Wilcox, Caroline (2010) To what extent is occupation of influence on the risk of dementia?: A systematic review. [Dissertation (University of Nottingham only)] (Unpublished)

Access from the University of Nottingham repository: http://eprints.nottingham.ac.uk/23605/6/Caroline_Wilcox_Dissertation.pdf

Copyright and reuse:

The Nottingham ePrints service makes this work by students of the University of Nottingham available to university members under the following conditions.

This article is made available under the University of Nottingham End User licence and may be reused according to the conditions of the licence. For more details see: http://eprints.nottingham.ac.uk/end_user_agreement.pdf

For more information, please contact eprints@nottingham.ac.uk
To what extent is occupation of influence on the risk of dementia?: A systematic review

Caroline Wilcox

Dissertation submitted for Master of Nursing Science, School of Nursing, Faculty of Medicine, University of Nottingham

I declare that this dissertation is my own work

Signed: ________________

Date: ________________
Acknowledgements

Thanks to my family and boyfriend who have pretended valiantly to listen, with interest, to my dissertation related musings.

Thanks to my housemates for providing much needed heckling, banter and tea when I’ve been trying to work.

But most of all:

I would like to offer my sincere thanks to Andy Meal, my dissertation supervisor for his patience, for the guidance and support that he has provided and also for the encouragement that I needed and most definitely appreciated.

(…and for reminding me how to eat an elephant).
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>1</td>
</tr>
<tr>
<td><strong>Chapter 1: Introduction and Background</strong></td>
<td></td>
</tr>
<tr>
<td>1.1 Introduction</td>
<td>2</td>
</tr>
<tr>
<td>1.2 Background</td>
<td>3</td>
</tr>
<tr>
<td>1.3 Research question</td>
<td>4</td>
</tr>
<tr>
<td>1.4 Hypothesis</td>
<td>5</td>
</tr>
<tr>
<td>1.5 Aims</td>
<td>5</td>
</tr>
<tr>
<td>1.6 Objectives</td>
<td>6</td>
</tr>
<tr>
<td><strong>Chapter 2: Method and Methodology</strong></td>
<td></td>
</tr>
<tr>
<td>2.1 Introduction to chapter</td>
<td>7</td>
</tr>
<tr>
<td>2.2 Methodology</td>
<td>7</td>
</tr>
<tr>
<td>2.3 Method</td>
<td>8</td>
</tr>
<tr>
<td>2.3.1 Search terms</td>
<td>9</td>
</tr>
<tr>
<td>2.3.2 Inclusion criteria</td>
<td>10</td>
</tr>
<tr>
<td>2.3.3 Exclusion criteria</td>
<td>11</td>
</tr>
<tr>
<td>2.3.4 Data extraction</td>
<td>12</td>
</tr>
<tr>
<td>2.3.5 Data analysis and synthesis</td>
<td>13</td>
</tr>
<tr>
<td>2.4 Chapter Summary</td>
<td>13</td>
</tr>
<tr>
<td><strong>Chapter 3: Results</strong></td>
<td></td>
</tr>
<tr>
<td>3.1 Results</td>
<td>14</td>
</tr>
<tr>
<td>3.2 Literature searching</td>
<td>14</td>
</tr>
<tr>
<td>3.3 Data extraction</td>
<td>24</td>
</tr>
<tr>
<td>3.4 Study Summaries</td>
<td>24</td>
</tr>
<tr>
<td>3.4.1 Case control studies</td>
<td>25</td>
</tr>
<tr>
<td>3.4.2 Cohort studies</td>
<td>31</td>
</tr>
<tr>
<td>3.5 Study characteristics</td>
<td>44</td>
</tr>
<tr>
<td>3.5.1 Number of participants</td>
<td>44</td>
</tr>
<tr>
<td>3.5.2 Study conclusions</td>
<td>44</td>
</tr>
<tr>
<td>3.5.3 Quality assessment</td>
<td>45</td>
</tr>
<tr>
<td>3.6 Chapter summary</td>
<td>46</td>
</tr>
<tr>
<td><strong>Chapter 4: Discussion</strong></td>
<td></td>
</tr>
<tr>
<td>4.1 Introduction to chapter</td>
<td>47</td>
</tr>
<tr>
<td>4.2 Discussion</td>
<td>47</td>
</tr>
<tr>
<td>4.3 Quality assessment</td>
<td>48</td>
</tr>
<tr>
<td>4.4 Assessing causation using the Bradford-Hill criteria</td>
<td>49</td>
</tr>
<tr>
<td>4.4.1 Strength</td>
<td>49</td>
</tr>
<tr>
<td>4.4.2 Consistency</td>
<td>49</td>
</tr>
<tr>
<td>4.4.3 Specificity</td>
<td>50</td>
</tr>
<tr>
<td>4.4.4 Temporality</td>
<td>52</td>
</tr>
<tr>
<td>4.4.5 Biological gradient</td>
<td>52</td>
</tr>
<tr>
<td>4.4.6 Plausibility</td>
<td>53</td>
</tr>
<tr>
<td>4.4.7 Coherence</td>
<td>54</td>
</tr>
</tbody>
</table>
## Contents

**Chapter 4: Discussion continued**

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4.8 Experiment</td>
<td>55</td>
</tr>
<tr>
<td>4.4.9 Analogy</td>
<td>55</td>
</tr>
<tr>
<td>4.5 Is a causal relationship likely?</td>
<td>56</td>
</tr>
<tr>
<td>4.6 Implications for further research</td>
<td>56</td>
</tr>
<tr>
<td>4.7 Implication for practice</td>
<td>57</td>
</tr>
<tr>
<td>4.8 Appraisal of this review</td>
<td>58</td>
</tr>
<tr>
<td>4.9 Chapter summary</td>
<td>59</td>
</tr>
</tbody>
</table>

**Chapter 5: Conclusion**

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
</tr>
</tbody>
</table>

**References**

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
</tr>
</tbody>
</table>

**Appendices**

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix 1-</td>
<td>CASP tool for case control studies</td>
<td>XI</td>
</tr>
<tr>
<td>Appendix 2-</td>
<td>CASP tool for cohort studies</td>
<td>XIV</td>
</tr>
<tr>
<td>Appendix 3-</td>
<td>Excluded studies</td>
<td>XVII</td>
</tr>
<tr>
<td>Appendix 4-</td>
<td>Data extraction form</td>
<td>XVIII</td>
</tr>
<tr>
<td>Appendix 5-</td>
<td>Study summaries</td>
<td>XIX</td>
</tr>
<tr>
<td>Appendix 6-</td>
<td>Bradford Hill criteria summary</td>
<td>XXI</td>
</tr>
<tr>
<td>Appendix 7-</td>
<td>CASP tool for reviews</td>
<td>XXIII</td>
</tr>
</tbody>
</table>
List of Figures

Figure 1 Selection process ................................................................. 11
Figure 2 Flow chart for papers found using ASSIA ......................... 15
Figure 3 Flow chart for papers found using Embase ....................... 16
Figure 4 Flow chart for papers found using Medline ..................... 17
Figure 5 Flow chart for papers found using Psych Info .................... 18
Figure 6 Flow chart for papers found using Pub Med ..................... 19
Figure 7 Flow chart for papers found using Science Direct ............ 20
Figure 8 Flow chart for papers found using Swetswise ................. 21
Figure 9 Flow chart for papers found using Wiley Interscience ....... 22
Figure 10 Chart to compare number of participants in each study .... 44
Figure 11 Chart to illustrate an overview of study conclusions ....... 44

List of Tables

Table 1 Search results ........................................................................ 23
Table 2 Case control study summaries ........................................... 30
Table 3 Cohort study summaries ..................................................... 43
Table 4 Summary of CASP based appraisal scores - Case controls .... 45
Table 5 Summary of CASP based appraisal scores - Cohort studies .... 45
Table 6: Results for Kröger et al (2002) ........................................... 52

Words: 15,822
Abstract

Introduction and background

Dementia is typically a disease of old age and is characterised by chronic disorder of behaviour and intellectual function. With an aging population the disease is becoming of increasing concern. Increased awareness of the disease as one of modifiable risk has prompted research to further investigate such risk factors. Current research indicates a number of lifestyle factors to be of influence in forming overall disease risk. This study aims to establish the effect occupation has on the risk of developing dementia.

Methodology

To achieve the study aims a systematic review was carried out. A literature search allowed relevant literature to be identified. Searching took place across a range of databases using predetermined search terms. After initial searching studies were then further selected for inclusion in the review based on clear inclusion and exclusion criteria. Articles were selected for inclusion in four stages; articles returned using search terms, relevance on reading title, relevance on reading abstract and finally relevance after reading full text.

Results and Conclusions

Three main outcomes were found within the included studies. No relationship between occupation and dementia, highly skilled occupation linked with low risk of dementia and low skilled occupation linked with high risk of dementia. The potential for a causal relationship was identified and further investigated using the Bradford Hill criteria for causal relationships. The findings fulfilled six of the nine criteria indicating a causal relationship is likely. However, this relationship is difficult to disentangle from the effects of social interaction and education on the risk of dementia. This review concluded that a strong relationship exists between occupation and dementia. The author also recommends targeted health promotion to allow those more at risk of dementia to be provided with cognitively stimulating tasks and be encouraged to engage in socially stimulating environments.
Chapter 1: Introduction and Background

1.1 Introduction

Dementia can be defined as “a chronic or persistent disorder of behaviour and higher intellectual functioning due to organic brain disease. It is marked by memory disorders, changes in personality, and deterioration in personal care, impaired reasoning, and disorientation.” (Oxford Dictionary of Nursing, 2004, p. 125). Dementia affects some 6% of the total population aged 65 and over, rising to 20% of the population aged 80 (DoH, 2007). With an ever-aging population this amounts to an increasing number of persons affected, creating a major health problem worldwide. Without further understanding into the causes and risk factors of dementia the number of cases will continue to expand and put increasing strain on both the National Health Service as well as families and carers nationwide. Herbert et al. (2001) estimate that by 2050, the incidence rate of dementia will double; this has prompted a increasing interest to identify risk factors and to discover means by which dementia may be prevented or delayed. Management of this irreversible condition is currently limited to relief of symptoms and the slowing of its progressive nature through hormone replacement therapy, blood pressure management, and the use of non-steroidal anti-inflammatory drugs (Scharf et al., 1999). As of yet little is being done in terms of preventative strategies. Although age is widely acknowledged as the most prominent risk factor for dementia this is clearly not a modifiable risk, numerous other factors have, however been identified as contributory to the disease (Sirven & Malamut, 2008).

Currently the Department of health (2001) estimate that roughly 600,000 people in the UK have dementia and that based on figures from 1993, this amounts to a £1 billion cost to the NHS. It seems reasonable to suspect that such figures may now seem a little conservative; in view of the increasing aging population and the rise in cost of living the cost to the taxpayer may have somewhat escalated over the past few years. Within the National Service framework for older people (2001), mental health is identified as one of the eight key standards for the care for the older person. The standard aims to encourage the early detection of mental illnesses and to promote good mental health among older people. Since the publication of the NSF for older people (2001) a number of initiatives have been implemented to encourage older people to become socially included and
physically active as well as to improve general health, however as of yet a review of the effectiveness of these schemes has not been published. Although such initiatives are likely to be beneficial it is possible that they may come a little too late; evidence shows that various types of midlife activity can be protective against the onset of dementia. Medium - high levels of midlife leisure time physical activity appear to be related to a reduced risk of dementia (Rovio et al. 2005). So far research indicates cardiovascular risk factors, such as blood pressure, cholesterol, smoking and diabetes also prove to have a significant impact upon the onset of dementia. Strong inverse links have also been shown between the level of education a person attains and their risk of developing dementia (Sirven & Malamut, 2008). Furthermore continuation of cognitive activities and intellectually stimulating tasks throughout life are thought to provide a valuable cognitive reserve, which may serve to protect against cognitive decline. For many people a large proportion of time is spent in work and thus a vast proportion of cognitive activities and tasks are likely to relate to their occupation. For this reason it seems logical to further investigate the effects of occupation on the development of dementia in later life. This dissertation will investigate the relationship between occupation and dementia. For those more at risk of dementia health promotion campaigns and initiatives can be developed to specifically target these groups and awareness can be raised of the factors that contribute to the development of the disease.

