EXAMINING THE RELATIONSHIP BETWEEN POST-STROKE COGNITIVE DYSFUNCTIONS AND MOOD DISORDERS IN HOSPITALISED SAUDI PATIENTS

Sami Saleh Al-Arjan

BA., MA. (Psychology)

Thesis submitted to the University of Nottingham in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Clinical Psychology

February 2016

Abstract

Background: The Ministry of Health in Saudi Arabia estimates that there are at least 20,000 strokes per year across the country (126/100,000) and approximately half of those with stroke may develop cognitive dysfunction or mood disorders. However, a review of the literature revealed that research in the area of post-stroke cognitive dysfunction and mood disorders in the Kingdom of Saudi Arabia (KSA) is severely lacking. Accordingly, these studies aimed to bridge the knowledge gap with an emphasis on three central aspects. The first aim was to assess the prevalence of post-stroke cognitive dysfunctions in the KSA population using neuropsychological tests. The second aim was to assess the prevalence of post-stroke mood disorders in the KSA using self-report scales. The third aim was to evaluate the relationship between cognitive dysfunctions and mood disorders.

Method: Observational methods were used to collect descriptive information about the prevalence of cognitive dysfunctions and mood disorders in the Saudi population. Participants were recruited from three medical centres in the KSA: King Abdulaziz Medical City, King Fahad Medical City, and Sultan Bin Abdulaziz Humanitarian City. The target sample was age 18 years and above who were diagnosed by neurologists with ischemic or haemorrhagic stroke according to CT-scan results, and who were at least one month post first-ever stroke, and either attending out-patient clinics or admitted to medical centre. Participants were excluded from the study sample if they satisfied any the following conditions: severe dementia; sever aphasia; chronic psychiatric or other concurrent

neurological disorders; a known history of alcohol or drug abuse; blindness or deafness; participant non Saudi citizen; an inability to speak or understand Arabic; or medically unstable.

Results: For the empirical investigation, 76 men and 24 women were recruited (mean age 60.53 ± 11.26 years). Of these, 52% had deficits of orientation/attention, 55% of memory, 36% of fluency, 46% of language, 26% of visuospatial ability, 35.7% of visual neglect, 58.4% of visual-motor skills, 69% of executive function, and 52% had overall cognitive impairment, 36% had anxiety and 44% had depression after stroke. The results confirmed a strong relationship between cognitive dysfunctions and mood disorders. However, from the regression model, it was found that 'literacy' (literate *vs.* illiterate), 'time since stroke' (≤ 6 *vs.* ≥ 7 months), 'fluency impairment' and 'memory impairment' were significant predictors of the severity of anxiety disorder after stroke. Similarly, 'literacy' (literate *vs.* illiterate), 'time since stroke' (≤ 6 *vs.* ≥ 7 months), 'fluency impairment', 'memory impairment', 'visuospatial ability impairment' and 'visual neglect' were significant predictors of the severity of depression after stroke.

Conclusion: Based on the sample of Saudi patients (n= 100), it can be concluded that cognitive dysfunctions have an effect on the stroke patient's mood. The severity of cognitive dysfunction is significantly related with mood disorders, in particular depression disorder.

Dedication

I dedicate this thesis to my parents, my wife and my children for always standing by me in the difficult times. My father (may ALLAH rest his soul in peace) passed away 21 months ago, which was a very painful period of my life. However, due to his lifelong teachings and prayers, I was able to recover from my deep sorrow and pursue my education to accomplish his dream. He always taught me how to deal graciously with difficulties and reap something precious from the challenges of life. After his death, my mother played the role of both father and mother in encouraging me. Without their ongoing support, advice, and help, I could not have completed my PhD thesis. Their continuous struggle since my childhood, and guidance in setting the direction of my professional career, are the underlying factors that have always motivated me in striving for higher targets and then achieving those targets. Their unconditional love never let me down, whatever the situation. They have assisted me in studying and working long hours to complete my education. They have always been a source of joy and happiness for me. Without their financial and moral support, it would be impossible for me to pursue a professional career. For their precious ideas and for acting as role-models throughout my life, I have dedicated this thesis to my parents.

Similarly, the contribution of my wife and children is unforgettable as they were the most neglected due to my research pressure and busy schedule. Their sacrifices, support, and love are the cornerstones of my life's success – specifically, the achievement of completing this PhD thesis.

Acknowledgement

I am deeply indebted to all those who have directly or indirectly supported me in the completion of my thesis.

First, I would like to thank Almighty Allah for providing me with the strength and power to successfully complete this PhD thesis in clinical psychology. Without his grace and mercy, no achievement is possible. Through him, everything becomes possible. I am indebted to him for giving me the opportunity to pursue a professional career. I would like to thank him for all his blessings in the form of financial support as well as physical health, which enabled me to continue the PhD in the hard times too.

After Allah, all my thanks and gratitude is for my extraordinary and highly skilled supervisors, Prof. Nadina Lincoln and Dr. Shirley Thomas. They have been always present for guiding me towards the research ideas, methodologies, data collection and data analysis process. Part of the ideas in this thesis stems from their guidance and our communication. Their conversations were invaluable for designing the seven sections of this study. I am grateful to them for the generous amount of time they have dedicated to my thesis.

Similarly, I am sincerely thankful to the authorities in Saudi Arabia who allowed me to gain access to the records, data, staff and patients of the three medical centres in Riyadh. These institutes were: King Abdul-Aziz Medical City (KAMC), King Fahad Medical City (KFMC), and Prince Sultan Bin Abdulaziz Humanitarian City (SBAHC). The government authorities facilitated me in approaching in-patients and

out-patients clinics in different periods of the study, such as during baseline assessments as well as during the follow-up assessments.

I would also like to thank the patients in the three medical centres who were part of this research, whether directly or indirectly. Their patience, contribution and assessment responses for the different types of scales used in my study were remarkable. Post-stroke patients face severe behavioural issues due to the severity of their disease and the complex treatment process; it was therefore kind of them to support an academic study during such a stressful period of their lives. Similarly, I am indebted to the families and carers of these patients. Some of the patients required the support of their family members to understand and respond to the study's measuring instruments. Therefore, my deepest thanks go to them.

Furthermore, I would also like to express my appreciation to all the medical staff in the different operational or management levels in the three medical centres. They helped in preparing the sample of patients and the site of assessments, ensuring it was both comfortable and convenient for both the patients and for myself. Their support over such a long duration is simply commendable.

In addition, my deepest thanks go to the Ministry of National Guard – Health Affairs in Saudi Arabia, who assisted with both financial and non-financial resources at every stage of my thesis.

I owe my deepest gratitude to the staff of the Division of Rehabilitation and Aging and PGRs at the University of Nottingham, UK. Special thanks are also due to my

colleagues at the Division of Psychiatry and Applied Psychology at the University of Nottingham. I would like to express my gratitude to my friend Dr. Mohammed Al-Ghamdi and Dr. Ashraf AL-Hadith for their collaboration, discussion and support, including attending training together, during my doctoral studies at the University of Nottingham.

Lastly, I cannot forget the love and support of my sweet and lovely wife and kids in bearing pressure of long working hours and study with me. Their understanding, love, care and patience have made the completion of this research possible.

Publications and Conferences

- Alarjan, S., Thomas, S., & Linclon, N. (2015): Prevalence of Post-stroke Emotional Disorders in Saudi Arabia. *Phys Med Rehabil Int, 2(2), 1033*.

  http://austinpublishinggroup.com/physical-medicine/open-spl-issue.php

- Alarjan, S., Thomas, S., & Linclon, N. (2015): Screening of post-stroke cognitive dysfunctions in Saudi Arabia: Prospective study. Organisation for Psychological Research Into Stroke (OPSYRIS), 12 October, St Martin's Hospital, Canterbury, UK.

List of Contents

List of Tables

List of Figures

Chapter One: Literature Review

1.1 Stroke

1.1.1 Definition of stroke

Although different definitions of stroke can be found in the literature, it is commonly classified as a chronic and serious neurological disorder. Clinically, the effects of stroke occur in the central nervous system, specifically in the brain (Wityk & Llinas, 2007). The World Health Organisation (WHO) defines stroke as *"rapidly developing clinical signs of focal or global disturbance of cerebral function, with symptoms lasting more than 24 hours (unless interrupted by surgery or death), with no apparent nonvascular cause"* (Thomas, Stephen, & Colin, 2000, p.1).

1.1.2 Prevalence of stroke

Stroke is the second leading cause of death worldwide (Thomas et al., 2000). It is estimated that stroke accounts for 5.7 million deaths worldwide annually, with over 75% of those deaths occurring in developing countries (Thomas et al., 2000). For example, Cossi et al (2011) reported that the prevalence of stroke in the Republic of Benin, West Africa, is 460/100,000. Other studies have reported comparable figures for developing countries, such as rural Bolivia 174/100,000 (Nicoletti et al., 2000), Argentina 868/100,000 (Melcon & Melcon, 2005), Columbia 170/100,000 (Centers for Disease Control and Prevention , 2005), Taiwan 249/100,000 (Lin, Lin, Liu, Chen, & Chiu, 2007), and Iran 103/100,000 (Hosseini, Sobhani-Rad, Ghandehari, & Benamer, 2010).

Regarding the occurrence of stroke in the Kingdom of Saudi Arabia (KSA), Al Rajeh and Awada (2002) stated that stroke is the most common severe neurological disorder and is a leading cause of mortality or disability among adults. It is estimated that the annual incidence rate is 20.000 strokes across the KSA (at least 126/100,000). Despite a high prevalence of stroke in the country; it is currently believed that health care programmes for stroke are insufficient in the KSA (Al Khathaami et al., 2011).

In terms of the prevalence of stroke in western countries, Anderson, Arciniegas and Filley, (2014) reported that stroke is the third most common cause of death or disability in the United States. More than 750,000 new ischemic strokes occur each year, and more that 4 million Americans are living with the residual effects of stroke. In Canada, approximately 300,000 Canadians suffer the consequences of stroke (Ramasubbu, 1999). In the United Kingdom, stroke is identified as a significant cause of major disability (World Health Statistics, 2012). Approximately 152,000 people in the UK have a stroke each year (Stroke Association, 2016). A large portion of incidents occur in people over age 65 years, however stroke can affect people of all ages, including children (Stroke Association, 2016). The annual cost of stroke care in the UK is estimated as £8.9 billion. This annual cost is comprised of expenditure on diagnostic, therapeutic, financial and social services (Saka, McGuire, & Wolfe, 2009).

1.1.3 Types of stroke

The term stroke can be used broadly for explaining different conditions associated with the involvement and destruction of different blood vessels supplying nourishment to the brain, that is, either inside the skull or going into the brain (Caplan, 2013). Medical literature highlights that clinicians have traditionally distinguished between three types of stroke: ischemic, intracerebral haemorrhagic, and subarachnoid haemorrhage.

- **Ischemic strokes (infarction)**

A report of the American Stroke Association, (2015) states that ischemic strokes lead to approximately 87% of stroke conditions. They result from an obstruction in a blood vessel supplying blood to the brain. Ischemic stroke occurs due to a thrombus, referring to a blood clot that arises in a blood vessel that obstructs the flow of blood in an artery transporting blood to different parts of the brain. According to Alway and Cole (2009), cerebral thrombotic stroke is due to the blood clot structures within an artery of the brain. During the process, an embolus or an infarction is formed elsewhere in the body. The bloodstream carries the embolus until it clogs an artery leading towards or in the brain, resulting in the ischemic stroke. Patients with ischemic stroke face sudden *"onset of weakness, numbness, vision loss, diplopia, dysarthria, gait disorder, vergito, aphasia or disturbed level of consciousness"* (Alway & Cole, 2009, p. 2). Ischemic stroke patients may also suffer loss of vision or loss of hearing; it is extremely rare for such patients to experience a positive visual phenomenon (Alway & Cole, 2009).

Three types of infarctions or obstructions may be distinguished:

1. Thrombotic cerebral infarction occurs due to an atherosclerotic obstruction of the large cervical and cerebral arteries.
2. Embolic cerebral infarction occurs due to an embolism in the cerebral arteries coming from other parts of the arterial system, for example, from cardiac lesions.
3. Lacunar cerebral infarctions are due to a local disease causing small deep infarcts in small penetrating arteries, and are mainly related to chronic hypertension (Truelsen, Thudium, & Grønbæk, 2002).

Identifying the potential risk factors for ischemic stroke, Hankey (2006) states that approximately 60-80% of patients suffering from ischemic stroke show the following conditions or behaviours: *"high blood pressure, high blood cholesterol, cigarette smoking, carotid stenosis and diabetes mellitus (atherosclerotic ischemic stroke), and atrialfibrillation and valvular heart disease (cardiogenic ischemic stroke)"* (Hankey, 2006, p. 2181).

- **Intracerebral haemorrhagic (ICH) strokes**

A second type of stroke, intracerebral haemorrhagic stroke (ICH), is the most common type associated with death or major disability. According to Alway and Cole (2009), intracerebral haemorrhage refers to the condition of bleeding within the substance of the brain, especially in the ventricles. According to Zuccarello (2015, p.1), *"Ten percent of strokes are caused by ICH (approximately 70,000 new cases each year). ICH is twice as common as subarachnoid haemorrhage*

(SAH) and has a 40% risk of death". It occurs due to bleeding from one of the brain's arteries into the brain tissue. ICH occurs more frequently in men than in women. The medical severity of ICH can be seen from historical mortality rates: in 1997, among an estimated 37,000 Americans, 25-35% who had ICH died within one month, with approximately 50% of the deaths reported in the first two days (Broderick et al., 1999).

Examining the risk factors associated with ICH, Magistris, Bazak, & Martin, (2013) divide them into modifiable and non-modifiable risk factors. Modifiable factors of ICH include "*hypertension, anticoagulant therapy, thrombolytic therapy, high alcohol intake, previous history of stroke, and illicit drug use (particularly cocaine)".* Non-modifiable risk factors indicated "*advanced age, negroid ethnicity, cerebral amyloidosis, coagulopathies, vasculitis, arteriovenous malformations (AVMs), and intracranial neoplasms"* (Magistris et al., 2013, p. 16).

Although symptoms of ICH may be associated with headache, nausea, vomiting, decreased consciousness, and elevated blood pressure, Magistris et al. (2013) note that clinicians face difficulty in diagnosing ICH because many of its symptoms are invisible. In contrast, ischemic stroke has more visible symptoms such as syncope, coma, neck stiffness, seizure, diastolic blood pressure (BP) of >110 mmHg, nausea, vomiting, and headache.

Early advancement of neurological deficits occur in ICH patients as a consequence of ongoing bleeding and enlargement of the hematoma in the early

stages (within the first few hours) (Broderick et al., 1999). For diagnosis of ICH, computed tomography (CT) is a popular method, while clinical studies also suggest the use of magnetic resonance imaging (MRI) due to its high level of sensitivity and specificity (Sahni & Weinberger, 2007).

- **Subarachnoid haemorrhage (SAH) strokes**

Subarachnoid haemorrhage stroke occurs due to arterial bleeding into the space between the two meninges, pia mater and arachnoidea (World Health Organisation, 2006b). Subarachnoid haemorrhage stroke accounts for 5% of strokes (Alway & Cole, 2009).

Warlow, Dennis, and Gijin (2001) have identified the principal symptoms behind diagnosing a subarachnoid haemorrhage: several and sudden headaches; nausea; vomiting; neck stiffness; photophobia; loss of consciousness; and epileptic seizure.

Hypertension is the major cause of SAH (American Stroke Association, 2015). It follows that, by controlling blood pressure and reducing the diastolic blood pressure, one is able to reduce the risk of SAH. However, due to uncertainty in the relationship between hypertension and SAH, SAH is difficult for the clinicians to control and offer treatment (American Stroke Association, 2015). However, treatment of high blood pressure with antihypertensive medication is recommended for the prevention of ischemic stroke, intracerebral stroke as well as subarachnoid haemorrhage (Bederson et al., 2009). The clinical literature also points towards the influence of certain genetic syndromes on the prevalence

of SAH. According to Bederson et al. (2009) genetic syndromes are highly connected with an increased risk of SAH and support the concept of inherited susceptibility.

1.1.4 Risk factors

Studies have investigated the risk factors underpinning the different types of stroke. Wityk and Llinas (2007) highlighted different factors associated with ischemic stroke. Medical risk factors include a history of diabetes, hypertension and cardiovascular disease. The main demographic risk factor is age, where the elderly are at a higher risk of stroke, especially if there is a family history of stroke. World Health Statistics (2012) defines 'elderly' as age 50 and above. The literature confirms that the risk of stroke increases with an increase in age. Behavioural risk factors consist of cigarette smoking and unhealthy lifestyles which lead to high blood pressure such as obesity and a lack of exercise. Physically, 60-80% of ischemic strokes can be attributed to high blood pressure, smoking, diabetes, high cholesterol and coronary artery disease (Wityk & Llinas, 2007).

Additionally, Brainin, and Heiss (2014) used the Framingham Stroke Risk Profile, which is commonly used to identify risk factors. The profile takes into account a range of risk factors that need to be considered in diagnosing a patient with stroke. These include: blood pressure, history of diabetes, cigarette smoking, cardiovascular disease, atrial fibrillation, and left ventricular hypertrophy on electrocardiogram.

1.1.5 Symptoms and diagnosis

According to The American Stroke Association (2015), the typical symptoms of stroke are likely to include:

- numbness, weakness or paralysis on one side of the body;
- slurred speech or difficulty finding words or understanding speech;
- blurred vision or loss of sight;
- confusion or unsteadiness;
- severe headache (usually associated with a bleed).

The American Stroke Association (2015) further added that diagnostic procedures should be performed to identify these symptoms, by clinical and radiological examinations, including:

- gathering a medical history
- performing a physical and neurological examination
- performing certain laboratory (blood) tests
- doing a computerised tomography (CT) or magnetic resonance imaging (MRI) scan of the patient
- studying the results of other diagnostic tests that might be needed

Additionally, CT and MRI scans are required to determine whether the stroke is caused by an infarction or a haemorrhage and to identify the location and size of the lesion (Warlow et al., 2001).

The Oxford Stroke Classification, also known as the Bamford classification (Bamford, Sandercock, Dennis, Warlow, & Burn, 1991) is commonly used to categorise ischemic strokes according to the localisation of damage in the cerebrum and the clinical symptoms, as shown in Table 1.1.

Table 1.1: Oxford Stroke Classification

Classification	Diagnosis
TACS: Total Anterior Circulation Stroke: Large cortical stroke in middle / anterior cerebral artery areas	All three of the following: 1. Unilateral weakness (and/or sensory deficit) of face, arm and leg. 2. Homonymous hemianopia. 3. Higher cerebral dysfunction (dysphasia, visuospatial disorder).
PACS: Partial Anterior Circulation Syndrome: Cortical stroke in middle / anterior cerebral artery areas	Two of the following: 1. Unilateral weakness (and/or sensory deficit) of face, arm and leg. 2. Homonymous hemianopia. 3. Higher cerebral dysfunction (dysphasia, visuospatial disorder).
POCS: Posterior Circulation Syndrome	One of the following: 1. Cerebellar or brainstem syndromes. 2. Loss of consciousness. 3. Isolated homonymous hemianopia.
LACS: Lacunar Syndrome Subcortical stroke due to small vessel in basal ganglia or pons	One of the following: 1. Unilateral weakness (and/or sensory deficit) of face and arm, arm and leg or all three. 2. Pure sensory stroke. 3. Ataxic hemiparesis.

Source: Reproduced from Bamford et al. (1991)

It has been noted that individuals with stroke may develop not only physical disabilities but also a wide range of mood and neuropsychological disorders. These include: depression (Beekman et al., 2000; Carod-Artal, Ferreira, Trizotto, & Menezes, 2008); anxiety (Burton et al., 2013); quality of life disturbance (Ahmad et al., 2005; Bays, 2001; Kim, Warren, Madill, & Hadley, 1999); aphasia (Carota, Staub, & Bogousslavsky, 2002; Kauhanen et al., 1999); and impairment of cognitive functions (Tatemichi et al., 1994). Accordingly, it has been suggested that neuropsychologists should be more actively involved than has hitherto been the case in the assessment and rehabilitation of those who have been diagnosed with stroke.

Having reviewed prevalence, types of stroke, risk factors, and their diagnosis and symptoms, the next section reviews the literature on stroke in Saudi Arabia.

1.2 Stroke in Saudi Arabia (KSA)

Before summarising past research about stroke in the Kingdom of Saudi Arabia (KSA), it is necessary to understand the demographic context and the rate of stroke prevalence in the KSA. Figure 1.1 below presents population statistics and distribution in different cities within KSA. A greater proportion of the population is aged 15 years and above, while a smaller proportion is aged 15 years and below. The figure also reveals the low growth and birth rates in the country.

Figure 1.1: Population in Saudi Arabia

Source: Reproduced from Al-Kawi (2013)

In their review of the recent literature on strokes in the KSA, Robert and Zamzami (2014) discussed the prevalence and incidence of stroke, noting that cases of stroke are increasing in the KSA, however, there is little recent research on the prevalence and incidence of stroke (Robert & Zamzami, 2014). Three studies have shown that the prevalence and incidence of strokes in KSA were low (126 per 100,000) in comparison with those in western countries (Al Rajeh & Awada, 2002;

Al Rajeh et al., 1993; Poungvarin, 1998). This may be due to the fact that a large proportion (42.49%) of the Saudi population is young people (15 years and less), as shown in Figure 1.1. Robert and Zamzami (2014) cited a study by Al-Rajeh et al. (1997) that reported that the incidence rate for individuals having a first stroke in Saudi Arabia was 29.8 per 100,000 each year. This study further highlighted that, in the past, the incidence rate of ischemic strokes in the KSA was 69%, compared to the rarest form of stroke, sub-arachnoid haemorrhage (SAH), which has an incidence rate of 1.4%. In contrast, Al Rajeh et al. (1993) found that between 1982 and 1992, in a hospital specifically for the Saudi Arabian National Guard, the annual incidence rate was 43.8 per 100,000.

Awada and Rajeh (1999) undertook an analysis of the first 1,000 consecutive patients with a first stroke, from two large hospitals in Saudi Arabia, since 1982 until 1999, and found the following types of stroke, in descending order of prevalence: ischemic heart disease, atrial fibrillation, rheumatic heart disease, congestive cardiomyopathy, mitral valve prolapse, prosthetic valve, congenital cardiopathy, patent foramen ovale, cardiac surgery, bacterial endocarditis (Awada & Rajeh, 1999). Importantly, 76% of all cases were ischemic strokes, and a third of these were lacunar infarcts. Most of the haemorrhagic strokes were Intra-Cerebral Haemorrhages (ICHs); however, 2% of all strokes were for SAHs. Other research by Al-Rajeh et al. (1991) and Emam, Ali, and Babikr (2009) also showed that the frequency of ischemic stroke was higher when compared with the other types.

1.2.1 Risk factors for stroke in KSA

Two studies have established risk factors for stroke in Saudi Arabia (Awada & Rajeh, 1999; El Sayed, Adeuja, El-Nahrawy, & Olaish, 1999). Analysing the 1,000 patients who had suffered their first stroke, Awada and Rajeh (1999) reported that the risk factors for stroke in Saudi Arabia were hypertension, diabetes, IHD, cigarettes, atrial fibrillation. In a prospective study of stroke, El Sayed et al. (1999) found that the main risk factor for stroke was the combined impact of hypertension and diabetes mellitus.

Awada and Rajeh (1999) also reported the likely causes of cerebral haemorrhages in the 1,000 patients. From highest to lowest prevalence, these were: hypertension, undetermined cause, blood dyscrasias, uncommon causes, arteriovenous malformations, tumour, mycotic aneurysm, pregnancy, renal transplant, heroin addict, amyloid angiopathy, CNS angeiitis. Sixty-two percent had hypertension, whereas, 22% of the 1,000 patents had an undetermined cause of stroke. Uncommon causes of cerebral infarcts were, in descending order of prevalence, which ranged from 2 to 9 people: pregnancy, meningitis, thrombocytes, polycythemia, oral contraceptives, sickle cell disease, and chronic lymphocytic leukrome (Awada & Rajeh, 1999).

1.2.2 Gender differences in stroke in KSA

Yaqub, Shamena, Kolawole, and Patel (1991) reported that men have higher rates of stroke than women. Al-Jadid and Robert (2010) confirmed these findings by stating that men are more at risk of stroke than women. Al Rajeh et al. (1993)

found that, out of 500 patients who had recently had a stroke, 13.6% were women and 68.4% were men.

1.2.3 Age differences in stroke in KSA

In their review of the recent literature on strokes in KSA, Robert and Zamzami (2014) found that Orzuza and Zurru (2011) had identified age as a risk factor for stroke. Orzuza and Zurru (2011) argued that, since there is an increasing population of older people, there might be 56.9 million nonagenarians in the world by 2050. They reported that this group of people has the highest incidence and prevalence of stroke and that this has a high impact on mortality and morbidity. In relation to strokes in the KSA, Al-Rajeh et al. (1989) found that the possibility of strokes increases until people are in their 70s. However, Al-Jadid and Robert (2010) found that stroke occurred more frequently in those aged 61-70 years, and less frequently in those aged between 20-40 years.

1.2.4 Public knowledge of stroke in KSA

Kamran et al. (2006) investigated public knowledge of stroke in Gulf Cooperation Countries (GCC), including Saudi Arabia, Oman, Bahrain, and Qatar. Interviewing 3,750 health care workers, they showed that knowledge of stroke in patients was low. For example, 29% knew the term 'stroke' and 29.3% believed those aged 30-50 were at most risk of having a stroke. Approximately 27.3% perceived smoking to be a risk factor, and 23.1% believed that hypertension was a risk factor. Symptoms of stroke were perceived by 21.7% of those interviewed to be ‘problems with speech’. ‘Blocked blood vessels’ was seen as a cause of stroke by 22%.

Better knowledge of stroke was found in those individuals who had a higher educational background. Lack of knowledge of stroke was found in those at higher risk, such as those with a poorer educational background and smokers.

1.2.5 Stroke care in KSA

Figure 1.2: Stroke programmes in Saudi Arabia

Source: Reproduced from Al-Kawi (2013)

A range of programmes has been designed by the KSA government in two cities for stroke care. Figure 1.2 shows that the main cities targeted through this programme are Riyadh and Jeddah. Two large medical centres have been established in Jeddah for stroke patients, while four large medical centres have been developed in Riyadh. This information was helpful for selecting primary investigation sites for the current study.

Al Khathaami et al. (2011) conducted telephone interviews with 83 neurologists to investigate their views on care practices for stroke in the KSA. The researchers

found that, out of 350 hospitals, one had a unit to deal with strokes and seven provided treatment for thrombolysis. The researchers estimated that 50 patients each year, out of 24 million inhabitants, were treated for thrombosis, which is a medical condition related to blood clot in the blood vessels. The neurologists saw an average of 362 patients requiring acute stroke care. The neurologists argued that priorities for acute stroke care in the country include: establishing more stroke units; increasing public awareness of stroke; providing training for providers of healthcare; and collaboration between providers. The researchers concluded that Saudi Arabia falls behind developed countries in stroke healthcare and knowledge about strokes is not being used to inform stroke practices, thereby leading to the provision of inadequate care for stroke patients.

Having reviewed the prevalence, risk factors, likely causes of stroke, gender and age differences in stroke, public knowledge and acute care of stroke in the Saudi context, the next section reviews the literature on cognitive dysfunctions after stroke. This is followed by a review of the literature on mood disorders after stroke.

1.3 Post-stroke cognitive dysfunction

Terms such as ‘dysfunction’, ‘impairment’, ‘decline’, ‘disorder’ and ‘deficit’ are often used to describe cognitive dysfunction after stroke. To avoid confusion in the terminology of this study, the term ‘post-stroke cognitive dysfunction’ is used to refer to the cognitive disorder in which the patient becomes, as a result of stroke, unable to perform mental tasks, such as remembering, awareness, comprehension and speech. This term may be sufficient given that neuropsychological tests, by their very nature, can provide general scores estimating a patient’s cognitive abilities.

Almost two-third of patients experience cognitive dysfunction after a stroke (Gialanella & Ferlucci, 2009). While some patients recover from cognitive dysfunctions within a few weeks after a stroke, the majority remain cognitively impaired permanently in attention, visuospatial ability, memory, language, and executive functions (Cumming, Marshall, & Lazar, 2013). In particular, the pattern and severity of cognitive dysfunction often depend on the location of the lesions in the brain (Lee et al., 2008). Frontal lobe stroke, for example, may lead to loss of motivation, attention, and inhibition (Robinson, 2006).

Many clinical studies have focused on the effects of stroke on cognitive function. Al-Qazzaz, Ali, Ahmad, and Islam (2014) conducted a review of studies of the assessment of post-stroke dementia based on patients’ stroke risk factors and cognitive function within the first 3 months after stroke onset. Based on a review of 19 articles, the results showed that there is a relationship between the individual

risk factors and post-stroke vascular dementia development. Numerous risk factors such as cardiovascular disease (CVD), hypertension, heart disease and hyperlipidemia were identified. Diabetes mellitus was also one of the other risk factors highlighted. Moreover, where age and sex were determined as non-modifiable risk factors, the findings revealed a correlation between the risk of vascular dementia and being of an older age. On the contrary, the results showed no significant relationship between dementia development and patients' sex. CVD was identified as a major risk factor for cognitive impairments. Importantly, this research demonstrated a visible connection between a risk factor and the decline or even loss of one or more cognitive functions in almost all of the studies reviewed (Al-Qazzaz et al., 2014).

Similarly, Van Rijsbergen, Mark, de Kort, and Sitskoorn (2014) determined the prevalence of subjective cognitive complaints after stroke through a literature review. This found that the prevalence of subjective cognitive complaints (SCC), assessed between 1 month and 54 months after a stroke, varied between 28.6% and 92%. A large portion of these complaints related to memory, mental speed, and concentration. However, language-related cognitive complaints were found to a lesser extent. These complaints were also more prevalent among the post-stroke patients as compared to the control groups. Demographic and clinical characteristics were not significantly associated with the prevalence of subjective cognitive complaints. On the other hand, depressive symptoms were found to be positively correlated with SCC (Van Rijsbergen et al., 2014).

1.3.1 Prevalence of post-stroke cognitive dysfunction

The reported prevalence of cognitive dysfunction after stroke varies enormously between populations according to the time elapsed since the stroke (Middleton et al., 2012). Leśniak et al. (2008) assessed the frequency of cognitive disorders two weeks after a first-ever stroke and re-evaluated the frequency at a one-year follow-up. In the acute phase, the authors found that the most frequent cognitive dysfunctions were in the domains of attention (48.5%), aphasia (27%), short-term memory (24.5%), and executive functions (18%). At the one-year follow-up, attention disorder was the most frequent symptom. On other hand, executive dysfunction, aphasia, and short-term memory disorder were significantly less frequent than in the acute stage. In another study, Blake, McKinney, Treece, Lee, and Lincoln (2002) investigated the sensitivity and specificity of the screening battery using 12 neuropsychological tests. The results showed that over 70% of patients were cognitively impaired on each of the measures within one month of a stroke. The frequency of impairment in descending order was as follows: verbal memory (56%), executive functions (52%), spatial perception (51%), visual memory (42%), language (40%), visual inattention (26%), and visuospatial perception (11%).

Similarly, Tatemichi et al. (1994) concluded that, three months after admission to hospital for a stroke, the frequency of impairment in the following domains was as follows: memory (19.5 to 24.6%), orientation (25.8%), language (13.3 to 32.7%), visuospatial skills (16.8 to 25%), abstract reasoning (16.1 to 20.1%) and attention (20.2 to 38.5%). They also found that 26% patients were diagnosed with dementia

3 months after an ischemic stroke. In another investigation, Bogousslavsky and Cummings (2000) found that the prevalence of cognitive impairment was 35-70% three months after a stroke occurred, and that the most frequently impaired cognitive domains were: memory, orientation, language, attention, visuospatial and visuo constructive tasks, arithmetic, and speed of information processing.

The influence and prevalence of post-stroke cognitive dysfunctions can be better analysed by examining each domain. The following sections discuss in detail a selection of dysfunctions.

1.3.2 Post-stroke cognitive dysfunctions by domain

In addition to overall cognitive dysfunction, the five cognitive domains that were selected for study were: impairments in attention, memory, language, visual neglect and executive functions.

1.3.2.1 Attention deficits

Attention deficit is the inability to concentrate on a particular event (Lezak, 2004). It is frequently associated with right-hemisphere damage (Barker-Collo, Feigin, Lawes, Senior, & Parag, 2009) and occurs in 46-92% of stroke patients (Lincoln, Kneebone, Macniven, & Morris, 2012). However, recent studies have shown that the time elapsed since the stroke and the subtype of attention disorder may influence the prevalence of attention deficit (Hurford, Charidimou, Fox, Cipolotti, & Werring, 2013; Hyndman & Ashburn, 2003; Hyndman, Pickering, & A. Ashburn, 2008; Stapleton et al., 2001).

With regard to time elapsed since the stroke, Barker-Collo et al. (2009) found that 50% of patients had severe impairment in attention three weeks after the stroke. Nys, et al. (2006) concluded that, within the acute phase of stroke, namely, one month, 45-71% of stroke patients demonstrate severe attention deficit. Wehling et al. (2012) found that, 12 months after the stroke, 61% of patients had attention disorder. In a follow-up, Rasquin, Lodderb, Winkens, Jolles, and Verhey (2004) found that the frequency of attention deficit was 32%, 34%, and 30.6%, 1, 6 and 12 months after stroke, respectively.

However, different categories of attention deficit have been identified. For example, it was found that sustained attention deficit is very common in stroke patients (Chen, Koh, Hsieh, & Hsueh, 2009). Individuals with this disorder cannot remain focused on a specific task for a long period of time (McAvinue, O'Keeffe, McMackin, & Robertson, 2005). Consequently, they develop poor balance and have poor functional outcomes (Hyndman & Ashburn, 2003).

Another type is selective attention which enables a person to concentrate on a particular stimulus even when a distraction is present (Kellogg, 2011). Both auditory and visual selective attention disorders are frequent in stroke patients. Thirty-six percent of stroke patients had auditory selective attention disorder, whereas 37% of them had visual selective attention disorders, 12 months after the stroke (Hyndman, Pickering, & Ashburn, 2008).

Divided attention allows an individual to handle two or more tasks at one time (Bernstein, 2013). Disorder in divided attention negatively affects functional

recovery after a stroke, although there is insufficient evidence of its direct influence on long-term functional outcomes post stroke (Lincoln et al., 2012).

Evidence suggests that, after a stroke, some types of attention deficit occur more frequently than others. In a pilot study, Stapleton, Ashburn, and Stack (2001) found that 46% of stroke patients suffered from sustained attention deficits, 62% were impaired on tests of auditory selective attention, and nearly 92% presented with impairment scores on tests of visual selective attention. Similarly, Hyndman and Ashburn (2003) found that approximately 10% of stroke patients have visual inattention, 31% have deficits of sustained attention, 19% have auditory selective attention, 35% have visual selective attention, and 43% have divided attention deficits.

In sum, based on the findings of the above literature, attention deficit can be defined as a loss of the ability to concentrate on a specific task that can be evaluated in a neuropsychological manner. Although impaired attention is frequent after a stroke, the prevalence varies according to the type of attention and the time elapsed between the stroke and the assessment. Previous studies have detected sustained, selective, and divided attention disorders in stroke patients. The prevalence of attention disorders might be higher during the acute phase of stroke than in later stages.

1.3.2.2 Memory disorders

Memory function allows a person to store information in the brain and remember it at differing times. In addition, it often involves different types of mental

functions such as a manipulation of information, talking, learning, reading, writing, and recognising previous experiences. Thus, damage in the memory processing areas of the brain after a stroke may cause forgetfuless, confusion, loss of concentration and recollection of personal experiences. Such disorders may have serious implications for the quality of life of the stroke patient.

Post-stroke memory disorders are commonly related to damage in areas of the brain such as the cortex, hippocampus and temporal lobe. Associations between stroke in these brain areas and post-stroke memory dysfunction have been studied widely. For example, Jokinen et al. (2004) evaluated the relationship between mild temporal lobe atrophy and memory deficit in a consecutive cohort of elderly non-demented patients with ischemic stroke. A total of 260 patients were assessed on the Wechsler Memory Scale (WMS). After controlling for the effects of age, the total volume of the infarcts and general cortical atrophy, the results showed that the patients with moderate and severe mild temporal lobe atrophy had poorer performance in memory functions.

Burton et al. (2004) compared 96 stroke patients and 23 people without dementia to explore correlations between the volume of white matter hyperintensties and impairments in memory and other cognitive functions. According to this study, memory deficit was significantly associated with the volume of right temporal white matter hyperintensities, whereas working memory was significantly associated with the volume of left temporal white matter hyperintensities.

Although there is evidence that lesions in the temporal lobe may play an important role in memory disorders after stroke, recent studies have found that memory deficits might be manifested when the stroke is diagnosed either in the temporal lobe or in other parts of the cerebrum. This may be due to the complexity of the memory system and number of different parts of the brain deing involved in remembering or recognising information. Accordingly, it is difficult to determine which specific lesions lead to memory impairment after stroke (Baddeley, Kopelman, & Wilson, 2004). In this regard, Chen, Sun, and Liu (2005) have summarised lesion locations which may lead to post-stroke memory disorders. Table 1.2 shows that stroke in different regions can also lead to memory problems. Stroke in the frontal lobe, basal ganglia and thalamus can negatively affect digit-span memory, whereas stroke in both the right and left hemispheres may cause language memory impairment. Other memory abilities such as visual recall may be associated with strokes in the thalamus as well as in the partial and basal ganglia.

Table 1.2: Associations between lesion locations and cognitive dysfunctions

Location	Cognitive dysfunction
Frontal lobe stroke	Executive function Digit span memory
Partial stroke	Executive function Language memory Visual recognition
Basal ganglia stroke	Digit span memory Language memory
Thalamus stroke	Executive function Digital span memory Visual recognition Visual recall
Partial and basal ganglia stroke	Executive function Language memory Visual recognition visual recall
Left and right side stroke	Language memory Visual recognition

Source: Adapted from Chen, Sun, and Liu (2005)

These findings have been supported by Lim and Alexander (2009) who studied the type of memory dysfunction caused by each stroke subtype, shown in Table 1.3. They found that verbal memory impairment can be caused by stroke in different parts of the brain such as the hippocampus and anterior thalamus, while visual-spatial memory impairment may relate specifically to stroke in the right regions (right PCA, right anterior thalamus, and right genu internal capsule). Deficits in retrograde memory can be related to bilateral and medial thalamus stroke rather than to other regions.

Table 1.3: Summary of stroke subtypes causing memory disorders

Location/vascular territory	Anatomy	Memory deficits	Associated deficits
Left PCA	Hippocampus Medial temporal lobe Collateral isthmus	Verbal memory	Visual field deficits Colour agnosia Alexia without agraphia Anomia
Right PCA	Hippocampus Medial temporal lobe Collateral isthmus	Visuospatial memory	Visual field deficits Prosopagnosia
Bilateral PCA	Hippocampus Medial temporal lobe Collateral isthmus	Explicit memory Retrograde memory	Cortical blindness Apperceptive agnosia Associative agnosia
Left anterior thalamus	Anterior thalamus Mammillothalamic tract Internal medullary lamina	Verbal memory Visuospatial memory	Executive dysfunction Mixed transcortical aphasia
Right anterior thalamus	Anterior thalamus Mammillothalamic tract Internal medullary lamina	Visuospatial memory	Executive dysfunction Visuoperceptual deficits
Left genu internal capsule	Anterior thalamic peduncle Inferior thalamic peduncle	Verbal memory	Frontal lobe system
Right genu internal capsule	Anterior thalamic peduncle Inferior thalamic peduncle	Visuospatial memory	Frontal lobe system
Medial thalamic	Dorsomedial nucleus Centromedian nucleus Internal medullary lamina	Verbal memory Visuospatial memory Retrograde memory	Hypersomnolene Attentional deficits Ocular motility
Basal forebrain	Septal nucleus	Verbal memory Visuospatial memory	Confabulation Executive impairment Anosognosia for amnesia

Source: Adapted from (Lim an Alexander (2009)

On other hand, the clinical literature has categorised memory impairments in stroke into long-term, short-term and working memory.

