect the complexity of the participants attending and the health gains achieved. Bariatric surgery referral is an appropriate clinical result in some cases. The Rotherham Institute of Obesity (RIO) was the trailblazer, and the Norfolk services were guided and supported by RIO. The challenges and solutions at each site are discussed in this presentation. Challenges included: securing stable funding, recruiting and training staff, designing the clinical protocol, advertising the service to local GP practices, integrating with Tier 2 services and secondary care, maintaining academic links, selecting the core dataset and managing the data, collecting long term follow-up data, and statistical analysis of the data. In addition it was important to ensure that commissioners understood the medical complexity of the participants and did not make inappropriate outcome comparisons with Tier 2 services. The National Obesity Observatory standard evaluation framework provides guidance on a core dataset and recommends that 10% of the budget should be allowed for evaluation of a new service, but this is rarely the case in practice. Primary care does not have the financial or academic infrastructure to subsidise the significant administrative burden of collecting a large range of data, and the organising long term follow-up required to assess the true efficacy of these services. The development of partnerships with academic centres would increase the value of these services to the NHS.

http://dx.doi.org/10.1016/j.appet.2014.12.138

Motor competence and weekend sedentary time predict body mass index in pre-schoolers

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This study examined the extent to which motor competence (MC) and physical activity (PA) predicted body mass index (BMI) in preschoolers. Following ethics approval and informed consent, 51 children (22 boys, 29 girls), aged 3–4 years from preschools in central England wore a triaxial accelerometer (GENEActiv) measuring at 10 s epochs and 100 Hz for 4 days, including at least one weekend day to determine PA. Height (m) and body mass (kg) were measured, from which BMI was determined. The proportion of time spent in light, moderate and vigorous PA was determined using specific cut-off points for counts per minute (cpm) related to children. MC was determined using the Test of Gross Motor Development-2. Linear backwards multiple regression indicated a significant model ($P = .011$, adjusted $R2 = .201$) the variance in BMI was explained by the percentage of time spent in sedentary PA ($P = .014$), and MC scores for the leap ($P = .038$) and jump ($P = .03$). The results of this study support theoretical models on the association of obesity with MC and suggest that sedentary time at weekends and locomotor MC explain 20.1% of the variance in BMI in pre-schoolers.

http://dx.doi.org/10.1016/j.appet.2014.12.139

Evaluating the role of a commercial slimming organisation within type 2 diabetes management

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Type 2 diabetes (T2D) is a major public health problem closely linked to overweight and obesity. Weight management is highlighted as the principal strategy for managing blood glucose levels in T2D (Dyson et al., 2011). This research investigated the impact of a commercial weight management organisation, Slimming World (SW), in diabetes management. SW members with diabetes were invited to complete a questionnaire hosted on SW's member website for a 2-week period. Quantitative and qualitative questions, including Impact of Weight on Quality of Life, were used. Respondents were split by diabetes type and length of SW membership. Of the 628 respondents, 88% were female and 551 had T2D. For those members with T2D who had attended SW longer than 3-months (mean attendance 12.2 months), ($n = 368$), mean weight and BMI fell by 11.7 kg (10.9%) and 5.4 kg/m^2 respectively. Where data were provided ($n = 221$), mean blood glucose and HbA1c fell by 4.8 mmol/l and 2.1% respectively ($P < 0.000$). Of all members with T2D taking medication (87%, $n = 479$), 38% reported a reduction in medication and of the 123 taking insulin, 61% reported a reduction in dosage, since joining SW. Respondents also reported significant improvement in their physical function, self-esteem, sexual life, public distress and working experiences ($P < 0.000$). SW members with T2D lost weight, reported improved blood glucose, HbA1c levels and reductions in medication. Alongside improved glycaemic control, improvements in quality of life were also reported, indicating attendance at Slimming World is a practical, effective option for supporting weight management in type 2 diabetes.

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Appendix 3. Related presentations delivered;

1. **All parliamentary party group on childhood obesity, July 2016 (invited speaker).** Title; The importance of providing the best start in life for later health (Quick wins in Public health). This presentation emphasised the importance of early nutrition, from conception onwards through to the early years and included a summary of interventions which have endeavoured to promote better maternal nutrition and looked at the impact on subsequent infant nutritional status, including breastfeeding rates.
2. **RCM annual conference for maternity support workers, June 2016 (invited speaker).** This presentation summarised the NICE 2015 public health guidance on Maternal and Child Nutrition and the NICE 2010 guidance on weight management before, during and after pregnancy. The aim was to encourage maternity support workers to see pregnancy as an opportunity to raise the issue of weight management and as a consequence improve both maternal and child outcomes. Links to the Healthy Start scheme were discussed as an approach to reducing health inequalities.
3. **RSPH annual conference for health trainers, June 2016 (invited speaker).** The title of this ten minute presentation was behaviour change for successful weight management. One slide listed the behavioural change strategies known to be successful and then the focus was on the importance of target setting with a summary of data from the Setting targets research (paper 13). This presentation followed an excellent workshop on promoting mental well-being where the number one strategy for better mental health is 'being optimistic'. The two presentations went together very well.
4. **ASO annual conference 2015 (oral abstract presentation).** This was a ten minute presentation summarising the Setting Targets research.
5. **BDA joint DOM/DMEG annual conference September 2014.** This presentation looked at the associations between maternal obesity and gestational diabetes and considered interventions to reduce the prevalence of both and the related benefits to mother and child.
6. **Maternal Obesity conference for Midwives, Doncaster 2014.** This presentation included findings from the HELP feasibility study.
7. **RCN Nursing in Practice, London & Newcastle, 2013 (invited speaker).** Title; 'Appetite for Knowledge: sustainable weight management solutions'. This presentation questioned primary care nurses about their current practice in supporting people to lose weight and the opportunities that have to make a positive difference to weight management. An example was provided of the complications which may arise from a woman having a high pre-pregnancy BMI.