1.2 Background

Reviews conducted by Verghese et al. (2003) and Wilson et al. (2002) examined the effects of continued cognitive activities throughout life on the risk of dementia; both concluded that cognitive activity reduces the risk of developing dementia. Stern (2002) suggests that such cognitive activity may provide cognitive reserve. He explains cognitive reserve as a brain’s developed ability over time to adapt an efficient use of brain networks conferring better performance in the event of brain damage.

Whalley et al. (2006) discuss the life course approach to dementia considering an accumulation of exposures throughout life to provide a combined effect on the risk of dementia. They further expand upon this to propose that certain exposures may be more influential at different points in life course. Whalley et al (2006) argue the point that exposures are not necessarily independent, with one factor influencing another. In terms of occupation it is difficult to disentangle the effects of education and childhood mental ability on occupational attainment and
therefore more difficult to assess occupation as an independent exposure. In the same way it seems important not to overlook the influence occupation has on subjecting people to other exposures. For those in occupations such as telephone line engineers, radio operators and utility workers, aside from the influence of physical and cognitive demand of the job, high exposure to electromagnetic fields may also be contributory in their risk of dementia. Sobel et al. (1995) found high exposure to electromagnetic (EM) fields to be associated with increased dementia; some evidence suggests this is linked to an inflammatory response of nerves to the EM field. Sobel et al. (1995) point out, a job title may be deceptive; the tasks entailed in an occupation may not be synonymous with the expectations associated with the job title, providing potentially confounding variables.

Current research into the effect of occupation on the risk of dementia is at present limited to empirical research and as of yet no review appears to have been published. Preliminary reading suggests that certain occupations may be associated with a higher risk of dementia. In 1984 Schooler proposed that for dementia free older people, increased complexity of work and a cognitively rich environment throughout life was advantageous for the maintenance of subsequent mental function. It therefore seems reasonable to conceive similar conclusions may be drawn for dementia; for individuals who have participated in higher levels of cognitive activity dementia may be delayed or prevented.

1.3 Research question

The research question is therefore:

**To what extent is occupation of influence in the development of dementia?**

**Definition of terms**

Occupation refers to a person’s work or job and the principal means by which money is earned. In this review it is the nature and demands of the occupation that are of interest.

This study aims to look at dementia broadly and does not seek to focus on one type of dementia. From initial literature scoping there does not appear to be a sufficient number of studies on any specific dementia for a review to be carried out on the effect of occupation on any one type of dementia. To clarify, the use of the term ‘influence’ refers to an aim to determine any potential positive or
negative effects an occupation or type of occupation may confer on a person developing dementia

1.4 Hypothesis

Initial reading suggests that increased leisure time physical and cognitive activity confers a protective advantage in preventing or delaying the onset of dementia (Rovio et al. 2005, Verghese et al. 2003, Wilson et al. 2002). In addition to this higher educational attainment has also been implicated as beneficial (Sirven & Malamut, 2008). It therefore seems reasonable to suppose that for occupations in which physical, cognitive and educational tasks are involved the onset of dementia may be delayed. Neural pathways are more likely to continue to be created and existing ones maintained, leaving a person with better cognitive reserve.

Thus the following directional hypothesis is proposed:

The onset of dementia is more likely to be reduced or delayed in persons with occupations that are cognitively and educationally demanding.

1.5 Aims

The aim of this review is to establish the effect occupation has on the risk of developing dementia.

This area of research is of relevance to recent and ongoing health priorities as indicated in the NSF for Older People (2001). With an aging population and dementia typically a disease of old age (Jellinger et al, 2002) research into risk factors for dementia is of increasing concern. Current research indicates links between a number of lifestyle factors and dementia (Nelson et al, 2004) With occupation forming such a large proportion of a persons life it seems logical to consider the effects of occupation on dementia risk. Identification of occupations more at risk of dementia may allow health promoters to target high-risk populations and to promote other potentially protective health behaviours.
1.6 Objectives

The objectives of this review are:

- To determine whether a relationship is present between occupation and dementia.
- To explore factors which may explain a link if one is found
- To consider how the findings of the review might be of use to health promoters.

The next chapter presents the methodology and methods used in conducting this review.
Chapter 2: Method and Methodology

2.1 Introduction to chapter

This chapter details the methodology used and the rationale behind the use of a systematic review. This chapter also presents the searches used to find relevant papers and the methods used to appraise the papers.

2.2 Methodology

The methodology employed to consider the effect of occupation on the development of dementia is a systematic review; there is as yet no published systematic review on the topic and thus no apparent overview of available evidence on the effect of occupation on dementia.

Health care is not an exact science and remains based on probabilities (Friedland, 1998). Potential outcomes may be theorised on the basis of previous experience and knowledge; hence the emergence of evidence based practice. Systematic reviews assemble the evidence base, summarising and drawing together smaller studies to find an answer to a clear question (CRAG, 1996). This is required for informed practice. Systematic reviews can therefore be viewed as a valuable foundation for evidence based practice (Freeman et al, 2006).

As defined by Mulrow (1987):
"Systematic reviews are concise summaries of the best available evidence that address sharply defined clinical questions" (Mulrow, 1987 p486)

The concise nature, whilst useful in summarising evidence may be criticised as reductionist and over generalising. Systematic reviews can be a necessary tool and useful indicator for health professionals, researchers and policy makers (Oxman et al 2009); assimilation of large quantities of information allows a comparison of the results of different studies and provides a basis to assess the generalisability of the findings. However, with results being compiled from a range of different studies the succinctness of a review may overlook the specific relevance of a study and therefore make it difficult to apply to practice (Greenhalgh, 1997).
Whilst this type of review aims to remain objective in selection of research, without clearly defined parameters for inclusion and rejection of material there remains the potential for bias (Oxman, 1995). A lack of critical appraisal and an over weighting of the less robust studies can result in misrepresentation and the drawing of skewed conclusions (Hill & Spittlehouse, 2009). It is therefore important to have a clearly defined question, explicit inclusion criteria and appropriate method for determining the weighting of the contribution of studies. Moreover, a high-quality systematic review should be replicable, (Sayers, 2007), without these characteristics the reproducibility of the review is diminished.

Regarding this topic area a systematic review seems a relevant methodology to determine the influence of occupation on dementia onset with a range of evidence included in forming any conclusions. The use of a systematic review can also help identify gaps in the research on this topic area and perhaps prompt further research.

2.3 Method

To examine the research question and hypothesis as stated on page 5, careful selection of appropriate and relevant literature was required. The search strategy and search terms needed to be suitably explicit for research to be relevant, yet not overly limiting so that relevant studies might be excluded due to restrictive search terms. Furthermore, creating clearly defined inclusion criteria reduced the potential for bias.

2.3.1 Search Terms

Literature scoping allowed search terms to be refined. Literature scoping allows the reviewer to get a feel for the literature and become familiar with the key works associated with the subject area (Griffiths, 2009). For this review searches were carried out to find research relating to risk factors for dementia. Searching for ‘dementia’ found a number of references to subtypes of dementia, with most actually containing the word ‘dementia’ in their description. As a result Alzheimer disease, a type of dementia, was often not found in searches using the search term ‘dementia’. Searches were therefore broadened to include both search terms. This produced a greater number of results. It was decided both search terms should be used for the final searches.
The key words entered in searches were:

**Search concept 1- Alzheimer disease OR Dementia**

**AND**

**Search concept 2- Occupation OR Work OR Job**

These search terms were entered into MEDLINE, CINAHL, WileyInterscience, PsycINFO, EMBASE, ASSIA Swetswise, ScienceDirect, PubMed and the Cochrane Control Trial Register to obtain relevant published literature. Relevant unpublished literature was searched for using the same search terms in The Networked Digital Library of Theses and Dissertations (NDLTD), Proquest Dissertations and Theses as well as the eDissertation facility of the University of Nottingham library however no relevant unpublished studies were found. Searching for relevant studies took place in July 2009, research published after this time was therefore not included in the review. The chosen databases were selected to provide a comprehensive view of the research, with a range of the key psychology, medical and social science databases being used. Articles found using the stated search terms were further selected for inclusion based on the following criteria.

### 2.3.2 Inclusion Criteria

Inclusion and exclusion criteria aimed to be explicit, minimising the potential for bias.

**Studies**

All types of empirical research published in the English language were considered for inclusion in the review (Pearson et al, 2005). Constraints on the language of publication were required based on the need to suitably understand and interpret the information in the articles. The inclusion of articles published in a language other than English would present not only the problem of the initial searching for article, but also the employment of a translator.

**Participants**

Participants of interest were those aged 60 and over. The minimum age of participants chosen for inclusion was selected because literature scoping showed that studies tend to be longitudinal. The potential effects of occupation on dementia is a relatively recent concept, therefore younger participants would not
yet be included in published research and would not yet have reached the age range associated with the onset of dementia.

Intervention
The intervention in each study was the nature of the participants’ occupation.

Outcome
The outcome assessed was the presence or absence of dementia in participants as determined through a clinical diagnosis of dementia using the Diagnostic and Statistical Manual III –R (American Psychiatric Association, 1987), National Institute of Neurological and Communicative Disorders and Stroke (NINCDS) guidelines (McKhann et al 1984), or through the use of a post mortem examination. The choice of a clinical diagnosis of dementia as the outcome is not only definitive but also follows a fairly standardised and evidence based criterion for diagnosis.

2.3.3 Exclusion Criteria

Occupation not independently assessed
For studies in which the effect of occupation on dementia is looked at in conjunction with other variables, such as education, and the effects of occupation cannot be isolated; in such cases occupation could not be independently assessed and such studies were not suitable to contribute to creating an overall synthesis.

Specific environmental exposures
Studies that looked specifically at the exposure of participants through occupation to environmental hazards were not included. For example occupations that expose a person to electromagnetic fields have been found to precipitate a higher risk of dementia owing to the inflammatory response (Sobel et al 1995) – inclusion of such studies would have altered the focus of the review and skewed the results; such a topic would be more suited to a review in its own right.
To allow winnowing out of the literature, relevant articles were selected in the following way:

<table>
<thead>
<tr>
<th>Keyword search</th>
<th>Keyword search terms were used to find potentially relevant literature in databases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>The titles of studies were read; many studies could be considered irrelevant based simply on the title.</td>
</tr>
<tr>
<td>Abstract</td>
<td>Next the abstracts of potentially relevant articles were read to further assess whether they might be included in the review.</td>
</tr>
<tr>
<td>Full text</td>
<td>Of the remaining articles a final decision of whether a study was suitable for inclusion could be made after reading the full text.</td>
</tr>
</tbody>
</table>

![Selection process](image)

**2.3.4 Data Extraction**

A data extraction form was used to help summarise data into a standard form and to make analysis of this data more straightforward.

The following key points were extracted from all studies:

- **Participants**
  The number included in the study and any specific relevant information about the participants selected. For case control studies further detail regarding the control groups was noted.

- **Intervention**
  A description of how the input variable of occupation was recorded.

- **Outcome**
  How each study assessed the outcome – for many studies in the review this may be a clinical diagnosis of dementia.

- **Results**
  What the study found

- **Conclusions**
  What may be concluded from the findings.

- **Criticisms**
  Criticisms of each study were also included in the data extraction form along with a numeric score derived from the CASP Critical Appraisal Tools (CASP 2004, CASP 2006)- with the methodology specific appraisal tool (appendix 1-2). Scores were
awarded based on the questions of the appraisal tool; a positive answer scored one point and a negative or ambivalent answer scored zero. A higher score was therefore indicative of a better quality of study. Critical appraisal using an appropriate standardised appraisal tool allowed the quality and weighting of studies included in the review to be assessed. The quality and weighting of each study will be considered when drawing conclusions.

*Examples of the data extraction forms can be found in appendix 4*

### 2.3.5 Data Analysis and Synthesis

Owing to diversity and complexity of the studies formal pooling of quantitative results was inappropriate. Whilst similarities occurred between each study, there was no standard or definitive means of measuring occupation, results were not directly comparable, and statistical analysis was not suitable. A narrative approach was therefore taken in analysing the results of the studies. The use of a textual approach allows an overall assessment to be made yet also allows in-depth analysis of relationships both within and between studies (Popay 2006).

The narrative synthesis was formed using the suggested framework for narrative synthesis as proposed by the Economic, Social and Research Council (ESRC) in their research methods programme (Popay et al, 2006):

- An initial theory was formed as to if and how occupation affects the development and onset of dementia.