- **Long-term memory disorder after stroke**

Rovee-Collier, Hayne, and Colombo (2000) defined long-term memory as an important subdivision of the individual's consciousness mind. According to the authors, long-term memory has unlimited storage and includes previous experiences and learnt skills. It is called *'concrete memory'* or '*remote memory'*

because most of the information is retained for a long time, maybe years or decades (Rovee-Collier et al., 2000). Furthermore, the long-term memory itself has been subdivided based on function. (1) *Explicit memory* is roughly equivalent to memory with consciousness or memory with awareness. It is divided into *episodic memory*, which enables the subject to recall events, and *semantic memory*, which refers to an ability to recollect facts about the world. (2) *Implicit memory*, on the other hand, refers to situations in which previous experiences facilitate performance on tests that do not require intentional or deliberate remembering.

Little consensus exists about which brain systems have an effect on episodic or semantic memory after stroke. Few studies have examined the effect of stroke on these two memories. Godefroy, Roussel, Leclerc and Leys (2009) examined 63 stroke patients to determine the anatomy of episodic memory disorders. A neuropsychological battery and neuroradiological assessment by CT scan were used. The results showed that the verbal episodic memory deficit was correlated with thalamic, medial temporal, frontal, centrum semiovale and lenticular lesions, with a predominance of left-hemisphere lesions.

- **Short term memory disorder after stroke**

According to the literature, short-term memory is distinct from long-term memory. Short-term memory enables humans to store information for a few seconds or minutes before it is transferred to long-term memory by another control process. This type of memory has a limited capacity to store information; the information appears to be in a state of fragility and quickly forgotten.

As a temporary and limited store, the information in short-term memory may be affected by stroke. Campos, Barroso, and Lara Menezes (2010) assessed the influence of stroke on memory encoding, storage and retrieval processes and the implications for motor practice. Twenty-four participants were divided into two groups: 12 with unilateral stroke and a healthy group of 12. A neuropsychological battery was administered including immediate figure recognition, immediate free word recall, late figure recognition and late word recognition. There were significant differences between patients and the control group with regard to visual and verbal encoding and verbal storage, but no significant differences on visual and verbal retrieval tests and visual storage. In addition, patients with lesions of the right hemisphere had a lower score on the visual coding process, while patients with left-hemisphere stroke obtained a lower score on verbal storage and verbal retrieval (Campos et al., 2010).

- **Working memory disorders after stroke**

It is thought that short-term memory and working memory are distinct and each has different characteristics. Information in short-term memory is often held passively, whereas information in working memory is stored by active processes and usually needs other executive functions, such as comprehension, problem-solving and reasoning, to complete the processing.

Working memory has been classified into two major types. *Verbal working memory* is for understanding and producing language (Weismer, Evans, & Hesketh, 1999), while *visual-spatial working memory* is used to remember the progression of

events, forms, and mathematics skills (Cornoldi & Vecchi, 2004). The site of the stroke is thought to be related to different types of working memory impairment.

In the light of this hypothesis, Meier et al. (2011) examined the impact on working memory performance of stroke and transient ischemic attack (TIA) in the left and right hemispheres. To examine the effects of age on working memory performance, the participants were divided into two groups: younger (<50 years) and older (>50 years). The results showed that older stroke patients had significantly more deficits than older TIA patients in encoding time and response time. In addition, the older right-hemisphere stroke patients had significantly more deficits than did the older TIA patients in encoding time and response time.

Similarly, Philipose, Alphs, Prabhakaran, and Hillis (2007) evaluated – in acute stroke patients only – whether right-hemisphere impairment causes deficits in spatial and verbal working memory, while left-hemisphere dysfunction causes impairment in verbal working memory. Working memory components include the ability to: (1) encode information, (2) accurately retain this information, and (3) retrieve the information. An examination of 94 patients with stroke and transient ischemic attack showed that a high percentage of stroke patients had spatial span deficits and verbal working-memory impairment. Moreover, patients with cortical stroke showed more deficits in spatial span than did those with TIA. Both right and left cortical stroke patients had significant deficits in verbal working memory.

These two studies support the idea that the type of working memory disorder depends on the location of the stroke, whether in the left or right hemisphere. It

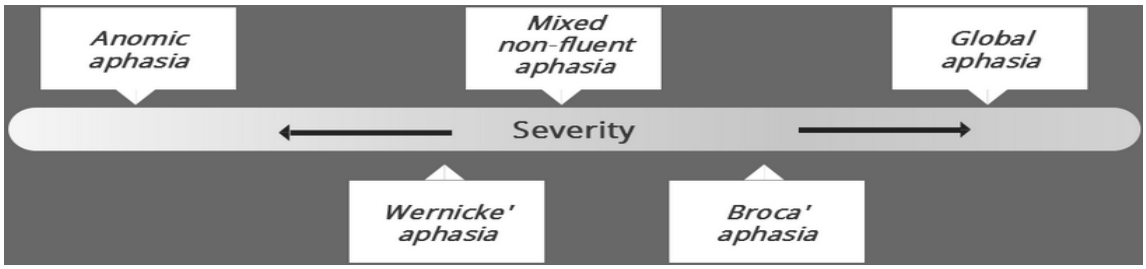
appears that patients with left-hemisphere stroke suffer from verbal working memory deficits because this side consists of language components (Broca's and Wernicke's areas), while damage in the right hemisphere is related more to visuo-spatial working memory impairment.

1.3.2.3 Language disorders

As noted by Dark and Sander (2014, p. 32), *"Language is a complex process that is at the heart of our functioning as social beings. There are many different ways that it can be damaged by a stroke"*. These include aphasia, alexia, agraphia and acalculia (Sinanović, Mrkonjić, Zukić, Vidović, & Imamović, 2011). Among the language disorders after a stroke, aphasia is the most common disorder. It can be categorised into disorders relating to fluency and comprehension abilities and can affect all modalities of language. According to the National Aphasia Association (2015), about 25% - 40% of patients who survive have aphasia after a stroke.

Aphasia can be divided into five broad categories based on which location of the brain is affected post stroke. Figure (1.3) summarises the common types of aphasia.

Figure 1.3: Categories of aphasia



Source: Reproduced from The National Aphasia Association (2015)

- **Global aphasia:** This form is the most severe type of aphasia. Survivors with global aphasia have difficulty speaking and understanding words. In addition, patients can neither read nor write.
- **Broca's aphasia (non-fluent):** Broca's aphasia is sometimes called expressive aphasia. It involves severe reduction in speech outputs, short utterances (less than four words); and limitation in vocabulary access. The formation of sounds is often laborious and clumsy.
- **Wernicke's aphasia (fluent):** Wernicke's aphasia is often described as a receptive aphasia. In this type of aphasia, patients can produce connected language and are sometimes able to hear a voice or read the print, but they may have difficulty understanding the meaning of the messages.
- **Anomic aphasia:** It is also known as 'anomia' because the patient struggles to supply the words for the very things they want to talk about particularly the significant nouns and verbs.
- **Primary progressive aphasia:** This is a rare disorder in which patients slowly and progressively lose their ability to talk, read and write, while other cognitive functions remain intact.

The severity of aphasia can range from relatively mild to very severe. With mild aphasia, patients may be able to converse, but have difficulty understanding complex conversations and finding the right word, with incorrect words occasionally coming out. Aphasia can also be severe. The patients may not be able to speak at

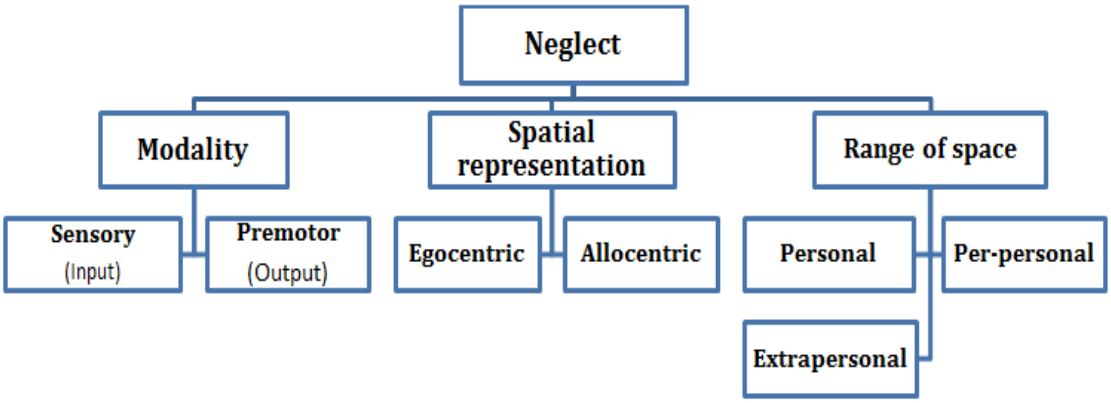
all and may not participate in or understand any conversation (The National Aphasia Association, 2015).

1.3.2.4 Visual neglect

Visual neglect, also known as visual inattention or hemispatial neglect, is a type of perception disorder that occurs because of stroke or traumatic brain injury. It is defined as *"a neurological disorder characterized by deficit in attention to stimuli on one side of the body, almost invariably contralateral to the side of cerebral lesion"* (Ting et al., 2011, p. 114).

According to Vallar (1998), visual neglect can be classified into different subtypes. Figure 1.4 summarises the different manifestations of visual neglect.

Figure 1.4: Manifestations of visual neglect



Source: Adapted from Ting et al. (2011)

- **Modality (input/output)**

  According to Ting et al. (2011), neglect is divided into sensory (input) and premotor (output) neglect. Sensory neglect is described as a failure to be aware of the sensory stimuli of different modalities, including tactile, auditory, and visual

in contralesional hemispace. In the case of premotor neglect, the ability to be aware of the stimulus is intact, but patients are unable to attend to the limbs in contralesional hemispace.

- **Spatial representation**

Likewise, in the study of Ting et al. (2011), spatial representation includes two subtypes: egocentric visual neglect (viewer-centred) and allocentric visual neglect (stimulus-centred). The former is characterised by a failure to orientate to stimuli in the contralesional hemispace with respect to the sagittal plane of the body, head and eye. In contrast, allocentric visual neglect is the inability to pay attention to the contralesional side of individual items. Whereas egocentric visual neglect is a disorder related to the position of the body or the patient's own personal space, allocentric visual neglect is an unawareness of the space within the patient's normal reach and the objects or environment beyond the body's current contact or reaching ability.

- **Range of space**

Range of space has been divided into personal, per-personal, and extra personal visual neglect. This classification is widely adopted in clinical practice during the assessment of visual neglect.

Clinically, it is important to note that visual neglect is not hemianopia, which refers to visual-field loss on the left or right side of the vertical midline (Lincoln et al., 2012), and it must be distinguished from visual extinction as well. In the case of visual extinction, impairment in awareness appears when stimuli are presented

on both sides simultaneously, whereas awareness is apparently normal when a stimulus is presented to a single side (Rees et al., 2000). In contrast, individuals with visual neglect lose the ability to respond or orient to meaningful stimuli on the contralesional side of space (Heilman, Watson, & Valenstein, 1993).

Patients with stroke are at an increased risk of developing visual neglect more than other neurological disorders. It is classically related to right-hemisphere stroke especially in posterior lesions in the parietal lobe; however, the evidence based on CT-scan results suggests that the frequency of visual neglect differs according to the location of the lesion after stroke. For instance, Nys et al. (2006) found that the prevalence of visual neglect is associated with the lesions in the both hemispheres of the brain. Within the first week of stroke, 28.6% of patients with left cortical stroke and 51% of those with right cortical stroke demonstrated neglect disorder, while only 17.6% with left subcortical stroke and 36% with right subcortical stroke developed neglect disorder. Additionally, Ringman, Saver, Woolson, Clarke, and Adams (2004) found that visual neglect after stroke was most frequently associated with lesions involving the temporal lobes (right 33%, left 43%), parietal lobes (right 60%, left 49%), parieto-temporal lobes (right 75%, left 42%), frontal lobes (right 42%, left 25%), fronto-partial lobes (right 57%, left 42%), occipital lobes (right 50%, left 33%), basal ganglia (right 24%, left 15%), and thalamus (right 44%, left 31%).

Studies based on neuropsychological tests have found that the prevalence of visual neglect after stroke is between 5.5% and 85% (Azouvi et al., 2002; Bowen,

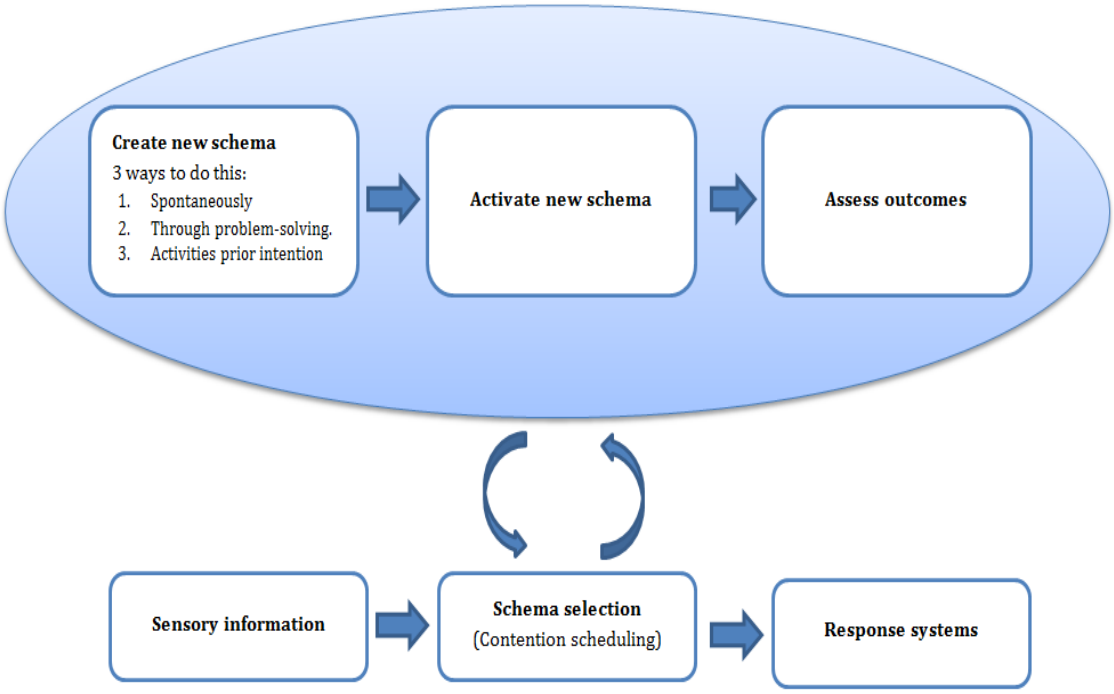
McKenna, & Tallis, 1999; Leśniak et al., 2008; Menon-Nair, Korner-Bitensky, Wood-Dauphinee, & Robertson, 2006; Nys, et al., 2006). The inconsistent rate of visual neglect disorder after stroke in those studies could be explained by insufficient awareness of this condition or it could reflect difficulties in detecting visual neglect in the presence of other, more acute medical conditions such as dysphasia, hemianopia or hemiplegia (Ting et al., 2011). Additionally, factors such as sampling, timing, and methods of assessment are important factors in the variance of the prevalence of visual neglect (Lincoln et al., 2012).

1.3.2.5 Executive dysfunctions

The concept of executive functions incorporates multiple cognitive domains. Executive functions can be defined as a series of mental abilities that enable an individual to cope with new situations, determine goals, create new and useful ways of achieving them, and effectively resolve the challenges they encounter in everyday life (Goldstein & McNeil, 2012). Similarly, Lezak (1982) reports that executive functions comprise goal formulation, planning, carrying out activities and effective performance.

Shallice and Burgess's theory (1996), cited in Goldstein and McNeil (2012), presents a general way of understanding the relationship between executive functions and the various parts of the brain.

Figure 1.5: Supervisory attention system



Source: Adapted from Goldstein and McNeil (2012)

Figure 1.5 shows the Supervisory System Model which specifies how thought and action schema become activated or suppressed for routine and non-routine circumstances. Every stimulus in the environment activates a schema for action and/or problem-solving processes, which determines a person's actions or thoughts. The schemas that are triggered can be sufficient to accomplish appropriate behaviours in routine situations. Under non-routine procedures, an executive monitoring system called the Supervisory Attentional System (SAS) controls schema activation. Because the Supervisory System is supported by the frontal lobe, damage to the frontal lobe can lead to a disturbance of the supervisory system and consequently to behavioural disorders (Goldstein & McNeil, 2012).

A new version of the theory by Cooper and Shallice (2000) proposed that this system is composed of a number of distinct modules which work together to support different types of executive function (e.g., inhibition, initiation, prospective memory etc.). Furthermore, these executive functions may be supported by different regions within the prefrontal cortex and posterior cortex (Goldstein & McNeil, 2012).

Difficulties in executive functions after stroke have traditionally been associated with frontal lobe injury (Baddeley, 1998). However, Lincoln et al. (2012) argued that executive dysfunctions could occur when other regions in the brain are damaged after stroke. This is because executive functions usually work in coordination with other cognitive abilities such as memory and language. This viewpoint that lesions in different parts of the brain after stroke can lead to executive dysfunction has been supported by recent research. Park, Yoon, and Rhee (2011) assessed executive dysfunctions and their associations with stroke in the occipital lobe. Twelve stroke patients underwent a neuropsychological screening battery including executive functions, attention, language, praxis, visuo constructive, visual and verbal memory tests. The findings revealed that seven of eight patients with lesions in the occipital lobe, which extended into the hippocampus or the splenium, demonstrated impairment of executive functions. Another study, by Nys, et al. (2006) found that the prevalence of executive dysfunction was 71.4% in patients with left cortical stroke, whereas nearly 43.8% of patients with right cortical stroke demonstrated deficits in executive functions.

1.3.3 Rationale for the study of post-stroke cognitive dysfunctions in Saudi Arabia

The literature review concluded that cognitive dysfunctions after stroke can affect all aspects of an individual's life. The effects depend on the severity of the cognitive dysfunction and what type of cognitive functioning is impaired, such as attention, memory, perception and language. The effects of these impairments have lasting impacts on the daily life activities experienced by the individuals. In this regard, Gottesman and Hillis (2010, p. 895) highlight that *"individuals can recover from physical disability resulting from stroke, but might be unable to return to their previous occupations or independent life because of cognitive impairments"*.

The term 'cognitive dysfunction post stroke' refers to a complex phenomenon, incorporating multiple domains. According to Cumming et al. (2013) cognition as a mental function is complex in that it has multiple spheres of influence on our everyday functioning, and each cognitive domain is interdependent for executing the different functions. They further describe cognitive domains in terms of different categories such as attention, executive function, visuospatial ability, memory and language. In context of attention, the authors refer to several tasks that can direct a specific stimulus or task including concentrating, modifying, dividing and maintaining attention. On the other hand, executive functioning refers to tasks related to planning, organisation of thoughts, and self-consciousness defining the extent of individual's control. Similarly, memory is defined as a domain related to the recalling and recognition of visual and verbal information and data. With the

help of the language domain, it becomes easier for individuals to express and receive feelings and thoughts (Cumming et al., 2013).

Additionally, in the context of assessing the literature for the clinical instruments used to study post-stroke cognitive dysfunctions, the researcher evaluated the effectiveness, specificity and 'severity of dysfunctions and disorders' of several studies. Cullen, O'Neill, Evans, Coen, and Lawlor (2007) conducted a systematic review of cognitive screening tests for neurological diseases including stroke, and examined the evidence for their validity. They found that different cognitive screening tests, which expanded on the Mini-Mental State Examination (MMSE), rated highest in terms of encompassing key cognitive domains and validity. However, the MMSE has been criticised for its limited ability to assess the extent to which cognitive deficits affect functioning after stroke (Bour et al., 2010; Dong et al., 2010; Lincoln et al. 2012). In addition, the MMSE has been criticised for its insensitivity for assessing specific neuropsychological domains such as visuospatial and executive function impairments after stroke (Dong et al., 2010). In this context, Lincoln et al. (2012) suggested the use of a neuropsychological battery for assessing cognitive domains in stroke patients, who have passed an initial screening assessment. To those who are still in the acute stage, they argue that using a brief screening instrument, such as the Addenbrooke's Cognitive Examination-Revised (ACE-R) (Mioshi et al., 2006), is more practical. The authors further argue that the psychometric properties of the ACE-R instrument is also supportive for acute stage patients (Lincoln et al., 2012).

A study by Morris, Hacker, and Lincoln (2012), assessed the effectiveness and reliability of using the Addenbrooke's Cognitive Examination-Revised (ACE-R) as a screening measure for detecting cognitive impairment after stroke. From a sample size of 101 participants who completed the ACE-R, the results showed that this measure is highly effective in the screening of cognitive functions in acute stroke patients. Despite its effectiveness in assessment, however, there were no-cut-off points identified for any of the subscales for specificity and sensitivity in detecting impairment in specific areas of cognitive functioning (Morris et al., 2012).

Other relevant literature considers overall cognitive dysfunction as a rapidly increasing problem after stroke and a major cause of disability in Saudi Arabia. A review of the literature pertaining to post-stroke cognitive dysfunction suggested that impairments in cognitive function have a significant influence on the rehabilitation outcomes and the quality of life of individuals after a stroke in a Saudi sample (Abdul-sattar & Godab, 2013). Therefore, it is important to know the prevalence of cognitive dysfunction post stroke in specific populations of health-service users in order to plan and develop health services effectively.

The literature review also concluded that research in the area of post-stroke cognitive dysfunctions in Saudi Arabia is severely lacking. Studies have neglected the incidence, prevalence and socio-demographic properties of stroke patients, and the topics that have been investigated remain insufficient. The present study therefore used robust methods for assessing post-stroke cognitive dysfunctions – from overall cognitive dysfunction to orientation/attention, memory, fluency,

language, visuospatial ability, visual neglect, visual-motor skills and executive-function impairments – specifically, for determining the prevalence of cognitive dysfunction after stroke in Saudi Arabia population.

Having discussed post-stroke cognitive dysfunction, the following section addresses post-stroke mood disorders.

1.4 Post-stroke mood disorders

Stroke patients can suffer from mood disorders which will exacerbate stroke outcomes (Anderson et al., 2014). Influence of these disorders can increase mortality and disability rates, while also increasing the duration of the hospital stay and negatively affecting a patient's daily functioning, interpersonal relationships and quality of life (Leppävuori, Pohjasvaara, Vataja, Kaste, & Erkinjuntti, 2001; Townend et al., 2007).

According to the American Stroke Association (2015), numerous mood disorders are associated with stroke, including depression, anxiety, emotionalism, anger, personality changes, other behavioural disturbances (American Stroke Association, 2015). However, among these different types of mood disorders, this study focuses on two specific disorders: anxiety and depression after stroke.

1.4.1 Anxiety after stroke

Anxiety disorder is mental health condition that covers a wide range of psychiatric disorders. These include panic attacks, agoraphobia, social phobia and specific phobia (American Psychiatric Association, 2013). The term 'anxiety disorder due to

a general medical condition' is commonly used to describe symptoms of anxiety that are gauged to be a direct physiological consequence of a medical ailment, such as a stroke (American Psychiatric Association, 2013). However, most studies use the term 'anxiety after stroke' to describe a worried mood caused by a stroke (Warlow, Dennis, & Gijn, 1998; Leśniak, Bak, Czepiel, Seniow, & Członkowska, 2007). It is clinically characterised by symptoms such as restlessness, being easily fatigued, difficulty concentrating or frequently experiencing the mind going blank, irritability, muscle tension and sleep disturbance (American Psychiatric Association, 2013). In addition, a range of other symptoms are also considered to indicate anxiety in stroke patients, such as a fear of falling, avoiding people in meetings, and experiencing memories and flashbacks of the stroke (Ayers et al., 2007).

In the differential diagnosis, structured and semi-structured interviews are usually applied to the diagnostic criteria of anxiety after stroke (Robinson, 2006). However, Lincoln et al. (2012) have argued that clinical interviews take too long time and require specific interview skills, therefore using standardised questionnaires, either self-administered or administered by professionals, are preferable. Accordingly, several researchers have investigated anxiety after stroke using validated questionnaires, including the Beck Anxiety Inventory (BAI) and the anxiety subscale of the Hospital Anxiety and Depression Scale (HADS).

While anxiety disorder occurs in any period after the stroke in about 20 - 25% of patients (Burton et al., 2013), the length of time elapsed since the stroke is a

critical factor in the prevalence of anxiety. Barker-Collo (2007) found a 21.1% prevalence of anxiety, from moderate to severe, among patients three months after the stroke. Meanwhile, Aniello et al. (2014) who examined the prevalence of anxiety disorder based on the length of time elapsed since the stroke, found that anxiety incidence rates increased most notably during the chronic stage of the stroke, with prevalence levels reaching 20%, 23% and 24% after 1, 5 and 6 months after the stroke, respectively. Recently, Burton et al. (2013) conducted a systematic review of 44 studies aimed at estimating the frequency of anxiety after stroke. The results showed that the prevalence of anxiety disorders was approximately 20 – 25% at any time after stroke. Three studies reported that one-third of stroke patients with anxiety had a history of mood disorders prior to the stroke. Ten studies found that 17–80% of stroke patients had anxiety and depression symptoms. Meta-analyses found a non-significant increase in the frequency of anxiety after stroke. During the acute phase of stroke, 19-27% of patients develop anxiety disorders. At 1-5 months post stroke, the prevalence of anxiety disorder was 23%. At 6 months and over, 24% of stroke, patients had anxiety disorder. This systematic review also discussed the frequency of anxiety disorder in three treatment settings. The authors concluded that prevalence of anxiety disorder in the acute phase, in rehabilitation-based settings, was significantly lower than in other settings. The estimated prevalence was 25% in population-based settings, 25% in hospital-based, 22% in community-based, and 21% in rehabilitation-based.

Additionally, the rate of prevalence for anxiety disorder varies depending on the assessment method used. The prevalence of anxiety disorders was found to be

18% when assessed by clinical interviews but this increased to 25% when assessed using a rating scale (Barker-Collo, 2007). It has also been observed that anxiety disorder occurs in female patients more than in male. For example, Burvill et al. (1995) found the prevalence to be 5% in men and 19% in women after four months of stroke.

Studies examining the neuroanatomical issues associated with anxiety disorder after stroke have been limited. A small number of studies have identified associations between anxiety disorder and the location of the stroke lesion (Bergersen, Frøslie, Sunnerhagen, & Schanke, 2010). According to Carota, Bogousslavsky, and Fisher (2009), anxiety with no simultaneous depression symptoms has the potential to affect right cortical lesions. On the other hand, within those patients who are already suffering from anxiety co-morbid with the depression, the likelihood of left cortical damage is most evident (Carota et al., 2009). A study by Tang et al. (2012) investigated the association between anxiety disorder and frontal lobe infarcts. They reported that, in comparing patients with anxiety after stroke with those without anxiety, the presence and location of anxiety disorder is more likely to occur in the right frontal acute infarcts. These infarcts were also analysed as the independent predictors of the anxiety disorder, which play a vital role in the development of the disorder. An investigation by Åström (1996), found that post-stroke anxiety was associated with right-hemispheric lesions. Likewise, Castillo, Starkstein, Fedoroff, Price, & Robinson (1993) found that post-stroke anxiety alone (without depression) was associated with right-hemisphere lesions.

Despite identifying a potential relationship between lesion location and anxiety disorder after stroke, the current literature does not offer a neuroanatomical model of anxiety disorder after stroke. Additionally, anxiety disorder can co-occur with other psychiatric disorders such depression.

1.4.2 Depression after stroke

Depression is a serious mental health illness, which is usually accompanied by various clinical features. Depression after stroke is a term used to identify mood disturbance among patients diagnosed with cerebral or haemorrhagic stroke. Comparable terms in previous studies include depressive mood, mood disorder, emotional disorder, and psychological distress. Medically, the criteria of the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) and of the Classification of Mental and Behavioural Disorders (ICD-10) are used to diagnose depression after stroke. Specifically, it is classified under ‘mood disorder due to a general medical condition’.

Clinical features have taken account of the frequency of occurrence and severity of depression after stroke in understanding various symptoms. These can be further categorised into emotional, physical, cognitive and behavioural symptoms for depression after stroke.

Emotional symptoms include: a depressed mood for most of the day; diminished interest or pleasure; frustration; feelings of worthlessness, and inappropriate guilt. *Physical symptoms* typically include: significant weight loss or weight gain; insomnia or hypersomnia; fatigue or loss of energy; bodily aches; and loss of

appetite. *Cognitive symptoms* may include: unrealistic evaluation of events, and a loss of an ability to think, concentrate or make decisions. Individuals may also report recurrent thoughts of death or suicide. Finally, *behavioural symptoms* for depression may include psychomotor agitation or retardation, social withdrawal, and neglect of self-caring and appearance (American Psychiatric Association, 2013). Similarly, in certain situations, the following symptoms may also be observed among depressed patients: reduced sex drive; intolerance; lack of enjoyment; worry; slow speech; change in appetite; unexplained aches; changes in the menstrual cycle; disturbed sleep patterns; avoidance of social activities; and difficulties at home and in living life (Gray & Lindsay, 2009).

Clinically and empirically, there are different ways of assessing depression after stroke; usually the purpose of an assessment determines the type of tools that are used to diagnose, screen or assess the severity of depression after stroke (Aben, Verhey, Lousberg, Lodder, & Honig, 2002). To assess depression after stroke, some studies have used structured or semi-structured interviews based on the above DSM or ICD-10 criteria. Others used depression-rating scales to screen or assess the severity of depression after stroke. Psychological instruments – such as the Beck Depression Inventory (BDI), Hospital Anxiety and Depression Scale (HADS-D), Hamilton Depression Rating Scale (HDRS), and Symptoms Checklist-90 depression subscale (SCL-90-D) – are used to assess the symptoms and severity of depression among stroke patients. These instruments also have cut-off points for classifying people as depressed and not depressed. Aben et al. (2002) examined the validity of these scales as screening instruments for depression in

stroke patients. The sensitivity of each was found to be: BDI: 80%; HADS-D: 73.1%; HAM-D: 62.5%; and SCL-90-D: 88.5%, while their specificity was as follows: BDI: 61.4%; HADS-D: 81.6%; HAM-D: 91.7%; and SCL-90-D: 60.7%. In addition to these four scales, Gaete and Bogousslavsky (2008) mention 12 other self-report tools which may be used to assess depression after stroke.

Clinical observation may also be used to assess depression after stroke. Nursing staff may fill out a structured questionnaire, such as the Stroke Aphasic Depression Questionnaire (SADQ) (Sutcliffe & Lincoln, 1998), about the patient's sleeping and eating habits, weight loss or gain, and mood. This kind of measurement is often used to assess observed depression symptoms in stroke patients with aphasia.

With respect to the prevalence of depression after stroke, the literature indicates that depression symptoms are observed in approximately 29% - 52% of stroke patients and may appear within a few weeks after a stroke and could be enduring up to 5 years after stroke (Ayerbe, Ayis, Wolfe, & Rudd, 2013). However, inconsistencies in prevalence rates can be examined in connection with the differences in the samples and assessment methods used in different studies. Furthermore, a number of studies have examined various contributing factors that might influence the occurrence or prevalence of depression after stroke. For instance, damage to specific brain sites has been investigated as one factor behind this disorder. In particular, the left hemisphere is generally considered to be more significantly associated with the presence of depression after stroke (Robinson, 2006). However, more than one systematic review found these findings to be

inconclusive, suggesting that both hemispheres could be linked to depression after stroke (Bhogal, Teasell, Foley, & Speechley, 2004; Singh, Herrmann, & Black, 1998).

Another significant factor in this regard is the length of time elapsed since the stroke. For instance, in a systematic review of 50 studies aimed at assessing the prevalence of depression after stroke, Ayerbe et al. (2013), explored the frequencies of depression symptoms at four intervals after stroke: 3 months and 1, 3 and 5 years. The findings showed that the frequency of depression was 33%, 28%, 32% and 31%, respectively (Ayerbe, et al., 2013). Similarly, Hackett and Pickles (2014) aimed to update and review the frequencies of depression after their previous systematic review (Hackett, Yapa, Parag, & Anderson, 2005). In this updated review, 61 studies were reviewed, considering 25,488 patients. Depression after stroke presented in 28% of stroke patients within the first month of stroke, 36% after a 2-5 month period, 31% after 6-9 months, 33% after the first year, 25% after 2-4 years, 23% at 5 years, and 31% beyond 5 years after the stroke.

In addition to the stroke's lesion location and the duration of time since the stroke occurred, further demographic factors relating to aspects and elements of depression after stroke have also been considered. Overall, depressed survivors tended to have lower education levels (Sienkiewicz-Jarosz et al., 2010), and severe language problems (Thomas & Lincoln, 2006), while being female was

significantly associated with depression (Townend, Tinson, Kwan, & Sharpe, 2010; Madureira, Guerreiro, & Ferro, 2001).

1.4.3 Rationale for the study of post-stroke mood disorders in Saudi Arabia

Clinical evidence from the literature review confirmed that several studies have examined the prevalence of stroke in Saudi Arabia, yet few of these have focused on investigating anxiety or depression after stroke. Indeed, only one study has investigated the prevalence of post-stroke mood disorder in Saudi Arabia. Conducted by Hamad, Siddiqui, Al-Mansoor, Al-Senani, and Sinha (2011), this study examined depression after stroke in a Saudi sample, finding incidents of depression in 17% of stroke survivors during the first month after stroke. The study by Hamad et al. (2011) was important in categorising depression after stroke into different types of depression, such as mild depression, moderate depression and severe depression. However, the study did not include sufficient data about demographic factors such as age, gender, literacy, time since stroke, treatment setting (hospital or rehabilitation unit), and side of weakness (left or right), in order to identify the frequency and severity of depression after stroke among Saudi participants. It also did not focus on anxiety disorder along with depression after stroke. This is a gap in the literature which the present study seeks to address. The current study contributed to the literature in terms of integrating anxiety and depression disorders after stroke as one investigation for enhancing our understanding of post-stroke mood disorders in hospitalised Saudi patients. Thus, by considering both anxiety and depression after stroke, the present study aimed

to provide a much-needed contribution to the current limited body of research on anxiety and depression after stroke in Saudi Arabia.

The limited scope and depth of existing research literature on Saudi healthcare highlights the need for an investigation into the prevalence of post-stroke anxiety and post-stroke depression in the country. As the literature review of findings in Chapter One showed, common clinical settings or research locations are European, American, and Asian countries. Due to significant cultural and demographic differences between geographical contexts, findings on the prevalence of post-stroke mood disorders in these countries cannot necessarily be generalised to the Saudi context. It can be expected that the treatment and quality of care offered to post-stroke patients differ between countries. It is also expected that hospital settings in Saudi Arabia for dealing with post-stroke care issues are different from those in other regions. In addition, the national culture of the country is likely to have a significant influence on the knowledge and awareness of mood disorders among the patients.

Moreover, patient characteristics may affect the emotions of post-stroke patients differently depending on the geographical region. This is because patient characteristics reflect to some degree the country's culture and the societal attitudes and values in which the post-stroke patient resides. For example, a relatively high degree of dependency between family members in Saudi Arabia, compared to their Western counterparts, is likely to play a vital role in shaping the emotions of post-stroke patients. A country-specific study will help to take into

account the hidden effects of the cultural and social factors that influence anxiety and depression after stroke.

The following section considers the relationship between cognitive dysfunction and mood disorders after stroke.

1.5 Relationship between cognitive dysfunction and mood disorders after stroke

Cognitive dysfunction may be an important predictor of mood disorders or a factor related to mood disorders (Ayerbe, Ayis, Rudd, Heuschmann, & Wolfe, 2011; Kauhanen et al., 1999; Pohjasvaara et al., 2002; Sharpe et al., 1990). Studies have shown that stroke patients who have a high degree of cognitive dysfunction are considerably more likely to develop depression or anxiety symptoms than are those who do not have such high levels of cognitive dysfunction (e.g., Downhill & Robinson, 1994).

Models of the relationship between cognitive dysfunctions and mood disorders can take two forms: neuroanatomical and neuropsychological.

1.5.1 The neuroanatomical model of the relationship between cognitive dysfunction and mood disorders after stroke

The neuroanatomical model examines lesions in the brain structures and their correlations with mood disorders post stroke. Researchers usually use functional neuroimaging to identify the relationship between brain damage after stroke and depression and anxiety. Lesion location and the volume of the injury are identified

as the most important factors for exploring the association between mood disorders and cognitive damage.

In this regard, Kövari et al. (2009) performed a detailed analysis of lesion type in consecutively autopsied stroke patients, both with and without depression, after stroke. Fourteen patients of 20 had major depression at six months after stroke. Furthermore, CT-scan results confirmed that basal ganglia, thalamic, and white matter lacunes were associated significantly with the occurrence of post-stroke depression. With the same purpose in mind, Hama, Yamashita, Yamawaki, and Kurisu (2011) examined 243 patients with haemorrhagic or occlusive stroke. CT scans were performed on all those patients at admission to assess the size and site of the damage in the basal ganglia and frontal lobe. The results showed that the severity of affective depression among stroke patients was associated with left frontal-lobe damage but not damage to the basal ganglia. Apathetic depression was related to injury of the basal ganglia in both hemispheres but was not related to the frontal lobe.

Additionally, the MRI scan for stroke patients diagnosed with depression disorder showed that, not only is frontal lobe damage related to mood disorders after stroke, but that damage in different parts of the brain may also lead to mood disorders. Vataja et al. (2001) used MRI to investigate the radiological correlates between type, side and size of lesions and depression in 275 patients, 3 to 4 months after stroke. Patients aged 55 - 85 years were included, and 40% of them were diagnosed with depressive disorder. The findings showed that there were

significant differences between depressed and non-depressed patients in some of structures the prefrontal subcortical, especially in the caudate, pallidum, genu of internal capsule, and anterior capsule. There were also significant differences in the frequency of infarcts in the occipital lobe, posterior corona radiate, and amygdala.

Using a similar MRI technique, Tang et al. (2010) conducted a study to assess the association between frontal subcortical circuit infarcts and depression after stroke. A total of 591 patients underwent an MRI scan and participated in a structured clinical interview based on DSM-IV criteria for major depression and dysthymia. The researchers found that 75 of the patients were diagnosed with depression after stroke. The results showed that frontal subcortical circuit infarct (acute or old) was significantly associated with depression after stroke. Moreover, the results of a multivariate logistic regression analysis indicated that frontal subcortical circuit infarct could be identified as an independent risk factor for depression after stroke.

Downhill and Robinson (1994) partially supported previous findings in their examination of 309 patients who were diagnosed with intracerebral haemorrhage or cerebral infarction. Their findings indicated that depression symptoms were related to the left lesion significantly more than to the right lesion. These studies confirmed that cognitive dysfunction present in stroke patients leads to the damage of or affects the left side of the hemisphere, which ultimately leads to mood disorders.

Although the evidence suggests that damage of the left hemisphere may be associated with mood disorders after stroke, in particular depression after stroke, other studies have found no significant relationship between lesion location and depressive symptoms in stroke patients. Carson et al. (2000) undertook a systematic review of all studies hypothesising that depression disorder in stroke patients is related to the left side lesion or left anterior lesions. Reviewing 35 studies conducted between January 1975 and August 1999, they showed no support for these hypotheses, and concluded that there was no significant relationship between depression symptoms and lesions in the brain. This conclusion has been supported by Bhogal et al. (2004) who conducted a systematic review of lesion locations and depression after stroke. Based on studies from January 1970 to March 2003, their review was comprised of 26 original articles. The authors observed that ten articles found no significant association between lesion location and the frequency or severity of depression after stroke. Only two studies found a significant association between right-hemisphere strokes and depression, while four articles reported a significant association between left-hemisphere strokes and depression.

The clear heterogeneity of the findings of the neuroanatomical model of correlation between cognitive dysfunction and mood disorders has prompted researchers to propose that other variables must be considered as part of the assessment of mood disorders in stroke patients, such as social and interpersonal factors, daily functions and cognitive disabilities. Accordingly, the hypothesis was modified by recent studies from its narrow focus on lesions to include the psychological

representations, which can develop after a stroke, leading some patients to be more depressed or anxious than others. Subsequently, a wide range of psychological and social aspects has been examined to determine their effect on emotion after stroke; one of these being a cognitive abilities deficit.

1.5.2 The neuropsychological model of the relationship between cognitive dysfunctions and mood disorders after stroke

According to a neuropsychological model, cognitive abilities are vital means of interacting with others. They entail manipulating information in the brain for various purposes such as talking, learning, reading, writing, and recognising previous experiences. Thus, damage in the cognitive areas of the cerebrum may adversely affect these abilities and impair the individual's quality of life. In contrast to the neuroanatomical model, the neuropsychological model of correlation between cognitive dysfunctions and mood disorders proposes that stroke patients become depressed or anxious because they lose their cognitive ability to recognise or communicate with their surroundings.

Stroke and its sequelae often occur suddenly, causing patients to face severe difficulties in their relationships and surroundings (Bays, 2001; Kim et al., 1999). Sufferers may fail to fulfil their roles in life (Owolabi, 2012), and such negative implications may result in permanent dependency. Physical and cognitive disabilities particularly can lead to retirement or long stays in hospitals or other institutions (Scott, Phillips, Johnston, Whyte, & MacLeod, 2012). These dramatic life-changes can adversely affect the patient’s mood and may lead to a loss of personal motivation and possibly depression and anxiety disorders (Dennis,

O'Rourke, Lewis, Sharpe, & Warlow, 2000). In this regard, Ayerbe et al. (2011) found that the frequency of depression increases when stroke patients lack family support, are unable to work, are living in an institution, and are suffering from cognitive impairment.

In many cases, the complicated post-stroke cognitive dysfunctions and mood disorders symptoms also play an important role in determining the seriousness of the stroke and the potential benefits from treatment. Moreover, severe mood and cognitive disorders after stroke can trigger more chronic psychological disorders such as suicide (Forsström, Hakko, Nordström, Räsänen, & Mainio, 2009). These concerns have led researchers to explore, in particular, the nature of the relationship between, in particular, cognitive dysfunctions and mood disorders after stroke.

1.5.2.1 Relationship between cognitive dysfunction and anxiety after stroke

Five studies (Ayerbe et al., 2014; Barker-Collo, 2007; Castellanos-Pinedo, 2011; Fure et al., 2006; Spalletta et al., 2002) which have addressed the relationship between cognitive dysfunction and anxiety after stroke used neuropsychological assessment. Data were tabulated in Table 1.4. The number of participants in these studies was ranged between 73 and 2179. The time of assessment since stroke was ranged between 2 days and 10 years. All studies reviewed included only adult samples; mean ages was ($\mu = 62.26 \pm 9.2$). The mean proportion of men was 54%. The Mini Mental Status Examination Scale (MMSE) was used (3 of 5 studies) and the Neuropsychiatric Inventory (NPI) was used (1 of 5 studies) in assessing overall

cognitive dysfunction. In 1 of the 5 studies, a battery of five neuropsychological tests was used to assess post-stroke impairments in four cognitive domains. For anxiety assessment, the Hamilton Anxiety Rating Scale (HARS) was used in 2 studies. Similarly, the Hospital Anxiety and Depression Scale (HADS) was used in 2 studies. The Beck Anxiety Inventory (BAI) was used in one study.

Out five studies, one study (Fure et al., 2006), as seen in the Table 1.4, found a significant correlation between overall cognitive dysfunction (as measured by MMSE) and anxiety after stroke in the acute phase of stroke. Another study by Spalletta et al. (2002) identified a significant relationship between post-stroke anxiety examining by the HARS and overall cognitive impairment assessing by the MMSE among only patients with left hemisphere stroke. The interesting observation was that in 2 studies using follow-up method (Ayerbe et al., 2011; Castellanos-Pinedo, 2011), the correlation was found to be significant predominantly in the late stages of stroke. Castellanos-Pinedo (2011) examined stroke patients at four times points and found a significant relationship between the NPI scores and the HARS at only 26 weeks after stroke. Likewise, Ayerbe et al. (2014) found that anxiety 5 years after stroke was significantly associated with lower scores on the MMSE.

As to the relationship between cognitive domains and anxiety, an examination of the five cognitive domains, Barker-Collo (2007) examined the relationship between four cognitive domains and anxiety after stroke. After three months post-stroke, a significant relationship was observed between difficulties in three cognitive

domains i.e. specify which ones long term memory, attention and cognitive speed, whereas the relationship between learning and anxiety was not significant.

From the general literature review, it can be analyzed that the strength and significance of the relationship between post-stroke cognitive dysfunction and anxiety disorder varied between the studies. The five studies covered in this section also revealed that some variables can be identified as important factors when the relationship between post-stroke cognitive dysfunction and anxiety disorder has been examined, including:

- Lesion location (Saplletta et al., 2002),
- Time since stroke (Ayerbe et al., 2011; Castellanos-Pinedo, 2011),
- Cognitive domain targeted (Barker-Collo, 2007).

On other hand, review of past studies showed that the relationship between cognitive dysfunction and anxiety fundamentally overlaps between cognitive, medical, and functional factors. This is the reason why anxiety after stroke was found to be correlated with the different cognitive dysfunctions. It was observed that patients with cognitive dysfunction often require a re-evaluation of their life in terms of individual goals, guidelines and directions, as well as review their social activities in order to take into account stroke-induced physical and cognitive insufficiencies. Those patients may increase their medical care and rehabilitation, resulting in treatment of medical complications with the passage of time; however, the influence of cognitive dysfunction post stroke can remain for a long period of time and can cause different disturbances, such as loss of communication with

surroundings, retirement from work, loss of eligibility, and ultimately anxiety disorder (Burton et al. 2013). Therefore, the past literature by (Åström, 1996; Brynjar Fure, Wyller, Engedal, & Thommessen, 2006; Leppävuori, Pohjasvaara, Vataja, Kaste, & Erkinjuntti, 2003; Raju, Sarma, & Pandian, 2010) reported a significant relationship between anxiety after stroke and both cognitive impairment and poor functional outcomes.

Table 1.4: Summary of articles included in the literature review (relationships between cognitive dysfunction and anxiety disorder after stroke)

Authors and year published	Time of assessment since stroke	Patient characteristics				Cognitive assessment		Anxiety assessment		Outcomes
		N	Type of stroke	Age (y) (μ,SD)	Gender (Male %)	Cognitive domain targeted	Tests used	Anxiety type targeted	Tests used	
Spalletta et al., 2002	μ = 3.10 m	153	First ever stroke	66.48 ± 13.4	47.3%	Overall cognitive function	MMSE	anxiety after stroke	HARS	High scores on the HARS associated significantly with low scores on the MMSE in patients with left hemispheric stroke
Fure et al., 2006	Between day 3 and day 7	178	Ischemic stroke	68.6 ± 11.4	62.9%	Overall cognitive function	MMSE	anxiety after stroke	HADS	The relationship between HADS-A score and MMSE was significant.
Barker-Collo, 2007	3 m	73	Ischemic and haemorrhagic stroke	51.7 ± 10.19	54.8%	Learning, Memory, Attention/Impulsivity, Cognitive speed	CVLT-II, VPA Digit and spatial spans Wechsler, IVA-CPT, Victoria Stroop	anxiety after stroke	BAI	Anxiety 3 months of stroke was significantly associated with long term memory, attention and cognitive speed
Castellanos-Pinedo, 2011	2 d, 4, 12, and 26 w	89	Ischemic stroke	Not reported	51.7%	Overall cognitive function	NPI	anxiety after stroke	HARS	Significant relationship between the NPI scores and HAM-A at 26 weeks after stroke.
Ayerbe et al., 2014	3 m, 1, 3, 5 and 10 y	2179	Stroke (undetermined)	Not reported	Not reported	Overall cognitive function	MMSE	anxiety after stroke	HADS	Anxiety 5 year after stroke was significantly associated with lower scores in the MMSE

Abbreviations: (d) days, (w) weeks, (m) months, (y) years, (MMSE) The Mini-Mental State examination, (HADS) The Hospital Anxiety and Depression Scale, (HARS) The Hamilton Anxiety Rating Scale, (CVLT-II) The California Verbal Learning Test-II, (VPA) The Visual Paired Associates, (IVA-CPT) The Integrated Visual Auditory Continuous Performance Test, (BAI) The Beck Anxiety Inventory, (NPI) The Neuropsychiatric Inventory.

1.5.2.2 Relationship between cognitive dysfunction and depression after stroke

The next chapter is a systematic review of past studies to examine the relationship between cognitive dysfunction and depressive symptoms. The review critically analyses and discusses the findings of past studies to show how overall cognitive dysfunction is associated with post-stroke depression.

1.5.3 Rationale for the study of the relationship between post-stroke cognitive dysfunctions and mood disorders in Saudi Arabia

The rationale for the current study was the lack of research on the association between cognitive dysfunction and mood disorders in the KSA. The purpose of the study was to fill the gaps identified above in the previous research literature.

The examination of the literature about stroke in the KSA shows that past researchers have focused only superficially on the neuropsychological aspects, despite the fact that a large portion of the stroke population in the country suffers from different types of cognitive dysfunctions. To our knowledge, only two published studies aimed to explore the prevalence of psychological disorders in the KSA. One investigation by Hamad, Siddiqui, and AI-Mansoor (2011) investigated the distribution of depression in 60 stroke patients in Saudi Arabia. Ten patients had depression, 7 patients had mild depression, 2 had moderate depression and 1 patient had severe depression. In conclusion, the team of researchers noted that the rates of depression were infrequent in the patients with stroke; however, depression was significantly linked to the individual's severity of disability rather than to the type of stroke. In the second investigation by Abdul-Sattar and Godab

(2013), the authors attempted to identify the possible factors influencing the functional outcomes of stroke patients after inpatient rehabilitation. They reported that the key neuropsychiatric conditions after stroke are: cognitive condition, depression, and stroke severity. Additionally, the findings found that the functional dependency of the Saudi population of post-stroke patients was highly correlated with their cognitive or neuropsychiatric conditions (Abdul-Sattar & Godab, 2013).

Among the available studies in KSA, stroke is becoming a growing problem for individuals in Saudi Arabia due to rapid changes in the health-related quality of life of the region. Individuals of all ages can suffer from stroke at any stage of life. To minimise this risk, timely diagnosis and outcomes are needed. An overview of the Saudi Arabian population was provided above, showing that the number of medical centres and research facilities available for treating stroke – only four – is too few for the country's population. The provision of treatment for blood clots is also lacking. Relatedly, Khathaami et al. (2011) have indicated a low level of awareness and poor practices in treating stroke, and accordingly poor outcomes and consequences from suffering a stroke in Saudi Arabia. The findings of the current doctoral research are expected to increase awareness of and knowledge about stroke outcomes, including cognitive and mood outcomes, and the indirect associations between the two.

A very limited number of past neuropsychological studies can be found which concentrate on the Saudi context. It is recommend that future research should focus on the impact of stroke on cognitive processes, which are directly associated

with the brain. Future research should also investigate the potential aspects associated with cognitive dysfunctions. Specifically, future studies should be directed towards demographic factors to identify their relation to cognitive dysfunction and mood disorders after stroke. These include: age, gender, and literacy, as well as 'side of weakness', settings, and time since stroke. Of these factors, literacy is of particular importance because, according to the Ministry of Education in Saudi Arabia, around 19% of people over 60 years of age are illiterate. The high level of illiteracy compared to Western countries, makes this neuropsychological study an urgent social and economic medical issue in the KSA. Similarly, the influence of old age on increasing stroke patterns, mainly in the seventh decade of a person's life needs further study to highlight the changes occurring in the cognitive functioning of the old-aged person in the post-stroke period. Exactly how the impairments suffered by such patients impact upon living their routine lives must also be more thoroughly studied. Moreover, past studies confirm that the prevalence of stroke in men is higher than that in women. This underscores the need to investigate cognitive functions in men, which will help in identifying differences in the relationship between the cognitive dysfunctions found among males as well as among females.

In addition, changes in patients' cognitive abilities, especially neuropsychological disorders, after stroke, have rarely been examined in Saudi Arabia. Loss of attention, memory and language may result in long-term dependence of the stroke patient on others and may contribute to feelings of frustration and fear due to being unable to communicate with others or carry out tasks for themselves. Due to the

cognitive dysfunctions that can occur after a stroke, some survivors may lose their jobs, and have less social contact and activity, thereby contributing to the development of depression and anxiety related to their disabilities. It follows that there may be potential interactions between neuropsychological dysfunctions (e.g., attention deficit, memory disorder, visual neglect and executive dysfunction) and mood disorders (depression and anxiety) after stroke. Thus, expanding the focus of neuropsychological studies in Saudi Arabia is critical for inferring patterns and differences between the cognitions of one stroke patient and another, which can help in offering effective interventions in the post-stroke period too.

In sum, the current research extends into multiple dimensions, including substantiating the general findings extracted from the literature review with the primary findings gathered from KSA medical centres. Another rationale for the present study is the lack of knowledge and awareness among KSA medical professionals as well as in the Saudi population about the relationship between cognitive dysfunctions and mood disorders.

1.6 Aims of thesis

The aims of the thesis are:

- To conduct a systematic review of the relationship between overall cognitive dysfunction and depression disorder after stroke.
- To investigate the prevalence of post-stroke cognitive dysfunctions which will be inclusive of overall cognitive dysfunction, as well as orientation/attention,

memory, fluency, language, visuo-spatial perception, visual neglect, visual-motor skills and executive functions impairments in Saudi Arabia population.

- To investigate the prevalence of post-stroke mood disorders (anxiety and depression) in Saudi Arabia using a self-report mood scale.
- To investigate the relationship between cognitive dysfunctions and mood disorders using neuropsychological tests and a self-administered scale.

Having examined the literature, the next chapter presents a systematic review of the relationship between post-stroke overall cognitive dysfunction and post-stroke depression disorder.

Chapter Two: Relationship between Overall Cognitive Dysfunction and Depression after Stroke: A Systematic Review

2.1 Introduction

According to the literature, approximately 70% of survivors are impaired in one or more cognitive functions (Blake et al., 2002; Girard et al., 2010; Nys, et al., 2006), and the pattern and severity of cognitive dysfunction often depend on the location of lesions in the brain (Robinson, 2006). The impact of a loss of function after stroke can have negative psychological effects. Many stroke patients suffer from depression in addition to cognitive dysfunction (Bour et al., 2010; Nys, et al., 2006; Pohjasvaara et al., 2002; Rasquin et al., 2004). According to Hackett et al. (2005) and Hackett and Pickles (2014), depression is common after stroke (an estimated 31-33%), but research is needed into the aetiology and risk factors associated with post-stroke depression.

Early studies, such as those by Robinson, Starr, Kubos, and Price (1983), found that stroke patients with cognitive dysfunction also suffered from depression, and suggest that cognitive dysfunction can be considered a related factor of depression after stroke. Similarly, Downhill, and Robinson (1994) found that stroke patients whose symptoms of depression abated showed a greater improvement in their cognitive functions than those whose symptoms of depression did not abate. These findings have led professionals and researchers to explore the possible correlation between overall cognitive dysfunction and depression disorder after stroke.

It is now partially accepted that neuroanatomical, overall cognitive dysfunction contributes to post-stroke depression. In order to understand the possible link more clearly, lesions in various parts of the brain have been studied to explore the association between cognitive dysfunction and depression post stroke, including:

- Frontal lobe (Downhill & Robinson, 1994; Eastwood et al., 1989; Hama et al., 2007; Spalletta et al., 2002; Tang et al., 2012).
- Cortical and subcortical structures (Tang et al., 2010).
- Amygdala (Sachdev, Chen, Joscelyne, Wen, & Brodaty, 2007).
- Basal ganglia, thalamus and white matter (Gold, et al., 2009; Mok et al., 2009; Vataja et al., 2001).
- Left and right hemispheres (MacHale, O'Rourke, Wardlaw, & Dennis, 1998; Nys, et al., 2006; Robinson, Bolla-Wilson, Kaplan, Lipsey, & Price, 1986).

Thus far, little is known about why the relationship between lesions in the brain and post-stroke depression occurs in some patients and not others. The above studies have revealed mixed results, with some studies concluding that there is a positive relationship between the lesions causing both cognitive dysfunction and depression symptoms, and others concluding that, while correlations between lesions and depression can be found, their association is not statistically significant (Bhogal et al., 2004; Carson et al., 2000; Murata et al., 2000; Sharpe et al., 1990; Spalletta et al., 2002). This variation may be attributed to the fact that, in the studies that did not find a significant relationship, cognitive dysfunction post stroke was considered only in terms of brain *structure*, and not *function*. In addition, these

studies did not use comprehensive assessments to identify the presence of cognitive dysfunction, but used the Mini Mental State Examination (MMSE) (O'Bryant et al., 2008), which is known not to be a sensitive measure for detecting cognitive impairment after stroke (Bour, Rasquin, Boreas, Limburg, & Verhey, 2010). The use of the MMSE, as opposed to measures that assess specific cognitive domains more thoroughly, may also have contributed to the lack of significant correlation found between cognitive dysfunctions and post-stroke depression.

Overall cognitive dysfunction and depression after stroke can affect patients' quality of life in general, and the outcome of treatment and rehabilitation programmes in particular (Bays, 2001; Beekman et al., 2000; Campbell Burton et al., 2011; Carod-Artal et al., 2008; Gottesman & Hillis, 2010; Kauhanen et al., 1999). In order to improve management and intervention planning, it is important for health and rehabilitation professionals working with stroke patients to understand the relationship between overall cognitive dysfunction and depression. Therefore, the aim of this review was to address the following question: Is there a significant relationship between overall cognitive dysfunction and depression post stroke? To answer this question, the researcher reviewed studies which assessed the relationship between overall cognitive dysfunction and depression disorder post stroke.

2.2 Method

2.2.1 Criteria for including studies in the review

Types of disorders

For the purposes of this review, cognitive dysfunction was defined as loss of overall intellectual ability due to stroke, as determined by neuropsychological assessments.

Depression after stroke was characterised by the following: low mood; loss of interest or pleasure in all activities; changes in appetite or weight, sleep and psychomotor activity. Other attributes of depression after stroke include: decreased energy; feelings of worthless or guilt; difficulty thinking, concentrating, and making decisions; and recurrent thoughts of death or suicidal ideation, plans, or attempts (American Psychiatric Association, 2013). The reason behind choosing these inclusion criteria was to exclude other types of mood disorders (e.g., bipolar I and bipolar II disorder).

Types of participants

All studies that were eligible for inclusion specified an adult participant sample (18 years old and over). Participants had to have a clinically verifiable diagnosis of stroke. The World Health Organisation defines ischemic stroke as: *"rapidly developing clinical signs of focal or global disturbance of cerebral function, with symptoms lasting more than 24 hours (unless interrupted by surgery or death), with no apparent nonvascular cause"* (Thomas et al., 2000, pp. 1-2).

Types of measures

Studies were eligible for inclusion if they:

a) Used a standardised neuropsychological test, which involves one test or a battery of tests, to obtain specific scores for examining overall cognitive dysfunction. These neuropsychological tests are administered under observation in standard conditions and use normative data whereby performance is compared to reference groups of the same age, sex, race, and education level.

b) Included assessment of depression disorder measures to identify and evaluate depression symptoms. The researcher included the rating scales which may be used to detect depression disorders post stroke. These included: the Beck Depression Inventory; Beck Depression Inventory Fast Screen; Brief Assessment Schedule Depression Cards; Center for Epidemiological Studies Depression Scale; General Health Questionnaire with 30 items (GHQ-30) and General Health Questionnaire with 28 items (GHQ-28); Geriatric Depression Scale; Geriatric Depression Scale 15; Hospital Anxiety and Depression Scale; Montgomery-Asberg Depression Rating Scale; Patient Health Questionnaire 2; Stroke Inpatient Depression Inventory; Symptom Checklist 90; Wakefield Depression Inventory; Yale Question. The following questionnaire, not listed by Lincoln et al. (2012), was also included in this review: Hamilton Rating Scale for Depression. The researcher also included questionnaires used with patients with communication problems. These scales included: Aphasic Depression

Rating Scale; Depression Intensity Scale Circles; Signs of Depression Scale; Smiley Faces; Stroke Aphasic Depression Questionnaire 10; Stroke Aphasic Depression Questionnaire Hospital version 21; Stroke Aphasic Depression Questionnaire Hospital version 10; Visual Analog Mood Scales; Visual Analog Mood Scales Sad item, Visual Analog Mood Scales Self-Esteem Scale (Lincoln et al., 2012).

Additionally, this review included studies that used either structured or semi-structured interviews to diagnosis depression disorder after stroke. The type of depression measurement was expanded to include the following: Structured Clinical Interview for the DSM-III; Structured Clinical Interview for the DSM-VI; Present State Examination; and Schedules for Clinical Assessment in Neuropsychiatry. When a depression disorder scale was reported in the study and not listed above, the researcher checked back through the references to clarify whether this scale is used to measure depression.

2.2.2 Search method for identification of studies

Types of studies

Published between January 1980 and December 2013, three types of study were selected: identify cohort, cross-sectional and case-control studies. The rationale for the limiting the search to period from the early 1980's onwards was that the examination of the relationship between post-stroke cognitive dysfunction and depression disorder conducted before then was very rare. Furthermore, extending

the searches for 33 years allowed including many studies, in order to increase the accuracy of this systematic review.

The review included only those studies that conducted correlation analysis to examine the relationship between overall cognitive dysfunction and depression disorder after stroke. Moreover, it included studies that sought to identify this correlation using at least one of the applications of the correlational statistical techniques. A final restriction pertained to language: non-English studies were excluded.

Study identification

To identify all relevant published studies conducted between January 1980 and December 2013, the following online databases were searched: Medline (May 1981 – December 2013; Appendix 1), EMBASE (March 1983 – December 2013; Appendix 2), and PsycINFO (January 1982 – December 2013; Appendix 3). The search strategy involved combining a number of terms for stroke. These terms included: stroke/ cerebrovascular accidents/ cerebral ischemia/ brain damage/ ischemia/ cerebrovascular disorders/ haemorrhage/ cerebral haemorrhage/ subarachnoid haemorrhage/ cardiovascular system/ geriatrics/ Alzheimer's disease/ embolisms/ thromboses. A range of terms describing cognitive dysfunction were also used, including: cognitive ability/ cognitive impairment/ cognitive processes/ cognitive psychology/ cognitive appraisal/ cognitive rehabilitation/ cognitive neuroscience/ cognitive assessment/ cognition/

neuropsychology/ neuropsychological rehabilitation/ neuropsychological assessment/ Mini Mental State Examination/ dementia/ vascular dementia/ semantic dementia/ senile dementia/ Alzheimer's disease. Likewise, other key terms were used for describing depression disorder: depression/ major depression/ long-term depression (neuronal)/ depression (emotion)/ psychiatric symptoms/ emotional disturbances/ emotional states/ psychiatric evaluation/ psychological assessment/ Beck Depression Inventory/ Zung Self Rating Depression Scale/ Psychological Screening Inventory. All titles identified in the search were reviewed for consideration. In addition, the reference lists of all retrieved studies, as well as the bibliographic references of existing reviews, were subsequently scrutinised for potentially relevant studies. All citations were assessed for relevance based on the study's abstract. Where it was not clear whether a study was eligible, the full article was accessed for further consideration.

Data extraction and analysis

To determine whether all the inclusion criteria were met, the researcher reviewed all of the selected articles. The data were then extracted and tabulated before being analysed. The following data were collected about each study:

- Full citation: authors; year of publication; country.
- Participant characteristics: types of stroke (ischemic, thromboembolic, intracerebral haemorrhage, subarachnoid haemorrhage, undetermined).
- Prevalence of overall cognitive dysfunction and prevalence of depression disorder.

- Study characteristics: sample size; settings; follow-up period.
- Assessments used: neuropsychological tests; depression measures.
- Findings: correlations between overall cognitive dysfunction and depression disorder post stroke.

The reviewer also assessed the quality of the studies included in the review by adopting the recommendations of the Centre for Reviews and Dissemination (CRD) for undertaking systematic reviews in healthcare. According to the CRD, quality assessment of any study must consider the appropriateness of the study design, the risk of bias, the choice of outcome measures, statistical issues, the quality of reporting, the quality of the intervention, and generalisability. Additionally, the external validity, internal validity and statistical validity of the studies were assessed for measuring the study's quality (Centre for Reviews and Dissemination, 2009). The Critical Appraisal Skills Programme (CASP) Checklist for Cohort Study (2013) (Appendix 5) was used to consider the strengths and weaknesses of evidences. The CASP Checklist for Cohort Study includes 12 questions to help in the process of carefully and systematically examining study to judge its trustworthiness, relevance and to assess the quality and validity of the material in each research.

2.3 Data analysis

In this study, a questionnaire was created to examine the methodological nature of the studies reviewed, that is, how well the study was planned, and to assess the

general quality of the evidence. In addition, Comprehensive Meta-Analysis Software (CMA) was used for combining the data from the studies under review, with a view to examining the severity and significance of the relationship between overall cognitive dysfunction and depression disorder; the software executed this by combining the results from two or more studies.

2.4 Results

2.4.1 Search process

The search produced 941 publication titles that were identified as potentially relevant. Of these titles, 794 were excluded on the basis that the titles did not refer to overall cognitive dysfunction and depression disorder after stroke, while the remaining 147 mentioned stroke, cognitive dysfunction and depression in the abstracts. Out of 147 abstracts, 57 were excluded due to the outcomes not being relevant to the focus of this review. The full texts of the remaining 90 articles were then read to determine if they were eligible based on the type of participants, the type of study, and the type of measures used. The reviewer excluded 73 of the articles for following reasons (Appendix 4): 7 were excluded as standardised neuropsychological or depression measurements were not used to examine the presence of overall cognitive dysfunction or depression post stroke; 11 were excluded as they did not include a correlation analysis between overall cognitive dysfunction and depression after stroke; 3 were excluded as the correlation values between cognitive dysfunction and depression after stroke were not shown in the findings section; 12 were excluded as they were limited to specific cognitive

function domains rather than overall cognitive function; 6 studies were excluded as they examined the relationship between lesions and depression; 4 were excluded as a correlation analysis was not included; 5 were excluded as they examined correlations between cognitive dysfunctions and hyposthenia, fatigue or functional outcomes; 6 were excluded as they examined prevalence or changes of cognitive impairment since the stroke; 12 studies were excluded as the full text was not in English; and 2 were excluded as they were not quantitative studies. Therefore, in total 17 studies met the inclusion criteria, 15 of which were identified from the online database searches, and 2 of which were manually retrieved from a review of the reference lists and bibliographies. The search process is diagrammatically represented in Figure 2.1.

Figure 2.1: Search process and excluded/included studies

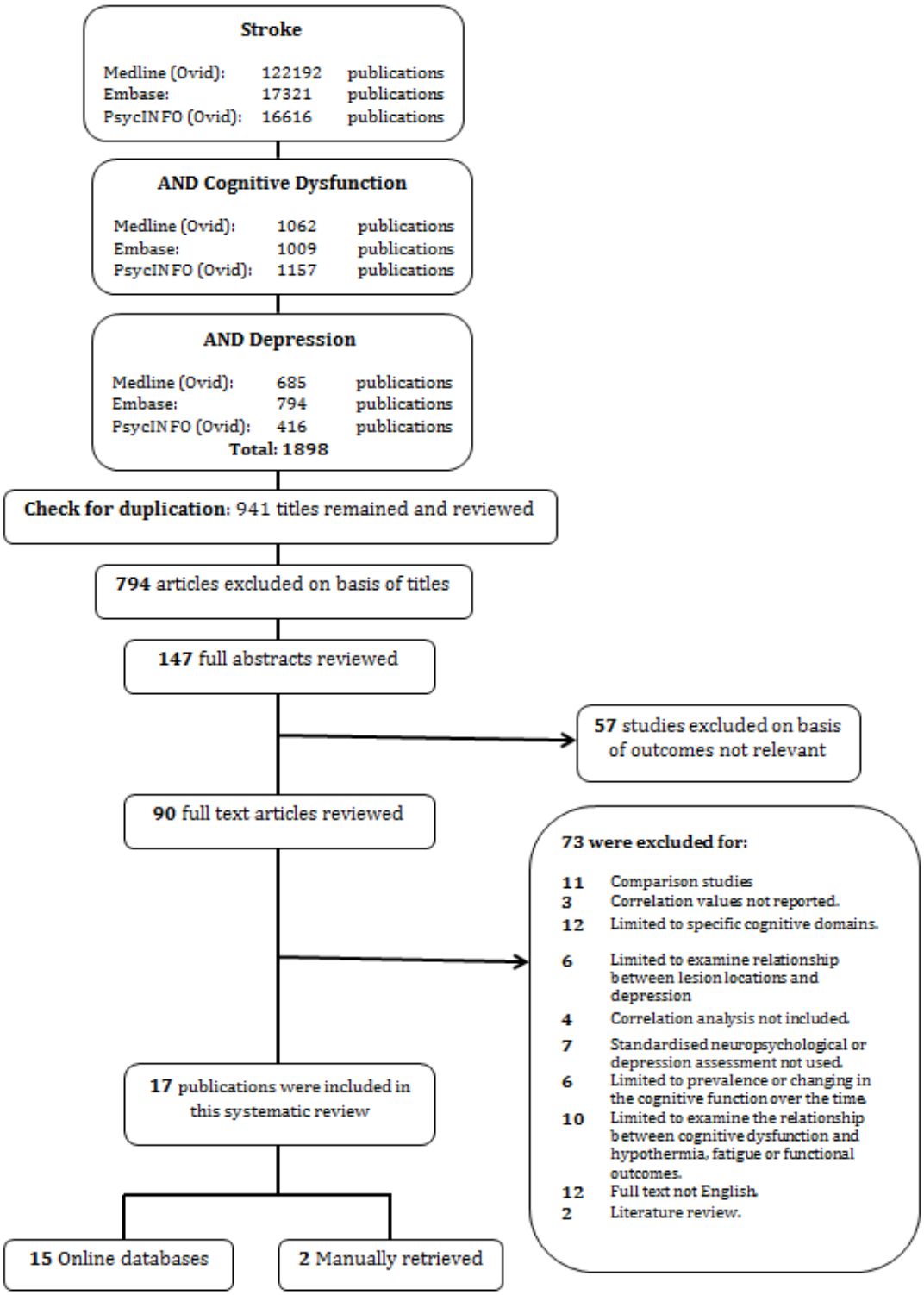


Table 2.1: Studies suitable for systematic review

Authors, year published & country	Setting	Time of assessment since stroke	Patient characteristics				Overall cognitive dysfunction		Depression	
			N	Type of stroke	Age (years) (μ,SD)	Gender (Male %)	Test used	%	Test used	%
Robinson and Price (1982) USA	Hospital	6 m 12 m	103	Stroke (undetermined)	63 ± 11	44%	-	-	GHQ	30% 16%
Parikh, Lipsey, Robinson, and Price (1987) USA	Hospital	2 w 3 m 6 m 12 m 24 m	86	Thromboembolic stroke or an intracerebral haemorrhage	60 ± 13	68%	-	-	-	-
Starkstein et al. (1989) USA	Hospital	μ = 15.3 days	93	Right hemisphere thromboembolic infraction or intracerebral haemorrhage	61.4 ± 10.75	62.5%	-	-	-	Major 18.28% Minor 11.88%
Eastwood et al. (1989) Canada	Rehabilitation	4 m	87	Stroke (undetermined)	63.3 ± 13.7	63%	-	-	ZDS GDS HRSD	50%
House et al. (1990) UK	Community	1 m 6 m 12 m	128	First-ever stroke	71.2	58%	MMSE	21% 26% 26%	BDI	80% 88% 77%
Jonkman, Weerd, and Vrijens (1998) The Netherlands	Hospital	3 m 12 m	35	Stroke (undetermined)	55.1 ± 3.8	71.43%	-	-	-	-
Starr, Nicolson, Anderson, Dennis, and Deary (2000) Scotland	Hospital	μ = 4.3 years	49	Stroke (undetermined)	74.2 ± 7.9	58.18%	-	-	-	-

Authors, year published & country	**Setting**	**Time of assessment since stroke**	**Patient characteristics**				**Overall cognitive dysfunction**		**Depression**	
			N	**Type of stroke**	**Age** (years) (μ,SD)	**Gender** (Male %)	Test used	**%**	Test used	**%**
Spalletta et al. (2002) Italy	Hospital	μ = 3.10 m	153	First ever stroke	66.48 ± 13.4	47.3%	**-**	**-**	SCID-P-DSM-IV	Major = 41% Minor = 17%
Narushima, Chan, Kosier, and Robinson (2003) USA	Rehabilitation	6 m	59	Intracerebral haemorrhage or cerebral infraction	58.5± 15.6	76%	**-**	**-**	**-**	**-**
Wilz and Barskova (2007) Germany	Rehabilitation	3 m 15 m	81	Stroke (undetermined)	58	66%	**-**	**-**	CDS	21% 18%
Passier et al. (2009) Netherlands	Hospital	3 m	111	Subarachnoid haemorrhagic	52.8 ± 13	18%	Battery	Mild 46.8% Severe 25.2%	BDI-II	39.6%
Duits, Munnecom, van Heugten, and van Oostenbrugge (2008) The Netherlands	Hospital and community	4 m	105	Stroke (undetermined)	50 ± 13	40.95%	Battery	74%	CLCE-24	42%
Farner et al. (2010) Norway	Rehabilitation	13 m	126	Ischemic or haemorrhagic stroke	75.0 ± 11.3	54%	**-**	**-**	MADRS	48%

Authors, year published & country	**Setting**	**Time of assessment since stroke**	**Patient characteristics**				**Cognitive dysfunction**		**Depression**	
			N	**Type of stroke**	**Age** (years) (μ,SD)	**Gender** (Male %)	Test used	**%**	Test used	**%**
Lamb, Anderson, Saling, and Dewey (2013) Australia	Hospital	6 m	25	First ever stroke	67 ± 10	64%	ABNAS	92%	**-**	**-**
Taylor-Piliae, Hepworth, and Coull (2013) USA	Community	μ = 3.3 years	100	Stroke (undetermined)	70 ± 10	54%	**-**	**-**	CES-D	35%
Hosking and Marsh (2013) New Zealand	Hospital	12 m	67	Ischemic stroke or intracerebral haematoma	74.0± 7	48%	Battery	28%	GDS	33%
Allan et al. (2013) UK	Hospital	3 m	355	Ischemic and haemorrhagic stroke	80 ± 4.10	51.8%	**-**	**-**	GDS	31.7%
		1 y								30.2%
		4 y								35.7%
		8 y								39.6%

Abbreviations: (-) not reported

2.4.2 Patient characteristics

The review included 17 studies with a combined sample of 1,763 participants. Data were extracted on participant demographics, and the types of stroke recorded in each study were tabulated in Table 2.1. All studies included only adult samples; mean ages of the samples ranged from 50 to 80 years ($\mu = 64.70 \pm 8.54$). The proportion of men ranged from 18% to 76% ($\mu = 55.59\%$). The type of stroke recorded in the participant sample of each study was also tabulated. Ten studies reported that stroke patients (undetermined types of stroke) were recruited; of those, 3 studies limited participants to a first-ever stroke. The remaining 7 studies investigated particular types of stroke, including: thromboembolic stroke or intracerebral haemorrhage; right hemisphere thromboembolic infarction or intracerebral haemorrhage; cerebral infarcts; subarachnoid haemorrhagic and ischemic and haemorrhagic stroke. Additionally, the selected studies included both hospital-based settings (10 studies) and community-based studies (2 studies). Recruitment from both hospital- and community-based settings was found in 1 study. Those in the hospital settings were undergoing treatment while in 4 studies participants were admitted to a rehabilitation setting.

2.4.3 Time of assessment since stroke

The reviewer also tabulated the initial assessment and follow-up periods recorded by each study. Two studies reported a mean (μ) period after stroke for the whole sample. The reviewer calculated the mean (μ) for two studies based on ‘time elapsed since stroke’ in subgroups. As shown in Table 2.1, 6 of the 17 studies

featured an assessment and reassessment strategy for monitoring overall cognitive dysfunction and depression disorder in post-stroke patients. Table 2.1 also highlights the time-point following a stroke at which patients were selected for initial assessment. As can be seen, 3 of the 17 studies featured an initial assessment within the acute post-stroke phase (i.e., within the first month). Other follow-up options included: three months (5 studies); four months (2 studies); six months (5 studies); and twelve months (6 studies). Only 5 studies adopted a long-term follow-up approach (over twelve months).

2.4.4 Prevalence of overall cognitive dysfunction post stroke

Out of 17 studies, only 5 reported data about the frequencies of overall cognitive dysfunction after stroke. According to these 5, 21-92% of participants ($\mu = 42.38\%$) were cognitively impaired at any time after stroke.

2.4.5 Prevalence of post-stroke depression

The researchers in the studies under review examined the rate of post-stroke depression. In 2 studies, 36.72% of patients had depression symptoms in the acute phase of stroke (within 1 month). Four studies estimated the frequency of depression to be 32.33% within three months after stroke. Two studies examined patients within four months of stroke and found depression in 46%. Similarly, 2 studies assessed patients after six months and found that 56% had developed depression symptoms.

In a study with a longitudinal design, 39.1% of participants remained depressed 12 months after stroke. The prevalence rate for depression after a period of more than 12 months was reported to be 29.49% of patients in the studies included in this review.

2.4.6 Neuropsychological measurements

1. Cognitive dysfunction assessment

In the studies under review, the authors utilised a wide range of neuropsychological instruments in order to assess overall cognitive dysfunction in patients. Table 2.2 presents the tests used. The Mini Mental Status Examination Scale (MMSE) was the most frequently used (10 of 17 studies) in assessing cognitive dysfunction. Furthermore, 8 of these 10 studies used the MMSE only in their assessment of cognitive abilities, whereas two studies used it in conjunction with other neuropsychological tests. In 2 of the 17 studies, a battery of five or more neuropsychological tests was used.

Among the different neuropsychological tests, the Mini Mental Status Examination (MMSE) was found to used mostly in the past studies. At second stance, Wechsler Adult Intelligence Scale-Revised was used. It can be found that these tests had different statistical properties and therefore to allow for comparison in the current research, testing was necessary for their homogeneity and heterogeneity. These tests were helpful in assessing whether the results of the different neuropsychological scales are similar to each other. Calculation of effect size was

also necessary to eliminate the technical differences. The precision of estimates was measured among all the scales of neuropsychological assessment. The psychometric properties of different neuropsychological tests were evaluated.

2. Depression measurement

However, while the list of depression disorder instruments reflects a similar lack of overlap as the cognitive assessments used, the inconsistency is less significant. The dominant test identified in the review is the Hamilton Scale for Depression (HDS) - adopted in 5 of the 17 studies, thus accounting for 29% of the total. The Zung Self-rating Depression Scale was used in 4 studies overall. The Hospital Anxiety and Depression Scale (HADS) was used in 4 studies. Beyond those three tests, however, no other instrument was adopted in more than four studies at most, including the Beck Depression Inventory (BDI) test, used in two studies (12%).