- A preliminary synthesis was formed based on the findings of included studies. A textual description of each study was systematically formed,

- The relationships within and between studies were explored and analysed. Results of studies were tabulated and grouped to allow comparison of findings. Studies were grouped according to study design; cohort studies formed one group and case control formed the other. Thematic analysis was used to explore common and recurrent outcomes.

- The robustness and transparency of the synthesis was explored through the discussion of the critical appraisal of studies involved and through reflection on the synthesis process.
2.4 Chapter Summary

This chapter has addressed the methodology and methods employed to answer the research question ‘To what extent is occupation of influence in the development of dementia?’ The results of searching and details of the studies found will be displayed in the next chapter.

Chapter 3: Results

3.1 Results

The aim of this chapter is to present the key aspects of the studies included in the review. The question underpinning this review will be addressed: 'To what extent is occupation of influence in the development of dementia?'

This chapter details the search for literature to be included in the review, provides description and critique of each study and includes tabulation of the main results and characteristics of each study.
3.2 Literature searching

Identification of literature occurred in four stages:

1) Searching using the search terms as stated on page 9
2) Assessing relevance based on the title
3) Further assessing relevance based on the abstract
4) Confirming relevance based on the full text

The results of this process for each database are displayed overleaf.

Both the CINHAL and Cochrane databases yielded no relevant studies; flow charts illustrating the search process for these databases are therefore not presented.
Figure 2: Flow chart for papers found using ASSIA
Figure 3: Flow chart for papers found using Embase
Figure 4: Flow chart for papers found using Medline

Number of articles found using search terms: 197

Reviewed title

Number excluded 101
( Did not meet inclusion criteria)

Reviewed abstract

Number excluded 4

Number Kept 15

Reviewed full text

Number excluded 4

Number Kept 12

Number Kept 8
Figure 5: Flow chart for papers found using Psych Info
Figure 6: Flow chart for papers found using PubMed
Figure 7: Flow chart for papers found using Science Direct
Figure 8: Flow chart for papers found using Swetswise
Figure 9: Flow chart for papers found using Wiley InterScience

Number of articles found using search terms: 3467

Reviewed title

Reviewed abstract

Reviewed full text

Number excluded: 3464

Number Kept: 3

(Did not meet inclusion criteria)

Number excluded: 0

Number Kept: 3

Number excluded: 1

Number Kept: 2
Below is a summary table of the search process. Journal articles found to be relevant following further selection are listed by main author name and publication year for each database:

<table>
<thead>
<tr>
<th>Database</th>
<th>Med-line</th>
<th>Embase</th>
<th>CIN-</th>
<th>Psych</th>
<th>Wiley</th>
<th>ASSIA</th>
<th>Cochrane</th>
<th>Science</th>
<th>Swets</th>
<th>Wise</th>
<th>Pub Med</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of studies found</td>
<td>197</td>
<td>306</td>
<td>0</td>
<td>100</td>
<td>3467</td>
<td>284</td>
<td>0</td>
<td>418</td>
<td>27</td>
<td>251</td>
<td></td>
</tr>
</tbody>
</table>

Number relevant on reading:

- Titles | 16 | 14 | 0 | 4 | 3 | 1 | 0 | 1 | 5 | 16 |
- Abstract | 12 | 10 | 0 | 1 | 3 | 1 | 0 | 1 | 3 | 12 |
- Full text | 8  | 7  | 0 | 1 | 2 | 1 | 0 | 1 | 3 | 10 |

Relevant Studies:
- Andel et al 2005
- Kröger et al 2002
- Kröger et al 2002
- Karp et al 2004
- Qiu et al 2003
- Callahan et al 1996
- Stern et al 1994
- Helmer et al 2001
- Jorm et al 1998
- Jorm et al 1998
- Jorm et al 1998
- Stern et al 1994
- Lupton et al 2009
- Helmer et al 2001
- Callahan et al 1996
- Jorm et al 1998
- Stern et al 1994
- Lupton et al 2009
- Evans et al 1997

Table 1: Search results
After searching the databases 12 studies were found to be relevant to this review. Some of the studies appeared more than once across the different databases and are thus included only once.

The studies used in the review were as follows:

1. Andel et al 2005  
2. Munoz et al 2000  
3. Potter et al 2007  
4. Callahan et al 1996  
5. Evans et al 1997  
6. Helmer et al 2001  
7. Jorm et al 1998  
8. Karp et al 2004  
10. Lupton et al 2009  
11. Qiu et al 2003  
12. Stern et al 1994

A table of studies excluded on reading the abstract or full text can be found in appendix 3, reasons for exclusion are listed.

3.3 Data extraction

It is possible to group studies found to be relevant to the literature review based on study design, with studies being either case control or cohort design. For the purposes of analysis studies will be grouped according to their design.

The following are case control studies:
1. Andel et al 2005  
2. Munoz et al 2000  
3. Potter et al 2007

The following are cohort studies:
1. Callahan et al 1996  
2. Evans et al 1997  
3. Helmer et al 2001  
4. Jorm et al 1998  
5. Karp et al 2004  
6. Kröger et al 2002  
7. Lupton et al 2009  
8. Qiu et al 2003  
3.4 Study Summaries

Over the next few pages narrative summaries are provided of each of the studies in turn. A summary table of all the studies can be found in appendix 5.

3.4.1 Case control studies


Andel et al (2005) aimed to examine the association between risk of dementia and complexity of occupation. They conducted a case control study involving 10,079 participants; of these 5244 were twins (2622 pairs) and 4835 were individual participants. Twin participants were derived from The Swedish Twin Registry, which listed all twins residing in Sweden. Same sex twin pairs were identified and those over the age of 65 were mailed questionnaires, non-responders were sent a second questionnaire. For those who responded, preliminary cognitive assessments were carried out over the phone. Pairs in which one or both twins presented with possible cognitive impairment were asked to attend a follow up in person to allow assessment for dementia to be carried out. Clinical diagnoses were made using DSM IV (American Psychiatric Association, 1994). Of the twins, 55 were identified as discordant for dementia.

Information regarding participants occupation was gathered using the question ‘What occupation did you have during the major part of your life?’. This information was obtained at the screening stage during telephone interviews. To minimise the risk of recall bias participants’ main lifetime occupation was confirmed by an informant, where this was not possible participants were excluded from the study. Occupation was then categorised by two independent raters using census categories. Initial agreement of the raters was 90%, where differences in coding occurred discussion between raters was carried out and a consensus reached. Occupation complexity scores were applied, using the Roos and Treiman (1980) scoring system. Scores were based on complexity of work with people, complexity of work with data and complexity of work with things with the score ranges 0-8, 0-6 and 0-7 respectively. Within the study the mean complexity of work with people was 6.3 (±2.0), work with data 3.0 (±1.6) and work with things 4.1 (±2.2).

Age, gender and educational attainment are all of impact in dementia risk (Zhang, 1990), statistical adjustments were therefore made to allow for these
factors. Within the case control groups after adjustment higher complexity of work was found at a 95% confidence interval to be protective against dementia, the odds ratio was calculated to be 0.84. The relationship between complexity of work with people and Alzheimer’s specifically, was found to be stronger with an odds ratio of 0.74 at a 95% confidence interval. Complexity of work with data and things was not found to have any statistically significant effect on the risk of dementia.

Within the co-twin controls the relationship was even stronger; amongst monozygotic and dizygotic twins at a 95% confidence interval the odds ratio was 0.44, amongst monozygotic twins alone the odds ratio was 0.27, providing strong support for the protective effects of higher complexity of work with people. Analysis also showed significant results for twins discordant for complexity of work with data with the odds ratio calculated as 0.77 at a 95% confidence interval, although not as significant as the effects of complexity of work with people the odds ratio does indicate a reduced risk of dementia for those with higher complexity of work with data.

The study by Andel et al (2005) was the first study of the effects of occupational complexity on dementia to use case control and co-twin design simultaneously. The design confers greater weight to the findings of the study. The use of twins reduces the confounding effects of genetic and familial factors on the development of dementia, providing further support for occupation being a risk factor in its own right. The findings of the study are supported by the ‘use it or lose it’ hypothesis, proposed by Katzman (1995) which suggests that cognitive exercise promotes and maintains brain function for later life. It seems important to note however that the findings of the study implicate social interaction, through complexity of work with people, as the main factor of influence in reducing the risk of dementia. In his seminal paper Sullivan (1953) points out that humans are social beings, and meaningful relationships and social validation are important factors in psychological well being. This is a point that has since been reiterated by many sociologists (Charon, 2009). With most people spending a vast proportion of their time in work such relationships may be of particular importance. It therefore seems reasonable to suggest that it may be more the impact of social interaction on dementia than specifically the complexity of an occupation that is of effect on subsequent risk of dementia. Critical appraisal of the study using CASP (2006) case control critical appraisal tool found the study to score well in all areas; a score of 11/11 was awarded.

Munoz et al (2000) aimed to determine whether patients with dementia have different socio-economic and occupational backgrounds compared with patients without dementia. The study was of case control design. Participants with dementia were derived from a cohort involved in the Ontario Dementia Study and controls obtained from University Hospital, Ontario. For both cases and controls diagnosis of dementia was confirmed post mortem and details of occupation during life obtained from reports from relatives. In total 257 participants were included in the study, 115 with dementia 142 without.

All autopsies were carried out within University Hospital, Ontario. Information on occupational status was gathered post mortem from relatives of the deceased. Participation was voluntary however nobody declined to participate in the study. Occupation was recorded as high, medium or low income and was also classified according to the Canadian census categories of 1981 from which a socio-economic status score was derived. Details of education level were also recorded to allow adjustment. Statistical analysis using logistic regression showed differences in level of socio-economic status were insignificant upon risk of dementia. It is worthy of note however that the dementia groups were 2.4 times more likely to be of a low-income occupation, with 15.6% of the dementia group of low income and 6.4% of the controls in the same income band.

Although the study concludes that no relationship can be determined between socio-economic status and risk of dementia, a trend, if statistically insignificant, can be observed. It would be interesting to see whether the results of a similar study with larger sample sizes might be more conclusive. The study scored highly in terms of critical appraisal, with high validity as well as careful consideration and adjustment for extraneous variables. The grouping of occupations was however somewhat reductionist, with socio-economic status being a poor measure of the level of skill a job entails. Estimations of socio economic status are typically formed from a culmination of factors, including education, job skill, wealth, income and family background. As socio-economic status is estimated from a so many factors, its use to determine occupational complexity may be inaccurate (Kraus & Keltner, 2008). The study by Munoz et al (2000) scored
highly in terms of critical appraisal with 10/11 on the CASP (2006) case control critical appraisal tool. However the potential for confounding variables remained an issue with reports for occupation obtained second hand, from relatives and friends.

Potter et al (2007)

Potter et al aimed to discover to what extent job characteristics may be of influence on the risk of dementia. This was examined using a case control study design in which both individuals and co-twin participants were included. Participants included in the study were comprised of 220 twin, male World War Two Veterans as well as 6075 individual participants. Twin participants were enrolled in an existing study looking at memory and aging, and all were members of the National Academy of Sciences- National Research Council. Occupational history was obtained via the telephone, usually from the participant, however a proxy was used if the participant was unable to take part in the interview. The published study does however not state how or from where case control participants were recruited. The case controls underwent the same interview process as the twin participants. Occupational history was recorded according to the 'Dictionary of Occupational Titles’ (United States Employment Service, 1991) then further assessed on complexity. Complexity was measured in terms of work with: data, people, things, mathematics, language, reasoning, vocational preparation and strength being assessed. Scoring of complexity of work with people, things and data was, as in Andel et al’s study, (2000) scored out of 8, 7 and 6 respectively. The lower the score the less complex the work. Mathematics and reasoning were both scored out of 6, language scored out of 5. Vocation preparation referred to the number of years of training required to carry out a job. Strength addressed how physically demanding a job was on a scale of 1 to 5.

Participants were required to complete cognitive assessments every three to four years. This was done using a modified telephone interview for cognitive status (Welsh et al 1993). Participants who attained low cognitive assessment scores required a proxy to complete a dementia questionnaire (Silverman et al, 1989). Questionnaires that indicated possible dementia led to an at home follow up from a geropsychiatrist. Dementia was then diagnosed using DSM III guidelines (American Psychiatric Association, 1987).