On the other hand, past studies were based on the results obtained through the Gold Standard Rating Scales such as Hamilton Rating Scale for Depression, Zung Self-Report Depression Scale, The Beck Depression Inventory and others. For comparing the results of different depression rating scale, different psychometric properties were considered such as reliability, inter-rater reliability, validity and cut-off scores because these differences may lead to different findings for a similar research question. Furthermore, it was also confirmed that the different depression rating scales are able to detect clinical changes with the depression treatments. There was a possibility that an individual rating assessment measure is valid but

has low sensitivity in detecting changes. For this purpose, sensitivity analysis of the all the depression scales was carried out for ensuring that the effects of the different assessment measures are fairly stable and does not underestimate the effects.

Table 2.2: List of neuropsychological tests

Study	Cognitive dysfunction assessment	Depression assessment
Robinson & Price (1982)	Mini Mental Status Examination	Hamilton Scale for Depression; Zung Self-Rating Depression Scale; Present State Examination
Parikh et al. (1987)	Mini Mental Status Examination	Hamilton Scale for Depression; Zung Self-Rating Depression Scale; Present State Examination
Starkstein et al. (1989)	Mini Mental Status Examination	Hospital Anxiety and Depression Scale; Zung Self-rating Depression Scale; Present State Examination
Eastwood et al. (1989)	Mini Mental Status Examination	Zung Self-rating Depression Scale; Geriatric Depression Scale; Hamilton Scale for Depression
House (1990)	Mini Mental Status Examination	The Beck Depression Inventory
Jonkman et al. (1998)	Wechsler Adult Intelligence Scale-Revised; Wechsler Memory Scale	Hospital Anxiety and Depression Scale; Present State Examination
Starr et al. (2000)	National Adult Reading Test; Raven's Coloured Progressive Matrices; Auditory Verbal Learning; Paced Auditory Serial Addition Test Verbal Fluency; Wechsler Adult Intelligence Scale-Revised (Mental Arithmetic); Informant Questionnaire on Cognitive Decline in the Elderly	Hospital Anxiety and Depression Scale
Spalletta et al. (2002)	Mini Mental Status Examination	Hamilton Depression Rating Scale.
Narushima et al. (2003)	Mini Mental Status Examination	Hamilton Depression Rating Scale.

Wilz and Barskova (2007)	Patient Competency Rating Scale	The Cornell Depression Scale
Passier et al. (2010)	Wechsler Adult Intelligence Scale-III (Back and forward digit span); Category Fluency; Ray-Osterrieth Complex Figure Test; Brixton Spatial Anticipation Test; Stroop Colour Word	The Beck Depression Inventory-II-NL; State-Trait Anxiety Inventory
Duits et al. (2012)	Raven's Coloured Progressive Matrices; Rivermead Behavioural Memory Test; Trail Making Test; The Tower London Test (Krikorian Version); Category (animal) Fluency from the Groninger Intelligence Test	Checklist for Cognitive and Emotional Consequences following Stroke-24
Farner et al. (2010)	Repeated Battery for the Assessment of Neuropsychological Status; Mini Mental Status Examination; Star Collection Test	Montgomery and Asberg Depression Rating Scale
Lamb et al. (2013)	Neuropsychological Assessment Schedule; Repeatable Battery for the Assessment of Neuropsychological Status	Hospital Anxiety and Depression Scale
Taylor- Piliae and Ruth (2013)	Mini Mental Status Examination	Epidemiological Studies-Depression Scale
Hosking and Marsh (2013)	Wechsler Adult Intelligence Scale-Revised; The National Adult Reading Test; Controlled Oral Word Association Wechsler Memory Scale-Revised	Geriatric Depression Scale
Allan et al. (2013)	Mini Mental Status Examination; Cambridge Cognitive Examination	DSM-IV Criteria for major depression; Geriatric depression scale; The observer-rated Cornell Scale

2.4.7 Quality of studies

Table 2.3 summarises the quality of the studies included in this review. All of these studies computed the correlation coefficients between overall cognitive dysfunction and depression in patients either soon after a stroke or at a longer follow-up. The

hypothesis, aim, and objectives of all 17 studies were the same. The aim was to determine the correlation coefficients between overall cognitive dysfunction and depression disorder after stroke, at different points in time after the stroke occurred. Seven studies used for meta-analysis were longitudinal studies (≥ 12 months follow-up) with few differences in the points of time of the initial and follow-up assessments. Robinson and Price (1982) used repeated assessment during a 12-month period at various intervals ranging from 5 months to 18 years after the time of the stroke. Parikh et al. (1987) used 2 weeks and 3, 6, 12, and 24 months after the time of the stroke. House (1990) used three time-points: 1, 6 and 12 months after the stroke. Jonkman et al. (1998) used 3, 6, and 12 months after stroke. Wilz and Barskova (2007) measured at 3 and 15 months post stroke. Hosking and Marsh (2013) measured at 12 months and Allan et al. (2013) used 3 time-points after stroke: 1, 4 and 8 years after the stroke.

Moreover, 12 studies explicitly used a cross-sectional design to identify the relationship between overall cognitive dysfunction and depression post stroke. These studies used fixed points of neuropsychological assessment ranging from 15.3 days to 6 months post stroke. Four studies under this systematic review did not report the exact time of psychological assessment. External validity explains how much the results can be generalised. In these 17 studies, no major exclusion criterion was used, with the exception of Robinson and Price (1982) and Parikh et al. (1987). Age details of the studies were given for 7 of these 17 studies: Starr et al. (2000); Wilz and Barskova, (2007); Narushima et al. (2003); Farner et al.

(2010); Duits et al. (2012); Hosking and Marsh (2013); and Allan et al. (2013). Gender details of the study's population were included in only four studies: Wilz and Barskova (2007); Farner et al. (2010); Duits et al. (2012); and Hosking and Marsh (2013).

Internal validity refers to how well a study was conducted; subjects who are unlikely to contribute to the results of the study are discounted from the study. For the present meta-analysis, the cohort-excluding percentages were as follows: Robinson and Price (1982) 19.42%; Starkstein et al. (1989) 63.39; Eastwood et al. (1989) 17.9%; Spalletta et al. (2002) 53.64%; Narushima et al. (2003) 43.3%; Passier et al. (2010) 41.42%; Farner et al. (2010) 35.1%; Lamb et al. (2013) 66.6%; Hosking and Marsh (2013) 65.4%; and Allan et al. (2013) 49.7%.

'Loss-to-follow-up' is a circumstance in which a study loses contact with a research subject, resulting in missing information. For the meta-analysis, the percentage of loss-to-follow-up in these studies was 74.42% for Parikh et al. (1987), 25.86% for House (1990), and 19.75% for Wilz and Barskova (2007). The justifications for using the measurements selected were included for almost all 17 studies with the exception of seven studies (Robinson and Price, 1928; Starkstein et al., 1989; Eastwood et al., 1989; House, 1990; Jonkman et al., 1998; Spalletta et al., 2002; and Wilz and Barskova, 2007). Level of sensitivity and specificity were included in 5 studies (Parikh et al., 1987; Wilz and Barskova, 2007; Lamb et al., 2013; Hosking and Marsh, 2013; and Allan et al., 2013). The cut-off scores for overall cognitive

dysfunction were included for nine studies (Parikh et al., 1987; House, 1990; Narushima et al., 2003; Wilz and Barskova, 2007; Farner et al., 2010; Lamb et al., 2013; Taylor-Piliae and Ruth, 2013; Hosking and Marsh, 2013; and Allan et al., 2013). The cut-off scores for post-stroke depression were included for all studies with the exception of five studies (Robinson and Price, 1982; Starkstein et al., 1989; Eastwood et al., 1989; Starr et al., 2000; and Spalletta et al., 2002).

Table 2.3: Assessing the strength of evidences

	Authors, year published																
Criteria	Robinson and Price (1982)	Parikh et al. (1987)	Starkstein et al. (1989)	Eastwood et al. (1989)	House (1990)	Jonkman et al. (1998)	Starr et al. (2000)	Spalletta et al. (2002)	Narushima et al. (2003)	Wilz and Barskova (2007)	Passier et al. (2010)	Duits et al. (2012)	Farner et al. (2010)	Lamb et al. (2013)	Taylor- Piliae and Ruth (2013)	Hosking and Marsh (2013)	Allan et al. (2013)
Study details																	
Hypothesis/aim/ objective	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Characteristics of the population	-	-	-	-	-	+	+	-	+	+	+	+	+	-	+	+	+
Time points of assessment	12m	2w, 3, 6, 12, 24 m	-	4m	1,6,12 m	3,6, 12m	-	-	-	3,15m	3 m	2 w	12-15m	6m	3.3 y	12 m	1,4,8y
Period of recruitment	18m	-	-	18m	9 m	-	-	25 m	6 y	4 y	23 m	4 m	18 m	10 m	24 m	-	-
External validity																	
No major exclusion criteria (≤ 5 criteria)	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Age details of study population	-	-	-	-	-	+	-	-	+	+	-	+	+	-	-	+	+
Sex details of study population	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	+	-
Internal validity																	
Cohort excluded %	19.42	-	63.39	17.9	-	-	-	53.64	43.3	-	41.42	-	35.1	66.66	-	65.1	49.72
Cohort lost follow-up %	-	74.42	-	-	25.86	-	-	-	-	19.75	-	-	-	-	-	-	-

Measurements																	
Justifications for using	-	+	-	-	-	-	+	-	+	-	+	+	+	+	+	+	+
Level of sensitivity	-	+	-	-	-	-	-	-	-	+	-	-	-	+	+	+	-
Level of specificity	-	+	-	-	-	-	-	-	-	+	-	-	-	+	+	+	-
Cut-off scores for CD	-	+	-	-	+	-	-	-	+	+	-	-	+	+	+	+	+
Cut-off scores for DD	**-**	**+**	**-**	**-**	**-**	**+**	**-**	**-**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**

Abbreviations: (+) clearly included, (-) not reported, (d) days, (w) weeks, (m) months, (y) years, (CD) cognitive dysfunction, (DD) depression disorder

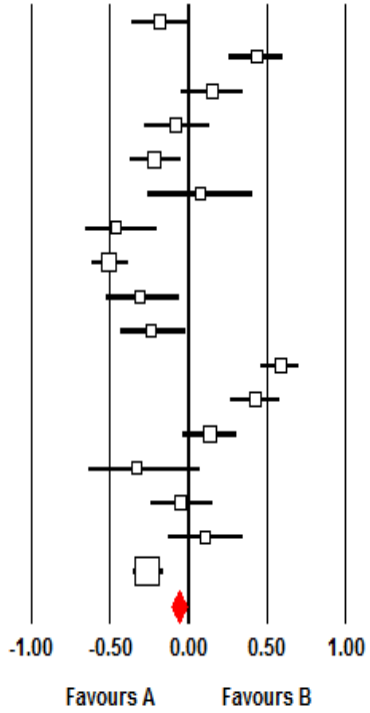
2.4.8 Meta-analysis results for correlation coefficients between overall cognitive dysfunction and depression disorder post stroke rated from questionnaires

2.4.8.1 Correlation coefficients for all 17 studies

The meta-analysis results are presented in figures below. The Figure 2.2 has provided a visual summary of the strength and significance of the relationships model between overall cognitive dysfunction and depression questionnaire for all the 17 studies together. It shows that the correlation coefficient between overall cognitive dysfunction and depression disorder after stroke is *r* = - 0.06 (95% CI – 0.11 to - 0.01) (p = 0.01). The meta-analysis found the correlations ranged from - 1 to 1. For further detecting the relationships, the research was focused in assessing how many studies have investigated significant outcomes and how many studies have reported non-significant outcomes. The forest plot analysis (Figure 2.2) has substantiated that both types of studies were included in the research. 9 of 17 studies (Parikh et al., 1987; House et al., 1990; Starr et al., 2000; Spalletta et al., 2002; Narushima et al., 2003; Wilz and Barskova, (2007); Passier et al. 2010; Duits et al. 2012; Allan et al. 2013) reported significant relationship between overall cognitive dysfunction and depression disorder at any time since stroke.

Figure 2.2: Correlation coefficients between post stroke overall cognitive dysfunction and depression disorder for all 17 studies

Authors & year published	Size of sample	Statistics for each study				
		Correlation	Lower limit	Upper limit	Z-Value	p-Value
Robinson & Price (1982)	103	-0.18	-0.36	0.01	-1.82	0.07
Parikh et al., (1987)	86	0.44	0.25	0.60	4.30	0.00
Starkstein et al., (1989)	93	0.15	-0.06	0.34	1.43	0.15
Eastwood et al., 1(989)	87	-0.08	-0.29	0.13	-0.73	0.46
House et al., (1990)	128	-0.22	-0.38	-0.05	-2.50	0.01
Jonkman et al., (1998)	35	0.08	-0.26	0.40	0.45	0.65
Starr et al., (2000)	49	-0.46	-0.66	-0.21	-3.37	0.00
Spalletta et al., (2002)	153	-0.51	-0.62	-0.38	-6.89	0.00
Narushima et al., (2003)	59	-0.31	-0.52	-0.06	-2.40	0.02
Wilz and Barskova, (2007)	81	-0.24	-0.44	-0.02	-2.16	0.03
Passier et al., (2010)	111	0.59	0.45	0.70	7.04	0.00
Duits et al., (2012)	105	0.43	0.26	0.57	4.64	0.00
Farner et al., (2010)	126	0.14	-0.04	0.31	1.56	0.12
Lamb et al., (2013)	25	-0.33	-0.64	0.07	-1.61	0.11
Taylor- Piliae and Ruth (2013)	100	-0.05	-0.24	0.15	-0.49	0.62
Hosking and Marsh (2013)	67	0.11	-0.13	0.34	0.88	0.38
Allan et al., (2013)	355	-0.26	-0.35	-0.16	-4.99	0.00
		-0.06	-0.11	-0.01	-2.50	0.01



For publication bias, Egger's test employed to explore whether there is significant publication bias in the study (Figure 2.3). The test confirmed that there exists no publication bias at 5% significance level (P = 0.115) for the 17 studies.

Figure 2.3: Publication bias test for all 17 studies

Number of studies = 17 Root MSE = .0041

Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
slope	-.3093319	.114793	-2.69	0.017	-.5540075	-.0646563
bias	.0030999	.0018508	1.67	0.115	-.000845	.0070447

Test of H0: no small-study effects P = 0.115

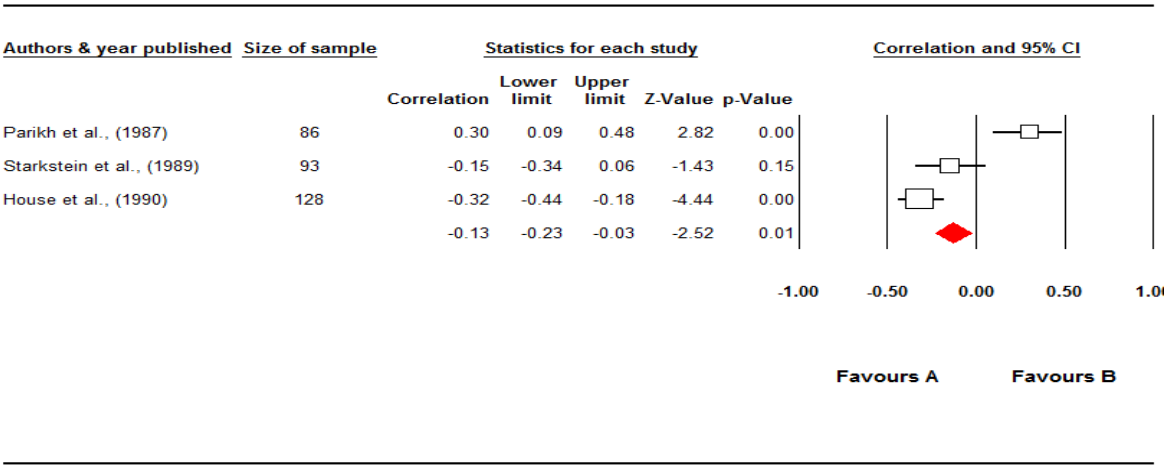
Additionally, the meta-analysis results for the relationship between overall cognitive dysfunction and depression disorder were divided according to time since stroke. They are presented in five forest plots below.

2.4.8.2 Correlation coefficients within the acute phase (1 month of stroke)

In 3 of 17 studies (Parikh et al., 1987; Starkstein et al., 1989; House et al., 1990), the relationship between overall cognitive dysfunction and depression disorder was investigated within the first month of stroke. The meta-analysis found the correlations ranged from -0.5 to 0.5. Figure 2.4 shows that the correlation coefficient between overall cognitive dysfunction and depression disorder after stroke is r = - 0.13 (95% CI – 0.23 to – 0.03) (p = 0.01). For further detecting of the relationships, the research was focused on assessing how many studies have

investigated significant outcomes and how many studies have reported non-significant outcomes. The forest plot analysis (Figure 2.4) has substantiated that both types of studies were included in the research. 2 of 3 studies (Parikh et al., 1987; House et al., 1990) reported significant relationship between overall cognitive dysfunction and depression disorder within the acute phase of stroke.

Figure 2.4: Correlation coefficients within the acute phase (1 month of stroke)



For publication bias, Egger's test in (Figure 2.5) confirmed that there exists no publication bias at 5% significance level (P = 0.062) for the 3 studies.

Figure 2.5: Publication bias test for studies examined the relationship within acute phase of stroke

Number of studies = 3 Root MSE = 3.9e-04

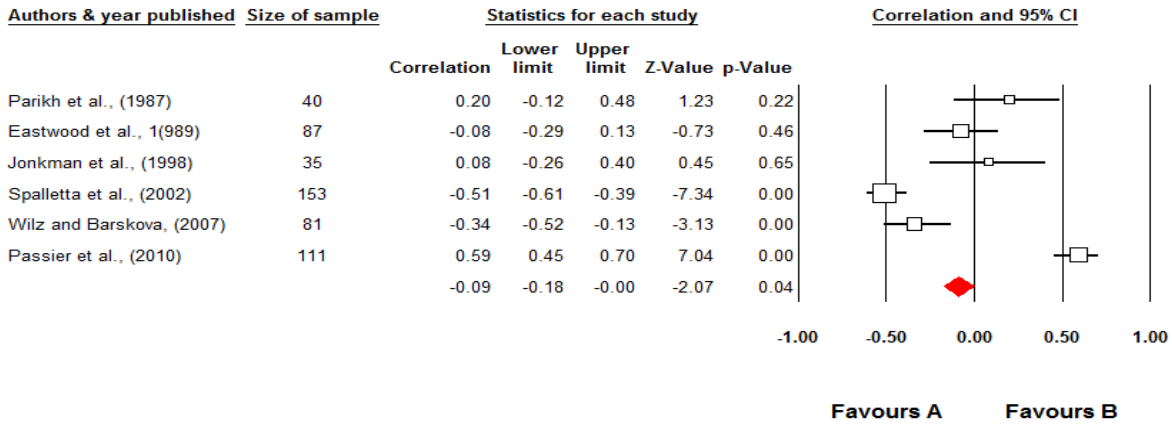
Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
slope	1.526292	.1383544	11.03	0.058	-.2316669	3.284251
bias	-.0144941	.0014106	-10.27	0.062	-.0324179	.0034297

Test of H0: no small-study effects P = 0.062

2.4.8.3 Correlation coefficients 3 months after stroke

Out of 17 studies, 6 studies (Parikh et al., 1987; Eastwood et al., 1989; Jonkman et al., 1998; Spalletta et al., 2002; Wilz and Barskova, 2007; Passier et al., 2010) reported a relationship between overall cognitive dysfunction and depression disorder 3 months after stroke. The meta-analysis in Figure 2.6 found that the correlations ranged from -1and 1. The correlation coefficient between overall cognitive dysfunction and depression disorder after stroke is r = - 0.09 (95% CI – 0.18 to – 0.00) (p = 0.04). For further detecting of relationships, the research was focused on assessing how many studies have investigated significant outcomes and how many studies have reported non-significant outcomes. The forest plot analysis (Figure 2.6) has substantiated that both types of studies were included in the research. 3 of 6 studies (Spalletta et al., 2002; Wilz and Barskova, 2007; Passier et al., 2010) reported a significant relationship between cognitive dysfunction and depression disorder after 3 months of stroke.

Figure 2.6: Correlation coefficients 3 months after stroke



For publication bias, Egger's test in (Figure 2.7) confirmed that there exists no publication bias at 5% significance level (P = 0.485) for the 6 studies.

Figure 2.7: Publication bias test for studies examined the relationship after 3 months of stroke

Number of studies = 6 Root MSE = .004

Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
slope	.2190215	.1999971	1.10	0.335	-.3362594	.7743024
bias	-.0027015	.0035116	-0.77	0.485	-.0124512	.0070483

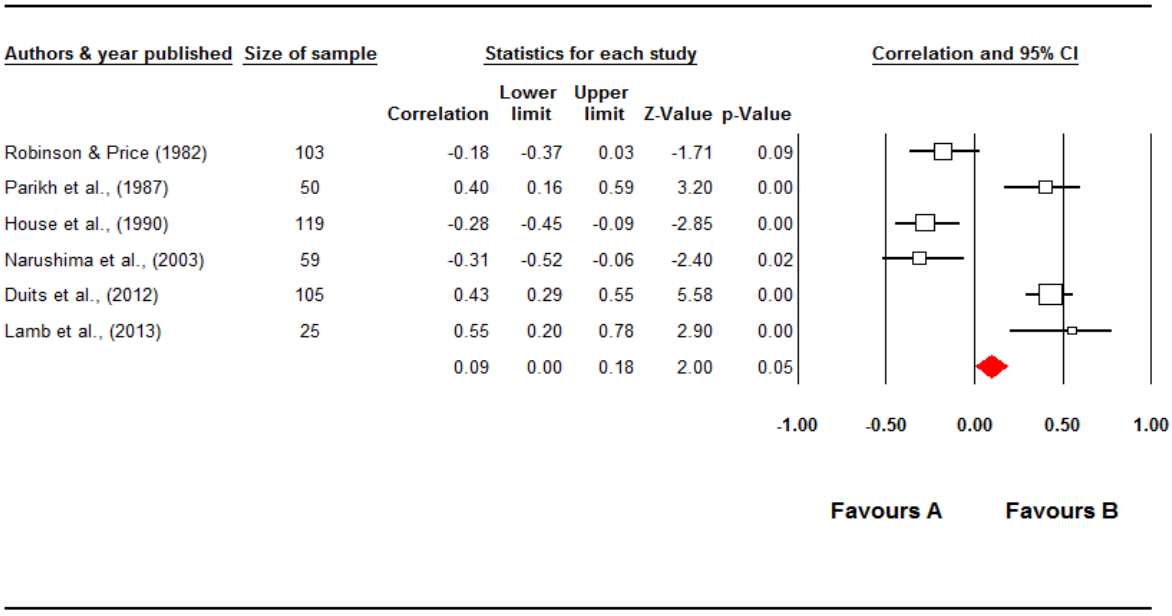
Test of H0: no small-study effects P = 0.485

2.4.8.4 Correlation coefficients 6 months after stroke

Out of 17 studies, 6 studies (Robinson & Price, 1982; Parikh et al., 1987; House et al., 1990; Narushima et al., 2003; Duits et al., 2012; Lamb et al., 2013) used 6 months after stroke as the time-point to assess the relationship between overall cognitive dysfunction and depression. Figure 2.8 shows that the correlation coefficient between overall cognitive dysfunction and depression disorder after stroke is r = 0.09 (95% CI 0.00 to 0.18) (p = 0.05) and the meta-analysis found that the correlations ranged from -0.5 to 1. For further detecting relationships, the research was focused on assessing how many studies have investigated significant outcomes and how many studies have reported non-significant outcomes. The forest plot analysis (Figure 2.8) has substantiated that both types of studies were included in the research. 5 of 6 studies (Parikh et al., 1987; House et al., 1990; Narushima et al., 2003; Duits et al., 2012; Lamb et al., 2013) reported a

significant relationship between overall cognitive dysfunction and depression disorder after 6 months of stroke.

Figure 2.8: Correlation coefficients 6 months after stroke



For publication bias, Egger's test employed to explore whether there is significant publication bias in the study (Figure 2.9). The test confirmed that there exists no publication bias at 5% significance level (P = 0.113) for the 6 studies.

Figure 2.9: Publication bias test for studies examined the relationship after 6 months of stroke

Number of studies = 6 Root MSE = .0055

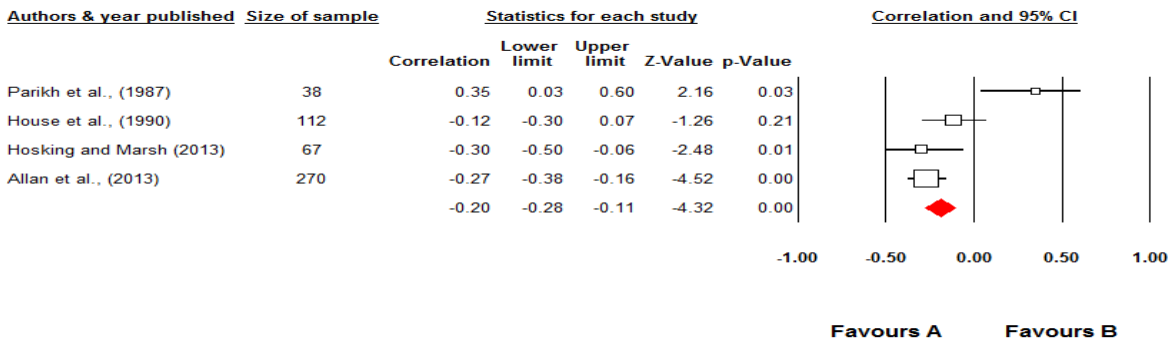
Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
slope	.7250993	.2045536	3.54	0.024	.1571674	1.293031
bias	-.0085157	.0042111	-2.02	0.113	-.0202075	.0031761

Test of H0: no small-study effects P = 0.113

2.4.8.5 Correlation coefficients 12 months after stroke

In 4 of 17 studies (Parikh et al., 1987; House et al., 1990; Hosking and Marsh, 2013; Allan et al., 2013), the relationship between overall cognitive dysfunction and depression disorder was examined 12 months after stroke. Figure 2.10 is a visual summary of the strength and significance of this relationship. The meta-analysis found that the correlations ranged from -0.5 to 0.5. The correlation coefficient between overall cognitive dysfunction and depression disorder after stroke is r = -0.20 (95% CI – 0.28 to - 0.11) (p < 0.001). For further detecting the relationships, the research was focused on assessing how many studies have investigated significant outcomes and how many studies have reported non-significant outcomes. The forest plot analysis (Figure 2.10) has substantiated that both types of studies were included in the research. 3 of 4 studies (Parikh et al., 1987; Hosking and Marsh, 2013; Allan et al., 2013) reported a significant relationship between overall cognitive dysfunction and depression disorder after 12 months of stroke.

Figure 2.10: Correlation coefficients 12 months after stroke



For publication bias, Egger's test in (Figure 2.11) confirmed that there exists no publication bias at 5% significance level (P = 0.370) for the 4 studies.

Figure 2.11: Publication bias test for studies examined the relationship after 12 months of stroke

Number of studies = 4 Root MSE = .0049

Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
slope	.4465546	.293557	1.52	0.268	-.8165191	1.709628
bias	-.005349	.0046617	-1.15	0.370	-.0254069	.0147089

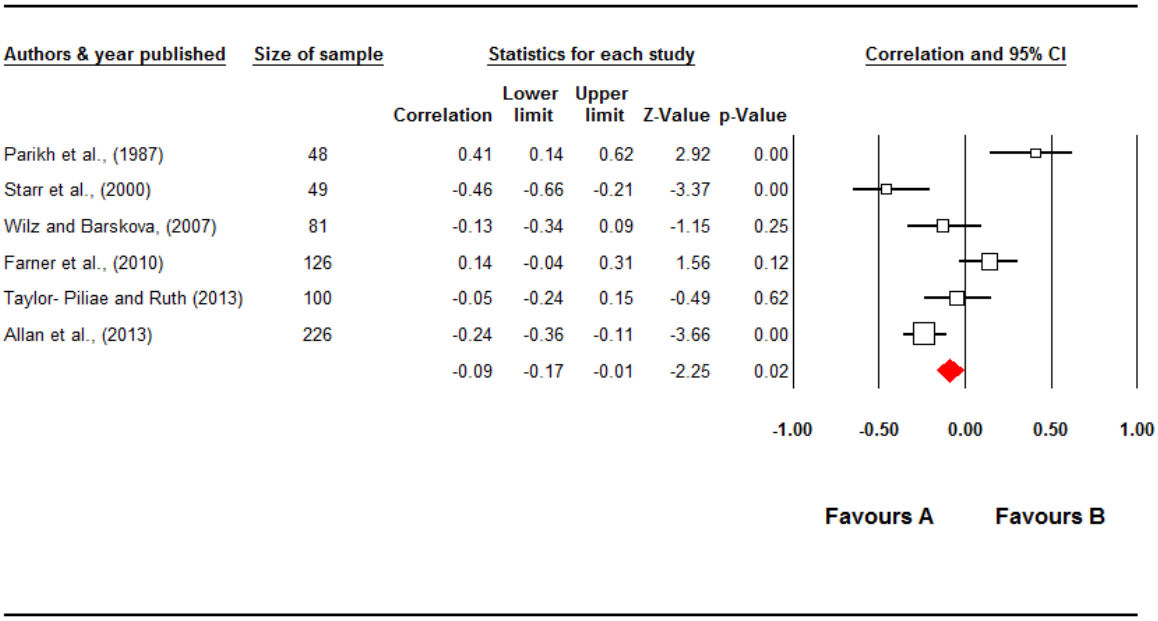
Test of H0: no small-study effects P = 0.370

2.4.8.6 Correlation coefficients more than 12 months after stroke

Six of the 17 studies (Parikh et al., 1987; Starr et al., 2000; Wilz and Barskova, 2007; Farner et al., 2010; Taylor- Piliae and Ruth, 2013; Allan et al., 2013) used time-points of between 13 and 24 months after stroke to examine the relationship between overall cognitive dysfunction and depression questionnaires scores. The meta-analysis in Figure 2.12 found that the correlations ranged from -0.5 to 0.5. The correlation coefficient between overall cognitive dysfunction and depression disorder after stroke is r = - 0.09 (95% CI – 0.17 to – 0.01) (p = 0.02). For further detecting of relationships, the research was focused on assessing how many studies have investigated significant outcomes and how many studies have reported non-significant outcomes. The forest plot analysis (Figure 2.12) has substantiated that both types of studies were included in the research. 3 of 6 studies (Parikh et al., 1987; Starr et al., 2000; Allan et al., 2013) reported a

significant relationship between overall cognitive dysfunction and depression disorder after more than 12 months of stroke.

Figure 2.12: Correlation coefficients more than 12 months after stroke



For publication bias, Egger's test in (Figure 2.13) confirmed that there exists no publication bias at 5% significance level (P = 0.923) for the 6 studies.

Figure 2.13: Publication bias test for studies examined the relationship more than 12 months of stroke

Number of studies = 6 Root MSE = .0064

Std_Eff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
slope	.0107163	.4287967	0.02	0.981	-1.179814	1.201247
bias	-.0006193	.0060274	-0.10	0.923	-.0173539	.0161153

Test of H0: no small-study effects P = 0.923

2.4.8.7 Summary of findings of the correlation coefficients between overall cognitive dysfunction and depression disorder

The findings of the meta-analysis were summarised in terms of the time-intervals that were used in each assessment. This categorisation (Table 2.4) helps to elucidate how the timeframe after stroke influences the strength and significance of the relationship between overall cognitive dysfunction and depression disorder. Another reason behind this categorisation was to compare the period immediately after the stroke with a longer time-period subsequent to the stroke.

Table 2.4: Summary of meta-analysis findings

Investigation	Time since stroke	Relationship	
		r	*P value*
(Parikh et al., 1987; Starkstein et al., 1989; House et al., 1990)	Within the acute phase (1 month)	- 0.13	0.01
(Parikh et al., 1987; Eastwood et al., 1989; Jonkman et al., 1998; Spalletta et al., 2002; Wilz and Barskova, 2007; Passier et al., 2010)	3 months	- 0.09	0.04
(Robinson & Price, 1982; Parikh et al., 1987; House et al., 1990; Narushima et al., 2003; Duits et al., 2012; Lamb et al., 2013)	6 months	0.09	0.05
(Parikh et al., 1987; House et al., 1990; Hosking and Marsh, 2013; Allan et al., 2013)	12 months	- 0.20	< 0.01
(Parikh et al., 1987; Starr et al., 2000; Wilz and Barskova, 2007; Farner et al., 2010; Taylor- Piliae and Ruth, 2013; Allan et al., 2013)	Between 13 and 24 months	- 0.09	0.02
All 17 studies together	At any time since stroke	- .06	0.01

2.5 Discussion

Seventeen published studies were reviewed. This review revealed that correlations between overall cognitive function and depression after stroke were of varying strength and significance. The strength the relationship varied from moderate to weak in the studies under review, depending on the type of time-interval used for the post-stroke assessment. The meta-analysis found that overall cognitive dysfunction was positively and significantly related to depression disorder at 6 months after stroke. A positive relationship between these two disorders indicated that at 6 months after stroke, as the level of cognitive dysfunction increases so too does the level of depression. The meta-analysis results further showed that overall cognitive function was significantly negatively correlated with depression at 1, 3, 12 and more than months after stroke. It showed that, with a decrease in overall cognitive function after stroke, the severity of depression increases. Similarly, the review found a significant negative significant relationship between overall cognitive dysfunction and severity of depression post stroke regardless of the time since stroke. It confirmed that, with the decrease in overall cognitive function at any time after stroke, the severity of depression disorder increases.

It can be concluded, based on the 17 studies reviewed, that the relationship between the overall cognitive dysfunction and depression disorder in post-stroke patients has not been confirmed. Although the findings showed a significant relationship between cognitive dysfunction and depression disorder at all time-intervals after stroke, the correlation coefficients showed that this strength of this

relationship was at a low level. It was also found that, despite the paucity of studies on the relationship between cognitive dysfunction and depression disorder post stroke, there were four factors which may lead to heterogeneity in the strength and significance of the relationship between the two variables. These four factors will be explored in more depth in the following sections.

Timing of neuropsychological assessment after stroke

'Timing of assessment after stroke' was identified as an important factor in terms of the statistical significance of the relationship between overall cognitive dysfunction and depression disorder after stroke. However, a significant correlation between the overall cognitive function and depression was found consistently in those studies that used time-intervals within first year of stroke for their assessments. On other hand, most of the studies indicated that this relationship was weak and not statistically significant at time-intervals of more than 12 months after stroke. For example, 8 studies in this review (Parikh et al., 1987; Eastwood et al., 1989; Starkstein et al., 1989; House, 1990; Spalletta et al., 2002; Wilz & Barskova, 2007; Duits et al., 2012; Passier et al., 2010) indicated in their findings that depression disorder is significantly related to overall cognitive dysfunction in the early period (< 12 months), whereas only 1 study (Lamb et al., 2013) found that this relationship is not significant in the early term (< 12 months). On the contrary, 5 studies in this review (Robinson et al., 1982; House, 1990; Jonkman et al., 1998; Wilz and Barskova, 2007; Taylor- Piliae and Ruth, 2013) found no significant relationship between depression and cognitive dysfunction in the longer term (> 12 months).

Additionally, only 1 study (Parikh et al., 1987) found a strong, significant relationship in the longer term (> 12 months).

We can also observe this significant relationship between overall cognitive dysfunction and depression disorder through longitudinal studies. For example, both Parikh et al. (1987) and House (1990) found significant relationships between cognitive dysfunction, assessed using the MMSE, and depression disorder, at 1 and 6 months after stroke, however 12 months after stroke, Parikh et al. (1987) found that this relationship is still significant whereas House (1990) found that it was not significant.

Therefore, it can be depicted that the first year of the neuropsychological evaluation after the stroke is a relevant factor in determining the significance of the relationship between overall cognitive function and depression disorder. In particular, 6 and 12 months after stroke are valuable in assessing the relationship between these two variables. The reason behind that are effects of overall cognitive dysfunction on recovery after 6 and 12 months of stroke. This disorder can increase mortality and disability rates, as well as lengthen the duration of patients' hospital stay. It might lead to depression because patients are unable to return to their usual life. As well as, those survivors who suffer from cognitive dysfunction often require a re-evaluation of their life in terms of individual goals, guidelines and directions, as well as review their social activities in order to take into account stroke-induced cognitive insufficiencies.

Methodological issues

The heterogeneity in the relationship between overall cognitive dysfunction and the severity of depression after stroke may be explained by differences in the aims and methodologies of the 17 studies reviewed. In practical terms, the objective of any particular study usually determines the type of measures, tools and methods that are adopted. In this regard, most of the studies in this review examined the relationship between lesions in the brain after a stroke and post-stroke depression in patients by analysing data either from CT-scans or MRI results, as well as from some screening neuropsychological instruments, to assess patients' cognitive abilities. This may be insufficient, given that neuropsychological tests, by their very nature, can provide only general scores estimating a patient's cognitive abilities. To take an important example, in addition to barriers to using the MMSE to assess cognitive dysfunction among stroke patients, it consists of 30 questions, and is intended as a screening tool to indicate where more detailed neuropsychological testing is needed. It is therefore insufficient for providing a comprehensive or precise assessment of the different domains of cognitive functioning.

Despite this argument, the use of more robust assessments that include different subscales is still lacking. Likewise, few of the studies under review utilised a battery of cognitive assessment tests to examine post-stroke cognitive dysfunction, and this may influence the findings. Firstly, a wide range of cognitive abilities can potentially be disturbed after a stroke. Secondly, using independent scales to examine a specific function enables researchers to obtain a more valid and reliable

assessment of the patient's cognitive dysfunctions, than using a general neuropsychological tool such as the MMSE.

Neuropsychological assessment methods

Post-stroke cognitive dysfunction invariably involves multiple cognitive domains, it is clearly necessary to conduct neuropsychological assessment using a battery of tests, which allows for the examination of each domain in detail in order to get a clearer picture of the nature of the cognitive dysfunction that may be present. This will enrich our understanding of any relationship that may emerge between an overall or specific cognitive function and the presence of depression disorder. Considering the studies in this review, the meta-analysis found that the strength and significance of the relationship were inconsistent across the studies. Possible reason for this is: (1) the cut-off scores chosen in each study, for example, the cut-offs for the MMSE ranged between 15 and 23 in the 8 studies that used the MMSE in this review; (2) validation of the tests listed to assess cognitive dysfunction after stroke; or (3) the use of neuropsychological tests that have not been widely validated. For instance, the Wechsler Adult Intelligence Scale (WAIS) was used in only 5 studies. Similarly, the Wechsler Memory Scale (WMS), the Trial Making Test, and the Wisconsin Card Sorting Test, were all used at an equally low frequency. More surprisingly, in addition to those tools that were rarely used or mentioned, a number of neuropsychological tests that are considered to be valid and sensitive instruments for assessing stroke patients were missing altogether from this review. For example, the Addenbrooke's Cognitive Examination (ACE-R)

presents a tool of satisfactory sensitivity and specificity for assessing cognitive domains in stroke patients (Gaber, Parsons, & Gautam, 2011). In addition, the Montreal Cognitive Assessment (MoCA) has superior sensitivity to assess cognitive domain after stroke compared to the MMSE (Pendlebury, Mariz, Bull, Mehta, & Rothwell, 2012). Yet, neither the ACE-R nor the MoCA were used in any of the 17 studies considered in this review.

The selection of neuropsychological scales used in the studies under review often depended on stroke patients' characteristics and the exclusion criteria applied, which can limit the range of characteristics of the participants. In this context, aphasia is often a barrier when verbal tests are used. In particular, severe aphasia was an exclusion criterion in most of the studies under review, and its correlation with post-stroke depression has been left equally unexamined. No study out of the 17 reviewed included patients who suffered from severe aphasia and used non-verbal screening assessment. Moreover, all depression scales that were categorised under depression in Table 2.2 were intended to be administered verbally.

Neuropsychological assessment settings

Another important observation produced by this review concerns the nature of the settings chosen to conduct the studies under consideration. In particular, this review has shown that the majority of studies were undertaken in hospitals or rehabilitation units rather than in communities. Therefore, the finding of this study

can identify the possibility of relationship between overall cognitive dysfunction and depression in the hospital-setting but not in the community-setting. Community settings yield much larger sample sizes of patients with cognitive dysfunction, compared with those in hospital settings. However, the studies under review purposefully selected participants in the early stages post stroke, namely within the acute phase, as well as at 3 and 6 months after stroke. Participants in those stages post stroke are more likely to be found in admission wards, while rehabilitation wards primarily provide services for the period starting 3 to 6 months post stroke. This was evidenced in the studies under review here, with the hospital-based and rehabilitation-based samples being larger than the single, community-based sample. This particular community-based study also happened to be the only longitudinal study with follow-up periods at one year and more, post stroke.

2.6 Limitations of the review process

Some limitations of this study should be acknowledged. The review process was limited to three databases and dissertations were not searched. This review also limited studies to English language only as the researcher did not have the resources to translate from different languages. Grey literature (unpublished) was also not searched. This may increase the risk of bias. Lastly, the review process in this study was conducted by a single researcher.

2.7 Conclusion

Despite having reviewed published studies dating back 33 years, little was known about the relationship between overall cognitive dysfunction, rated by neuropsychological testing, and depression after stroke. Most of the reviewed studies included the examination of this relationship as an incidental component of their aim rather than as the focal point of their investigation. Based on an examination of the relevant studies in this review, there is evidence to suggest that a correlation exists between overall cognitive dysfunction and depression disorder post stroke. The meta-analysis found that a correlation between overall cognitive function and depression after stroke existed and varied between moderate or weak. However, further investigation is needed into this relationship with regard to the time elapsed since the stroke and the nature of the neuropsychological assessment used. This will provide valuable insight that will enable health professionals to identify stroke patients who are at high risk of developing depression and enable better targeting of the prevention and treatment of cognitive and depression disorders post stroke.

2.8 Recommendations for future studies on the relationship between cognitive dysfunctions and depression disorder after stroke

In light of the above, it can be proposed that further research is needed to identify the influence of important factors on the strength and significance of the relationship between overall cognitive dysfunction and depression disorder after stroke. More specifically, further studies are needed to explore the influence of the

timing of the measurement after a stroke, issues over the study's methods, and the neuropsychological assessment used to examine the relationship between the two variables. A consistent approach to determine the correlations between post-stroke cognitive dysfunction and depression disorder would facilitate a more accurate understanding of this subject area as well as a proper comparison of the research findings.

Future studies need to focus on overall cognitive dysfunction, in addition to individual cognitive domains after stroke, using neuropsychological measurements as opposed to the more commonly used, brief screening measures such as the MMSE. In addition, it is recommended that follow-up assessment be used to identify the relationship between cognitive dysfunction and depression disorder after stroke. Future studies should ensure that baseline assessments are conducted during the early stages of stroke (that is, within 6 months of the stroke occurring), since stroke patients are likely to be physically and psychologically unstable during the early stages. The follow-up assessments need to be conducted separately in the later stages, at 6 and 12 months post stroke. In the later stages, patients may show signs of stability which would ensure more reliable tracking of the development of depression disorder in relation to overall cognitive dysfunction.

Lastly, participants for future studies should ideally be selected from communities or multiple centres as this will increase the sample size and produce more

representative samples, which will help to enhance the reliability and validity of the empirical findings.

Chapter Three: General Method

3.1 Introduction

This chapter presents details of the methodology adopted to identify the relationship between post-stroke cognitive dysfunctions and post-stroke mood disorders in Saudi Arabia. This chapter is organised into the following sections: design, selection of participants, ethical considerations, procedures, clinical assessment protocol, standardised psychometric assessment procedures, demographic and clinical data, and statistical analysis. These methods will help in accomplishing the following primary and secondary objectives.

- **Primary objectives**

1. To investigate whether a statistically significant relationship exists between the severity of mood disorders and cognitive dysfunctions in stroke patients.
2. To examine whether there are significant differences between stroke patients with and without mood disorders in terms of their cognitive functions.

- **Secondary objectives**

This study also aimed to determine the prevalence of the following in a Saudi Arabian sample:

1. Post stroke anxiety disorder at least one month after stroke.
2. Post stroke depression disorder at least one month after stroke.
3. Cognitive dysfunctions (orientation/ attention deficit, memory disorder, visuospatial problems, fluency difficulties, language delay, visual neglect,

executive dysfunctions, and overall cognitive dysfunction) at least one month after stroke.

3.2 Design

An observational design was undertaken to identify the prevalence of and relationship between cognitive dysfunctions and mood disorders after one month or more following an ischemic or haemorrhagic stroke. Both primary and secondary objectives were accomplished by addressing them in terms of one study. The study took place between 1 December 2013 and 31 December 2015.

3.2.1 Design for Chapter 4: Prevalence of post-stroke cognitive dysfunctions in Saudi Arabia

An observational method was employed to collect descriptive information about the prevalence of cognitive dysfunctions in a Saudi stroke population. The researcher observed and systematically collected information about the research subjects but did not try to change them or their circumstances. The assessment of the cognitive functioning of each participant was the primary source of information to be collected and analysed. A cross-sectional survey design was used because it facilitated the examination of association between stroke and cognitive dysfunctions by collecting data on ‘exposure’ and ‘outcome’ at a single point in time. This investigation defined ‘exposure’ as the occurrence of ischemic or haemorrhagic stroke, while ‘outcome’ is the presentation of cognitive dysfunctions.

3.2.2 Design for Chapter 5: Prevalence of post-stroke mood disorders in Saudi Arabia

An observational method was undertaken to identify the prevalence of mood disorders one month or more following an ischemic or haemorrhagic stroke. A follow-up assessment, after three months, was also carried out to explore any variations within the observed frequencies of anxiety and depression after stroke. The participants in the follow-up group were contacted by telephone three months after baseline assessment. The researcher implemented the telephone follow-up assessment. Each telephone call lasted 10 to 15 minutes. The researcher communicated with participants via telephone to examine the patient's mood using the HADS with emphasis on the importance and necessity of compliance of the ethical considerations in this study.

3.2.3 Design for Chapter 6: Relationship between cognitive dysfunctions and mood disorders in Saudi stroke patients

An observational method was used to examine post-stroke mood disorders (anxiety and depression), and their relationship with dysfunctions in orientation/attention, memory, fluency, language, visuospatial ability, visual neglect, executive functions and overall cognitive function in a hospital-based sample of first-ever stroke patients in Saudi Arabia.

3.3 Selection of participants

Participants were recruited from three medical centres in Riyadh, the capital city Saudi Arabia: King Fahad Medical City, King Abdulaziz Medical City and Prince

Sultan Bin Abdulaziz Humanitarian City. On average, 700 stroke patients per year are admitted to each of these centres.

In *King Fahad Medical City (KFMC),* approximately 300 stroke patients are admitted to the KFMC stroke programme annually, of which 85% are ischemic stroke cases. The centre provides two stroke-prevention clinics weekly; about 10-12 stroke patients visit these clinics every week. A structured database for the acute stroke unit has been maintained by KFMC since 2005, and the centre also received Joint Commission International accreditation for their stroke programme.

The second centre, *King Abdul-Aziz Medical City (KAMC),* admits approximately 1,600 stroke patients annually to the SANG Health Affairs Stroke Program in the KAMC. Almost half of the stroke patients have no or mild deficits. These patients are usually admitted to ICU for 4-6 days. Patients in need of rehabilitation are given the opportunity to reside in acute stroke unit for 6 weeks. Of these patients, 10-15% may die or require long-term placement due to severe disability. Discharged patients are also examined every 6 weeks within the stroke clinic. This hospital has also received Joint Commission International Accreditation for their stroke programme.

The third centre, *Prince Sultan bin Abdulaziz Humanitarian City (SBAHC)*, has three stroke wards, two of which are dedicated to men and one to women. Approximately 288 patients are admitted to each ward every year; 70% males and 30% females. Among these patients, a large portion – almost 90% – are ischemic stroke patients. These patients are allowed to stay in the centre for 12 weeks

divided into three periods of admission. This centre has also received accreditation from the Joint Commission International Accreditation.

The following criteria were applied to potential participants.

Inclusion criteria

Participants who satisfied the following criteria were deemed eligible for participation in the study:

- aged 18 years and over;
- definitive diagnosis of first-ever ischemic or haemorrhagic stroke had been documented in their medical notes by a Consultant Neurologist according to CT-scan results;
- at least one month since onset of stroke (to increase likelihood of patient being medically stable);
- assessed by a neurologist, nursing staff, or a speech therapist to be: conscious, orientated, and able to sufficiently comprehend and communicate informed consent.

Exclusion criteria

Participants were excluded from the study if they satisfied any of the following conditions:

- Severe dementia was documented in their medical charts.
- Severe aphasia was documented in their medical charts.

- Chronic psychiatric or other concurrent neurological disorders were documented in their medical charts.
- A history of alcohol or drug abuse was documented in their medical charts;
- Participant was blind or deaf (required for standardised administering of neuropsychological assessments).
- Participant was non Saudi citizen.
- Participant was unable to speak or understand Arabic (neuropsychological assessments were in Arabic).
- Participant was medically unstable.

3.4 Ethical considerations

Ethical considerations were important for ensuring the integrity of the research process.

3.4.1 Informed consent

The researcher respected the rights of the participants to choose what would or would not happen to them by ensuring that satisfactory standards of informed consent were met. Thus, before participation, the researcher ensured protection of both the participants and the researcher himself by communicating clearly and obtaining clear agreement from the participants.

Participants were provided with information about the research aims, the research procedure, and the potential risks and benefits. It was also clearly communicated to participants that they could withdraw from the study at any time. Since the study

was concerned with measuring the prevalence of neuropsychological dysfunctions and mood disorders, it was recognised that some participants might not have the cognitive ability to fully understand this information, which could compromise the ability of the researcher to obtain informed consent. In these cases, a third party (legal representatives of patients) was used who acted in the best interests of the participant. Legal representatives for the purpose of current study were family members, carers and blood-relations of the participant. They gave consent on behalf of their patients. Third parties were provided with access to the research process so that they could withdraw the participant from the study at any time if they felt it was not in the best interest of the participant.

The researcher introduced the study to the participants as follows (in Arabic):

"My name is Sami, and I am a PhD student at the medical school at the University of Nottingham in the UK. I am conducting a study about the prevalence of cognitive dysfunctions, anxiety and depression disorders after having a stroke. The study is supervised by Prof. Nadina Lincoln and Dr. Shirley Thomas, and has received ethical approval from the Faculty of Medicine & Health Sciences (FHMS) Research Ethics Committee, University of Nottingham, UK. If you decide to participate in my study, you will be asked to give your responses to four questionnaires, using pencils to mark your response on the forms provided. These will take about 60 minutes to complete. You are not forced to participate in this study and can withdraw anytime during the process. Kindly consider all the details and do not

hesitate to ask any question. If you confront any difficulties with reading, your caregiver's support will be appreciated".

3.4.2 Confidentiality and privacy

The researcher respected the confidentiality and privacy of all participants. As part of informed consent, participants were made aware of the personal and demographic data that were accessed by the researcher, and that the researcher would have access to medical files and medical personnel regarding the participants' medical histories and health status. Further, for maintaining privacy, assessments from participants were conducted in a private room in the hospital or medical centre.

3.4.3 Other ethical considerations

- Participants gave their written informed consent to participate. For those who were illiterate or had reading difficulties, their legal representatives were allowed to help them to review information about participation and sign the consent form on the patient's behalf (refer to the ethical approval in Section 3.2.2 above for further details).
- In the event that the Hospital Anxiety and Depression Scale identified a high level of depression or anxiety in a participant, the researcher obtained permission verbally from the participant to pass on their assessment results to his internal supervisor in the medical centre.

- If the participant was distressed during the assessment, he or she took a half-hour break from the assessment, after which they were asked whether they wanted stop and continue at another time.

3.4.4 Ethical approvals

The study design, as well as the information sheet and consent form, were approved by the following organisations:

- The Faculty of Medicine & Health Sciences (FHMS) Research Ethics Committee, University of Nottingham, UK, (Reference no. D12122013 SoM Rehab & Age).
- King Abdullah International Medical Research Centre, National Guard, Riyadh, Saudi Arabia, (Reference no. SP13/018).
- Institutional Review Board in King Fahad Medical City, Ministry of Health, Riyadh, Saudi Arabia (Reference no. 13-256E).
- Prince Sultan bin Abdulaziz Humanitarian City, Research Ethics Committee, Riyadh, Saudi Arabia (Reference no. 01/2014).

3.5 Procedures

The researcher attended the outpatient clinics and in-patient wards in King Fahad Medical City (KFMC), King Abdul-Aziz Medical City for National Guard (KAMC), and Prince Sultan bin Abdulaziz Humanitarian City (SBAHC).

The Consultant Neurologist, physiotherapist or nursing staff identified whether the patients were able to participate, based on the above-mentioned selection criteria.

The recruitment process was further categorised into outpatient recruitment and in-patient recruitment.

Outpatient recruitment

For those in outpatient clinics, the Consultant Neurologist informed eligible patients about the study and invited their participation, at the end of their appointment. Those who agreed to speak to the researcher were referred to an investigation room to meet him (S. A.) after their appointment.

In-patient recruitment

Regarding patients who had already been admitted to rehabilitation centres, ward staff identified whether such patients were eligible to participate in this study and informed such patients about the study. The researcher approached only those patients who had given permission for him to speak to them about the study. The researcher visited them in their hospital rooms to discuss their participation.

3.6 Clinical assessment protocol

Initially, the medical staff were informed about the study objectives and the inclusion criterion for participation. It was important that the medical personnel supported the study, as they played a significant role in the identification and recruitment of appropriate patients for participation in the study. Neurologists and nursing staff, both in the wards and outpatient clinics, assisted the researcher in identifying patients who satisfied the inclusion criteria, and informed the relevant patients about the study, requesting permission for the researcher to approach them to provide further information. Outpatients who agreed to participate met the

researcher in a private examination room, while in-patients admitted to the wards were approached in the privacy of their rooms.

After welcoming patients, the researcher introduced himself and explained the research objectives and procedures. Information about the study was given verbally to patients and their partners, along with the study information sheet (Appendix 6). The researcher gave the patients and their partners the opportunity to read the information sheet and consent form, while the researcher remained available to answer any questions. When both parties were satisfied, the patient was asked to sign a consent form. Patients were given a break after reading the consent form to rest or use the toilet. Their consent was obtained before starting the assessments; after consent was obtained, the neuropsychological assessment commenced.

The assessment began with three neuropsychological tests (the Addenbrooke's Cognitive Examination – Revised; Trail Making Test; and Apple Cancellation Test), before administering the Hospital Anxiety and Depression Scale (HADS). Demographic data were obtained from patients after the examination session, as well as from medical staff and medical charts. To measure performance in activities of daily living (ADL), staff were asked to complete the Barthel Index (BI) for the patients for the purposes of the study. It took up to two hours to collect all the data from each patient. After the assessment, patients were thanked for participating in this research.

3.7 Materials

In order to provide a consistent environment, the neuropsychological assessments were conducted in the hospital setting by the PhD student who is a qualified clinical psychologist. This limited contamination of assessment by confounding factors. The researcher himself is registered by the Saudi Commission for Health Specialties as a qualified health professional and for working as a clinical psychologist in Saudi Arabia.

Other factors that may affect neuropsychological assessment after stroke were the validity and reliability of tests. The assessments were selected after considering their validity and reliability in measuring cognitive dysfunction and mood disorders. The measures chosen were also found to be suitable for assessing an Arabic sample. Furthermore, these assessments – which included presenting numerical and alphabetical sequences and figures – were short enough to complete without overtiring the participant.

Three types of psychological measurement were used: neuropsychological assessment; a mood disorders questionnaire; and a demographic questionnaire, which gathered data on the patients' demographic and stroke characteristics. An experienced clinical psychologist administered each test, discussed in more detail below.

The selection of tests for the purposes of this study was undertaken primarily based on their suitability for the chosen sample group, notably in terms of linguistic

and cultural characteristics. This was in order to mitigate the impact of individual variations – notably in terms of their education level – on the validity of the results.

3.7.1 Standardised neuropsychological assessment procedures

Three neuropsychological tests were used for assessing the prevalence of cognitive dysfunctions among the participants. These tests were selected after considering their stability with the Saudi Arabian sample. Assessing the degree of sensitivity and specificity of these three tests in identifying cognitive problems within the Saudi Arabian population, the researcher found stability for each of these tests as compared to other population groups. Details of these three measures are provided below.

3.7.1.1 The Arabic Addenbrooke's Cognitive Examination – Revised (Arabic ACE-R)

The ACE-R (Mioshi et al., 2006) has been heralded for its diagnostic accuracy as a cognitive screening tool. It incorporates questions from the MMSE and expands on the domains of orientation/attention, memory, fluency, language and visuospatial ability. Al Salman (2013) developed an Arabic version of the ACE-R, which was used in this study. One of the clinical advantages of using the Arabic ACE-R is that no specialised equipment or trained assessors are required, and it only takes approximately 20 minutes to administer (Mathuranath, Nestor, Berrios, Rakowicz, & Hodges, 2000). The cut-off points for this the Arabic ACE-R are highly associated with the age-bands, although literacy and illiteracy also played an important role in deciding cut-off points for both the categories of assessment i.e.,

Receiver Operating Curve (ROC) and the fifth percentile range. Thus, variables such as age and level of education do not influence the predictive outcome, compared to other screening measures such as the MMSE (Mathuranath et al., 2000).

For the literate group, the cut-off points of 73 for the fifth percentile range showed good sensitivity and specificity for identifying patients with an experimental diagnosis of either Alzheimer's disease or mild cognitive impairment. Within the sub-categories, based on the age-bands of this literate group, it was identified that participants in the 50s age-band showed cut-off points of 83 for the fifth percentile range while participants in the 60+ age-band showed cut-off points of 71 for the fifth percentile range (Al Salman, 2013).

For the illiterate group, the cut-off points of 69 for the fifth percentile were used. The examination of the Receiver Operating Curve (ROC) revealed the effectiveness of the Arabic ACE-R in distinguishing, with high sensitivity and specificity, between healthy controls and patients with a diagnosis of having either Mild Cognitive Impairment (MCI) or dementia of the Alzheimer's type (DAT). Moreover, within the sub-categories, based on the age-bands of the illiterate group, it was identified that participants in the 50s age-band showed cut-off points of 72 for the fifth percentile range while participants in 60s age-band showed cut-off points of 69 for the fifth percentile range, and for the 70+ age-band, the cut-off points were 66 for the fifth percentile range. Internal reliability was found to be high, that is, well above 0.9 in both types of assessment (Al Salman, 2013).

3.7.1.2 Apple Cancellation Test

The Apple Cancellation Test was developed as part of the Birmingham Cognitive Screen (BCOS) (Humphreys, Bickerton, Samson, & Riddoch, 2012). It was designed in such a way that the education or culture of the participants does not bias the results of the test. The Apple Cancellation Task provides a measure of different forms of neglect associated with visuospatial deficits. The most common visuospatial disorder post stroke is unilateral neglect, whereby the patient is unaware of the side of the body affected by stroke and therefore neglects this side (Chechlacz et al., 2012).

The BCOS (2012) stipulate the administering and scoring of the test as follows:

The test was designed on size A4 size paper with a depiction of 50 apples on each sheet. As shown in Figure 3.2, these apples were divided equally into 10 indistinguishable boxes, that is, 15 apples in each column. In each box, there are 5 complete apples (targets), 5 right opening incomplete apples and 5 left opening incomplete apples (distracters). Each participant was given five minutes to cancel out complete apples only.

This Apple Cancellation Test takes into account scores for total visual neglect, egocentric neglect and allocentric neglect:

- Visual neglect – total was considered to assess the targets selected by the participants in both left- and right-side boxes. The cut-off for the total number of target omissions was 42/50; based on, 5th percentile and across age groups.

- Egocentric neglect refers to the patient's inattentiveness to stimuli presented on the side of the body opposite to the site of the brain lesion (contralesional). The examination of egocentric neglect was made through the analysis of the number of targets missed by the participants. The asymmetry score for left and right-side egocentric neglect was calculated using the formula:

(No. correct in boxes 7 + 8 + 9 + 10) minus (No. correct in boxes 1 + 2 + 3 +4)

The minimum score was - 20 and the maximum was 20. Negative values indicate that more targets were selected on the left than on the right side (right egocentric neglect) and positive values indicate that more targets were selected on the right than on the left side (left egocentric neglect). The cut-off scores for the left- and right-side egocentric neglect were shown in Table 3.1; based on 5th percentile and across age groups. Additionally, for the purpose of comparison between subgroups, the scores were rescored to remove the direction, so that the score = 0 represented no egocentric neglect and the score = 20 represented severe egocentric neglect.

- Allocentric neglect refers to the patient's inattentiveness to the contralesional side of individual objects. The assessment of allocentric neglect was made by examining the number of distracters cancelled by the participant. The asymmetry score for left- and right-side allocentric neglect was calculated using the formula:

(No. false positive with LEFT opening) minus (No. false positive with RIGHT opening)

The minimum score was - 50 and the maximum was 50. Negative values indicate (right allocentric neglect) and positive values indicate (left allocentric neglect). The cut-off scores for the left- and right-side allocentric neglect were shown in Table 3.1; based on 5th percentile and across age groups. For the purpose of comparison between subgroups, the scores were rescored to remove the direction, so that (the score = 0) represented no allocentric neglect and (the score = 50) represented severe allocentric neglect in either directions.

Figure 3.1: Sample item for the Apples Cancellation Test

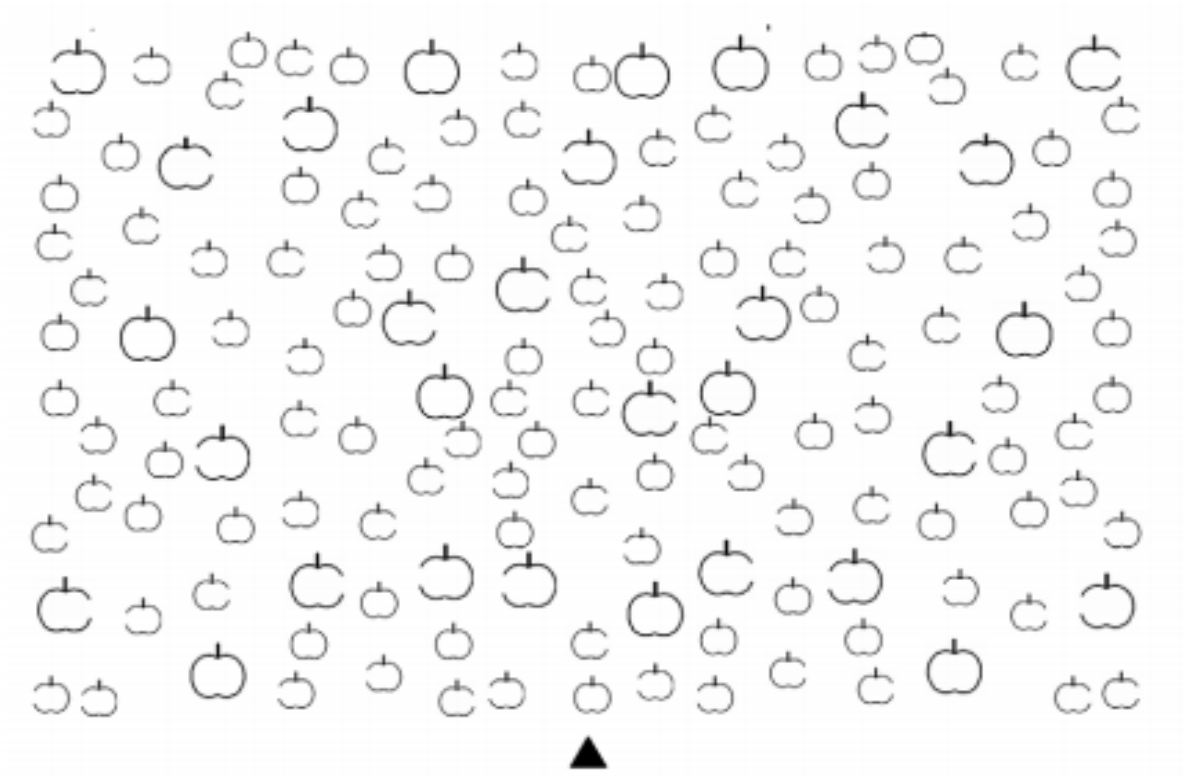


Figure 3.2: Template for scoring the Apple cancellation

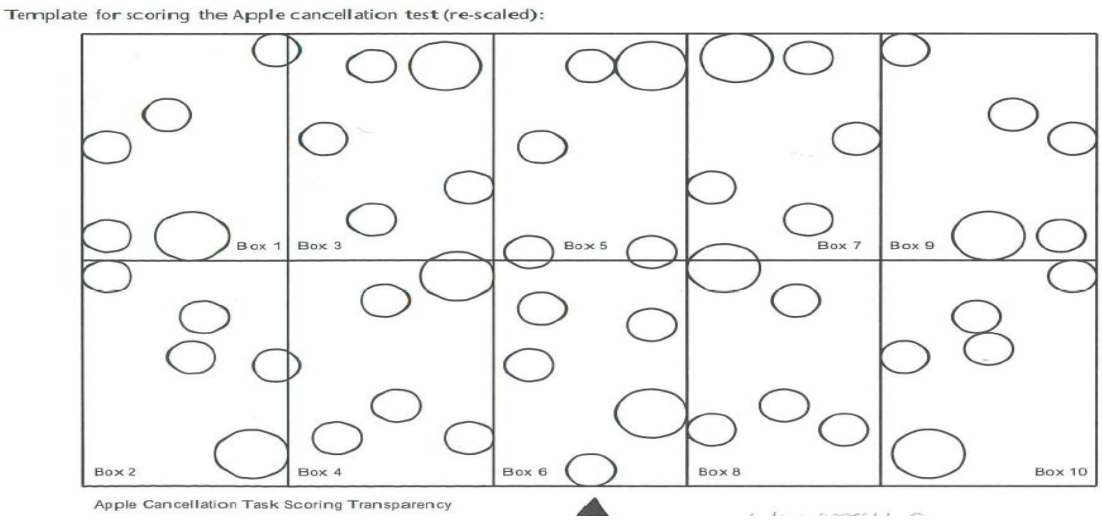


Table 3.1: Cut-off scores based on fifth percentile for the Apple Cancellation Test

Types of visual neglect		≤ 64 years-old	65-74 years-old	≥ 75 years-old
Egocentric neglect	Right	<–2	<–2	<–2
	Left	>2	>3	>3
Allocentric neglect	Right	<–1	<–1	<–1
	Left	>1	>1	>1

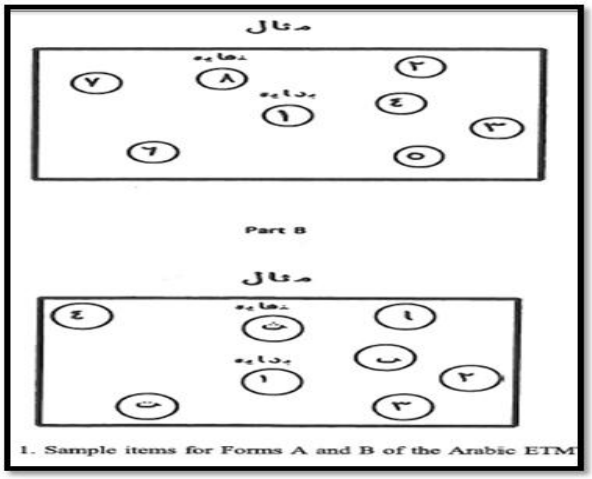
3.7.1.3 Trail Making Test – Arabic version

The Trail Making Test (TMT) consists of two parts: A and B. Although TMT provides information about attention, visual search speed, scanning, speed of processing, mental flexibility, as well as executive functioning (Tombaugh, 2004), Part A was used in this investigation primarily to examine visual motor skills while Part B used to examine executive functions.

In the TMT, the participant is instructed to connect a set of 25 dots as fast as possible while still maintaining accuracy (Arnett & Labovitz, 1995). In the figures given below for Part A, circles numbered 1-25 are presented to the patient who is instructed to draw lines to connect the numbers in ascending order (Tombaugh, 2004). In Part B, the circle includes numbers 1-13, as well as letters A-L. In addition to drawing lines to connect the circles in ascending pattern, there is the additional task of alternating between the numbers and letters (i.e., 1-A-2-B-3, etc.) (Tombaugh, 2004). A participant was required to connect the circles as quickly as possible without lifting the pen. If the patient made an error, the researcher pointed out the error and the patient was required to correct it. Errors, therefore, affect the time the patient took to complete the task, thereby affecting the score. The test was suspended after 5 minutes, regardless of whether the patient had completed the task or not. The higher the time scores (in terms of how fast participants reached their targets compared to others), the higher the indication of dysfunctions in executive function. However, a key skill needed to complete this task is the fine motor skill of drawing lines quickly. Therefore, when a participant showed upper-limb paralysis or uncoordinated movement was present, as was likely after a stroke, the researcher considered the validity of the test and this was noted in the analysis of the results. The cut-off score for the Arabic version was based on age for Part A and on age and education for Part B, as shown in Table 3.3 (Stanczak, Stanczak, & Awadalla, 2001).

Figure 3.3: Sample items for form A and B of the Arabic TMT

$$Cutoff\ Scores = \frac{(s_1 * \bar{x}_2) + (s_2 * \bar{x}_1)}{s_1 + s_2}$$



1. Sample items for Forms A and B of the Arabic ETMT

Source: Reproduced from Stanczak, Stanczak, and Awadalla (2001)

Table 3.2: Scoring for TMT Parts A and B by age and level of education

Age in years↓	**Percentiles (10%)**	**Part A (Seconds)**	**Parts B (Seconds)**	
Education level attained→			**≤ Grade 12**	**> Grade 12**
65- 69	10	53	137	77
70- 74	10	61	172	112
75 and over	10	70	189	178

3.7.2 Standardised mood-disorders assessment procedures

3.7.2.1 The Hospital Anxiety and Depression Scale (HADS)

The Hospital Anxiety and Depression Scale was designed to detect states of anxiety and depression distress amongst patients who were being treated for a

variety of clinical conditions (Zigmond & Snaith 1983). The scale was not designed to be a clinically diagnostic tool (Whelan-Goodinson et al. 2009). The HADS was devised for brief measurement of both anxiety and depression disorders, with 7 of its 14 items assessing depression and 7 assessing anxiety. In the present study, the Arabic version of the HADS (El-Rufaie & Absood, 1987) was used. El-Rufaie and Absood (1987) found this scale to be reliable and show significant levels of sensitivity and specificity. Similarly, Malasi, Mirza, and El-Islam (1991) concluded that the psychometric properties of the Arabic version of the HADS has high sensitivity and specificity scores (79% and 87% respectively) for measuring both anxiety and depression.

The recommended cut-off points for stroke patients ranged from 4/5 to 5/6 for anxiety and from 4/5 to 7/8 for depression (Lincoln et al., 2012). However, for researchers using the Arabic version of HADS, El-Rufaie and Absood (1995) suggested cut-off points of 8/9 (sensitivity = 65.9% and specificity = 92.3%) for anxiety, and 5/6 (sensitivity = 69.8% and specificity = 93.3%) for depression; accordingly, these cut-off points were adopted in this study.

3.7.3 Activities of daily living assessment

The Barthel Index (BI) was used to measure performance in personal activities of daily living (ADL). The original version of the index was designed by Barthel and Mahoney (1965) to assess the extent to which stroke patients can function independently and have mobility in their ADL, including feeding, bathing, grooming, dressing, bowel control, bladder control, toileting, chair transfer, ambulation and

stair climbing. However, the current study used an updated version by Collin, Wade, Davies, and Horne (1988).

3.8 Demographic and clinical data

The patient's demographic data were compiled by the researcher. The collection process was completed mainly with the help of patients' medical records. However, if there was insufficient information in these records, the patients were asked about their medical history by the researcher. The demographic questionnaire elicited essential information about the patient, such as age, gender, literacy and treatment setting. It also elicited information about their history of stroke, other psychiatric disorders; time elapsed since stroke, side of weakness, and lesion location according to CT-scan results.

Participants were divided into sub-groups based on six major variables so as to collect the necessary information based on a pre-determined protocol.

- *Age:* From a review of the literature, the mean age of stroke patients in the KSA is 60-65 years. Al Rajeh, Awada, Niazi and Larbi, (1993) reported it as 63 - 71 years while Robert and Zamzami (2014) reported 61-70 years. Similar findings were identified for the mean age of the global population (i.e. $\mu = 64.70 \pm 8.54$, refer to identified patient characteristics in the systematic review of 17 studies in Section 2.4.2). Sixty years old was used as the average to divide the Saudi participants into two groups of patients: those aged 60 years and under, and those aged 61 years and over.

- *Gender:* Male and female.
- *Literacy:* It was considered necessary to divide the sample into 'literate' and 'illiterate' subgroups, since a significant segment of the over-60 population in Saudi Arabia is illiterate. In this study, the level of literacy of participants was assessed after meeting with the research participants, based on their ability to read and write. In this context, the term 'illiterate' refers to a participant who was unable to read and/or write, while 'literate' indicates a participant who was able to read and write, or who had received a level of formal education.
- *Time since stroke:* The sample was divided into two subgroups, patients at 6 months or less since their stroke and those at 7 months or more. This variable was selected based on evidence from past studies showing that the first 6 months after the stroke are sensitive for the patients as the chance of another stroke or permanent physical disability is higher if proper and adequate treatment is not obtained. In contrast, the period after the first 7 months is associated with a reduced chance of suffering another stroke or severe disability (Saxena, Ng, Yong, Fong, & Koh, 2008).
- *Side of weakness:* Patients having either left- or right-side weaknesses in their body were considered for the purpose of present study.
- *Treatment setting:* Hospital or a rehabilitation unit.

3.9 Statistical analysis

The statistical analyses were performed using SPSS version 22. All the factors that may have affected the results for the different participants were analysed. These

included demographic factors and other patient characteristics. The statistical processes used in the data analysis are specified below.

Parametric and non-parametric tests were used for cross-relating the findings of different tests with each other. Non-parametric tests were selected for their validity for both non-normally distributed data and normally distributed data; however, flexible modelling could only be done using parametric tests. To conduct the assessment from different points including testing significance, and estimating parameters and confidence intervals, a mixed approach for analysis was selected for the current thesis.

1- The *Pearson Correlation Coefficient* (*r*) was used to test the strength of relationship between mood disorders (anxiety and depression), assessed through the HADS scores, and activities of daily living (ADL), assessed through the Barthel Index (BI).
2- *A T-Test* was used to compare differences between 'anxious' and 'non-anxious' participant scores on the Arabic versions of the ACE-R, ACE and TMT (i.e., overall cognitive function, orientation/attention, memory, fluency, language, visuospatial ability, visual neglect, and executive functions). Moreover, this analysis was performed after participants had been categorised into 'depressed' and 'non-depressed' groups.
3- A *linear regression analysis* (stepwise) was undertaken to analyse whether demographic characteristics and cognitive dysfunctions (i.e., overall cognitive function, orientation/attention, memory, fluency, language, visuospatial ability,

visual neglect, and executive functions) predicted the severity of mood disorders (anxiety and depression). The scores of the HADS-A and HADS-D were used as dependent variables, while the predictor variables adopted included demographic characteristics (i.e., age, gender, literacy, time since stroke, side of weakness, treatment setting) and the scores of the Arabic ACE-R, ACT and TMT. A *p*-value of ≤ 0.05 was defined as statistically significant.

4- The *Mann-Whitney test* was performed to compare differences in the Arabic ACE-R, ACT, TMT and HADS scores between the subgroups. The means, SDs, and percentiles were calculated for the Arabic ACE-R, ACT, TMT and HADS scores, and a Z-score was measured to confirm whether the observed value differed from the mean. The test helped to determine whether there are significant differences between stroke patients with and without mood disorders in terms of their cognitive functions. *Chi-Square* (X^2) was performed after re-grouping all participants into two subgroups, 'anxious' and 'non-anxious'. Six demographic characteristics (age, gender, literacy, time since stroke, side of weakness, treatment setting, as stipulated in Section 3.2.3 above) and neuropsychological dysfunctions were compared for these two groups. Moreover, this analysis was performed after participants had been categorised into 'depressed' and 'non-depressed' groups.

Having discussed the general methods used in this study, the next chapters present the prevalence of post-stroke cognitive dysfunctions and mood disorders in the Saudi Arabia population.

Chapter Four: Results1: Prevalence of Post-Stroke Cognitive Dysfunctions in Saudi Arabia

4.1 Introduction

This chapter recounts the investigation that was conducted for assessing post-stroke cognitive dysfunctions among the patients in three hospitals of Saudi Arabia: King Abdul-Aziz Medical City (KAMC), King Fahad Medical City (KFMC), and Prince Sultan bin Abdulaziz Humanitarian City (SBAHC). The investigation focused on different types of cognitive dysfunction recognised within post-stroke patients in Saudi Arabia. Further, this investigation aimed to identify the impact of different patient characteristics on the prevalence of cognitive dysfunctions. The procedures for data collection and neuropsychological tests in this investigation were explained in more detail in Chapter 3 (General method).

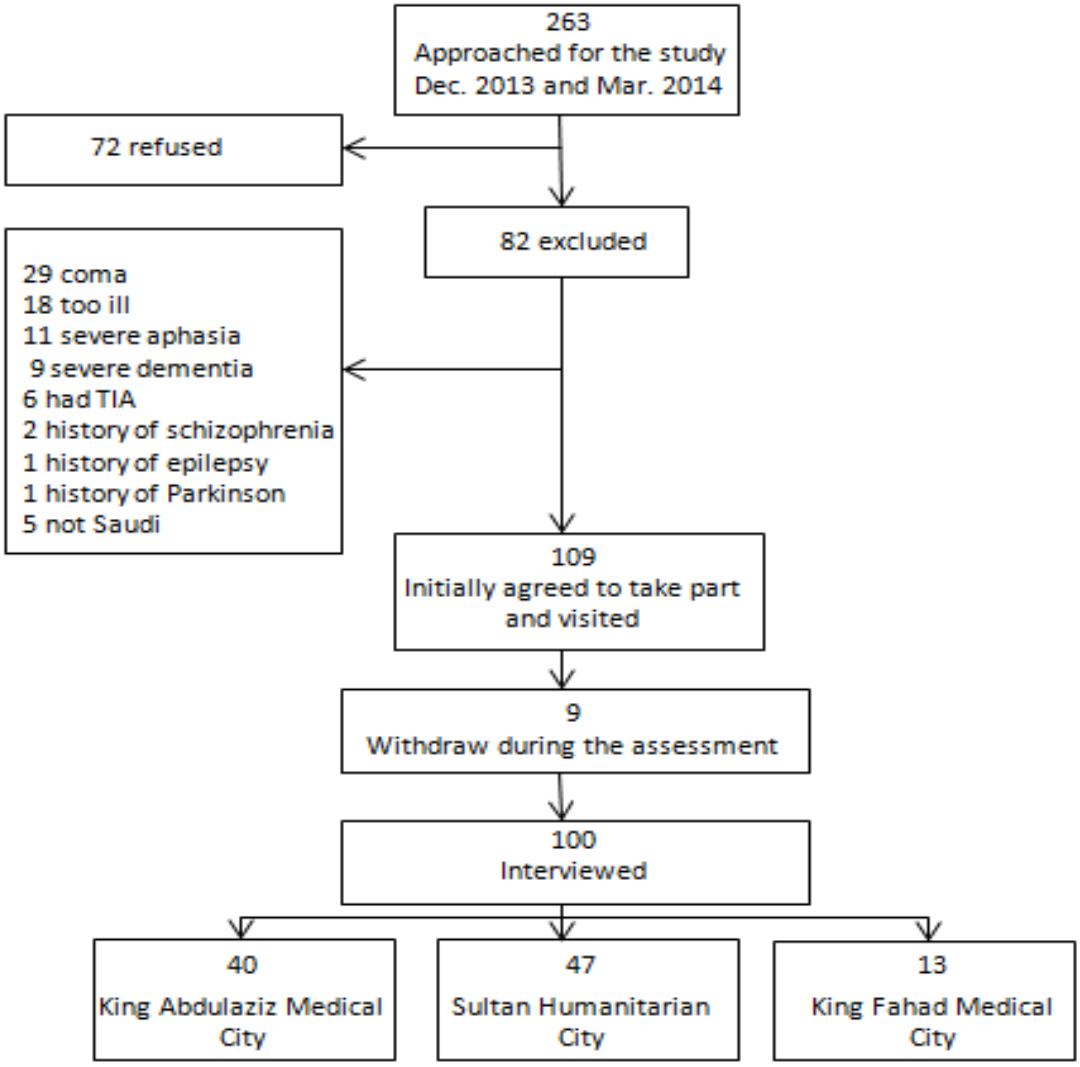
4.2 Results

4.2.1 Characteristics of participants

The researcher reviewed the medical charts of 263 patients who were diagnosed with stroke. Of those, 114 (43.4%) were hospitalised for an acute stroke within a rehabilitation ward or outpatient clinic at King Abdul-Aziz Medical City (KAMC) between 23 December 2013 and 30 March 2014. In addition, 127 (48.3%) were admitted to stroke rehabilitation units at Sultan bin Abdul-Aziz Humanitarian City (SBAHC) between 13 January 2014 and 3 March 2014; and 22 (8.3%) patients were enlisted in the acute stroke unit, rehabilitation centre or neurology clinics at King Fahad Medical City (KFMC) between 27 January 2014 and 30 March 2014.