Results for the case control part of the study showed that participants without dementia had significantly higher scores for occupation complexity than their
counterparts with dementia. Further statistical analysis showed that work with data, maths and level of vocational training were statistically significant with a confidence interval of 95%. For maths and vocational training a hazards ratio (HR) of less than one indicated decreased dementia; the hazard ratio for vocational training was 0.908 and for maths 0.882. Owing to the way in which occupation complexity with data was recorded a hazard ratio above 1 indicated decreased dementia risk; the hazard ratio for data was 1.115. Analysis of the results for the co-twin part of the study showed further statistically significant relationships. Higher complexity of work with data (HR 1.41), reasoning (HR 0.632), maths (HR 0.631), language (HR 0.599) and vocational training (HR 0.625) were all found to be statistically significant decreasing dementia hazard within the co-twin analyses.

Potter et al (2007) concluded that higher complexity of specific job characteristics might be of influence on a person’s risk of developing dementia. Higher complexity of work with data, maths and vocational training was consistently advantageous, reducing dementia hazard in both the co-twin and the case control analyses. The fact that a statistically significant relationship in co-twin analyses exists provides strong support for the influence of occupation on dementia.

Critical appraisal of the study using the CASP (2006) critical appraisal tool for case control studies indicates that the study had high validity. Scoring of the study resulting in 9/11. The published article failed to explain where case control participants were derived from and how they were selected. For the twin participants, although the methods of recruitment and selection are explicit twins were derived from a scientific council. The recruitment of participants from the National Academy of Sciences- National Research Council reduces the variance of participants and may skew data. Members of a scientific council are likely to be well educated and keen to maintain cognitive activity. This is not likely to be representative of the general population, thus the external validity of the study is reduced.

A summary table of the case control studies can be found overleaf.
<table>
<thead>
<tr>
<th>Study main author</th>
<th>Description</th>
<th>Number of participants</th>
<th>Mean age in years</th>
<th>Results</th>
<th>Conclusions</th>
<th>Critique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andel 2005</td>
<td>Occupation measured as complexity of work with data, people and things; DSM III-R for diagnosis</td>
<td>10079 total: 4555 individuals 2522 twins</td>
<td>79.1</td>
<td>95%</td>
<td>Case controls: OR 0.74 (people)</td>
<td>Greater complexity of work reduces the risk of dementia</td>
</tr>
<tr>
<td>Munoz 2000</td>
<td>Occupation classified as skilled, semiskilled or unskilled; Diagnosis confirmed in autopsy</td>
<td>257 total 115 dementia, 142 dementia free</td>
<td>76.6</td>
<td>95%</td>
<td>-</td>
<td>Dementia 2.4 times more likely to have low income occupation, statistically insignificant</td>
</tr>
<tr>
<td>Potter 2007</td>
<td>Occupation complexity measure in terms of work with: people, things, language, reasoning, vocational training and strength; DSM III-R for diagnosis</td>
<td>6075 total: 226 male twins, 5055 individuals</td>
<td>77.1</td>
<td>95%</td>
<td>Case control: SVF - 0.908, Maths - 0.882, Date - 1.115</td>
<td>Occupations with increased complexity confer a reduced risk of dementia</td>
</tr>
</tbody>
</table>

Table 2 Case Control Study Summaries

CI = confidence interval; OR = odds ratio, HR = hazard ratio. Other = other method of assessment.
3.4.2 Cohort studies

Callahan et al (1996) aimed to explore the relationship between occupation and dementia among African Americans. Their study was of cohort design and involved 351 participants from Indianapolis. Interviewers visited 60% of residential addresses within the city. The inclusion criteria required participants to be over the age of 65 and to be of African American descent. In homes where residents were eligible and willing to participate in the study the interviewer carried out a Community Screening Instrument for Dementia. This screening tool was developed by researchers for this study and is made up of aspects of a number of evidence based screening and assessment tools. Callahan et al (1996) report sensitivity of the test as 87% and the specificity 83%. Participants with a cognitive deficit were further examined and a diagnosis of dementia was ascertained, for some participants this was made using DSM III guidelines (American Psychiatric Association, 1987), for others NINCDS guidelines were used (McKhann et al 1984)

Primary lifetime occupation was recorded and then coded into one of 12 categories: professional, sales, clerical, domestic, protective, service, farming, repair, production, labour, transport or none. Results were analysed using logistic regression, however as nothing could be concluded from this the researchers reclassified occupation. The new categories for occupation were low or high occupational attainment. Despite the reclassification of occupation no conclusion was reached with regard to the effects of occupation on dementia. The only stated conclusion was that age is a risk factor for dementia.

Critical appraisal of the study using the CASP (2004) critical appraisal tool for cohort studies showed the study lacked validity on a number of points and scored just 4/12. Overall the study seemed disorganised, somewhat distracted and uncertain of its finding. The study failed to identify confounding factors, this meant no adjustments were made and suggests such factors were not considered. The reclassification of occupation, with no real explanation, increases the classification and measurement bias; the study no longer measures what it intended to and suggests the study seeks a relationship that may well be absent in the study population. Not all participants received the same follow up and there is no indication of timescale. Follow-ups appear haphazard with no pattern
to the follow up received. Another point worthy of note is the wider context of participants involved. The participants involved in the study would have been born and brought up in a time of great civil unrest, social upheaval and discrimination for the African American population. Traumatic experiences are frequently documented as having an effect on mental health. As Cook et al (2003) point out such trauma may well be of impact on cognitive decline and dementia in later life.

Evans et al 1997

Evans et al (1997) aimed to assess the relation of occupational prestige and income on the risk of Alzheimer’s disease. They carried out a cohort study, which followed participants over the age of 65 for an average of 4.3 years. In total 642 participants were included in the final study. Participants included in the study were derived from a stratified random sample community resident in the East Boston area. All participants were from a working class urban area and were free of dementia at baseline. At stage one of the study 3623 participants were interviewed in their own home and received brief cognitive function tests. Of these, 2313 were found to be dementia free. Of the remaining 2313 a stratified random sample of 642 participants was included in the study.

Occupation was recorded as a prestige score, the higher the score the more prestigious the job was considered. Jobs further up the scale are claimed to be fewer in number, more prized, require greater skill and are harder to get (Hauser & Featherman, 1977). Each of the remaining 642 participants was asked to complete a number of questionnaires. These assessed memory, visual retention, visuospatial ability and use of geometric figures. Participants were then further assessed according to NINCDS guidelines (McKhann et al 1984) to confirm the presence or absence of Alzheimer’s disease.

Of those with dementia 68% were of lower occupational prestige (less than 12). After adjustment, logistic regression analysis for risk of Alzheimer’s disease in relation to occupational prestige shows the odds ratio to be 0.97 and for income 0.79. This indicates a link between socio-economic status and dementia risk, with those of low prestige being at higher risk.
Independently occupational prestige and income were of statistical significance, however combined results were more prominent. Evans et al (1997) therefore conclude that low socio-economic status is a strong risk factor in the development of dementia.

In the study many of the participants did not speak English, this could result in misinterpretation and skew results. Efforts were apparent to make questionnaires accessible by getting them translated into the appropriate language but there does remain the possibility of subtleties becoming lost in translation. All participants were from a working class urban area- providing little variation within in the study population. This may reduce the external validity of the study and the extent to which findings may be extended beyond the confines of the study population. Critical appraisal of the study using the CASP (2004) critical appraisal tool for cohort studies flagged up a number of issues with the study; measurement of occupational prestige appeared a little subjective, the rationale behind allocation of scores was not made clear. Whilst reference to confounding factors was made, and adjustments made the study does not state precisely what was adjusted for. The results do however fit in with existing evidence and the study remains focused on answering the research question. Overall the study achieved a score of 8/12.

Helmer et al 2001

Helmer et al (2001) aimed to determine whether principal lifetime occupation was a risk factor for dementia. Participants were derived from the PAQUID cohort. PAQUID was an epidemiological study set up to determine causes and risk factors for dementia. Participants of PAQUID formed a representative sample of people over the age of 65 living in their own homes in Gironde and Dordogne. Participants in Helmer at al’s (2001) study were required to be dementia free at the initial interview. Of the PAQUID cohort 2950 participants were eligible and willing to be included in the study.

Psychologists interviewed participants in their own home on six occasions, first for the initial interview then 1, 3, 5, 8 and 10 years subsequently. In each interview sociodemographic factors were recorded, psychometric tests carried out and cognitive ability assessed. The results of the first interview were taken as baseline results. In each successive interview participants were subject to the same tests to allow their condition to be tracked. Main lifetime occupation was recorded in
the first interview. Occupation was then classified into one of seven categories: housewives and inactives, farmers, blue-collar workers, white-collar workers, domestic occupations, craftsmen and professionals. Participants who, on interview presented with memory impairment, cognitive impairment and interference in social life were referred for further assessment by neurologists. Neurologists then carried out full assessments as per DSM III guidelines (American Psychiatric Association, 1987) to ascertain the presence or absence of dementia.

Of the 2950 participants 393 developed dementia. For analysis adjustments were made for factors such as gender, education, alcohol consumption, smoking, income, diabetes, hypertension and history of stroke. After adjustment relative risk was calculated for each occupational group; blue-collar workers and farmers were calculated as having the highest relative risk with values of 1.15 and 1.08 respectively. At 95% confidence interval results were however statistically insignificant. Helmer et al (2001) concluded that no relationship could be determined between occupation and dementia.

Critical appraisal of the study using the CASP (2004) critical appraisal tool for cohort studies highlighted a number of problems, scoring 7/12. The article fails to state exactly how the cohort was initially recruited for the PAQUID study- from which participants in Helmer et al’s study were derived. This remains somewhat ambiguous for the reader and thus cannot resolve questions of selection bias. The grouping of occupations seems somewhat reductionist and does not consider the individual characteristics of each. Adjustment for income seems strange; income serves as further descriptor of level of occupation. Adjustment for this may skew data and hide any relationships that may be present.

Jorm et al 1998

The aim of Jorm et al’s study was to assess whether occupation can be of use in predicting dementia. The study was of cohort design and used only male participants over the age of 70. A total of 518 Participants were selected from both the electoral register for Canberra and Queanbeyan and from a census of residential care homes in the area.
Participants were required to complete two interviews. In the first interview
dementia status was determined using DSM III guidelines (American Psychiatric
Association, 1987) and main lifetime occupation recorded. Occupation was then
coded into one of 6 occupational categories: artistic, conventional, enterprising,
investigative, realistic, social or none. The categories used originate from the
John Holland occupation categories (Holland, 1996) that aim to describe
personality and work environment types. In the second and final interview
dementia status was rechecked, the average follow up period was 3.6 years.

The highest incidence of dementia was in the realistic group. Occupations in this
group typically involved physical labour and work with machines. This was also
the group with the highest number of people. Hierarchical multiple regression was
carried out to allow adjustment for age, education and first language. After
adjustments realistic occupations remained the highest risk group for dementia.

Jorm et al (1998) concluded that realistic occupations, namely manual, trade and
technical were at highest risk of dementia. It is however suggested that it is not
the rate of cognitive decline that is affected by occupation. The rate of cognitive
decline is suggested to be similar across the different professions. Jorm et al
(1998) suggest that the cognitive starting point is made higher by having a more
cognitive and intellectually demanding job. For those with higher baseline
cognitive ability the level of reduced cognitive ability associated with dementia is
not reached until later. Clinical presentation of dementia is therefore delayed.

Critical appraisal of Jorm et al’s study (1998) left it well considered scoring 10/12.
The findings tie in with brain reserve theory as suggested by Katzman et al
(1988) Katzman suggests that a stimulated brain can more easily adapt an
efficient use of brain networks conferring better performance in the event of brain
damage. If damage occurs in a brain with high cognitive reserve neural networks
otherwise not engaged in an undamaged brain may come into play and help allow
normal functioning to continue (Stern, 2002). The study does however not
mention the confidence interval used to ascertain statistical significance. This
omission seems strange, as it does not allow the reader to judge the level of
confidence with which results are deemed significant. Also the follow up, at an
average 3.6 years is fairly short participants are however older at baseline than in
many other studies. Thus the use of a short follow up interval is of less concern
than if participants were younger at baseline. Dementia is a disease associated
with age (Jellinger et al, 2002), had younger participants been used dementia
may not yet have developed.
Karp et al (2004) aimed to evaluate the relationship between socio-economic status and risk of Alzheimer’s disease. Their study involved a cohort of 931 participants recruited from Stockholm. Participant were derived from the Kungsholmen project, a community based longitudinal study of aging and dementia. Both male and female participants were used in the study and all were over the age of 75.