The inclusion and exclusion criteria specified in the research design were then applied to the 263 reviewed patients (Figure 4.1). Of those, 82 (31.17%) did not meet the criteria due to: (a) patient in a coma (n=29, 35.36%); (b) too ill to complete neuropsychological assessment (n=18, 21.95%); and (c) severe aphasia (n=11, 13.41%). Other reasons included: (d) severe dementia (n=9, 10.97%); (e) had transient ischemic attack (TIA) (n=6, 7.31%); (f) history of schizophrenia (n=2, 2.43%); (g) history of epilepsy (n=1, 1.21%); (h) history of Parkinson (n=1, 1.21%); and (i) not Saudi (n=5, 6.09%). After excluding these individuals, the remaining 181 were approached by the researcher to take part in this study. Seventy-two patients or their legal representatives (as explained in Chapter 3) declined to participate, while nine (4.97%) patients withdrew from the study during the neuropsychological assessment.

Figure 4.1: Recruitment procedures



As shown in Table 4.1, a total of 100 patients were assessed in this study. Data were collected on patient characteristics, including demographic details (age, gender, literacy) as well as side of weakness, time elapsed since stroke, and disorders, documented in the medical files as being due to ischemic or haemorrhagic stroke.

Table 4.1: Characteristics of participants (n= 100)

Characteristics	Distribution
Age (years)	
Mean	60.53
Median (min. to max.)	60 (36 to 85)
SD	11.26
Gender	
Male	76
Female	24
Time since stroke (months)	
Mean (SD)	8.15 (10.49)
Median (min. to max.)	3.00 (1 to 48)
Literacy	
Literate	72
Illiterate	28
Medical centres (%)	
King Abdulaziz Medical City	40
King Fahad Medical City	13
Sultan bin Abdulaziz Humanitarian City	47
Side of weakness	
Right side	51
Left side	49
Treatment settings	
Hospitals	41
Out-patients	13
In-patients	28
Rehabilitation	59

4.5.2 Frequency of post-stroke cognitive dysfunctions assessed using the Arabic ACE-R

Figure 4.2 shows overall frequency of post-stroke cognitive dysfunction by domain. It shows that, based on the 100 research participants, the prevalence of memory disorder was the most common cognitive dysfunction in this sample.

Figure 4.2: Frequency of post-stroke cognitive dysfunction by domain across the whole sample (n= 100)

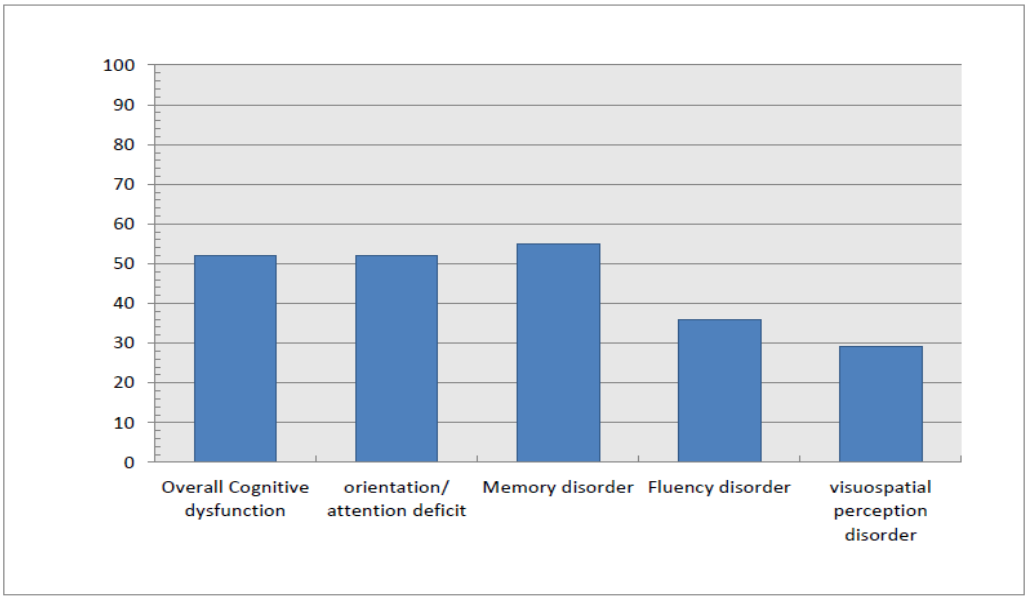
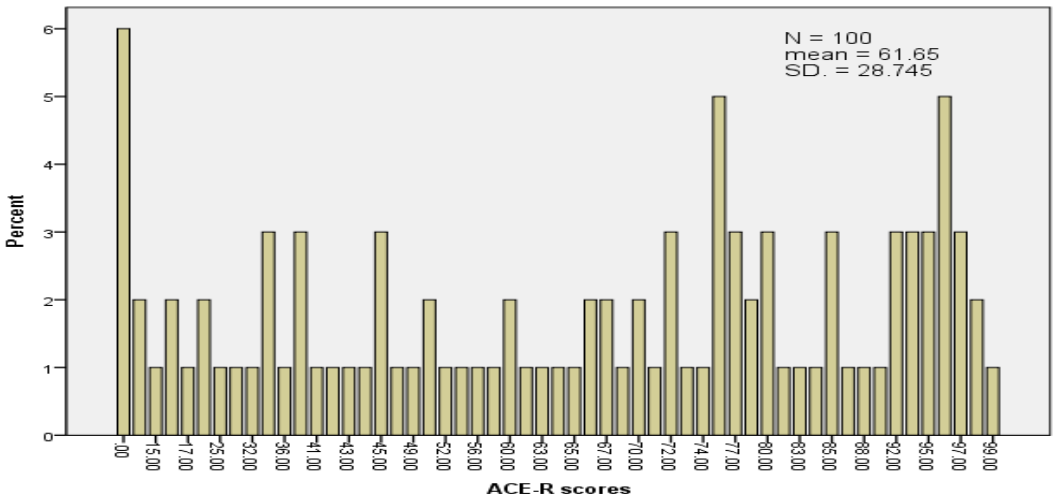


Figure 4.3 shows that the distribution of overall cognitive dysfunction assessed using Arabic ACE-R in this Saudi sample has a mean of 61.65 and SD of 28.75.

Figure 4.3: Histogram of the distribution of total scores on the Arabic ACE-R across the whole sample (n= 100)



In terms of age, out of 100 patients, impairments in orientation/attention and memory functions were found to have a relatively high frequency (52.8%) in the ≤ 60-years age group, while other functions like fluency (42.6%), language (46.8%), visuospatial ability (34%), and overall cognitive functioning (59.6%) were more frequently impaired in the ≥ 61-years age group. Similarly, in terms of gender, cognitive dysfunctions were found to be more prevalent in women, ranging from 45.8% to 75% compared to 23.7% to 50% in men.

A third demographic factor, 'literacy', was categorised into two subgroups: literate (n= 72) and illiterate (n= 28). The frequencies reveal that dysfunctions in orientation/attention, memory, fluency, language, and visuospatial were more frequent in the illiterate group, range from 50% to 75% compared to 23.7% to 50% in the literate Saudi patients.

Likewise, 'time since stroke' was categorised into two subgroups: ≤ 6 months (n= 74) and ≥ 7 months (n= 26). It was found that there is a high risk of acquiring 35.1% to 62.2% dysfunctions in cognitive domains in first 6 months after a stroke, while the risk of acquiring these cognitive dysfunctions was lower, range from 11.5% to 34.6% among Saudi patients after ≥ 7 months of suffering a stroke. The figures confirm the significant influence of 'time after stroke' in the prevalence of cognitive dysfunctions.

The variable 'side of weakness' was categorised into a right-side subgroup (n= 51) and a left-side subgroup (n= 49). It was found that dysfunctions in all cognitive

domains were more prevalent in patients with a right-side weakness, range from 35.3% to 60.8% compared to range from 22.4% to 49% among those with left-side weakness.

Finally, for ‘treatment setting’, mixed results were found for the prevalence of different cognitive dysfunctions. The findings indicate that memory disorders are more prevalent in those Saudi patients who were admitted to hospital settings, while orientation/attention are more likely to be found among the patients in rehabilitation settings.

Table 4.2: Frequency of post-stroke cognitive dysfunctions using the Arabic ACE-R (n= 100)

Subgroups / *Domains*	*n*	ACE-R Orientation/ attention	ACE-R Memory	ACE-R Fluency	ACE-R Language	ACE-R Visuospatial	ACE-R Overall cognitive dysfunction
Age							
≤ 60 years	53	28 (52.8%)	28 (52.8%)	16 (30.2%)	24 (45.3%)	13 (24.5%)	24 (54.7%)
≥ 61 years	47	24 (51.1%)	27 (57.4%)	20 (42.6%)	22 (46.8%)	16 (34%)	28 (59.6%)
Gender							
Male	76	34 (44.7%)	38 (50%)	23 (30.3%)	30 (39.5%)	18 (23.7%)	35 (46.1%)
Female	24	18 (75%)	17 (70.8%)	13 (54.2%)	16 (66.7%)	11 (45.8%)	17 (70.8%)
Literacy							
Literate	72	32 (44.4%)	34 (47.2%)	18 (25%)	27 (37.5%)	15 (20.8%)	29 (40.3%)
Illiterate	28	20 (71.4%)	21 (75%)	18 (64.3%)	19 (67.9%)	14 (50%)	23 (82.1%)
Time since stroke	74	45 (60.8%)	46 (62.2%)	30 (40.5%)	39 (52.7%)	26 (35.1%)	43 (58.1%)
≤ 6 months	26	7 (26.9%)	9 (34.6%)	6 (23.1%)	7 (26.9%)	3 (11.5%)	9 (34.6%)
≥ 7 months							
Side of weakness	51	29 (56.9%)	31 (60.8%)	22 (43.1%)	28 (54.9%)	18 (35.3%)	31 (60.8%)
Right	49	23 (46.9%)	24 (49%)	14 (28.6%)	18 (36.7%)	11 (22.4%)	21 (42.9%)
Left							
Settings							
Hospital	41	18 (43.9%)	23 (56.1%)	13 (31.7%)	16 (39%)	10 (24.4%)	22 (53.7%)
Rehabilitation	59	34 (57.6%)	32 (54.2%)	23 (39%)	30 (50.8%)	19 (32.2%)	30 (50.8%)
All cases	100	52%	55%	36%	46%	29%	52%

Based on Tables 4.3, 4.4, 4.5, 4.6, 4.7 and 4.8 a post-hoc analysis using the Mann-Whitney test was conducted to assess differences between subgroups for all the domains of cognitive dysfunctions, based on median, percentile range, *Z*-value and *p*-value. If the absolute value of the obtained *Z* is less than the critical value, and the value of *p* is less than the value of *alpha* = 0.05 then the result for a subgroup in each domain was said to be significant.

- **Orientation/attention deficit**

Table 4.3 shows that age, gender, 'literacy', and 'time since stroke' showed significantly different results in terms of orientation/attention. In contrast, results for 'side of weakness' and treatment setting showed no significant results. However, for subgroup differences, median results confirmed an increased risk of orientation/attention disorders in the following groups: the age subgroup of 61 years and over; females; the illiterate subgroup; and those within 6 months of having a stroke. No significant differences were found for 'side of weakness' and 'treatment setting'; both the hospital and rehabilitation settings showed a median of 14.

Table 4.3: Differences between subgroups in post-stroke orientation/attention deficit (n= 100)

Domain (scores)	Subgroups	*n*	Mean	SD	Percentiles			*Z*	95% Confidence Interval	
					25th	50th (median)	75th		Lower	Upper
Orientation/attention (0 to 18)	**Age**									
	≤ 60 years	53	13.62	4.82	11	16	18	- 2.83 *	12.23	15.04
	≥ 61 years	47	10.62	6.01	6	14	16		9.36	12.64
	Gender									
	Male	76	13.03	5.30	8	15	18	- 2.65 *	11.8	14.24
	Female	24	9.63	5.79	5.25	11	14.75		7.18	12.07
	Literacy									
	Literate	72	13.75	4.75	11	16	18	- 4.45 *	12.63	14.9
	Illiterate	28	8.25	5.7	4	8.5	14		6.04	10.46
	Time since stroke									
	≤ 6 months	74	11.14	5.77	6	13	16	- 3.48 *	9.79	12.47
	≥ 7 months	26	15.27	3.66	14	17	18		13.79	16.75
	Side of weakness									
	Right	51	11.22	5.99	6	13	17	- 1.62	11.25	14.67
	Left	49	13.25	4.98	9	15	17		9.53	12.9
	Treatment setting									
	Hospital	41	12.39	5.45	7.5	14	17	- .03	10.67	14.11
	Rehabilitation	59	12.09	5.73	8	14	17		10.59	13.57

- **Memory disorders**

For the memory domain, the results of the Mann-Whitney test in Table 4.4 revealed significant differences in patient characteristics. Age, 'literacy' and 'time since stroke' all showed significant differences, while there was no significant difference for gender, 'side of weakness' and 'treatment setting'. These findings confirm that memory disorders are more common in those aged 61 years and over, in the illiterate group, and in those who suffered a stroke 6 months ago or less.

Table 4.4: Differences between subgroups in post-stroke memory disorder (n= 100)

Domain (scores)	Subgroups	*n*	Mean	SD	Percentiles			*Z*	95% Confidence Interval	
					25th	50th (median)	75th		Lower	Upper
Memory (0 to 26)	**Age**									
	≤ 60 years	53	18.47	6.5	13	18	24.50	- 3.09 *	16.69	20.62
	≥ 61 years	47	13.62	7.71	7	16	20		12.03	16.16
	Gender									
	Male	76	17	7.14	12	18	23	- 1.88	15.37	18.63
	Female	24	13.63	8.04	6	15	20.75		10.23	17.02
	Literacy									
	Literate	72	18.28	6.35	13.25	18	24	- 4.21 *	16.79	19.69
	Illiterate	28	10.82	7.55	4.50	10.50	17.50		7.89	13.75
	Time since stroke									
	≤ 6 months	74	14.99	7.65	10	16	21	- 2.71 *	13.21	16.76
	≥ 7 months	26	19.62	5.78	15.75	20.50	25.25		17.95	21.95
	Side of weakness									
	Right	51	15.09	8.04	10	16	22	- 1.25	15.39	19.25
	Left	49	17.33	6.71	11.50	18	23		12.84	17.36
	Treatment setting									
	Hospital	41	16.63	7.14	12.50	17	22	- .38	14.38	18.89
	Rehabilitation	59	15.88	7.73	10	18	22		13.87	17.89

- **Fluency disorder**

Fluency disorder was higher in those aged 61 years and over, in women, in the illiterate subgroup, in those within 6 months or less of suffering a stroke, and in those with right- side weakness. No significant differences were found for 'treatment setting', with both hospital and rehabilitations showing a median of 6, as shown in Table 4.5.

Table 4.5: Differences between subgroups in post-stroke fluency disorder (n= 100)

Domain (scores)	Subgroups	*n*	Mean	SD	Percentiles			*Z*	95% Confidence Interval	
					25th	50th (median)	75th		Lower	Upper
Fluency (0 to 14)	**Age**									
	≤ 60 years	53	6.96	4.19	3	7	10.50	- 2.49 *	5.88	8.33
	≥ 61 years	47	4.93	4.13	1	5	8		3.9	6.2
	Gender									
	Male	76	6.54	4.26	2	7	10	- 2.25 *	5.57	7.51
	Female	24	4.29	3.88	.25	3	7.75		2.65	5.93
	Literacy									
	Literate	72	7.21	4.06	4	8	10.75	- 4.56 *	6.25	8.16
	Illiterate	28	2.89	3.07	0	2	5		1.7	4.08
	Time since stroke									
	≤ 6 months	74	5.20	4.01	1.75	5	9	- 3.25 *	4.27	6.13
	≥ 7 months	26	8.27	4.23	4.50	10	12		6.56	9.98
	Side of weakness									
	Right	51	5.19	4.12	2	5	9	- 1.89 *	5.6	8.07
	Left	49	6.84	4.29	2	8	10		4.04	6.35
	Treatment setting									
	Hospital	41	5.88	3.93	2	6	9.50	- .27	4.64	7.12
	Rehabilitation	59	6.08	4.52	2	6	10		4.91	7.26

- **Language disorder**

Language disorder was more frequent in those aged 61 years and older, in women, in the illiterate subgroup, and in those who suffered a stroke within 6 months ago, as shown in Table 4.6.

Table 4.6: Differences between subgroups in language disorder post stroke (n= 100)

Domain (scores)	Subgroups	*n*	Mean	SD	Percentiles			*Z*	95% Confidence Interval	
					25th	50th (median)	75th		Lower	Upper
Language (0 to 26)	**Age**									
	≤ 60 years	53	20.75	5.47	18	23	25	- 3.01 *	19.3	22.57
	≥ 61 years	47	17.75	8.83	6	20	23		13.91	18.57
	Gender									
	Male	76	19.38	7.01	15.25	22	24.75	- 2.28 *	17.78	20.98
	Female	24	15.29	8.79	7	18.5	22		11.58	19.01
	Literacy									
	Literate	72	20.69	5.88	19	23	25	- 4.96 *	19.31	22.07
	Illiterate	28	12.5	8.51	3	14.50	20.75		9.2	15.8
	Time since stroke									
	≤ 6 months	74	17.38	7.97	13	20	23.25	- 2.63 *	15.53	19.23
	≥ 7 months	26	21.31	5.77	19.50	23	25		18.98	23.64
	Side of weakness									
	Right	51	17.02	8.35	13	20	23	- 1.78	17.95	21.73
	Left	49	19.84	6.58	16	22	25		14.67	19.37
	Treatment setting									
	Hospital	41	18.59	7.49	15	22	24	- .028	16.22	20.95
	Rehabilitation	59	18.27	7.68	13	21	24		16.24	20.29

- **Visuospatial perception disorder**

Results in Table 4.7 showed visuospatial disorder was more frequent in those aged 61 years and over, in the illiterate subgroup, and in those who suffered a stroke 6 months ago or less. There were no significant differences found for 'side of weakness' and treatment setting.

Table 4.7: Differences between subgroups in visuospatial perception disorder post stroke (n= 100)

Domain (scores)	Subgroups	*n*	Mean	SD	Percentiles			*Z*	95% Confidence Interval	
					25th	50th (median)	75th		Lower	Upper
Visuo-spatial (0 to 16)	**Age**									
	≤ 60 years	53	10.68	4.29	6.50	12	14	- 3.63 *	9.55	12.15
	≥ 61 years	47	6.83	5.32	2	7	12		5.77	8.61
	Gender									
	Male	76	9.42	5.07	5	10	14	- 1.89	8.26	10.58
	Female	24	7.13	5.12	3.25	6.50	11.50		4.96	9.29
	Literacy									
	Literate	72	10.75	4.39	8	12	14	- 5.78 *	9.72	11.8
	Illiterate	28	4.04	3.58	0	4	6		2.65	5.43
	Time since stroke									
	≤ 6 months	74	8.01	5.27	4	7	12	- 2.69 *	6.79	9.23
	≥ 7 months	26	11.31	3.95	9	12	14.25		9.71	12.9
	Side of weakness									
	Right	51	8	5.23	5	8	12	- 1.69	8.34	11.2
	Left	49	9.78	4.97	5	11	14		6.53	9.47
	Treatment setting									
	Hospital	41	8.59	5.42	5	10	14	- .35	6.88	10.29
	Rehabilitation	59	9.07	4.99	5	10	14		7.76	10.37

- **Overall cognitive dysfunction**

Table 4.8 shows that overall cognitive dysfunction differed significantly for the following patient characteristics: age, gender, 'literacy', and 'time since stroke', while 'side of weaknesses' and treatment setting were not found to be significant. It further shows that overall cognitive disorder is high in those aged 61 years and over, in females, in the illiterate subgroup, and in those within 6 months or less of suffering a stroke.

Table 4.8: Differences between subgroups in post-stroke overall cognitive dysfunction (n= 100)

Domain (scores)	Subgroups	*n*	Mean	SD	Percentiles			*Z*	95% Confidence Interval	
					25th	50th (median)	75th		Lower	Upper
Overall cognitive dysfunction (0 to 100)	**Age**									
	≤ 60 years	53	70.75	23.83	49.50	74	93	- 3.10 *	64.43	78.62
	≥ 61 years	47	51.38	30.54	22	56	77		45.04	61.43
	Gender									
	Male	76	65.04	27.31	44.25	72	87.50	- 2.06 *	58.79	71.28
	Female	24	50.92	31.09	20	56	75.50		37.79	64.04
	Literacy									
	Literate	72	70.67	24.08	56.75	76.50	92	- 4.91 *	65.01	76.32
	Illiterate	28	38.46	27.04	14.25	42.50	66.75		27.98	48.95
	Time since stroke									
	≤ 6 months	74	56.92	29.42	35.25	64	80	- 2.79 *	50.1	63.74
	≥ 7 months	26	75.12	22.13	63	78.50	95.25		66.18	84.05
	Side of weakness									
	Right	51	56.47	30.41	40	63	80	- 1.80	59.53	74.55
	Left	49	67.04	26.12	47	76	88		47.92	65.02
	Treatment setting									
	Hospital	41	62.07	28.18	44	68	85	- .018	53.18	70.69
	Rehabilitation	56	61.36	29.39	40	72	85		53.7	69.01

4.5.3 Frequency of visual neglect assessed using the Apple Cancellation Test

This section shows the frequencies of visual neglect, gathered through the Apple Cancellation Test, according to the different patient characteristics. As shown in Table 4.9, Of 100 participants, only 84 completed this test. The remaining 16 were unable to understand the task because the impact of stroke on their cognitive abilities was severe. Those 16 patients failed to perform the Apple Cancellation Test, and were likely to obtain low scores which would eventually adversely effect on the prevalence of visual neglect.

The excluded participants included 5 females and 11 males, aged 55-81 years (mean = 71.94, SD = 8.93), with a 'time since stroke' of some 3 months (mean = 3.19 months, SD = 1.68). Eleven of these excluded participants were illiterate and 5 were literate. Nine patients had right-side weakness and 7 had left-side weakness. Seven patients were in a hospital setting and 9 were in a rehabilitation setting.

Table 4.9: Characteristics of participants who took Apple Cancellation Test (n= 84)

Subgroups	***n* = 84**
Age (years) Mean SD (min. to max.)	 58.36 10.336 (36 to 85)
Gender Male Female	 65 19
Literacy Literate Illiterate	 69 15
Time since stroke (months) Mean SD (min. to max.)	 9.214 11.531 (1 to 48)
Side of weakness Right Left	 42 42
Treatment setting Hospital Rehabilitation	 32 52

Figure 4.4 shows that the mean of scores for the Apple Cancellation Test for whole sample (N= 84) was 38.51 (SD = 10.55; min. = 6 and max. = 50).

Figure 4.4: Histogram of the distribution of total scores on the Apple Cancellation Test across the whole sample (n= 84)

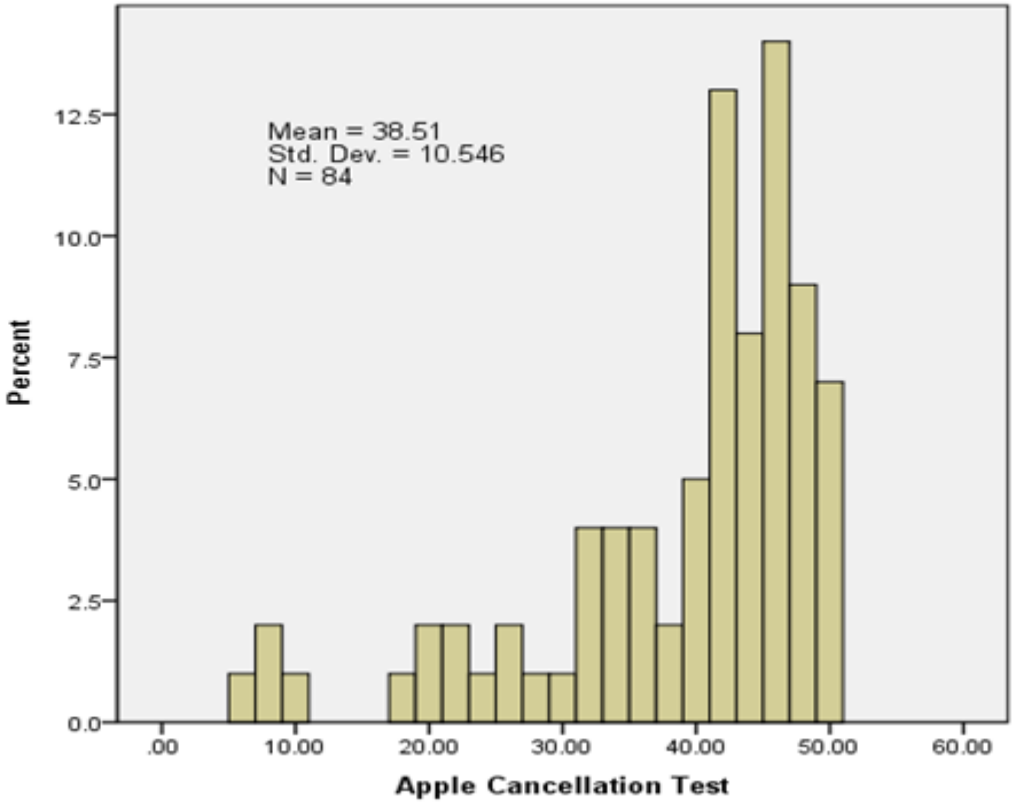


Table 4.10 shows the frequency of visual neglect – total assessed by the Apple Cancellation Test, using a cut-off score of 42/50. Of the 84 participants showing evidence of ischemic or haemorrhagic stroke in Saudi Arabia, visual neglect was found in only 30 (35.7%). Visual neglect problems were found to be more prevalent at 61 years of age and over (47.1%), in the illiterate subgroup (46.7%), and within the first 6 months after stroke (39.7%). In addition, visual neglect was higher in left-side weakness (40.5%), and mostly found among the patients in rehabilitation settings (36.5%).

Table 4.10: Frequency of visual neglect – total assessed using Apple Cancellation Test (n= 84)

Subgroups	*n*	*Frequency*
Age		
≤ 60 years	50	13 (26%)
≥ 61 years	34	16 (47.1%)
Gender		
Male	65	23 (38.4%)
Female	19	7 (36.8%)
Literacy		
Literate	69	21 (30.4%)
Illiterate	15	7 (46.7%)
Time since stroke		
≤ 6 months	58	23 (39.7%)
≥ 7 months	26	7 (26.9%)
Side of weakness		
Right	42	13 (31%)
Left	42	17 (40.5%)
Treatment setting		
Hospital	32	11 (34.4%)
Rehabilitation	52	19 (36.5%)
All cases	84	30 (35.7%)

Shown in Table 4.11, the results of the Apple Cancellation Test were further assessed using a Mann-Whitney test to examine the differences between subgroup factors and the extent of their significance or lack of significance in being associated with visual neglect - total. It was found that 'literacy' ($p = .001$) 'time since stroke' ($p = .046$), and 'side of weakness' ($p = .048$) are associated with visual neglect -total while all the other factors, including 'age' ($p = .12$), 'gender' ($p = .37$), and treatment setting ($p = .54$) showed non-significant results.

It is necessary to consider the results of differences in percentile ranges for the subgroups who took the Apple Cancellation Test. Visual neglect – total was found to be the most common in the illiterate patients. This subgroup has a low median (50^{th} percentile) of 36, compared to a higher median of 43 for the literate patients. For 'time since stroke', those within 6 months or less of suffering a stroke showed a lower median percentile (42) compared to those who suffered a stroke 7 months ago or longer (45).

The median percentile for left-side weakness showed a lower median (41) compared to those with right-side weakness (44). However, no significant difference in the median was found for age, gender and treatment setting. This suggests that visual neglect – total is common in illiterate patients, in ≤ 6 since stroke subgroup and in those with left-side weakness.

Table 4.11: Differences between subgroups on the Apple Cancellation Test (n= 84)

Test	Subgroups	*n*	Mean	SD	Percentiles			*Z*	95% Confidence Interval	
					25th	50th (median)	75th		Lower	Upper
Apple Cancellation Test - total	**Age**									
	≤ 60 years	50	40.25	9.36	36.50	42.50	46	- 1.56	37.88	43.24
	≥ 61 years	34	36.6	11.53	31.25	41.5	45		31.32	40.5
	Gender									
	Male	65	38.92	10.47	34.25	42	46	- .91	36.56	41.93
	Female	19	37.2	10.94	29.5	41.50	43.75		33.66	42.81
	Literacy									
	Literate	69	40.46	9.14	36	43	46	- 3.34 *	37.95	42.86
	Illiterate	15	31.39	12.45	21	36	42		23.76	37.71
	Time since stroke									
	≤ 6 months	58	37.47	10.75	33	42	44.25	- 1.99 *	35.77	41.14
	≥ 7 months	26	40.85	9.89	36.25	45	47		43.78	44.45
	Side of weakness									
	Right	42	40.14	9.77	37.75	44	47	- 1.98 *	37.34	44.38
	Left	42	36.88	11.14	33	41	43		34.98	42.02
	Treatment setting									
	Hospital	32	37.42	11.99	33	42	45	- .61	33.81	42.67
	Rehabilitation	52	39.22	9.55	34	42	46		35.98	41.9
	All cases	84	38.51	10.55	33.25	42	46		36.24	41.12

4.5.4 Frequency of visual neglect subtypes

4.5.4.1 Right and left egocentric neglect

Shown in Figure 4.5, the mean of asymmetry scores for the Apple egocentric neglect for whole sample (N= 84) was - .49 (SD = 3.056; min. = - 8 and max. = 8).

Figure 4.5: Histogram of the distribution of asymmetry scores for the Apple egocentric neglect across the whole sample (n= 84)

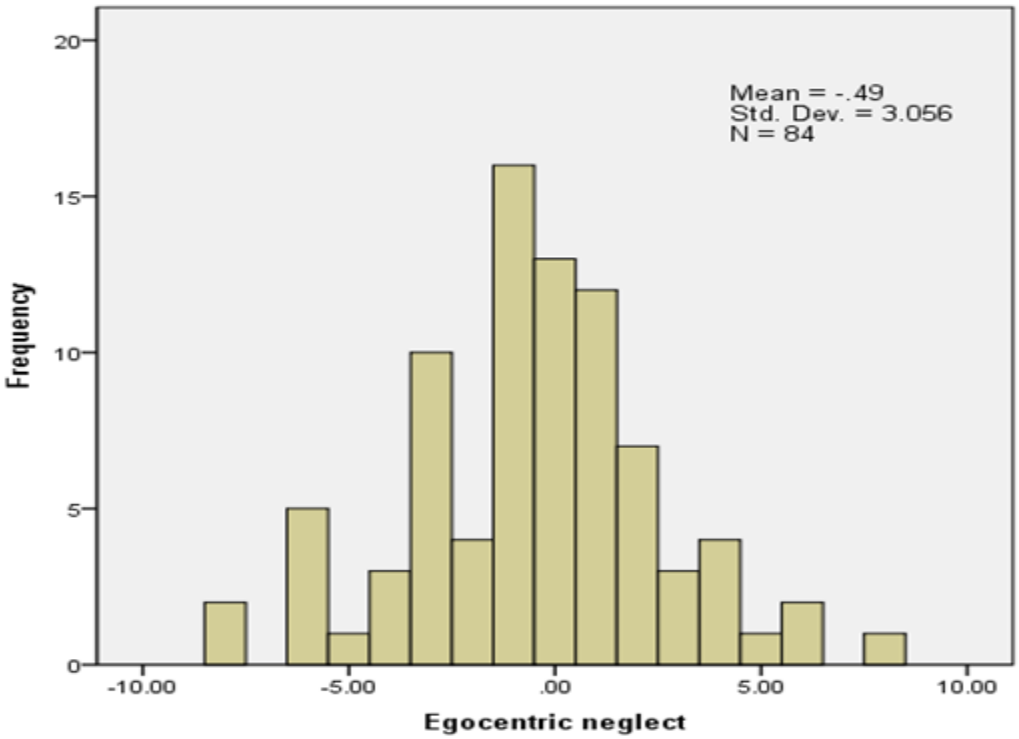


Table 4.12 shows that the frequency of asymmetry scores for the right egocentric neglect (negative omission error) was 21 (25% of all cases), while the frequency of asymmetry scores for left egocentric neglect (positive omission error) was 11 (13% of all cases). The frequencies for those aged ≥ 61 years with asymmetry scores for right and left egocentric neglect were higher than those aged ≤ 60 years. For gender, the frequency of asymmetry scores for the right egocentric neglect among men was 16 (24.7%), and similarly for women, the frequency was observed as 3 (26.3%). However, women sample showed high frequency in the left egocentric neglect 4 (21.1%) compared to 7 (10.8%) among men sample. For 'literacy', the illiterate subgroup showed higher frequencies in both the right and left egocentric

neglect compared to the literate subgroup. For 'time since stroke', the ≤ 6-months subgroup showed frequencies of 17 (29.3%), and 9 (15.5%), respectively, while for the ≥ 7-months subgroup, the frequencies were 4 (15.4%), and 2 (7.7%), respectively. That means, the ≤ 6-months subgroup had right and left egocentric neglect more than those the ≥ 7-months subgroup. For the side of weakness, the frequencies of the right and left egocentric neglect were presented among the left-side of weakness subgroup greater than the right-side of weakness subgroup. Similarly, the hospital subgroup showed frequencies of the right and left egocentric neglect more than those in the rehabilitation setting.

Table 4.12: Frequencies of egocentric neglect (n= 84)

Subgroups / Subtype	*n*	Egocentric neglect	
		Right	***Left***
Age			
≤ 60 years	50	9 (18%)	3 (6%)
≥ 61 years	34	12 (35.3%)	8 (23.5%)
Gender			
Male	65	16 (24.7%)	7 (10.8%)
Female	19	5 (26.3%)	4 (21.1%)
Literacy			
Literate	69	15 (21.7%)	7 (10.2%)
Illiterate	15	5 (33.3%)	4 (26.7%)
Time since stroke			
≤ 6 months	58	17 (29.3%)	9 (15.5%)
≥ 7 months	26	4 (15.4%)	2 (7.7%)
Side of weakness			
Right	42	9 (21.4%)	3 (7.1%)
Left	42	13 (30.9%)	8 (19%)
Treatment setting			
Hospital	32	9 (28.1%)	5 (15.6%)
Rehabilitation	52	12 (23.1%)	6 (11.5%)
All cases	84	21 (25%)	11 (13%)

Shown in Table 4.13, the results of the Apple Cancellation Test were further assessed using a Mann-Whitney test to examine the differences between subgroups and the extent of their significance or lack of significance in being associated with egocentric neglect domain. Table 4.13 shows that the *p-value* of the variables 'age' (≤ 60 *vs*. ≥ 61years), 'literacy' (literate *vs.* illiterate), 'time since stroke' (≤ 6 *vs.* ≥ 7 months), and 'side of weakness' (right *vs.* left) was < 0.05, indicating significant differences between the subgroups. For the remaining participant characteristics, the *p-values* for the domain egocentric neglect were non-significant.

Table 4.13: Differences between subgroups on egocentric neglect (n= 84)

Subtype	Subgroups	*n*	Mean	SD	Percentiles			*Z*	95% Confidence Interval	
					25th	50th (median)	75th		Lower	Upper
Egocentric neglect	**Age**									
	≤ 60 years	50	1.75	1.69	1	1	2.75	- 2.52*	6.81	12.15
	≥ 61 years	34	2.9	2.27	1	3	4		9.51	18.67
	Gender									
	Male	65	2.19	1.93	1	1	3	- .65	8.1	13.45
	Female	19	2.65	2.46	.25	2	3		7.19	19.34
	Literacy									
	Literate	69	1.91	1.78	1	1	3	- 3.16*	7.17	12.07
	Illiterate	15	3.72	2.42	1.75	3	5.25		12.29	26.24
	Time since stroke									
	≤ 6 months	58	2.66	2.16	1	2	4	- 2.46*	8.89	14.62
	≥ 7 months	26	1.5	1.56	0	1	2.25		5.63	15.29
	Side of weakness									
	Right	42	2.12	2.34	0	1	4	- 2.13*	7.62	14.66
	Left	42	3	1.78	2	2	4		9.03	19.06
	Treatment setting									
	Hospital	32	2.52	2.32	1	1	4	- .35	7.38	16.24
	Rehabilitation	52	2.16	1.88	1	2	3		8.09	14.02

4.5.4.2 Right and left allocentric neglect

Shown in Figure 4.6, the mean of asymmetry scores for the Apple allocentric neglect scores for whole sample (N= 84) was - .17 (SD = 1.455; min. = - 4 and max. = 4).

Figure 4.6: Histogram of the distribution of asymmetry scores for the Apple allocentric neglect across the whole sample (n= 84)

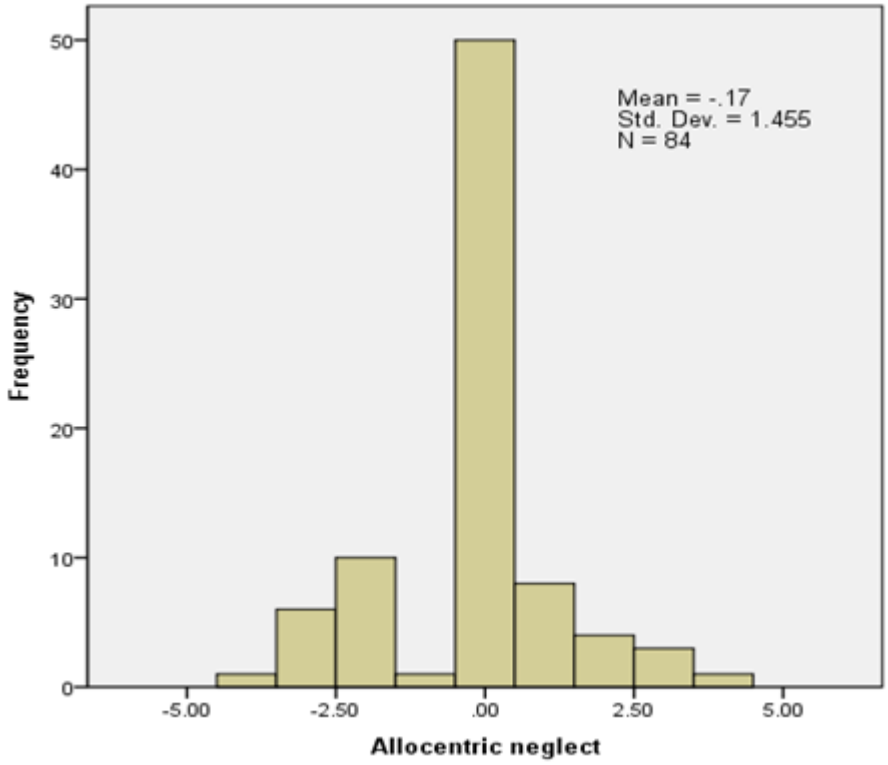


Table 4.14 shows that the frequency of asymmetry scores for the right allocentric neglect (negative commission error) was 17 (20.2% of all cases), while the frequency of asymmetry scores for left allocentric neglect (positive commission error) was 8 (9.5% of all cases). The frequencies for those aged ≥ 61 years with asymmetry scores for the right and left allocentric neglect were high compared to

those aged ≤ 60 years. For gender, the frequencies of asymmetry scores for the right and left allocentric neglect were almost similar among men and women. For 'literacy', the illiterate subgroup showed the higher frequencies in both the right and left allocentric neglect compared to the literate subgroup. For 'time since stroke', the frequency of right allocentric neglect was 7 (22.4%) among the time ≤ 6 months subgroup, while it was 4 (15.4%) for the ≥ 7 months subgroup. In the left allocentric neglect, the performance of subgroup ≤ 6-months was better than those the subgroup of ≥ 7 months, the frequencies were 5 (8.6%) and 3 (11.5%), respectively. For the side of weakness, the frequency of the left allocentric neglect was high 7 (16.7%), among the left-side of weakness subgroup compared to the right-side of weakness subgroup. Similarly, the rehabilitation subgroup showed frequencies of the right and left allocentric neglect more than those in the hospital setting.

Table 4.14: Frequencies of egocentric neglect (n= 84)

Subgroups / Subtype	*n*	Allocentric neglect	
		Right	***Left***
Age			
≤ 60 years	50	9 (18%)	2 (4%)
≥ 61 years	34	8 (23.5%)	6 (15%)
Gender			
Male	65	12 (18.5%)	7 (10.8%)
Female	19	4 (21.1%)	2 (10.5%)
Literacy			
Literate	69	12 (17.4%)	6 (8.7%)
Illiterate	15	4 (26.7%)	2 (13.3%)
Time since stroke			
≤ 6 months	58	13 (22.4%)	5 (8.6%)
≥ 7 months	26	4 (15.4%)	3 (11.5%)
Side of weakness			
Right	42	7 (16.7%)	4 (9.5%)
Left	42	9 (21.4%)	7 (16.7%)
Treatment setting			
Hospital	32	4 (12.5%)	3 (9.4%)
Rehabilitation	52	13 (25%)	5 (9.6%)
All cases	84	17 (20.2%)	8 (9.5%)

As shown in Table 4.15, for this domain of allocentric neglect, only 'side of weakness' (right *vs.* left) was significant ($p = 0.011$). For the remaining subgroups, the *p-values* for all the subgroups were non-significant. The 42 patients with left side weakness tended to make commission errors more than these 42 patients with right side weakness. The *Z-score* values were between -2.55 and +2.55 and their respective *p-values* were < 0.05.

Table 4.15: Differences between subgroups on allocentric neglect (n= 84)

Subtype	Subgroups	*n*	Mean	SD	Percentiles			*Z*	95% Confidence Interval	
					25th	50th (median)	75th		Lower	Upper
Allocentric neglect	**Age**									
	≤ 60 years	50	.75	1.12	1	1	2.75	- .82	1.3	3.37
	≥ 61 years	34	.98	1.25	1	3	4		2.51	6.08
	Gender									
	Male	65	.84	1.16	0	0	2	- .06	1.91	3.99
	Female	19	.90	1.29	0	0	2		1.22	6.14
	Literacy									
	Literate	69	.77	1.11	0	0	2	- 1.05	1.46	3.32
	Illiterate	15	1.17	1.42	0	.50	2		3.51	9.43
	Time since stroke									
	≤ 6 months	58	.89	1.22	0	0	2	- .33	2.11	4.47
	≥ 7 months	26	.76	1.11	0	0	2		.99	4.47
	Side of weakness									
	Right	42	.91	1.27	0	0	2	- 2.55*	1.61	4.39
	Left	42	1.36	1.01	1	1	2		4.87	8.61
	Treatment setting									
	Hospital	32	.73	1.18	0	0	1	- .84	1.65	5.35
	Rehabilitation	52	.94	1.19	0	0	2		1.79	3.98

4.5.5 Frequency of visual-motor skills dysfunction assessed using the TMT Part A

The Trail Making Test (TMT) Part A (TMT-A) includes digits from 1 to 25; those participants who could not distinguish between or read digits were excluded (n=23), resulting in a total number of 77 participants from the overall sample of 100.

Table 4.16 presents the characteristics of the participants who took the TMT-A with the corresponding frequencies for visual-motor skills dysfunction. Most of the

participants were male (n= 60, 77.9%), with left-side weakness (n=40, 51.95%), and were in rehabilitation units (n=48, 62.34%), as opposed to hospital settings.

Table 4.16: Characteristics of participants who took the TMT Part A (n= 77)

Subgroups	***n*= 77**
Age (years) Mean SD (min. to max.)	 57.57 9.995 (36 to 79)
Gender Male Female	 60 17
Time since stroke (months) Mean SD (min. to max.)	 9.623 11.524 (1 to 48)
Side of weakness Right Left	 37 40
Treatment setting Hospital Rehabilitation	 29 48

Frequency of visual-motor skills dysfunction post stroke assessed by the TMT-A was based on the 10% percentile. Overall, out of 77 participants having stroke, visual-motor skills dysfunction was found in 45 of those (58.4%). Table 4.17 categorises these frequencies according to participant characteristics. The results indicate that visual-motor skills dysfunction was more prevalent in the subgroup aged 61 years and over (69%), in men (61.7%), and in those within 6 months or less of suffering a stroke (63.5%). On the other hand, visual-motor skills dysfunction was higher in those who had right-side weakness (78.4%) and was

mostly found among the patients in hospital settings (69%). Along with other characteristics, 'literacy' was not considered for this test because it was mainly designed for literate participants who are able to distinguish between and read digits.

Table 4.17: Frequency of post-stroke visual motor skills assessed using TMT Part A (n= 77)

Subgroups	*n*	*Frequency*
Age		
≤ 60 years	48	25 (52.1%)
≥ 61 years	29	20 (69%)
Gender		
Male	60	37 (61.7%)
Female	17	8 (47.1%)
Time since stroke		
≤ 6 months	52	33 (63.5%)
≥ 7 months	25	12 (48%)
Side of weakness		
Right	37	29 (78.4%)
Left	40	16 (40%)
Treatment setting		
Hospital	29	20 (69%)
Rehabilitation	48	25 (52.1%)
All cases	77	45 (58.4%)

As shown in Table 4.18, the results of the TMT Part A were further assessed using the Mann-Whitney test to examine the differences between subgroups and the extent of their significance or lack of significance in being associated with visual-motor skills dysfunction. In the TMT Part A, the following patient characteristics showed a significant differences with the prevalence of visual-motor skills

dysfunction: age (*p = 0.04*), 'time since stroke' (*p = 0.02*), and 'side of weakness' (*p = 0.014*), while gender and treatment setting showed non-significant results, that is, no association with the aforementioned dysfunctions.

By taking into consideration percentile ranges for the subgroups in the TMT Part A, visual-motor skills dysfunction are identified as most common in patients aged ≥ 61 years. This subgroup has a high median (50^{th} percentile) of 03.02, compared to the median of 01.19 for those post-stroke patients aged ≤ 60 years. Visual-motor skills dysfunction is identified as most common in men. This subgroup has a high median (50^{th} percentile) of 02.29, compared to the median of 00.59 for women. Similarly, for 'time since stroke', the ≤ 6-months subgroup showed a higher median percentile of 02.48, compared to 01.09 for the ≥ 7-months subgroup. For 'side of weakness', the patients with a right-side weakness were more likely to have visual-motor skills dysfunction, as indicated by a median of 03.10, compared to a median of 01.01 for the patients with a left-side weakness. Lastly, the median percentile for hospital setting and rehabilitation setting showed similar results: a median of 03.02 and 01.19, respectively. This indicates that visual-motor skills dysfunction was most prevalent in patients in hospital settings.

Table 4.18: Differences between subgroups on the TMT Part A (n=77)

Test	Subgroups	*n*	Mean (minutes: seconds)	SD	Percentiles			*Z*	95% Confidence Interval	
					25th	50th (median)	75th		Lower	Upper
TMT Part A	**Age**									
	≤ 60 years	48	02:23	01:54	00:49	01:19	03:46	- 2.03*	01:50	02:57
	≥ 61 years	29	03:02	01:46	01:04	03:02	04:47		02:21	03:42
	Gender									
	Male	60	02:44	01:53	00:52	02:29	04:13	- .60	02:14	03:13
	Female	17	02:17	01:50	00:54	00:59	03:43		01:20	03:14
	Time since stroke									
	≤ 6 months	52	02:52	01:52	00:58	02:48	04:37	- 2.32*	02:21	03:24
	≥ 7 months	25	02:08	01:50	00:45	01:09	03:44		01:22	02:53
	Side of weakness									
	Right	37	03:08	01:44	01:33	03:10	04:29	- 2.45*	02:34	03:43
	Left	40	02:10	01:53	00:49	01:01	03:40		01:33	02:46
	Treatment setting									
	Hospital	29	02:57	01:47	00:55	03:02	04:29	- 1.19	02:16	03:38
	Rehabilitation	48	02:26	01:55	00:52	01:19	03:40		01:53	03:00
	All cases	77	02:38	01:52	00:53	02:21	04:04		02:12	03:03

4.5.6 Frequency of executive dysfunctions assessed using the TMT Part B

As the TMT Part B (TMT-B) is based on digits and alphabet, it is important that only those who are able to read and distinguish between digits and alphabetical letters participated in the test. Accordingly, 71 of the 100 participants were excluded, leaving 29 participants who completed this test.

Table 4.19 presents the characteristics of the participants who took the TMT-B and the corresponding frequencies of executive dysfunctions. Most of the participants were male (n= 27, 93.1%), with left-side weakness (n= 19, 65.52%), and located in rehabilitation settings (n= 18, 62.1%).

Table 4.19: Characteristics of participants who took the TMT Part B (n= 29)

Subgroups	*n*= 29
Age (years) Mean SD (min. to max.)	 55.76 9.523 (39 to 71)
Gender Male Female	 27 2
Time since stroke (months) Mean SD (min. to max)	 9.379 9.582 (1 to 36)
Side of weakness Right Left	 10 19
Treatment setting Hospital Rehabilitation	 11 18

Frequency of executive dysfunction assessed using the TMT Part B was based on the 10% percentile. Overall, out of 29 participants having stroke, more than half 20 (69%) had executive dysfunctions. Table 4.20 categorises these frequencies according to participant characteristics. The results indicate that executive dysfunctions, when assessed using digit and alphabetical differentiations, were more prevalent in the subgroup aged 61 years and over (70%), and in those who suffered a stroke 6 months ago or less (70.6%). On the other hand, these executive dysfunctions were associated with right-side weakness (78.9%) and were mostly found among the patients in hospital settings (81.8%).

Table 4.20: Frequency of post-stroke executive dysfunction assessed using TMT Part B (n=29)

Subgroups	*n*	*Frequency*
Age		
≤ 60 years	19	13 (68.4%)
≥ 61 years	10	7 (70%)
Time since stroke		
≤ 6 months	17	12 (70.6%)
≥ 7 months	8	(33.3%)
Side of weakness		
Right	19	15 (78.9%)
Left	10	5 (50%)
Treatment setting		
Hospital	11	9 (81.8%)
Rehabilitation	18	11 (61.1%)
All cases	29	20 (69%)

As shown in Table 4.21, the results of the TMT Part B were further assessed using the Mann-Whitney test to examine differences between subgroups and the extent of their significance or lack of significance in being associated with executive dysfunctions post stroke. The findings of the TMT Part B were different from those of the TMT Part A. In the TMT Part B, the following factors did not show an association with executive dysfunctions: age ($p = .81$), time since stroke ($p = .29$), side of weakness ($p= .09$), and treatment setting ($p= .18$). However, executive dysfunctions were identified as most common in those within 6 months or less of suffering a stroke, indicate by a high median (50^{th} percentile) of 04.16, compared to 03.20 for the ≥ 7-months subgroup. Similarly, the median range for those with right-side weakness was 04.12, compared to 02.54 for those with left-side weakness.

This indicates that executive dysfunctions were common in patients with a right-side weakness. Lastly, the median percentile for hospital setting was higher (04.12) than that for rehabilitation settings (03.20).

Table 4.21: Differences between subgroups on the TMT Part B (n= 29)

Test	Subgroups	*n*	Mean (minutes: seconds)	SD.	Percentiles			Z	95% Confidence Interval	
					25th	50th (median)	75th		Lower	Upper
TMT Part B	**Age**									
	≤ 60 years	19	03:44	01:39	02:14	03:49	04:25	- .23	02:56	04:32
	≥ 61 years	10	03:39	01:16	02:14	03:51	04:37		02:45	04:34
	Time since stroke									
	≤ 6 months	17	03:46	01:22	02:12	04:16	04:41	- 1.01	03:03	04:29
	≥ 7 months	12	03:37	01:45	02:14	03:20	04:07		02:30	04:44
	Side of weakness									
	Right	19	03:52	01:05	03:19	04:12	04:33	- 1.65	01:51	04:55
	Left	10	03:23	02:08	01:56	02:54	04:11		03:21	04:24
	Treatment setting									
	Hospital	11	04:17	01:43	03:38	04:12	04:33	- 1.35	03:07	05:27
	Rehabilitation	18	03:21	01:17	02:11	03:20	04:26		02:42	04:00
	All cases	29	03:42	01:31	02:15	03:49	04:28		03:08	04:17

Chapter Five: Results 2: Prevalence of Post-Stroke mood Disorders in Saudi Arabia

5.1 Introduction

The objectives of this chapter were (1) to explore the prevalence of post-stroke anxiety disorder in Saudi Arabia, (2) to explore the prevalence of post-stroke depression disorder in Saudi Arabia, (3) to examine the relationship between post-stroke mood disorders and physical dependency, (4) to identify the main factors affecting the prevalence of post-stroke mood disorders, and (5) to compare post-stroke mood disorders at baseline and after a follow-up period of three months. Key subgroups were identified based on six major variables: age, gender, literacy, time since stroke, side of weakness, and treatment setting.

5.2 Results

A sample of 100 stroke patients was assessed. Their demographic and other characteristics were given in the results section of Chapter 4.

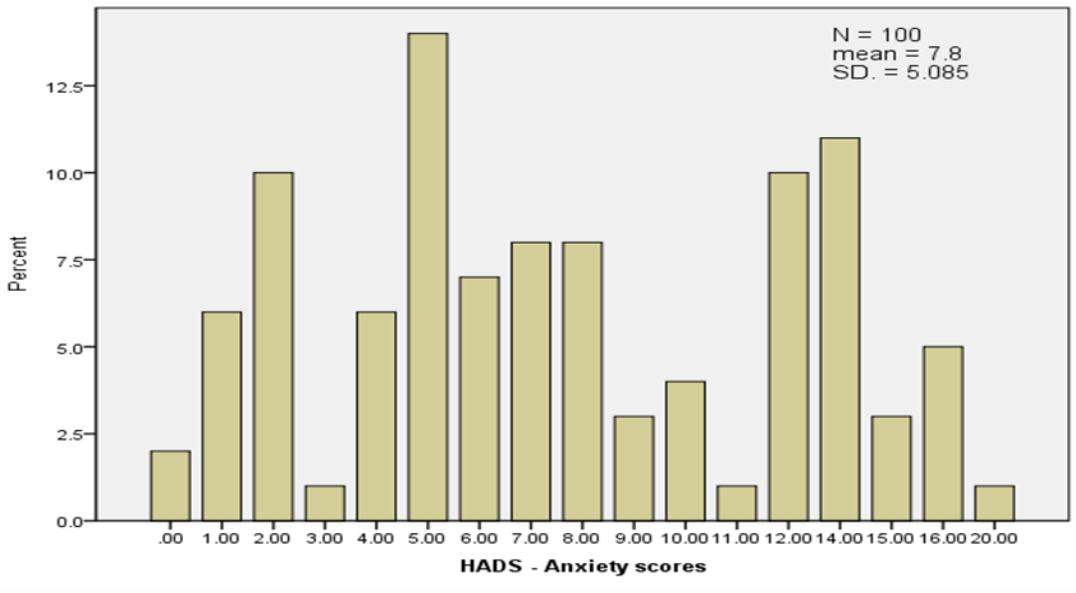
5.2.1 Results from baseline assessment

The overall prevalence rate of anxiety was 36% and the overall prevalence of depression was 44%. These results are categorised more specifically below.

5.2.1.1 Prevalence of anxiety after stroke

The HADS-Anxiety mean score was 7.8 (SD = 5.08), as shown in Figure 5.1.

Figure 5.1: Histogram of the distribution of total scores on the Arabic HADS-Anxiety across the whole sample (n=100)



The prevalence figures of anxiety after stroke for various patient characteristics are presented in Table 5.1. These findings show that, for the two age subgroups, anxiety after stroke was found in 30.2% of the ≤ 60-years group and in 42.6% of the ≥ 61-years group. In terms of gender, anxiety after stroke was found in 34.2% of male patients and in 41.7% of female patients. In terms of literacy, the findings confirm that illiteracy has a considerable bearing on the likelihood of anxiety after stroke in the patient: anxiety was found in 53.6% of illiterate patients while it was found in only 29.2% of literate patients. In terms of 'time elapsed since the stroke', anxiety was found in 41.9% of the subgroup within 6 months or less of the suffering a stroke while only 19.2% of the ≥ 7-months subgroup was affected. Furthermore, anxiety was found in 37.3% of those with a right-hand side weakness, and in 34.7% of those with a left-hand side weakness.

Table 5.1: Frequencies of anxiety after stroke (n= 100)

Variables	Subgroups	*n*	*Frequency*
Age	≤ 60 years ≥ 61 years	53 47	16 (30.2%) 20 (42.6%)
Gender	Male Female	76 24	26 (34.2%) 10 (41.7%)
Literacy	Literate Illiterate	72 28	21 (29.2%) 15 (53.6%)
Time since stroke	≤ 6 months ≥ 7 months	74 26	31 (41.9%) 5 (19.2%)
Side of weakness	Right Left	51 49	19 (37.3%) 17 (34.7%)
Treatment Setting	Hospital Rehabilitation	41 59	14 (34.1%) 22 (37.3%)
All cases		**100**	**36%**

5.2.1.2 Differences in anxiety after stroke prevalence between subgroups

Results from the analysis using the Mann-Whitney test revealed differences in post-stroke anxiety between the subgroups. The anxiety scores were found to be significantly affected by differences in age (*z = -2.34; p = 0.019*), literacy (*z = -3.07; p = 0.002*), and the 'time elapsed since stroke' (*z = -4.02; p = 0.001*). However, there was no significant difference in anxiety scores for gender, side of weakness, and 'time since stroke'.

Table 5.2 shows the prevalence of anxiety after stroke in the two age subgroups: ≥ 61 years with a median of 8, compared to ≤ 60 years with a median of 6. Likewise,

the illiterate group had a higher median (12) compared to that of the literate group (6). For 'time since stroke', a higher median (8) was found for the subgroup within 6 months or less of the suffering a stroke while the ≥ 7-months subgroup showed a lower median (5).

Table 5.2: Comparison of anxiety after stroke among subgroups (n= 100)

Variables	Subgroups	*n*	Mean (min. to max.)	SD	Percentiles			*Z*	*P*
					25th	50th (median)	75th		
Age	≤ 60 years	53	6.81 (0 to 20)	4.74	2	6	10	- 2.34	.019
	≥ 61 years	47	8.96 (0 to 16)	4.60	5	8	14		
Gender	Male	76	7.65 (0 to 20)	5.01	4	7	12	- 1.05	.29
	Female	24	8.33 (1 to 16)	3.67	5	7	12		
Literacy	Literate	72	6.76 (0 to 20)	4.51	3.25	6	9.75	- 3.07	.002
	Illiterate	28	10.54 (1 to 16)	4.43	6	12	14		
Time since stroke	≤ 6 months	74	8.91 (1 to 20)	4.80	5	8	14	- 4.02	.001
	≥ 7 months	26	4.73 (0 to 12)	3.08	2	5	5.25		
Side of weakness	Right	51	8 (0 to 20)	4.33	5	7	12	- .63	.52
	Left	49	7.63 (0 to 16)	4.76	4	7	12		
Treatment settings	Hospital	41	8.24 (1 to 20)	4.89	5	7	12	- .73	.46
	Rehabilitation	59	7.53 (0 to 16)	4.71	4	7	12		

5.2.1.3 Differences between anxious and non-anxious subgroups

Table 5.3 shows differences in the prevalence of anxiety symptoms between participants classified as 'anxious' and 'non-anxious', with significant differences found in two subgroups: 'literacy' ($X^2 = 10.31, p = .001$) and 'time since stroke' ($X^2 = 4.29, p = .03$). For 'literacy', anxiety was found to be higher in the illiterate subgroup of anxious patients (60.7%) than in the literate subgroup (26.4%). For 'time since stroke', anxiety was found to be higher in the ≤ 6-months subgroup (41.9%) of anxious patients and higher in the ≥ 7-months subgroup (80.8%) of non-anxious patients.

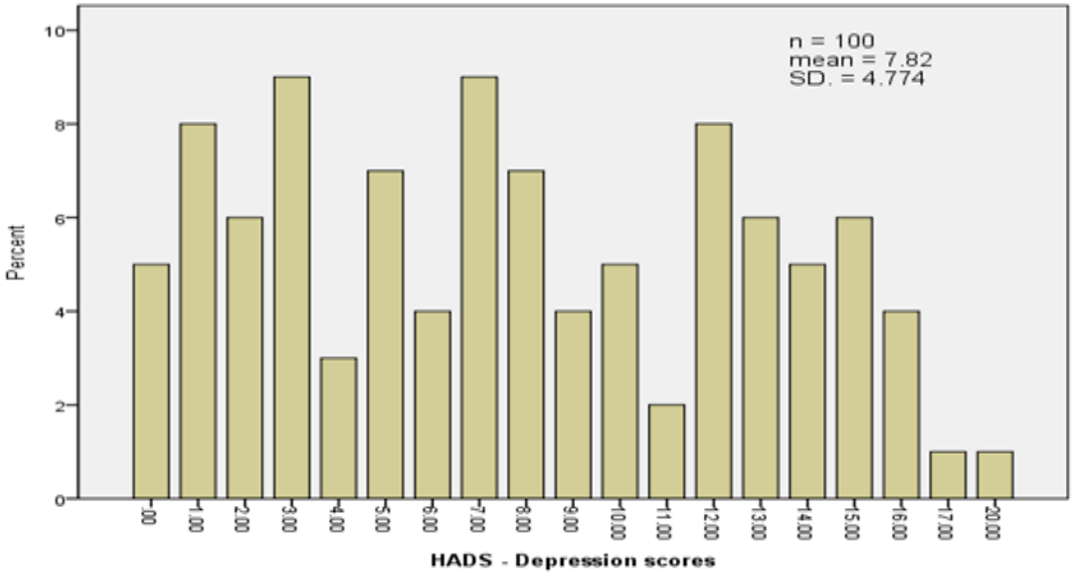
Table 5.3: Differences between anxious and non-anxious subgroups on the Arabic HADS-Anxiety (n=100)

Variables	Subgroups	Classification on the HADS -A		X^2	Sig.
		Anxious (n= 36)	Non-anxious (n= 64)		
Age	≤ 60 years	15 (28.3 %)	38 (71.7%)	2.90	.08
	≥ 61 years	21 (44.7%)	26 (55.3%)		
Gender	Male	26 (34.2%)	50 (65.8%)	.44	.06
	Female	10 (41.7%)	14 (58.3%)		
Literacy	Literate	19 (26.4%)	53 (73.6%)	10.31	.001
	Illiterate	17 (60.7%)	11 (39.3%)		
Time since stroke	≤ 6 months	31 (41.9%)	43 (58.1%)	4.29	.03
	≥ 7 months	5 (19.2%)	21 (80.8%)		
Side of weakness	Right	19 (37.3%)	32 (62.7%)	.071	.79
	Left	17 (34.7%)	32 (65.3%)		
Treatment setting	Hospital	15 (36.6%)	26 (63.4%)	.010	.91
	Rehabilitation	21 (35.6%)	38 (64.4%)		

5.2.1.4 Prevalence of depression after stroke

The HADS-Depression mean score was 7.82 (SD = 4.774), as shown in Figure 5.2.

Figure 5.2: Histogram of the distribution of total scores on the Arabic HADS-Depression across the whole sample (n=100)



The prevalence figures of depression after stroke for various patient characteristics are presented in Table 5.4. These findings indicate that depression was found among 39.6% of those aged ≤ 60 years, and in 48.96% of those aged ≥ 61 years. Depression was found in 40.8% of men and in 54.2% of women. Furthermore, depression was found in 37.5% of the literate subgroup, but in 60.7% of the illiterate subgroup. Depression was found also in 52.7% of the subgroup within 6 months or less of the suffering a stroke, whereas it affected only 19.2% of the ≥7-months subgroup. Finally, depression was found in 47.1% of patients with a right sided weakness and in 40.8% with a left sided weakness.

Table 5.4: Frequencies of depression after stroke (n=100)

Variables	Subgroups	n	*Frequency*
Age	≤ 60 years	53	21 (39.6%)
	≥ 61 years	46	23 (48.9%)
Gender	Male	76	31 (40.8%)
	Female	24	13 (54.2%)
Literacy	Literate	72	27 (37.5%)
	Illiterate	28	17 (60.7%)
Time since stroke	≤ 6 months	74	39 (52.7%)
	≥ 7 months	26	5 (19.2%)
Side of weakness	Right	51	24 (47.1%)
	Left	49	20 (40.8%)
Treatment Setting	Hospital	41	18 (43.9%)
	Rehabilitation	59	26 (44.1%)
All cases		**100**	**44%**

5.2.1.5 Differences in depression after stroke prevalence among subgroups

Shown in Table 5.5, a post-hoc analysis using the Mann-Whitney test for depression after stroke indicated significant differences in depression according to 'literacy' ($z = -3.51; p = 0.001$) and 'time since stroke' ($z = -3.16; p = 0.002$). Depression was found to be higher in the illiterate subgroup of anxious patients (median = 10) than in the literate subgroup (median = 7). Likewise, for 'time since stroke', a higher median was reported for the ≤ 6-months subgroup (8) than for the ≥ 7-months subgroup (3.5). No other characteristics were significant in the context of depression after stroke.

Table 5.5: Comparison of depression after stroke among subgroups (n= 100)

Variables	Subgroups	*n*	Mean (min. to max.)	SD.	Percentiles			*Z*	*P*
					25th	50th (median)	75th		
Age	**≤ 60 years**	53	6.98 (0 to 20)	5.04	2	7	12	- 1.89	.06
	≥ 61 years	47	8.72 (0 to 17)	5.09	5	8	14		
Gender	**Male**	76	7.53 (0 to 20)	5.29	3	7	12	- .73	.46
	Female	24	8.66 (1 to 17)	4.33	5	8.5	12		
Literacy	**Literate**	72	6.861 (0 to 20)	4.88	3	7	11.75	- 3.51	.001
	Illiterate	28	10.21 (1 to 17)	4.86	6.25	10	14		
Time since stroke	**≤ 6 months**	74	8.743 (0 to 20)	4.99	5	8	13	- 3.16	.002
	≥ 7 months	26	5.12 (0 to 16)	4.40	1.75	3.5	7		
Side of weakness	**Left**	51	8.16 (0 to 20)	5.05	5	8	12	- .39	.69
	Right	49	7.43 (0 to 17)	4.76	3	7	12		
Treatment Setting	**Hospital**	41	8.37 (1 to 20)	5.41	3	8	13	- .70	.48
	Rehabilitation	59	7.41 (0 to 16)	4.85	3	7	12		

5.2.1.6 Differences between depressed and non-depressed subgroups

Table 5.6 shows differences in the prevalence of depression symptoms between participants classified as 'depressed' and 'non-depressed', with significant differences found in two subgroups: 'literacy' ($X^2 = 4.41$, $p = .03$) and 'time since stroke' ($X^2 = 8.75$, $p = .003$). For 'literacy', depression was found to be higher in the illiterate

subgroup (60.7%) than in the literate subgroup (37.5%). For 'time since stroke', depression was found to be higher in the ≤ 6-months subgroup (52.7%) than in the ≥ 7 months subgroup (19.2%).

Table 5.6: Differences between depressed and non-depressed subgroups on the Arabic HADS-Depression (n=100)

Variables	Subgroups	Classification on the HADS -D		X^2	P
		Depressed (n= 44)	Non-depressed (n= 56)		
Age	≤ 60 years	21 (39.6%)	32 (60.4%)	.87	.34
	≥ 61 years	23 (48.9%)	24 (51.1%)		
Gender	Male	31 (40.8%)	45 (59.2%)	1.32	.25
	Female	13 (54.2%)	11 (45.8%)		
Literacy	Literate	27 (37.5%)	45 (62.5%)	4.41	.03
	Illiterate	17 (60.7%)	11 (39.3%)		
Time since stroke	≤ 6 months	39 (52.7%)	35 (47.3%)	8.75	.003
	≥ 7 months	5 (19.2%)	21 (80.8%)		
Side of weakness	Right	24 (47.1%)	27 (52.9%)	.39	.53
	Left	20 (40.8%)	29 (59.2%)		
Treatment setting	Hospital	18 (43.9%)	23 (56.1%)	.000	.98
	Rehabilitation	26 (44.1%)	38 (6434%)		

5.4.1.7 The relationship between post-stroke mood disorders and dependence in personal activities of daily living

Pearson's correlation analysis found significant negative correlations between Barthel Index scores and both anxiety scores ($r = -0.62, p < 0.001$) and depression scores ($r = -0.63, p<0.001$). This means that patients who had higher levels of independence in personal activities of daily living had lower levels of mood distress.

5.4.2 Results from the 3-month follow-up assessment

5.4.2.1 Characteristics of participants

At the 3-month post-stroke follow-up, the incidence frequencies for anxiety and depression after stroke were established and examined against the corresponding figures from the early evaluation (see Table 5.7). Thirty participants failed to complete the follow-up assessment (see Table 5.7). Out of 30, 7 (23.3%) died during the period due to illness while 23 (76.7%) were discharged from the clinical setting and declined to be contacted for further assessment. Of these, 17 (56.7%) had anxiety and 19 (63.3%) had depression in the baseline assessment. Therefore 70 of the 100 took part in the follow-up assessment. Follow-up participants had a mean age of 57.76 years (SD =10.43), with 80% of the participants being male. Out of 70 patients, 42.9% were in a hospital setting while 57.1% were in a rehabilitation setting. Furthermore, it was found that 78.6% of patients were literate while 21.4% were illiterate, and 51.4% of patients exhibited right-side weaknesses while 48.6% exhibited left-side weaknesses.

Table 5.7: Characteristics of participants who completed and did not completed follow-up assessment

Variables	Did not complete follow-up (n= 30)	completed follow-up (n=70)
Age (years)		
mean	67	57.76
(min. to max.)	(49 to 85)	(36 to 79)
SD.	10.57	10.43
Gender		
Male	20 (66.7%)	56 (80%)
Female	10 (33.3%)	14 (20%)
Literacy		
Literate	15 (50%)	55 (78.6%)
Illiterate	15 (50%)	15 (21.4%)
Time since stroke (months)		
mean (SD.)	4.3 (3.17)	9.8 (12.03)
(min. to max.)	(1 to 12)	(1 to 48)
Side of weakness		
Right side	15 (50%)	36 (51.4%)
Left side	15 (50%)	34 (48.6%)
Treatment setting		
Hospital	11 (36.7%)	30 (42.9%)
Rehabilitation	19 (63.3%)	40 (57.1%)

5.4.2.2 Individual analysis of distribution of scores for 70 stroke patients who completed the HADS at baseline and follow-up assessments

The individual analysis of the HADS scores between baseline and follow-up assessments showed significant differences between anxiety and depression scores. As seen in Table 5.8, Out of 70 patients, 12 (17.14%) obtained scores at follow-up assessment greater than their scores in the baseline assessment. This means that anxiety symptoms were increased among them. 53 (75.7%) patients obtained scores at follow-up assessment less than their scores in the baseline assessment. This means that anxiety symptoms were decrease among them after 3 months follow-up. 5 (7.1%) patients shown no changes in their scores between baseline and follow-up assessments. 31 (44.3) obtained scores ≥ 7 on HADS-Anxiety at the baseline whereas the percentage dropped out to 23 (32.9%) at the

follow-up assessment. It is important to make individual analysis of the patients who changed their HADS-Anxiety scores at follow-up assessment relative to the baseline results for anxiety. It can be examined that those patients had higher baseline assessment results i.e. from four (4) till twenty (20). The highest individual decrease in the baseline results for anxiety score was reported for patient 11 by 50% i.e. baseline result = 20 and follow-up assessment result = 10. On the contrary, the lowest individual decrease in the baseline result was reported for patient 15 i.e. baseline result = 1 and follow-up assessment = 0. Similarly, some individual patients (13%) also surprisingly confirmed increase in baseline results during the follow-up assessment for anxiety scores i.e. patients 19, 34, 36, 37, 51, 57, 58, 59, 62. On the other side, the individual analysis of the patients who did not change their HADS-Anxiety scores at follow-up highlighted that they initially already had a very low baseline scores i.e. 2 (patients 13, 52 and 53) or 1 (patient 39). In such a lower baseline assessment results, the margin of improvement is already minimal for the follow-up assessment.

The individual analysis for HADS-Depression revealed that out of 70 patients, 21 (30%) obtained scores at follow-up assessment greater than their scores in the baseline assessment. 38 (45.7%) patients obtained scores at follow-up assessment less than their scores in the baseline assessment. This means that depression symptoms decreased after 3 months follow-up. 33 (47.14) obtained scores ≥ 7 on HADS-Depression at the baseline whereas the percentage dropped out to 25 (35.7%) at the follow-up assessment. 1 (15.7%) patients showed no changes in their scores. Like anxiety, it is vital to make individual analysis of the

patients who changed their HADS-Depression scores for depression at follow-up assessment relative to their baseline results. The highest individual decrease in the baseline results for depression score was reported for patient 11 i.e. baseline result = 20 and follow-up assessment result = 14. On the contrary, the lowest individual decrease in the baseline result was reported for patient 39 i.e. baseline result = 1 and follow-up assessment = 0. Additionally, some individual patients (12%) also confirmed increase in baseline results during the follow-up assessment for depression scores i.e. patients 4, 8, 10, 19, 22, 23, 35, 36. On the other side, the individual analysis of the patients who did not change their HADS scores at follow-up highlighted that unlike anxiety they initially already did not have very low baseline scores for depression i.e. 12, 16, 0, 3, 10 (patients 9, 15, 29, 34, 40, 41, 50, 62) or 1 (patient 39).

Table 5.8: Individual analysis of distribution of scores for 70 stroke patients who completed the HADS at baseline and follow-up assessments

No.	Anxiety		Depression	
	Baseline assessment	Follow-up assessment	Baseline assessment	Follow-up assessment
1	4	1	3	0
2	7	2	7	6
3	5	2	5	3
4	2	0	2	0
5	10	9	15	16
6	16	12	16	14
7	5	3	3	5
8	5	3	2	3
9	16	14	16	16
10	14	12	8	10
11	20	10	20	14
12	2	0	3	1
13	2	2	7	4
14	8	4	2	1
15	1	0	0	0
16	2	0	2	0
17	9	7	11	6
18	7	5	8	4
19	12	14	14	16
20	4	2	3	2
21	6	6	7	5
22	12	6	13	14
23	8	7	9	14
24	6	5	7	3
25	12	7	10	7
26	6	2	7	4
27	2	3	2	1
28	8	4	10	6
29	7	5	12	12
30	4	3	3	3
31	16	12	15	13
32	7	6	10	12
33	8	5	7	6
34	1	2	1	1
35	0	1	1	2
36	5	6	5	7
37	2	3	1	2
38	14	6	15	7
39	1	1	1	0
40	7	5	6	6
41	1	0	0	0

42	5	3	5	6
43	10	6	12	5
44	11	7	8	7
45	4	2	3	2
46	3	2	5	1
47	1	0	1	0
48	2	0	1	0
49	4	2	3	2
50	5	2	3	3
51	6	8	4	9
52	2	2	0	0
53	2	2	2	1
54	14	8	12	7
55	5	3	4	6
56	12	9	14	12
57	5	10	9	12
58	5	9	4	7
59	5	7	6	8
60	14	12	12	14
61	4	4	5	2
62	5	8	10	10
63	12	7	12	10
64	13	5	7	5
65	10	4	3	6
66	10	12	12	14
67	5	5	5	2
68	12	7	11	12
69	6	5	5	4
70	8	7	9	10

5.4.2.3 Frequencies of anxiety at follow-up assessment

The overall prevalence rate of anxiety after stroke was 18.6% at 3-months follow-up. Table 5.9 shows that a significant difference was found in the follow-up results relative to the earlier evaluation in terms of the time elapsed since stroke. In particular, of the 48 patients in the ≤ 6-months subgroup, 35.4% were found to suffer from anxiety after stroke at the baseline assessment, while this reduced to 20.8% at the 3-month follow-up.