At baseline participants were required to complete psychometric tests to screen for dementia. Those who screened positive for possible dementia were then subject to clinical examination as per DSM III guidelines (American Psychiatric Association, 1987) to determine dementia status. At this stage participants were also assessed in terms of socio-economic status. Relatives of participants were interviewed and participants’ lifetime work history recorded. Socio-economic status was assessed in three ways: main occupation socio-economic status, lifetime socio-economic status and socio-economic mobility. To assess main occupation socio-economic status occupations were grouped according to the Statistics Sweden’s socio-economic classification system (Statistics Sweden, 1982). For participants who were homemakers for the longest period in their occupation history their second longest held occupation was used to assess socio-economic status. Homemakers with no other occupational history were excluded from the study. To assess lifetime socio-economic status a weighted average of all occupations was calculated. Socio-economic mobility was assessed by tracking and measuring differences in participant’s socio-economic status at ages 20, 40 and 60.

Participants were required to attend a second interview an average of 3 years later. In this interview psychometric screening was again carried out. As in the first interview, those who scored positively for dementia in the screening process received further clinical assessment using DSM III guidelines (American Psychiatric Association, 1987) to determine the presence or absence of dementia.

Of the 931 participants in the study, 101 developed dementia. 49% of those who developed dementia were considered to be of low socio-economic status. Logistic regression was used to evaluate differences in baseline characteristics. Cox proportional hazard regression was used to analyse relative risk. After adjustment the relative risk of dementia with high socio-economic status was 1, and for low socio-economic status 1.5. Whilst low socio-economic status was marginally
associated with increased risk of dementia, Karp et al (2004) suggest that level of education was found to be of more influence in determining risk, values to confirm this are not stated in the study. The effect of socio-economic status was more pronounced in determining Alzheimer’s risk. The relative risk after adjustment for Alzheimer’s in those with low socio-economic status was 1.6. At a 95% confidence interval this relationship was found to be statistically significant. The authors therefore concluded that low socio-economic status is associated with increased risk of Alzheimer’s disease, however level of education is a greater determinant for risk for all type dementia.

On the whole this study appeared to be well designed. The study question was well focused and adjustments in statistical analysis were appropriate. Critical appraisal of the study was carried out using the CASP (2004) critical appraisal tool for cohort studies, achieving a score of 11/12. A point was dropped due to the potentially confounding effects of using homemaker’s second occupation to determine socio-economic status. For a number of participants time spent in this second occupation was short and not a clear reflection on the participant’s socio-economic status. Although the follow up interval was fairly short, at an average of 3 years, participants were considerably older than in other studies in this review. Participants in Karp et al’s study (2004) had an average age of 81.5 years, as dementia is an age related disease (Jellinger et al, 2002) the short follow up is not a major concern. The study did however have a disproportionate number of female participants, which may be of influence on the results.

Kröger et al 2008

Kröger et al (2008) aimed to evaluate the association of complexity of work with data people and things on the incidence of dementia. Their study was part of a series of studies for the Canadian Study of Health and Aging, an epidemiological study of dementia in Canada. Participants in Kröger et al’s study formed a representative sample of those involved in the Canadian Study of Health and Aging over the age 65 and from all provinces across Canada. Initially 9008 participants were selected for inclusion; at wave one on the study participants underwent dementia and cognitive impairment screening. Participants who scored positively, i.e. had a degree of cognitive impairment or suspected dementia were excluded from the study population. Participants were further excluded where no occupation history was obtained, if other risk factors were not available, if principal occupation was homemaker or if patients did not attend follow-ups. This left a final study cohort of 3557 participants.
Occupation of the longest duration was recorded according to the 1970 US census categories (Miller et al, 1980). Predetermined complexity scores for each of the US Census codes were then applied. Scores were such that a low score indicated high complexity and high scores indicated low complexity. Participants received 3 follow-ups, spanning an average 10 years. In the final interview dementia status was assessed according to DSM IV guidelines IV (American Psychiatric Association, 1994).

Of the final 3557 participants included in the study 440 developed dementia. After adjustment for all recorded confounders hazard ratios were calculated. To allow comparison the hazard ratio for low complexity was assumed to be one, and hazards ratios for intermediate and high complexity calculated accordingly. For work with data greater complexity seemed to reduce risk (Owing to the way in which occupation complexity with data was recorded a hazard ratio above 1 indicated decreased dementia risk). Intermediate complexity scored 1.14 and high complexity scored 1.77 on the hazard ratio. Work with people and things also showed statistically significant results. High complexity of work with people resulted in a hazard ratio of 0.36, and intermediate complexity of work with people 0.80. High complexity of work with things produced a hazard ratio of 0.45 and intermediate complexity resulted in a hazard ration of 0.61. Intermediate and high complexity of work with data, people and things was statistically significantly linked with reduced risk of dementia. Kröger et al (2008) therefore concluded that there was a statistically significant link between high complexity of work with data, things and people and reduced incidence of dementia. They also suggest that the duration of work is of influence on the risk of dementia.

The study was critically appraised using the CASP (2004) critical appraisal tool for cohort studies, scoring 11/12. Although the study seems well designed the published article can appear a little muddled and contradictory at times, this point is perhaps more a reflection on the editing of the article than the study design. The published article also does not include a full account of the methods used. These are however readily available online. The finding of this study support the brain reserve theory as proposed by Katzman et al (1988). In addition to analysing the statistics Kröger et al (2008) also consider changes of brain function. Participants also underwent CT scans to assess cerebral blood flow, as reduced cerebral blood flow is associated with dementia (Grubb et al, 1977). Results showed that for those with high complexity of work with things and people despite a reduced cerebral blood flow, normally associated with dementia, participants were asymptomatic. These findings provided further support for the
theory of cognitive reserve and suggest that protective effects conferred by occupational complexity may delay the clinical expression of dementia.


Lupton et al aimed to determine the effects of midlife employment on the onset of Alzheimer’s disease. This was explored using a cohort of 382 participants with possible dementia. Participants were recruited via dementia support groups, from nursing and care homes and through media advertising.

Information as to participants’ occupational history was obtained by proxy, from a relative. Occupational status was noted; this was defined as a professional, manager or worker. As a measure of responsibility notes were also made regarding the number of people the participant was responsible for whilst at work. Age of retirement was also recorded.

Each participant underwent cognitive testing and assessment for Alzheimer’s disease using NINCDS guidelines (McKhann et al 1984). The age of onset of Alzheimer’s disease was also recorded.

Results were inconclusive; no relationship emerged between job status and age of onset of Alzheimer’s disease. Similarly, no statistically significant results were reported for job status and onset of Alzheimer’s. Lupton et al (1998) therefore concluded no relationship could be determined between occupational characteristics and onset of dementia.

Critical appraisal of the study using the CASP (2004) critical appraisal tool for cohort studies highlighted a number of problems with the study. Lupton et al (1998) fail to identify explicitly how participants were recruited. There is little more than a vague mention of advertising. There is no information about the cohort other than participants have probable dementia at baseline. Confounding variables do not appear to be accounted for. There is very limited information regarding the follow-up of participants. Overall the study seems disorganised, unclear and muddled. The lack of identification of how exactly participants were recruited and the omission of any information about them leaves it near impossible to relate the findings beyond the confines of the study. The lack of external validity coupled with an apparent unawareness of internal confounding variables leaves the study by Lupton et al (1998) with a critical appraisal score of 5/12. Thus little weighting shall be given to the findings of this study.
Through the use of a cohort study Qui et al aimed to observe the effects of principal lifetime occupation on the risk of Alzheimer’s disease. Qui et al invited all inhabitants over the age of 75 in a region of Stockholm to participate in their study. 1,810 responses were received and of these 1,473 were eligible to participate in the study. All participants were required to complete two interviews, an average of 6 years apart. For the second interview 913 participants attended and thus only these were included in the final study.

Information regarding participants’ occupation was collected retrospectively from participants. Information included details of work activities, job type, employer and period of employment. Principal lifetime occupation was then coded using the Nordic Occupational Classification System (Statistics SNCBo, 1958). Data was also collected regarding participants age, gender, level of education and also any cardiovascular medical history.

All participants took part in extensive clinical evaluation and underwent psychological assessments at both the initial interview and also at the second interview an average of 6 years later. Participants were also seen by physicians to confirm the presence or absence of dementia as per DSM III guidelines (American Psychiatric Association, 1987).

Of the 913 participants 260 developed dementia, 197 of these being Alzheimer’s type. After adjustment for sociodemographic variables and past medical history relative risk was calculated at a 95% confidence interval. Relative risk of dementia with non-manual work was assumed to be 1.0, risk of manual work was calculated accordingly, with a relative risk of 1.2, indicating a higher risk of dementia with manual labour. For Alzheimer’s relative risk with non-manual work was again assumed to be 1.0, and manual work calculated at 1.2, again indicating higher risk associated with manual occupations. Further statistical analysis found these results to be statistically significant. Qui et al (2003) therefore concluded manual labour, in particular goods production to be a significant risk factor in the development of dementia.

The study by Qui et al (2003) appeared to be very well designed, results were clearly displayed and methods explicitly described. Critical appraisal using the CASP (2004) critical appraisal tool for cohort studies further confirmed the
validity of the study, scoring 12/12. The study question was clearly addressed,
confounding variables accounted for appropriately and objective measurements
were used throughout the study. The quality of design provides both high internal
and external validity and allows the findings of the study to be considered beyond
the study population.

Stern et al 1994

Stern et al aimed to discover whether low occupational attainment is a risk factor
for dementia. This was investigated through a cohort study of dementia free
individuals over the age of 60 from the community. Participants were selected
through the North Manhattan registry of those at risk of dementia, roughly 30%
of those approached participated in the study resulting in a total 593 participants.

Main lifetime occupation was noted in the initial visit and then recorded as one of
seven groups derived from the US census: student, housewife, unskilled worker,
skilled worker, clerical staff, manager or professional. Occupation was then
further classified as high or low level; with managerial, professional and skilled
workers assigned to the high level group. Information regarding age, gender and
level of education was also recorded to allow adjustment and further analysis.

Participants were required to take part in yearly evaluations in which cognitive
ability was assessed. Where cognitive deficit was noted participants underwent
further clinical assessment and a diagnosis confirmed or ruled out according to
DSM III guidelines (American Psychiatric Association, 1987). Of the 593
participants roughly half received only one follow up a year after their initial
interview. The remaining participants received up to 4 follow-ups, in which the
same cognitive measures were assessed each time.

Of the 593 participants 106 developed dementia, 71 of these had participated in
low skilled occupations. After adjustment for gender, age and education relative
risk was calculated at a confidence interval of 95%. With high-level occupations
assumed to have a relative risk of 1.0, low-level occupations were calculated to
have a relative risk of 2.25. This indicated a statistically significant high risk of
dementia associated with low-level occupations. Stern et al. (1994) therefore
concluded that low-level occupation is associated with a high risk of dementia and
also that high-level occupations are associated with low incidence of dementia.
The study was critically appraised using the CASP (2004) critical appraisal tool for cohort studies achieving a score of 9/12. For roughly half the participants follow up was just one year, this seems very short follow up, for some participants, dementia may not yet have reached the stage of clinical presentation. The length of follow up is not consistent for all participants, with length of follow up ranging from 1-4 years. The use of a registry of people at risk of dementia does not allow results to be representative of the general population. In the general population 5% of over 65s are affected by dementia, in the study 18% of participants develop dementia, the choice of participant therefore reduced external validity of the study. The grouping of occupations as high or low level is quite reductionist, and may overlook the subtleties if each occupation in the group the grouping is also somewhat subjective and serves to reduce the internal validity of the study. Compared with many other studies of similar design the study population is relatively small. The use of small sample raises concerns of whether results may be an artefact of the study, the findings are however consistent with larger studies.

A summary table of the case control studies can be found overleaf.
<table>
<thead>
<tr>
<th>Study Main Author</th>
<th>Description</th>
<th>No of cases</th>
<th>Mean age in years</th>
<th>Results</th>
<th>CI</th>
<th>OR</th>
<th>HR</th>
<th>RR</th>
<th>Other</th>
<th>Conclusions</th>
<th>Critique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Callahan 1996</td>
<td>Occupation put into 1 of 2 categories: ppts with no occupation were not included in the study. Diagnosis - DSM III</td>
<td>351</td>
<td>74</td>
<td>95%</td>
<td>White collar - 0.52</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>No conclusion stated</td>
<td>Study appears muddled. Ppts subject to civil unrest may skew data</td>
<td></td>
</tr>
<tr>
<td>Evans 1997</td>
<td>Occupation reported by participants, or careers, this was assigned a prestige score, low &lt;12, high ≥ 12 Diagnosis- NINCDS</td>
<td>642</td>
<td>76</td>
<td>95%</td>
<td>High prestige - 0.97 High income - 0.79</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>68% of those with dementia - low 065</td>
<td>Low socioeconomic status increases the risk of dementia</td>
<td>All participants urban-based variation. Many non-English speakers - misinterpretation</td>
</tr>
<tr>
<td>Heldner 2001</td>
<td>Occupation categorised into 1 of 7 groups: housewife/inactive, farmer, blue collar, other employed, craftsman, domestic, professionals. Diagnosis - DSM III</td>
<td>2950</td>
<td>74</td>
<td>95%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Blue collar-1.19 Farmers - 1.06</td>
<td>No significant effects noted</td>
<td>Occupational grouping reductionist. Potential for selection bias.</td>
</tr>
<tr>
<td>Jorms 1998</td>
<td>Occupation recorded as: artistic, conventional, entrepreneurial, investigative, realistic, social, none. DSM III-R used to diagnose</td>
<td>518</td>
<td>72.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td><em>Realistic</em> group 15% developed dementia</td>
<td>Manual occupations have an increased risk of dementia</td>
<td>Supported by brain reserve theory. CI not stated.</td>
</tr>
<tr>
<td>Keiper 2004</td>
<td>Occupation recorded as either blue collar or white collar. Diagnosis - DSM III &amp; NINCDS</td>
<td>931</td>
<td>0.16</td>
<td>95%</td>
<td>-</td>
<td>-</td>
<td>Low SES - 1.5 High SES - 1.0</td>
<td>-</td>
<td>A lower socio-economic status results in a higher risk of dementia</td>
<td>For housewives second longest occupation used - not true reflection.</td>
<td></td>
</tr>
<tr>
<td>Kröger 2004</td>
<td>Occupation complexity measured in terms of work with people, data, things. Diagnosis - DSM IV and NINCDS</td>
<td>3557</td>
<td>73.6</td>
<td>95%</td>
<td>Work with people - High 0.96 Low - 1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>The greater the complexity of work the lower the risk of dementia,</td>
<td>Full details of methods not available.</td>
<td></td>
</tr>
<tr>
<td>Lupton 2009</td>
<td>Occupation classified as skilled, semi-skilled or unskilled. Diagnosis - NINCDS</td>
<td>362</td>
<td>75.6</td>
<td>95%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Nothing found - nothing reported</td>
<td>No relationship determined</td>
<td>Low internal and external validity. Muddled throughout.</td>
</tr>
<tr>
<td>Liu 2002</td>
<td>Occupation coded using the Nordic Occupation classification system. Diagnosis - DSM III-R</td>
<td>920</td>
<td>0.3</td>
<td>95%</td>
<td>-</td>
<td>-</td>
<td>Manual 1.2 Non Manual - 1.0</td>
<td>-</td>
<td>A manual occupation is at greater risk of dementia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stein 1994</td>
<td>Occupation recorded in 1 of 7 groups: student, housewife, unskilled, skilled, clerical, manager, professional Diagnosis - DSM III-R</td>
<td>593</td>
<td>73.0</td>
<td>95%</td>
<td>-</td>
<td>-</td>
<td>High complexity 1.0 Low complexity 2.25</td>
<td>-</td>
<td>Low lifetime occupational attainment results in a higher risk of dementia.</td>
<td>Occupation groups reductionist. Participants already at risk of dementia.</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 Cohort Study Summaries

CI = confidence interval, OR = odds ratio, HR = hazard ratio, Other = other method of assessment.
3.5 Study Characteristics

3.5.1 Number of Participants

The studies varied a great deal in terms of number of participants. Typically larger studies allow greater precision and can allow more sensitive hypothesis testing. Increased accuracy can infer increased statistical power. However a small well designed study can more useful than a larger poorly designed one (Festing, 1997).

![Number of Participants](image)

Figure 10: Chart to compare the number of participants in each study

3.5.2 Study Conclusions

For each of the studies the conclusion fell into one of four categories:

1. Low complexity of work is linked with increased risk of dementia
2. High complexity of work is linked with reduced risk of dementia
3. Low complexity of work is linked with increased risk of dementia and high complexity of work is linked with reduced risk of dementia
4. No relationship determined

Below is an illustration of an overview of conclusions of all the studies:

![Study Conclusions](image)

Figure 11: Chart to illustrate an overview of the
3.5.3 Quality Assessment

Each of the studies underwent assessment using the appropriate CASP (2004, 2006) critical appraisal tool. Scores were awarded based on the questions of the appraisal tool; a positive answer scored one point and a negative or ambivalent answer scored zero. A higher score was therefore indicative of a better quality of study.

**Case Control Studies**

<table>
<thead>
<tr>
<th>Study By Author</th>
<th>Score on CASP tool</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andel et al 2005</td>
<td>11/11</td>
<td>1</td>
</tr>
<tr>
<td>Munoz et al 2000</td>
<td>10/11</td>
<td>2</td>
</tr>
<tr>
<td>Potter et al 2007</td>
<td>9/11</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 4 Summary of CASP based scores- Case control studies (colour coded according to conclusion)

**Cohort Studies**

<table>
<thead>
<tr>
<th>Study By Author</th>
<th>Score on CASP tool</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qiu et al 2003</td>
<td>12/12</td>
<td>1</td>
</tr>
<tr>
<td>Kröger et al 2002</td>
<td>11/12</td>
<td>=2</td>
</tr>
<tr>
<td>Karp et al 2004</td>
<td>11/12</td>
<td>=2</td>
</tr>
<tr>
<td>Jorm et al 1998</td>
<td>10/12</td>
<td>4</td>
</tr>
<tr>
<td>Stern et al 1994</td>
<td>9/12</td>
<td>5</td>
</tr>
<tr>
<td>Evans et al 1997</td>
<td>8/12</td>
<td>6</td>
</tr>
<tr>
<td>Helmer et al 2001</td>
<td>7/12</td>
<td>7</td>
</tr>
<tr>
<td>Lupton et al 2009</td>
<td>5/12</td>
<td>8</td>
</tr>
<tr>
<td>Callahan et al 1996</td>
<td>4/12</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 5 Summary of CASP based scores- Cohort studies (colour coded according to conclusion)
3.6 Chapter Summary

This chapter has looked at addressing the main findings of each of the studies, providing summaries and presenting data in an accessible format to allow thorough discussion to take place in the next chapter.

Illustration and tables were provided to further display findings and draw together main themes.

There were four main conclusions of the studies:

1. Low complexity of work is linked with increased risk of dementia
2. High complexity of work is linked with reduced risk of dementia
3. Low complexity of work is linked with increased risk of dementia and high complexity of work is linked with reduced risk of dementia
4. No relationship determined

The weighting of the findings of each study will be considered in light of quality assessment and critical appraisal. Low quality studies will be given less weighing than higher quality ones.

*The next chapter will discuss the results displayed in this chapter.*
Chapter 4: Discussion

4.1 Introduction to chapter

The aim of this chapter is to provide an unbiased discussion of the results presented in the previous chapter. This chapter will assess the strength of evidence that each study provides, consider potential biases and limitations of the review and discuss the generalisability of the results. This chapter will also consider the implications of the review on future research and on the potential impact on patient care and health promotion (The Cochrane Collaboration, 2008).

4.2 Discussion

Although, as mentioned on page 44 the studies found four conclusions the conclusion from Stern et al (1994) stated that high complexity of work was linked with low risk of dementia and also that low occupational complexity was linked to high risk of dementia. Theses conclusions can therefore be divided into three main outcomes:

1. No relationship between occupation and dementia risk.
2. Highly skilled or more complex occupations are associated with a lower risk of dementia.
3. Lower skilled or less complex occupations are associated with a greater risk of dementia.

Although points two and three allude to a similar concept it is important to note that these are not the same conclusion. The relationship is not necessarily causal and thus will not be treated as so. Of the studies that found a relationship it was only Stern et al (1994) that explicitly stated the conclusion that both highly skilled occupations are associated with a lower risk of dementia and lower skilled occupations are associated with a greater risk of dementia. Although a number of other studies included in the review implied a causal relationship such allusions were only implicit and cannot therefore be taken as firm conclusions of a study. To assess the potential for a causal relationship the Bradford Hill criteria (1965) will be used as an explanatory framework. The guidelines, set out by Hill (1965) include nine key concepts from which causality may be assessed. A summary of Hill’s (1965) original concepts can be found in appendix 6.
4.3 Quality assessment

Before discussion of causality is commenced it seems important to consider the validity of studies included in this review to ascertain the extent to which finding may contribute to the overall synthesis. Quality assessment was carried out for all studies included in the review using the appropriate CASP Critical Appraisal Tools (CASP 2004, CASP 2006). These appraisal tools assessed studies in terms of both internal and external validity. Khan et al (2003) defines study quality as 'the degree to which it employs measure to minimise error in its design, conduct and analysis (Khan et al, 2003). Appraisal of studies used in a review can therefore be considered one of the most important aspects of a review. None of the studies included in this review were randomised control studies, which Khan et al (2003) consider to be the most valid method of research. All studies were observational in nature and could be classified as either cohort or case control studies. Despite the lower validity of observational studies, they remain an important tool for health professionals to observe cause and effects relationships (Black, 1996). The conduction of a randomised control trial for a study of this topic area would not be possible. The absence therefore of randomised control trials from this review should not be considered a limitation to the overall results.

As displayed in chapter 3 (tables 4 and 5), studies have been ranked in order of their critical appraisal score. Noticeably the three lowest scoring studies all concluded that no relationship was apparent between occupation and dementia. The other study concluding no relationship (Munoz et al (2000), despite its meagre sample size was of noticeably higher quality. All of the four studies that found high occupational skill and complexity to reduce the risk of dementia were, when critically appraised, deemed as high quality with the lowest appraisal score 9/11. All four of these studies examined occupation in a multifaceted way, considering the impact of many aspects of occupation. The studies that concluded low skilled occupation to be linked with dementia tended to take a more general approach to assessing occupation. Occupational categories tended to be broad, with some studies commenting on the level of manual labour as an additional descriptor. On critical appraisal all of the studies that concluded less skilled or complex occupation to be linked with increased risk of dementia proved to be of good design and high validity, contribution to the conclusion can therefore be accordingly high. For this group the lowest critical appraisal score was 8/12.
4.4 Assessing causation using the Bradford-Hill criteria

4.4.1 Strength

From an overview of the conclusions of each of the studies, as illustrated in fig.13 (p50), it is clear that a relationship between occupation and dementia is apparent. Overall eight of the twelve studies conclude a statistically significant relationship. Perhaps the strongest links can be found in the work of Stern et al (1994) and Kröger et al (2002). Stern et al (1994) found the relative risk of a low skilled occupation to be 2.25, compared with a relative risk of 1.0 for highly skilled occupations. Kröger et al (2002) calculated the hazard ratio for job complexity; low complexity occupations had a hazard ratio of 1.0 and highly complex occupations a hazard ratio of 0.36. Although other studies that concluded a relationship to be apparent did not have such dramatic findings, relationships are statistically significant at a 95% confidence interval none the less. The strength of association between occupation and dementia can be considered high.

4.4.2 Consistency

Consistent findings tend to be similar even when observed in many places at many times by many different observers in different circumstances (Hill, 1965). The studies perpetuated similar findings; aside from the studies that concluded no relationship, no contradictory conclusions were found. Results were consistent in many different settings, with studies in different populations finding similar results. Studies included in this review covered a range of 15 years; throughout this time findings were similar. The fact that study conclusions can be grouped into just three main outcomes, says a lot about the consistency of the results. The conclusions that high skilled occupation are linked with low dementia risk and low skilled occupations are linked with high dementia risk are complementary conclusions. A great deal of overlap can be identified between the explanations for both outcomes (Dunn, 2010). The consistency of the findings can be considered to be high strengthening the likelihood of a causal relationship.
4.4.3 Specificity

To assess specificity of findings it is important to consider the extent to which effects are limited to very specific situations where no other association is present (Hill, 1965). With studies included in the review representing a wide range of populations in different countries the specificity of the findings is likely to be low. Furthermore there are a number of other variables implicated that provide further explanation of the findings.

A review by Fratiglioni et al (2004) indicates that the level of social interaction a person engages in is of significant impact on their mental health and dementia risk. More frequent and complex social interaction was found to lower the risk of dementia. A large body of research supports this suggestion (Verghese et al, 2003; Katzman, 1995; Rovio et al, 2005; Fratiglioni et al, 2004). Of the studies included in this review three have found significant relationships between the level of social interaction a job requires and a persons subsequent dementia risk (Andel et al, 2005; Potter et al, 2007; Kröger et al, 2002). With socially complex jobs requiring someone of more developed social skills to be effective in the role, this raises the issue of which is of more influence; is it the level of social interaction the job entails or the level of inherent social skill that a person possess that is more of influence? Although this question is difficult to answer it seems reasonable to suppose that regardless of intrinsic social ability, perpetuation of social interaction may confer a protective advantage (Fratiglioni et al 2004).

Qui et al (2003) found that those in physically demanding jobs were of higher risk than their more sedentary counterparts. In 2005 Rovio et al found that leisure time physical activity reduced the risk of dementia. It would therefore seem reasonable to suppose this were the case for work based physical activity. In a follow up study by Rovio et al (2007) this was examined. Like Qui et al (2003), Rovio et al (2007) concluded that greater work based physical activity increased dementia risk. Both Qui et al (2003) and Rovio et al (2007) suggested that physically demanding jobs involve little in the way of cognitive or mental challenges, and are typically adopted by those of lower intellect. They suggested that the advantages of increased physical activity were outweighed by the lifestyle factors associated.
Three of studies included in the review found that as well as occupation, education played an important part in determining dementia risk (Potter et al, 2007; Karp et al, 2004; Evans et al 1997). Karp et al (2004) found this link to be particularly strong; although a statistically significant link between occupation and dementia risk was ascertained Karp et al (2004) concluded that education was a more prominent risk factor for dementia. Potter et al (2007) found that amongst twins occupational complexity was of less impact than in controls. Potter et al (2007) suggested that education and social background might therefore play a substantial part in influencing a person’s dementia risk. As Karp et al (2004) points out, it is difficult to disentangle the effects of occupation and education; high level of education tends to lead onto a more complex job. Despite adjustment for level and duration of education the probability remains that without the necessary education a person is unlikely to have a highly skilled or complex job (Karp et al, 2004). It is therefore difficult to isolate occupation as an independent risk factor.

In an epidemiological study Schrijvers et al (1998) investigated the effects of low job skill on people’s overall mental and physical health. They found that jobs of low skill were typically associated with poorer working conditions, less control and reduced social support at work. Schrijvers et al (1998) reported that low skilled jobs more frequently had to deal with hazardous materials. Schrijvers et al (1998) concluded that low job skill was associated with poorer physical and mental health. Van-Yperen & Hagedoorn (2003) point out that factors such as those described are commonly associated with increased stress levels which itself precipitates an increased cardiovascular risk. Lower skilled occupations are also more commonly associated with lower socio-economic status (Galobrades et al, 2006). As Dunn (2010) points out lower socio economic status is often associated with negative health behaviours, such as increased alcohol consumption, smoking, obesity, sedentary lifestyle and poor diet. A review conducted by Jedrziewski et al (2005) found that all the factors listed are considered risk factors for dementia. The increased levels of stress, escalated cardiovascular risk and negative health behaviours may to some extent account for the association found between low occupational skill and high risk of dementia.

Within a number of other variables likely to be of influence on a persons risk of dementia the specificity of the findings is low. Other explanations however do not contradict the findings of the review. Such explanations raise the point that occupation is unlikely to be an independent risk factor for dementia and that risk is likely to be linked to many factors in conjunction.
4.4.4 Temporality

Temporality considers cause and effect. A study by Antilla et al (2002) investigated this concept considering whether a person’s dementia caused their low occupational attainment or whether their low occupational attainment contributed to their dementia. With dementia typically a disease of old age (Jellinger et al, 2002) it seems likely that dementia would not be of impact on a person’s occupation throughout life. Although Antilla et al (2002) suggested that pre-clinical, early onset dementia might result in cognitive deficit pre-retirement; they concluded that dementia is unlikely to cause a person to achieve a low skilled occupation throughout life. With all the studies included in the review assessing participants’ main life occupation it can be said confidence that it is the effect of occupation on dementia being observed and not the other way round.

4.4.5 Biological gradient

Hill (1965) suggests if causality is present greater exposure should result in greater effect. Thus in this case a biological gradient should follow a trend with higher the occupational skill or complexity the lower the risk of dementia. Of the studies included in the review only Kröger et al (2002) presented results that demonstrate a gradient. Other studies only presented results for high or low skilled occupations, with no middle ground. Kröger et al (2002) calculated hazard ratios for complexity of work with data, people and things. For all these measures of complexity a gradient was apparent. Hazard ratios were calculated as follows:

<table>
<thead>
<tr>
<th>Complexity of work with:</th>
<th>Hazard Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Data:</em></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
</tr>
<tr>
<td>Medium</td>
<td>1.14</td>
</tr>
<tr>
<td>High</td>
<td>1.77</td>
</tr>
<tr>
<td><em>People:</em></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
</tr>
<tr>
<td>Medium</td>
<td>0.80</td>
</tr>
<tr>
<td>High</td>
<td>0.56</td>
</tr>
<tr>
<td><em>Things:</em></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
</tr>
<tr>
<td>Medium</td>
<td>0.61</td>
</tr>
<tr>
<td>High</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Table 6: Results for Kröger et al (2002)

For each of the areas of assessment a gradient is present. As the complexity increases the hazard ratio changes accordingly.

* As mention previously (chapter 3, page 38) Owing to the way in which occupation complexity with data was recorded a hazard ratio above 1 indicated decreased dementia risk
Although other studies in this review do not present a graded measure of risk for occupation and dementia, the percentage incidence of dementia in a study Evans et al (1997) does appear to follow a gradient. Of those who developed dementia 28% were from occupations of very low prestige, 22% of low prestige, 17% medium and 5% high prestige occupation.

Although an inverse biological gradient is apparent in Kröger et al (2002) and to an extent Evans et al (1997) there is insufficient evidence from all the different studies to confirm a definite gradient.

4.4.6 Plausibility

The plausibility of findings refers to scientific credibility of the relationship (Hill, 1965). A number of studies and theories provide support for the findings of the studies included in the review.

Schooler et al (1999, 2004) conducted studies examining the effects of occupation on intellectual flexibility in dementia free participants. They found correlation between the level of occupational complexity and subsequent intellectual flexibility. Schooler et al (1999, 2004) concluded that a complex occupation improves and maintains intellectual levels over the years. The reduction in dementia risk with more complex or skilled occupations may also be attributable to such factors The findings of Schooler et al (1999, 2004) coincide with some well-researched scientific concepts; Katzman’s ‘use it or lose’ it hypothesis (1995) and Fratiglioni & Wang’s brain reserve hypothesis (2007).

In 1995 Katzman developed the ‘use it or lose’ it hypothesis. His hypothesis indicated that the brain needs mental exercise and challenges to maintain function. As Fotuhi (2004) explains, synapses and neural pathways are created and maintained through learning, reading and other cognitive and physical challenges. Raz and Rodrigue (Raz, 2005; Raz & Rodrigue, 2006) show that over time the areas of the brain most associated with learning and memory begin to shrink. Katzman’s ‘use it or lose it’ hypothesis (1995) make the connection between brain anatomy and cognitive decline indicating that without continued cognitive tasks brain function will not be preserved for later life.
Fratiglioni & Wang’s (2007) concept of brain reserve explains that people may build a tolerance to age related decline. Similar to Katzman’s (1995) ‘use it or lose it’ hypothesis, they suggest that cognitive function may be preserved through cognitive activity. Fratiglioni & Wang (2007) suggest that a number of lifestyle factors, including social interaction, education, and leisure time physical activity may work to delay the onset of dementia. In 2002 Stern further concluded that cognitive reserve confers better performance in the event of brain damage. He suggests function may continue through using formed brain networks otherwise not engaged in an undamaged brain.

The ‘use it or lose it’ hypothesis (Katzman, 1995) and brain reserve hypothesis (Fratiglioni & Wang, 2007) both explain the association between low job complexity and high dementia risk as well as between high job complexity and low dementia risk. The findings are highly plausible and wider research indicates them to be scientifically credible.

4.4.7 Coherence

The coherence of findings refers to the extent to which epidemiological findings relate to laboratory findings (Hill, 1965). A wide range of studies explores the observable changes in brain anatomy in relation to dementia; these are discussed below.

Jorm et al (1998) found that in those with more complex occupations more dense neural pathways could be identified. Katzman (1993) was able to demonstrate the relationship between neocortical synaptic density and cognitive decline in dementia, with greater density resulting in slower decline. The findings of Jorm et al (1998) provide anatomical evidence to confirm the protective advantage of more complex occupation. Research by Stern et al (1995) further demonstrated the brain reserve hypothesis. Participants’ cerebral blood flow was measured using a Novocerebrograph; particular attention was paid to parietal lobe perfusion. Reduced parietal lobe perfusion is assumed to be an indirect index of dementia pathology and of causation with disease severity (Stern et al, 1995). In participants of low occupational complexity parietal lobe blood flow was reduced. Stern (1995) concluded that participation in an occupation of high skill or complexity allowed the brain to maintain the reserve necessary to delay or prevent dementia.
Taking Stern’s (1995) idea a step further, Kröger et al (2002) investigated the trichotomous relationship between occupation, cerebral blood flow and clinical presentation of dementia. Interestingly Kröger et al (2002) found that not only was dementia delayed by having had a more complex occupation in midlife but also that participants with a complex occupational history and reduced cerebral blood flow tended to remain asymptomatic. Kröger et al (2002) suggested that even in the event of reduced cerebral blood flow more complex occupation may provide a buffer, delaying the symptomatic clinical presentation of dementia. Kröger et al’s (2002) findings provide a further interesting avenue of research to be explored.

The laboratory findings discussed are consistent with the epidemiological observations of studies included in the review. This consistency strengthens the overall findings and confirms the likelihood of the effect occupation has on dementia risk.

4.4.8 Experiment

As discussed earlier chapter (on page 48) randomised control studies were not included in the review. It is not realistically possible or ethically sound to randomly assign occupation to participants, for a topic of this nature randomised control trials do not provide a viable method (Black, 1996). No comparisons can therefore be drawn between epidemiological and experiment findings.

4.4.9 Analogy

Hill (1965) explains that the final criterion for assessing causal relationships requires comparison of findings with other similar phenomena. Valenzuela et al (2006) conducted a systematic review considering the effects of education on dementia. They found that the higher the level of education a person attains the lower their risk of dementia. Katzman (1993) also conducted a systematic review looking at risk factors for dementia; he focused on the effects of social interaction on dementia. Katzman (1993) concluded that greater social interaction is of benefit in reducing dementia risk. Both these reviews follow a similar trend to the findings of this study. Andel et al (2000), Kröger et al (2002) and Potter et al (2007) all found that participants with high level of complexity of work with people, i.e. jobs that require social interaction, had a reduced risk of dementia, similar reduction in risk of dementia could be observed for those in occupations of high complexity with data; such work is likely to require higher levels of
education. The parallels between this and existing reviews along with the casual relationships found in them strengthen the likelihood of a causal relationship between occupation and dementia.

4.5 Is a causal relationship likely?

Consideration of causality using the Bradford Hill criteria for causality (Hill, 1965) indicated that the strength and consistency of the relationship to be high; the association between occupation and dementia is strong and the findings consistent across the different studies. The presence of other risk factors reduces the specificity of the association however the nature of the relationship indicated high temporality. To a certain extent a biological gradient could be observed in the work of Kröger et al (2002) and Evans et al (1997), however to confirm the presence of such a gradient requires more research. In light of the use it or lose it hypothesis (Katzman, 1995) and the brain reserve hypothesis (Fratiglioni & Wang, 2007) findings seem plausible. Despite the obvious lack of RCT coherence, the support from laboratory studies of brain anatomy provides further scientific support to the epidemiological findings and when compared with other relevant published reviews findings are parallel and complementary. All things considered it seems likely that a causal relationship may be present but this relationship is difficult to disentangle from educational attainment and social interaction.

4.6 Implications for further research

The results of this study indicate the need for more high quality research to further assess the effects of occupation on dementia risk. Studies in which the design allows a biological gradient to be assessed would further help to determine whether a causal relationship is apparent. Although this review has concentrated solely on occupation as a risk factor for dementia, this itself needs further research to refine the concept; at present there remain questions as to whether occupation can be disentangled from other risk factors.
4.7 Implications for further practice

This review has highlighted the association between occupation and risk of dementia. Along with existing research into dementia risk factors a profile of disease risk may be developed. From a nursing perspective, developing a profile of risk allows targeted health promotion campaigns to be developed. Although occupation is realistically not modifiable identification of risk does allow supplementary protective behaviours to be adopted.

For those at risk but without dementia encouragement to participate in cognitively stimulating activities could be provided; this could be as simple as encouraging people to complete crosswords, sudukos and take up reading. Such activities may provide some protection and maintain brain reserve (Fratiglioni & Wang, 2007). Awareness could also be raised as to the value of social interaction; encouragement could be provided for people to engage in socially stimulation environments, particularly for people after retirement, this again may confer protection (Katzman, 1993).

Screening programmes could be developed to identify those in occupations most at risk. Currently initiatives exist to encourage those in sedentary occupation to participate in physical leisure activities. In the same way, for example, those in manual occupation could be targeted through their work place where cognitive activities could be encouraged and provided.

Although the general public may ask nurses for advice in minimising disease risk, nurse involvement is more likely to occur with members of the public diagnosed with dementia. For such people support groups may be of advantage. By simply attending a group the advantages of social interaction may be provided and through such groups further social interaction can be advocated and cognitive activities provided to further slow the onset of dementia (Fritsch et al, 2002). Education and further health promotion may also be use. This may be of use for both those with dementia and their careers and could allow further ways to slow the disease to be discussed.
Although there is a limit to which health promotion may be listened to and acted on even if a small percentage of the public feel encouraged to adopt positive health behaviours the overall disease burden may be reduced. Eventually the link between cognitive and social activities and dementia risk may be as common knowledge as, for example, the effects of exercise or cholesterol on heart disease (BHF, 2006).

4.8 Appraisal of this review

To assess the validity of this review the CASP critical appraisal tool for systematic reviews (2006) was used (appendix 7). This review has been successful in maintaining a clear focus to answer the research question. Selection of relevant literature followed a clear and systematic approach. Searching was undertaken using explicit search terms. Although the searches did in some databases retrieve a large number of studies the volume of literature found was not unmanageable. Through a multi stage selection process relevant literature was identified. Explicit, predetermined inclusion and exclusion criteria were adhered to. The selection process used minimized the potential for bias in the selection of review material.

Studies included were of case control or cohort design, both of which were relevant and useful to the topic area (Black, 1996). Care was taken to ensure each study was fairly and thoroughly appraised using an evidence-based critical appraisal tool appropriate to the study design (CASP, 2004; 2006). Appraisal was however carried out by only on reviewer, thus increasing the risk of bias. The study attempted to include studies from a wide range of sources and an appropriate mix of databases. The review is however limited by the omission of studies not published in the English language. Although efforts were made to identify relevant unpublished literature to include in the review none could be found.

Data extraction for each of the studies followed a pre determined standard format and is therefore easily replicable. Solely one reviewer carried out data extraction; this increases the risk of bias and potential for error. The results of the studies were well presented in a clear accessible format, with relevant information included. It was not possible or appropriate for the results of each of the studies to be statistically combined and this should not be considered a limitation of the review. Although the outcome, diagnosis of dementia, was fairly standard across
the different studies the measure of occupation was more varied and combining of data would be inappropriate. Odds ratios, relative risk and hazard ratio found in each study were reported in a summary table along with the confidence interval used. The clear reporting of results allows the reader to easily observe the results of each study for themselves and to assess the level of significance used in each study. The results clearly support the findings of the review and are able to back up the conclusions.

The review methods are clear and easy to follow. Each stage of the review is clearly explained and in all is highly replicable (Soper & Beins, 2003). The inclusion of a variety of studies from a number of countries in the western world allows the findings of the review to be widely transferable (Soper & Beins, 2003). Consideration is made for the effects of outcomes on the individual and on public and health policy however evidence is currently insufficient to indicate any changes of policy or practice. Findings of the review are intended to remain unbiased and representative of the research available and the author declares no conflict of interest. The critical appraisal score (CASP, 2006) awarded to the review is 8/10.

4.9 Chapter Summary

This chapter has discussed the findings observed from each of the studies and has drawn together these findings. The findings of the studies have been considered in light of quality assessment scores. Following consideration of the findings based on the Bradford Hill criteria for causation, the author suggests that a causal association might be present between occupation and dementia however this association is difficult to disentangle from risk factors such as education and social interaction.

The next chapter will sum up the overall findings of this review and draw conclusions from the evidence presented.
Chapter 5: Conclusion

The main aim of this review was to establish the effect that occupation has on a person's overall risk of dementia. The Centre for Reviews and Dissemination (2001) suggest that a systematic review should go further than simply identifying a link; ultimately they should aim to improve health care and health outcomes.

Through systematic and rigorous selection of relevant literature, a framework based narrative synthesis (Popay et al, 2006) and consideration of findings using well-appraised criteria for causal relationships (Hill, 1965) the conclusions of this review have developed. The main findings of this review, as displayed in chapter 3, tend to indicate a strong association between occupation and dementia. Of the 12 studies included in the review four concluded no relationship, of these three were considered to be of poor quality. Whilst the results of these were not completely disregarded the overwhelming conclusion of the high quality literature indicated a strong link between occupation and dementia.

With 4 studies concluding that high skilled occupations result in a lower risk of dementia, and 5 indicating that low skilled occupation result in a higher risk of dementia the possibility of a causal relationship was apparent. Further implication from study authors reaffirmed this possibility. To test this the Bradford Hills criteria for causal relationships (1965) was used. The findings of the studies fulfilled 6 of the 9 criteria set out by Hill (1965). With strong and consistent association, a clear temporal relationship apparent and a potential for a biological gradient, evidence points towards the likelihood of an inverse causal relationship.

In chapter 1 (page 5) the research question was set:

‘To what extent is occupation of influence in the development of dementia?’

Analyses of the findings indicate that a causal relationship is likely to be present between occupation and dementia, with dementia risk inversely related to occupational complexity. It is however important to note that occupation is not a sole risk factor for the disease (Nelson et al, 2004). Although all of the studies make adjustments for other risk factors the extent to which these adjustment truly account for such variables is limited (Iezzoni, 1994). It seems reasonable to suppose that occupation may provide further opportunity for people to exhibit
protective health behaviours such as cognitive challenges and social interaction. A well-educated, intellectual individual who enjoys social interaction is unlikely to pursue a career where social skills and intellect are not required; equally the opposite is unlikely to occur (Egerton, 2002). Egerton (2002) indicates that occupation may simply serve as an extension and perpetuation of a person’s intrinsic character and ability. Corresponding occupations are therefore likely to exaggerate such tendencies, conferring dementia risk increase, or risk reduction accordingly.

The findings of this review indicate that occupation is certainly of strong influence on a persons risk of dementia, however it is perhaps inappropriate to consider it, or any other risk factor a sole indicator of disease risk.

In the chapter one (page 5) a directional hypothesis was proposed:

‘The onset of dementia is more likely to be reduced or delayed in persons with occupations that are cognitively and educationally demanding.’

Studies conducted by Andel et al (2000), Kröger et al (2002) and Potter et al (2007) found that more complex occupations resulted in a reduced risk of dementia. Potter et al (2007) indicated that for individuals who participated in high levels of vocational training throughout their career, i.e. continued to engage in education, had a significantly lower risk dementia than those who did not. All three (Andel et al, 2000; Kröger et al, 2002; Potter et al, 2007) found that those who participated in occupations that involved high complexity of work with data also experienced reduced risk of dementia.

In addition to findings related to educational and cognitive demands, studies included in the review also indicated that high levels of social interaction were protective against dementia. Andel et al (2000), Kröger et al (2002) and Potter et al (2007) all looked at the association between levels of complexity of work with people and dementia risk. In each case the results indicated that complexity of work with people was of advantage in reducing the risk of dementia.

Therefore, within the limitations outlines above the hypothesis may be accepted as true; it may however be more accurate to expand the hypothesis to include the influence of social interaction on dementia risk:
Occupations that provide a cognitively, educationally and socially stimulating environment may serve to reduce a person’s risk of dementia.

While it seems unlikely that these factors alone are enough to protect against dementia, the findings of this review indicate a definite and strong relationship exists.

This review has provided valuable information on the effects of occupation as a risk factor. It has answered the study question and clarified the link between occupation and dementia. The relationship between occupation and dementia has been explored and reasons for the association considered. Furthermore this review has addressed the potential for impact on health care, considering to possibilities for health promotion. The aims and objectives of this review may therefore be considered effectively met. Although alone this review does not provide sufficient evidence to change health care provision, its findings and recommendations may help in devising health promotion initiatives.
References


BHF: British Heart Foundation, 2006, Joint British Societies’ Guidelines on the prevention of Cardiovascular Disease in Clinical Practice: Risk Assessment, British Heart Foundation in association with the British Cardiac Society, London

Black N, 1996, Why we need observational studies to evaluate the effectiveness of health care, British Medical Journal, vol 312 pp 1215-1218


CRAG Critical Reviews Advisory Group, 1996, Introduction to Systematic Reviews, School for Health And Related Research, Sheffield.

Department of Health, 2001, National Service Framework for Older People, HMSO, London,

with dementia, Department of Health.


Elwood M, 2007 Critical appraisal of epidemiological studies and clinical trials, Oxford University Press

Faraone SV, Tsuang MT, Tsuang DW, 1999, Genetics of mental disorders: what practitioners and students need to know, Guilford Press, pp29-38


Friedland D, 1998, Evidence-based Medicine, McGraw-Hill Professional, p xvi


Greenhalgh T, 1997, How to read a paper: Papers that summarise other papers (systematic reviews and meta-analyses) BMJ 315 pp672-675

Griffiths F, 2009, Research Methods for Health Care Practice, SAGE Publications Ltd, pp105-110


Hagino C, Simmons D, 2003 How to Appraise Research: A Guide for Chiropractic Students and Practitioners, Elsevier Health Sciences


Hill A, Spittlehouse C, 2009, What is critical appraisal?, What is...? series, Evidence Based Medicine, Second Edition, Hayward Medical Communications


Iezzoni LI, 1994, Risk adjustment for measuring health care outcomes, Health Administration Press


Karp I, Kåreholt I, Qiu C, Bellander T, Winblad B, Fratiglioni L, 2004, Relation of Education and Occupation-based Socioeconomic Status to incident Alzheimer’s Disease, American Journal of Epidemiology; 156(2)


Letenneur L, 2004, Risk of dementia and alcohol and wine consumption: a review of recent results, Biological Research, 37(2)


Schooler C, 1984, Psychological effects of complex environment during the lifespan: A review and theory. Intelligence; 8, 259–281.


Sirven J, Malamut B, 2008, Clinical Neurology of the Older Adult, Lippincott Williams & Wilkins

Sobel E, Danipour Z, Sulkava R, Erkinjuntti T, Wikstrom J, Henderson, Buckwalter G,
Bowman J, Lee P. 1995, Occupations with Exposure to Electromagnetic Fields: A Possible Risk Factor for Alzheimer's Disease, American Journal of Epidemiology 142(5)


Van-Yperen NW, Hagedoorn M, 2003, Do high job demands increase intrinsic motivation or fatigue or both? The role of job control and job social support, Academy of Management Journal, Vol.46, No.3, pp339–348


Zhang M, 1990, Prevalence study on dementia and Alzheimer disease,
References: Excluded Studies


Relationship lifetime occupation and patietal flow: implications for a reserve against Alzheimer's Disease pathology, Neurology January pp55-60