Figure 5.4: Histogram of the distribution of total scores for 70 stroke patients on the Arabic HADS-Anxiety across baseline assessment

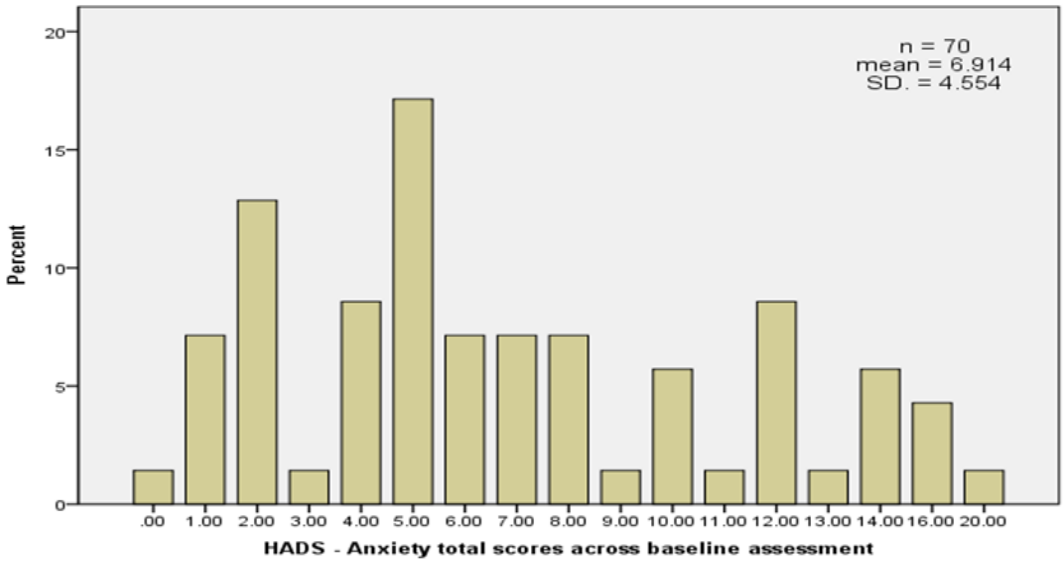


Figure 5.5: Histogram of the distribution of total scores for 70 stroke patients on the Arabic HADS-Anxiety after 3-months follow-up

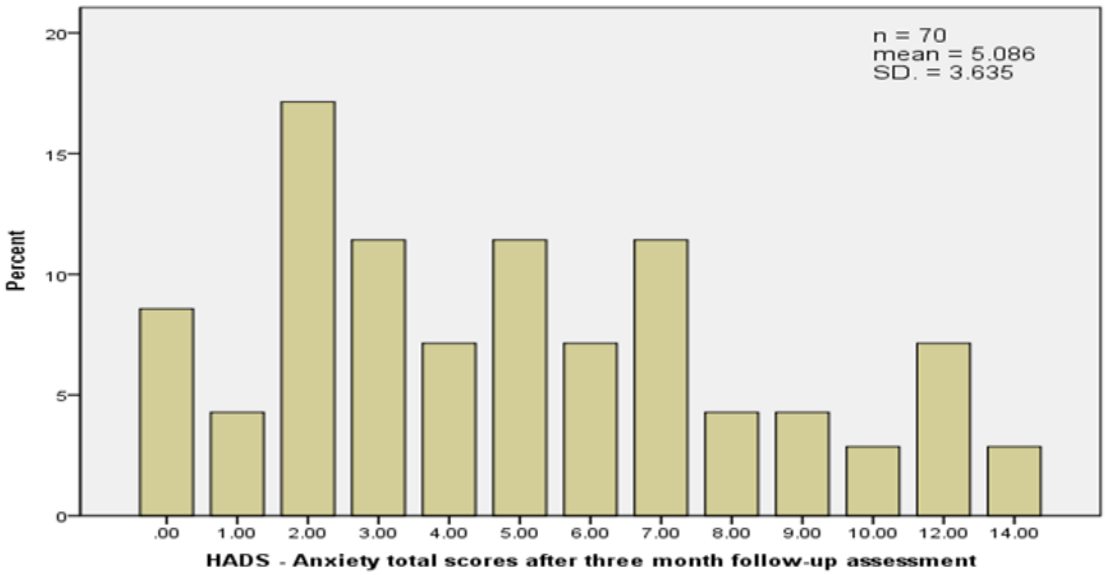


Table 5.9: Frequencies of anxiety for 70 stroke patients across baseline and 3-months follow-up assessment

Variables	Subgroups	*n*	Baseline	Follow - up
Age	≤ 60 years	38	12 (31.6%)	8 (21.1%)
	≥ 61 years	32	9 (28.1%)	5 (15.6%)
Gender	Male	56	14 (25%)	10 (17.9%)
	Female	14	7 (50%)	3 (21.4%)
Literacy	Literate	55	16 (29.1%)	8 (14.5%)
	Illiterate	15	5 (33.3%)	5 (33.3%)
Time since stroke	≤ 6 months	48	17 (35.4%)	10 (20.8%)
	≥ 7 months	22	4 (18.2%)	3 (13.6%)
Side of weakness	Right	36	12 (33.3%)	6 (16.7%)
	Left	34	9 (26.5%)	7 (20.6%)
Treatment setting	Hospital	30	9 (30%)	6 (20%)
	Rehabilitation	40	12 (30%)	7 (17.5%)
All cases		**70**	**21 (30%)**	**13 (18.6%)**

5.4.2.4 Differences in anxiety after stroke among subgroups at follow-up assessment

Shown in Table 5.10, a post-hoc analysis using the Mann-Whitney test for anxiety at 3-months follow-up indicated significant differences in gender ($z = -2.86$; $p = 0.004$) and 'literacy' ($z = -2.56$; $p = 0.01$). No other characteristics were significant in the context of anxiety scores. Analysis of median percentiles revealed that anxiety scores were higher for women (median = 7) than for men (median = 3). Likewise, the level of literacy showed higher anxiety scores for the illiterate subgroup (median = 7) than for the literate subgroup (median = 3).

Table 5.10: Results from the post-hoc analysis conducted using the Mann-Whitney test examining differences in anxiety prevalence among subgroups for 70 stroke patients at the 3-month follow-up assessment

Subgroups	*n*	Mean	SD	Percentiles			Z	*P*
				25th	50th (median)	75th		
Age								
≤ 60 years	38	5.05	3.77	2	4.5	8	- .12	.91
≥ 61 years	32	5.13	3.53	2.25	5	6.75		
Gender								
Male	56	4.55	3.65	2	3	6.75	- 2.86	.004
Female	14	7.21	2.75	4.75	7	9.25		
Literacy								
Literate	55	4.75	3.25	2	4	7	- 2.56	.01
Illiterate	15	7.47	4.07	4	7	12		
Time since stroke								
≤ 6 months	48	5.44	3.78	2	5	7	- 1.22	.22
≥ 7 months	22	4.32	3.26	2	3	6.25		
Side of weakness								
Right	36	5.33	3.62	2	5	7	- .61	.54
Left	34	4.32	3.26	2	4	7.25		
Treatment setting								
Hospital	30	5.17	4.07	2	4.5	7	- .11	.91
Rehabilitation	40	5.03	3.32	2	5	7		

5.4.2.5 Frequencies of depression after stroke at follow-up assessment

Table 5.11 shows that overall, 18.6% of patients at the follow-up suffered from depression, including 21.6% of patients aged ≤ 60 years, and 21.6% of participants aged ≥ 61 years. Meanwhile, 23.2% of male participants were affected, compared to 42.9% of female. A notable change was found in the 'time since stroke' factor, where depression was found in 35.4% of patients in the ≤ 6-months subgroup whereas only 9.1% of those in the ≥ 7-months subgroup were affected.

Figure 5.6: Histogram of the distribution of total scores for 70 stroke patients on the Arabic HADS-Depression across baseline assessment

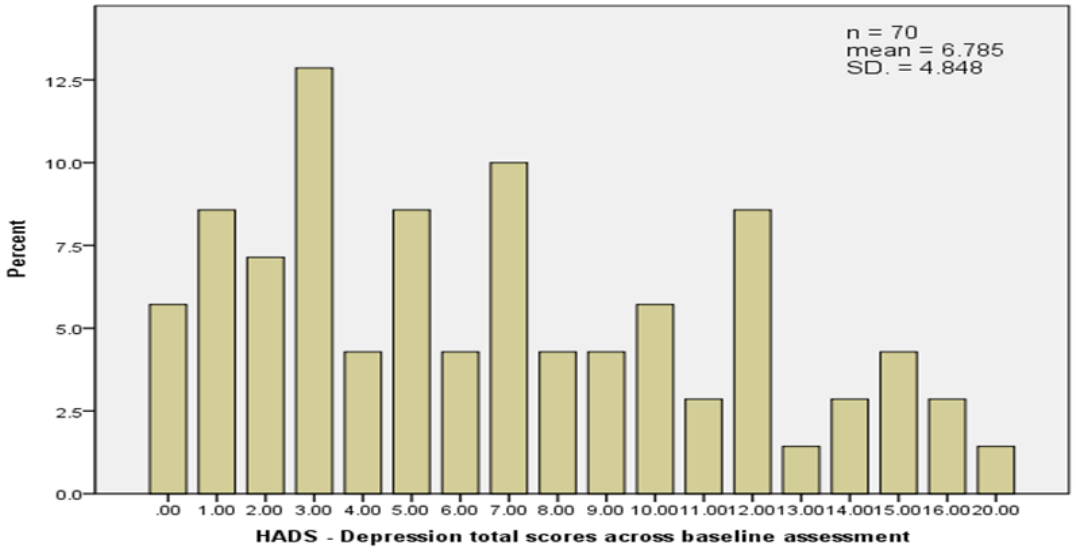


Figure 5.7: Histogram of the distribution of total scores for 70 stroke patients on the Arabic HADS-Depression after 3-months follow-up

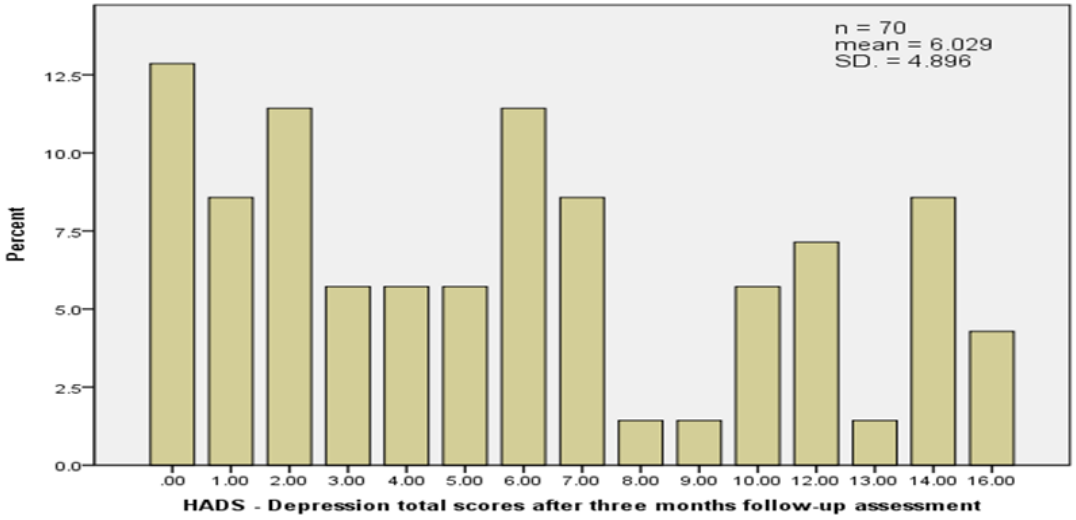


Table 5.11: Frequencies of depression for 70 stroke patients across baseline and 3-months follow-up assessment

Variables	Subgroups	n	Baseline	Follow - up
Age	≤ 60 years	38	11 (28.9%)	12 (31.6%)
	≥ 61 years	32	12 (37.5%)	7 (21.6%)
Gender	Male	56	18 (32.1%)	13 (23.2%)
	Female	14	5 (35.7%)	6 (42.9%)
Literacy	Literate	55	16 (29.1%)	12 (12.8%)
	Illiterate	15	7 (46.7%)	7 (46.7%)
Time since stroke	≤ 6 months	48	19 (39.6%)	17(35.4%)
	≥ 7 months	22	4 (18.2%)	2 (9.1%)
Side of weakness	Right	36	13 (36.1%)	8 (22.2%)
	Left	34	10(29.4%)	11 (32.4%)
Treatment setting	Hospital	30	11 (36.7%)	10 (33.3%)
	Rehabilitation	40	12 (30%)	9 (22.5%)
All cases		**70**	**21 (30%)**	**13 (18.6%)**

5.4.2.6 Differences in depression prevalence among subgroups at follow-up assessment

As shown in Table 5.12, a post-hoc analysis using the Mann-Whitney test for depression at 3-months follow-up indicated significant differences in gender ($z = -2.16$; $p = 0.03$) and 'literacy' ($z = -2.95$; $p = 0.05$). No other characteristics were significant in the context of depression scores. Analysis of the median percentile revealed that depression scores were higher for women (median = 12) than for men (median = 7). Likewise, the literacy showed higher depression scores for the illiterate subgroup (median = 12) than for the literate subgroup (median = 7).

Table 5.12: Results from the post-hoc analysis using the Mann-Whitney test examining differences in depression prevalence among subgroups for 70 stroke patients at the follow-up assessment

Subgroups	*n*	Mean	SD	Percentiles			Z	*P*
				25th	50th (median)	75th		
Age								
≤ 60 years	38	5.92	5.21	2	4.5	10.5	- .51	.61
≥ 61 years	32	6.16	4.59	2	6	7		
Gender								
Male	56	5.46	4.51	1	4.5	7	- 2.16	.03
Female	14	8.29	4.08	4.75	9	12		
Literacy								
Literate	55	5.43	4.68	2	5	7	- 1.95	.05
Illiterate	15	8.2	5.21	3	8	12		
Time since stroke								
≤ 6 months	48	6.61	5.03	2	5	7	- 1.33	.18
≥ 7 months	22	4.77	4.44	1.75	3	7		
Side of weakness								
Right	36	5.81	4.84	1.25	5	9.5	- .37	.71
Left	34	6.27	5.02	2	6	10.5		
Treatment setting								
Hospital	30	6.5	5.64	2	4	12.5	- .31	.75
Rehabilitation	40	5.68	4.29	2	6	8.75		

Chapter Six: Results 3: Relationship between Cognitive Dysfunctions and Mood Disorders in Saudi Stroke Patients

6.1 Introduction

This Chapter examined the relationships between cognitive dysfunctions (orientation/attention, memory, fluency, language, visuospatial, visual neglect and executive functions) and mood disorders (anxiety and depression) in a sample of hospitalised patients in Saudi Arabia who have suffered a first-ever stroke. A detailed description of the procedures was provided in Chapter 3 (General Method).

6.2 Results

6.2.1 Differences between non-anxious and anxious patients on three neuropsychological scales

Table 6.1 depicts the differences between non-anxious and anxious patients using three neuropsychological scales. Of the 100 research participants, 64 were non-anxious and 36 were anxious. Mean values for the non-anxious patients were significantly higher on all neuropsychological scales, with the exception of the Trial Making Test (TMT) Part B, which showed the opposite results. The difference in direction for the TMT Part B is due to the direction of scoring involved in the TMT Part B (TMT-B). A higher score (times in seconds) on the TMT-B means that the participant was slow in responding while a lower score (times in seconds) indicates greater efficiency in completing the given test. When the direction of scoring is

taken into account, there is no difference in the results given by different measurement scales.

Furthermore, the findings shown in Table 6.1 confirm that all the neuropsychological measures had significant *p*-values, that is, 0.01 or 0.02, confirming that there was a significant difference between the different cognitive dysfunctions and subgroups for anxiety disorders (anxious and non-anxious).

Significant *t*-statistics for the non-anxious patients indicate that cognitive dysfunctions have less effect on the non-anxious patients under these scales, while they have a larger impact on the anxious patients. Results were different for the Trial-Making Test, in which low *t*-statistics for the anxious patients indicated less chance that cognitive dysfunctions under these scales have an impact on anxious patients, compared to a higher chance that cognitive dysfunctions have an impact on the non-anxious patients. The difference in assessing *t*-statistics for the TMT-B here is due to the scoring criteria of this scale where a lower value (time in seconds) represents an above-average performance while a higher value reflects deficient or average performance.

Furthermore, for each of the neuropsychological scales given in Table 6.1 below, a statistically significant difference exists in the means between anxious and non-anxious groups.

Table 6.1: Differences between non-anxious and anxious patients on three neuropsychological scales

Neuropsychological Test		*n*	*mean*	*SD*	*t.*	*Sig.*	*95% confidence*	
							Lower	*Upper*
ACE-R Overall cognitive function	Non-anxious	**64**	75.08	21.63	7.95	.001	27.98	46.62
	Anxious	**36**	37.78	24.06	7.71			
ACE-R Orientation/attention	Non-anxious	**64**	14.84	4.08	8.07	.001	5.51	9.12
	Anxious	**36**	7.53	4.81	7.69			
ACE-R Memory	Non-anxious	**64**	19.5	5.73	7.13	.001	6.70	11.69
	Anxious	**36**	10.31	6.55	7.04			
ACE-R Fluency	Non-anxious	**64**	8.03	3.63	8.20	.001	4.28	7.01
	Anxious	**36**	2.39	2.61	8.98			
ACE-R Language	Non-anxious	**64**	21.63	5.29	6.80	.001	6.35	11.57
	Anxious	**36**	12.67	7.85	6.11			
ACE-R Visuospatial	Non-anxious	**64**	11.19	4.16	7.48	.001	4.73	8.15
	Anxious	**36**	4.75	4.07	7.53			
Apple Cancellation Test	Non-anxious	**60**	40.09	11.91	7.04	.001	15.17	27.07
	Anxious	**24**	18.97	18.02	6.30			
Trail Making - B (minutes: seconds)	Non-anxious	**18**	2:56	01:27	- 3.29	.002	- 02:08	- 00:31
	Anxious	**11**	4:16	01:36	- 3.11			

6.2.2 Differences between non-depressed and depressed patients on three neuropsychological scales

Of the 100 patients, 56 patients were not depressed and 44 were depressed. Table 6.2 shows the differences between non-depressed and depressed patients on the

neuropsychological scales. The results show significant differences between both subgroups (non-depressed and depressed).

Table 6.2: Differences between non-depressed and depressed patients on three neuropsychological scales

Neuropsychological scale		*n*	*mean*	*SD*	*t.*	*Sig.*	*95% confidence*	
							Lower	*Upper*
ACE-R Overall cognitive function	Non-depressed	**56**	75.79	22.45	6.65	.001	22.54	41.72
	Depressed	**44**	43.66	25.81	6.54			
ACE-R Orientation/Attention	Non-depressed	**56**	14.80	4.51	6.13	.001	3.99	7.80
	Depressed	**44**	8.91	5.11	6.04			
ACE-R Memory	Non-depressed	**56**	19.82	6.14	6.55	.001	5.75	10.76
	Depressed	**44**	11.57	6.41	6.51			
ACE-R Fluency	Non-depressed	**56**	8.13	3.84	6.77	.001	3.41	6.24
	Depressed	**44**	3.31	3.11	6.91			
ACE-R Language	Non-depressed	**56**	21.82	5.21	5.84	.001	5.14	10.42
	Depressed	**44**	14.11	8.05	5.56			
ACE-R Visuospatial	Non-depressed	**56**	11.52	4.06	7.10	.001	4.34	7.70
	Depressed	**44**	5.50	4.39	7.03			
Apple Cancellation Test	Non-depressed	**53**	40.80	11.82	6.29	001	12.93	24.85
	Depressed	**31**	21.91	18.11	5.99			
Trail Making -B (minutes: seconds)	Non-depressed	**16**	02:49	01:26	- 3.53	.001	- 01:58	-0:00:32
	Depressed	**13**	04:05	01:32	- 3.44			

6.2.3 Predictors of mood disorders (anxiety and depression) after stroke

The results of the multiple linear regression analysis are given below for the predictors of the severity of anxiety and depression post stroke, using the Arabic HADS-A and HADS-D as dependent variables. Demographic data (i.e., age, gender, literacy, time since stroke, side of weakness, treatment setting) and scores for the ACE-R, ACT, TMT-B tests at baseline assessment were used in the regression analysis as independent variables. The results can be used to assess the dependency of mood disorders (anxiety and depression) on the different predictor variables through the standardised coefficient (β).

6.2.3.1 Multiple regression models for HADS-Anxiety scores

First, the results of collinearity diagnostics for demographic variables, cognitive domains, the Apple Cancellation Test (ACT) and the TMT-B were calculated. The Variance Inflation Factor (VIF) was the statistical figure used for examining whether or not collinearly existed between the variables. VIF is a measure to estimate how much of the variance of a coefficient is inflated due to its linear dependence with other predictors. The criteria for assessing the Variance Inflation Factor (VIF) were as follows: a high VIF value, exceeding 5, means that a high collinearity exists between the research variables, while $1 < VIF < 5$, means that a moderate collinearity exists between variables, a lower figure, of less than 1, is evidence of non-collinearity between the research variables (Field, 2013).

The VIF values for four of the six demographic factors were higher than 1 and lower than 5 i.e., for age (1.11), gender (1.08), ‘literacy’ (1.050), ‘side of weakness’

(1.06), and treatment setting (1.10). This shows that there was moderate collinearity of concern between these variables. Table 6.3 also shows the results of the collinearity diagnostics for the cognitive domains predicting anxiety after stroke. According to VIF results, the ACE-R-Orientation/attention, ACE-R Memory, ACE-R-Fluency, ACE-R-Language, ACE-R-Visuospatial ability, the Apple Cancellation Test and TMT-B had moderate collinearity with HADS-Anxiety. The high VIF values (e.g. > 4) existed between HADS-Anxiety and the variables of ACE-R Orientation/attention, ACE-R Memory and ACE-R Fluency.

Table 6.3: Regression (beta) coefficients and collinearity diagnostics for multiple regression models for HADS-Anxiety scores in relation to demographic variables, ACE-R, Apple Cancellation Test (ACT) and Trail Making Test Part B (TMT-B)

Variables	Age	Gender	Literacy	Time since stroke	Treatment setting	Side of weakness	ACE-Overall	ACE-Orientation/attention	ACE-Memory	ACE-Fluency	ACE-Language	ACE-Visuospatial	ACT	TMT-B
Model 1														
β	- .103	.012	.304***	.278**	- .078	- .061								
t.	- 1.076	.103	3.280	2.997	- .820	- .648								
VIF	1.111	1.082	1.050	1.050	1.099	1.059								
R^2				**.206**										
R^2 adjusted				**.190**										
Model 2														
β	.014	.067	- .033	.183**	.035	- .106	-.650***							
t.	.188	.932	- .405	2.504	.477	- 1.479	- 8.894							
VIF	1.116	1.047	1.355	1.084	1.055	1.046	1.084							
R^2				**.522**										
R^2 adjusted				**.512**										
Model 3														
β	- .036	.084	- .003	.146*	.017	- .114		- .163	- .144	-.688***	.009	- .249		
t.	- .514	1.223	- .036	2.057	.224	- 1.659		- 1.141	- .978	- 9.686	.068	- 1.836		
VIF	1.067	1.054	1.273	1.112	1.051	1.048		4.501	4.769	1.112	3.501	4.141		
R^2				**.559**										
R^2 adjusted				**.550**										
Model 4														
β	.004	.006	.062	.202*	.088	- .038		- .060	- .615***	- .258	.034	- .215	-.120	.178
t.	.044	.066	.698	2.341	.998	- .439		- .341	- 7.146	- 1.368	.196	- 1.585	-1.207	1.806
VIF	1.029	1.058	1.080	1.023	1.062	1.017		4.180	1.023	4.971	4.026	2.594	1.377	1.382
R^2				**.456**										
R^2 adjusted				**.442**										

Abbreviations: (β) beta, (VIF), (***) p-value < .001, (**) *p*-value ≤ .01, (*) *p*-value ≤ .05

Table 6.3 shows the results of the regression (beta) coefficients and collinearity diagnostics for multiple regression models for the demographic variables as well as for the cognitive predictors of the HADS-Anxiety after stroke. Regression coefficients were calculated based on four models. Based on the results of Model 1, 'literacy' *(β = -.304***, p < .001)* and 'time since stroke' *(β = -.278*, p < .05)* were significant predictors of the severity anxiety after stroke. Both variables explained 19% of the severity of anxiety disorder assessed by the HADS-A. The demographic variables alone can predict anxiety to a relatively small extent. In Model 2, the results showed that 'time since stroke' (*β = -.183**, p < 0.01*), and ACE-R-Overall *(β = -.650*, p < .05)* were significant predictors of the severity of anxiety after stroke. Both accounted for 51.2 % of the severity of anxiety disorder assessed by the HADS-A. In Model 3, 'time since stroke' (*β = -.146*, p < .05*) and ACE-Fluency (*β = - .688***, p < .001*) were significant predictors of the severity of anxiety. The R^2 adjusted was (55%). Lastly, the model 4 showed that 'time since stroke' (*β = - .202*, p < .05*) and ACE-Memory (*β = -.615***, p < .001*) were significant predictors of the severity of anxiety. The value of R^2 in this model was (44.2%).

It was found that 'literacy', 'time since stroke', and fluency and memory impairments were the significant predictors of the severity of anxiety in this Saudi Arabian stroke sample.

6.2.4.2 Multiple Regression Models for HADS-Depression Scores

From the analysis of the VIF values given in the Table 6.4, it can be observed that no demographic variable showed high collinearity (i.e., VIF values were less than 5 and more than 1), which confirms that error variance for the unique effect of a predictor is moderate level.

In the Model 3, the VIF value for the ACE-R Orientation/attention was 5.038, for ACE- and for ACE-Memory it was 5.567. This highlights the presence of high collinearity among those predictors and anxiety after stroke. However, in Model 4, the extent of collinearity was different for specific cognitive domains: for ACE-Orientation/attention it was 4.294 and for ACE-Memory it was 1.406, indicating low VIF values, while the ACE-Fluency VIF value was high (5.068), that is, a relatively high VIF value.

Table 6.4: Regression (beta) coefficients and collinearity diagnostics for multiple regression models for HADS-Depression scores in relation to demographic variables, ACE-R, Apple Cancellation Test (ACT) and Trail Making Test Part B (TMT-B)

Variables	Age	Gender	Literacy	Time since stroke	Treatment setting	Side of weakness	ACE-Overall	ACE-Orientation/attention	ACE-Memory	ACE-Fluency	ACE-Language	ACE-Visuospatial	ACT	TMT-B
Model 1														
β	- .099	- .017	.249**	.263**	- .030	- .023								
t.	- 1.013	- .177	2.617	2.764	- .303	- .240								
VIF	1.111	1.082	1.050	1.050	1.099	1.059								
R^2				**.160**										
R^2 adjusted				**.143**										
Model 2														
β	.001	.034	- .022	.151	.100	- .050	- .640***							
t.	.015	.431	- .248	1.890	1.294	- .633	- 8.240							
VIF	1.113	1.047	1.343	1.084	1.000	1.036	1.000							
R^2				**.409**										
R^2 adjusted				**.403**										
Model 3														
β	.010	.043	- .093	.124	.067	- .059		- .120	- .162	- .310*	- .017	- .382*		
t.	.118	.560	- .990	1.573	.890	- .760		- 707	- .912	- 2.022	- .101	- 2.494		
VIF	1.172	1.054	1.560	1.112	1.003	1.039		5.038	5.567	4.141	4.645	4.141		
R^2				**.449**										
R^2 adjusted				**.438**										
Model 4														
β	.018	- .045	- .011	.191*	.071	- .024		.202	- .350**	.047	.288	- .040	- .260*	.165
t.	.187	- .459	- .110	2.010	.727	- .248		1.039	- 3.136	.219	1.516	- .245	- 2.34	1.500
VIF	1.043	1.059	1.181	1.025	1.069	1.035		4.294	1.406	5.068	4.162	2.981	1.377	1.384
R^2				**.345**										
R^2 adjusted				**.318**										

Abbreviations: (β) beta, (VIF), (***) *p*-value < .001, (**) *p*-value ≤ .01, (*) *p*-value ≤ .05

Table 6.4 shows the results of regression analysis for the demographic predictors of the HADS-Depression after stroke. After incorporating six independent demographic variables in the model, cognitive domains, the Apple Cancellation Test and the TMT-B, the results were assessed through four regression models. Based on the results of Model 1, 'literacy' (β = *-.249**, p < .01*) and 'time since stroke' (β = *-.263**, p < .01*) were significant predictors of the severity depression after stroke. Both these variables explained 14.3% of the severity of depression disorder assessed using the HADS-D. In Model 2, the results showed that only overall ACE-Overall scores *(β = -.640***, p < .001)* was significant predictor of the severity of depression after stroke*.* Further, this explained 40.3 % of the severity of depression assessed using the HADS-D.

In Model 3, ACE-R-Fluency (β = *-.310*, p < .05*) and ACE-R-Visuospatial ability (β = *-.382*, p < .05*) were identified as significant predictors of the severity of depression. The R^2 adjusted was 43.8%. Lastly, Model 4 showed that 'time since stroke' (β = *.191*, p < .05*), ACE-Memory (β = *-.350**, p < .01*) and the Apple Cancellation Test (β = *-.260*, p < .05*) were significant predictors of the severity of depression. The value of R^2 in this model was 31.8%.

It can be concluded that 'literacy', 'time since stroke', fluency, memory, visuospatial ability, and the Apple Cancellation Test are the significant predictors of the severity of depression in Saudi stroke patients.

Chapter Seven: Discussion and Conclusion

7.1 Introduction

The aim of the current research was to investigate the prevalence rate and relationship between the post-stroke cognitive dysfunctions and post-stroke mood disorders in Saudi Arabia. For assessing the degree of association between these disorders in the Saudi population, the research investigated different sub-domains of cognitive dysfunction and post-stroke mood disorders (i.e., anxiety and depression). It investigated and discussed them individually first before combining them in order to assess the relationship between them. In addition to this separate and combined neuropsychological assessment of dysfunctions and disorders, the extent of the relationship was measured through a systematic review of the literature.

The findings and the conclusions of the chapters 4, 5 and 6 are discussed in the present chapter under key themes. The aim is to enable research audiences to understand and draw correlations between different sets of findings in a single platform. The findings of each chapter are subsequently compared with those of Western-based studies. The present chapter also discusses methodological issues, the psychological aspects of assessment, the timing of the assessments, statistical techniques, the strengths and limitations of the study, factors not included in the study, clinical implications and recommendations for future research.

The next section discusses the findings of Chapter Four, addressing the prevalence of post-stroke cognitive dysfunctions in Saudi Arabia.

7.2 Discussion of findings of post-stroke cognitive dysfunctions in Saudi Arabia

7.2.1 Frequency of overall cognitive dysfunction

Using the Arabic ACE-R, it was found that 52% of participants demonstrated overall cognitive dysfunction. This percentage is consistent with the frequencies reported in the systematic review by Rijsbergen et al. (2014) who found that the frequency of cognitive dysfunction, assessed between one month and 54 months after stroke, varied between 28% and 92%.

This finding further corresponds with those of Abdul-Sattar and Godab (2013) who found that 47.2% of patients in Saudi Arabia were cognitively impaired after stroke. Although these two percentages roughly correspond (52% and 47.2%), there remains a 4.8% difference between the findings of Abdul-Sattar and Godab (2013) and those of the present study. A possible reason for this difference is the nature of the neuropsychological tools used in each study. Abdul-Sattar and Godab (2013) used the MMSE, whereas the present study used the Arabic ACE-R to assess overall cognitive dysfunction. The Arabic ACE-R found a higher rate of prevalence than did the MMSE due to its higher psychometric properties i.e., sensitivity and responsiveness to cognitive impairment. Comparing those same two neuropsychological tests and their effect on prevalence of cognitive impairment after stroke, Morris et al. (2012) found that the prevalence of cognitive impairment

measured by MMSE was 50%, while the corresponding figure using the ACE-R was 75% of 101 acute stroke patients.

Another possible factor contributing to the difference (4.8%) between the findings of Abdul-Sattar and Godab (2013) and those of the present study is the study setting. Abdul-Sattar and Godab (2013) assessed Saudi stroke patients in a rehabilitation setting, while the present study recruited participants from both: hospital and from rehabilitation. The present study found that rates of overall cognitive dysfunction were lower at 50.8% in the rehabilitation setting. This finding corresponds with those of Saxena et al. (2008) who concluded that the prevalence of cognitive impairment was 54% in stroke patients during their rehabilitation.

7.2.2 Factors found to be related to overall cognitive dysfunction

Thus, the present study found that there were significant differences between scores on the Arabic ACE-R for overall cognitive dysfunction according to four patient characteristics. These four characteristics were: age (≤ 60 vs. ≥ 61 years), gender (male vs. female), literacy (literate vs. illiterate), and 'time since stroke' (≤ 6 vs. ≥ 7 months).

Age (≤ 60 *vs.* ≥ 61 years):

In terms of the age of the patient, it was found that patients who were 60 years old and younger obtained a higher mean score on the Arabic ACE-R for overall cognitive dysfunction than those who were 61 years old and over. Previous research substantiates the finding that the prevalence of cognitive impairment after stroke is higher with increasing age (Barker-Collo et al., 2012; Mukhopadhyay,

Sundar, Adwani, & Pandit, 2012; Nys et al., 2006; Patel et al., 2002; Rasquin, Verhey, Lousberg, Winkens, & Lodder, 2002; Tang et al., 2006). A possible explanation is that older stroke patients in Saudi Arabia develop other serious neurological disorders as a result of stroke, such as dementia which is known to be a common disorder after stroke and significantly associated with older age ranges (Madureira et al., 2001).

Despite no specific reports exploring the frequency of neurological disorders (e.g., dementia) after stroke in Saudi Arabia, Ogunniyi et al. (1998) indicated that the rate of dementia in hospitalised Saudi patients was 19.3/100,000 while the mean age at onset of dementia was 74.6 years. The types of dementia were: Alzheimer's disease (51.9%), vascular dementia (18.2%), mixed (15.6%), dementia with Parkinson's disease (7.8%) and treatable dementia (5.2%). Investigating the rate of dementia among stroke patients in the Egyptian population , who are assumed to be culturally similar to people in Saudi Arabia, Khedr et al. (2009) found post-stroke dementia in 21% of patients and that it was significantly related to older age.

Gender (Male *vs.* Female):

Aside from age, the findings of Chapter 4 highlighted that gender was significantly related to the rate of overall cognitive impairment after stroke in the Saudi population. The post-hoc analysis revealed that female participants scored significantly lower than males on the Arabic ACE-R for overall cognitive impairment. This finding is consistent with previous studies, such as Rasquin et al. (2002), Yen et al. (2010), and Rasquin, Lodder, and Verhey, (2005). However,

likely reasons for the poor performance of females on the Arabic ACE-R scale in the current study include the higher age of women (60.58 years). However, the representativeness of the sample can be argued to be lower due to its small size in the current study i.e., only 24. This is supported by different studies that recruited a larger proportion of females. For example, Mukhopadhyay et al. (2012) found that the prevalence of cognitive impairment was increased higher in men than in women. Another major difference between the previous study and current study can be traced to the MMSE scores where, out of 27 stroke survivors evaluated for cognitive dysfunction, 18 (66.66%) had MMSE scores of less than 24. Likewise, such high scores can be attributed to the elderly population, aged 60 years and above, investigated in this study.

On the other hand, Patel et al. (2002), Ayerbe et al. (2011), and Douiri et al. (2013) found no significant differences between males and females in the severity of overall cognitive impairment post stroke. Therefore, to determine the impact of gender, further research is needed to establish whether being female has a greater influence than being male on cognitive ability after stroke.

Literacy (Literate *vs.* Illiterate):

The issue of illiteracy can be better explained by focusing on the level of poverty and differences in the social status of people in Saudi Arabia. Secondary data analysis revealed that illiteracy in Saudi Arabia is related mainly with older people (over 70 years old). The reason is related with the fact that Saudi Arabia became a nation formally in 1932 while education was made mandatory in 1958. Therefore,

current generations of population whole belonged to the period before 1958 are mostly illiterate. Additionally, it can also be examined that in Saudi Arabia there are numerous distant rural communities spread in the desert areas of the country, which can be characterised by instability measured through high illiteracy, poverty and ignorance. Besides the adversely influencing factors, illiteracy in Saudi Arabia can be characterised with the help of criticisms blaming the poor education system in the nation comparative to the developed countries of the world. Most of the educational institutions in the country encounter challenges related with poorly trained teachers, low retention rates, lack of rigorous standards, weak scientific and lack of technical instructions.

In addition to age and gender, illiteracy was found in the present study to be a significant factor in the level of overall cognitive impairment as rated by the Arabic ACE-R screening test in the Saudi sample. It was found that stroke patients who were illiterate had trouble organising essential information, lack of communication skills, and lack extensive vocabularies for understanding new words and keeping track of instructions for performing in the neuropsychological assessment. The fact that stroke patients with lower education levels performed worse on neuropsychological assessments is supported by previous literature (Desmond et al., 2000; Madureira et al., 2001; Pohjasvaara, Erkinjuntti, Vataja, & Kaste, 1997). However, this conclusion is still unconfirmed in Saudi Arabia because stroke patients may perform worse on neuropsychological tests as a result of the lack of reading and writing skills, and this could increase the rate of false positive cases of rates of cognitive impairment post stroke (Madureira et al., 2001). Reading and

writing skills required for the ACE-R include reading alphabetically, reading sentences, writing words, and writing sentences containing verbs and a subject and having meanings. In addition, due to the demographics in Saudi Arabia, the sample of the present study had a relatively high level of illiteracy the findings among most of the age groups, including elderly and older people, were different from the western-based studies, where the samples have a higher level of literacy due to higher education levels. Research literature on the performance of lower-educated stroke patients in neuropsychological tests remains limited, notably in terms of illiterate populations, therefore the influence of illiteracy on the prevalence of cognitive impairment after stroke is still uncertain.

Time since stroke (≤ 6 *vs*. ≥ 7 months):

Time elapsed since stroke was found to be an important variable for increased overall cognitive dysfunction in the Saudi stroke sample. Patients within 6 months or less of suffering a stroke showed a higher prevalence of cognitive dysfunction than those who were longer post stroke. A systematic review of subjective cognitive complaints after stroke by Rijsbergen et al. (2014) found different results. Only two of five studies in Rijsbergen et al.'s (2014) review indicated that the rate of cognitive complaints (i.e., cognitive impairments assessed on neuropsychological scales) decreased over time following the stroke, while three studies found that this rate increased over time since the stroke.

A possible explanation for the inconsistency in the findings between Rijsbergen et al.'s (2014) systematic review and those of the present study concerns the medical

system for caring for people with stroke in Saudi Arabia. Within the Saudi healthcare system, stroke patients are admitted to intensive care units in the hospitals for 4 days to 3 months, depending on the severity of the stroke symptoms. Those who need rehabilitation are referred to a rehabilitation centre, and their length of stay ranges from 6 weeks to 4 months. Typically, patients who are referred to a rehabilitation centre receive therapeutic strategies including cognitive rehabilitation to reduce the severity of their cognitive impairment. As 59% of the participants in the present study were sampled from rehabilitation units, it is expected that those patients were given special cognitive training to improve their cognitive functioning due to the severity of their cognitive problems, including subjective memory problems, perceived cognitive problems related to mental slowness, and other memory complaints.

7.2.3 Frequency of dysfunction in cognitive domains

The present study has included eight cognitive domains most commonly affected in stroke patients. The results for the Saudi Arabian sample (n=100) showed the following frequencies for the post-stroke dysfunctions by domains: orientation/attention (52%), memory (55%), fluency (36%), language (46%), visuospatial ability (29%), visual neglect (35.7%), visual-motor skills (58.4%), and executive dysfunction (69%).

To the researcher's knowledge, no published study has explored the prevalence of impairment in these cognitive domains in a population of Saudi stroke patients. However, the results of European studies reveal that developed countries report a

similar set of cognitive dysfunctions within the post-stroke period. It is therefore logical to discuss the findings of the present study in terms of these European-based findings. European studies include: Blake et al. (2002); Duits et al. (2008); Leśniak et al. (2008); Nys et al. (2005); Nys et al. (2006); Passier et al. (2010); Rasquin et al. (2004); Verhoeven et al. (2011). These studies highlight the presence and prevalence of impairments in visuospatial, memory and executive-function domains, comparatively more than any other dysfunctions in a European population, similar to that found in the present study. The frequency of the different cognitive dysfunctions within these studies are as follows: 26-72% of stroke patients had impaired attention (cf. 52% in the present study); 18.8-56% had memory impairment (cf. 55% in the present study); 21-40% had language disorder (cf. 46% in the present study); 27.5-66% had visual perception difficulties (cf. 29% in the present study); 19.3-42% had visual neglect (cf. 35.7% in the present study); and 18.5-52% had executive dysfunctions (cf. 63.7% in the present study), regardless of the time since the onset of the stroke. The findings showed that the rates of cognitive dysfunction in these investigated European countries are similar to or slightly higher than those in the current study.

Five cognitive domains (orientation/attention, memory, fluency, language, visuospatial ability) have been examined using the Arabia ACE-R. The prevalence of orientation/attention deficit in the present study was 52% (n=100). The literature further validated that orientation/attention deficits are common among stroke patients. Hyndman and Ashburn, (2003) estimated that range of attention deficit after stroke ranges from 10% to 43% regardless of ‘time since stroke’. The present

study, however, found that a higher proportion of orientation/attention disorder occurred in those within 6 months or less of suffering a stroke. This result also confirms that ‘time elapsed since stroke’ can be a significant factor in the rate of orientation/attention deficit after stroke in the Saudi population. For example, Stapleton et al., (2001) found that 42.9% to 85.71% of stroke patients had attention deficit within six weeks of stroke. Hurford, Charidimou, Fox, Cipolotti, and Werring, (2013) found that 72.4% of stroke patients presented attention disorder in the acute phase, while 37.9% of them presented attention deficits three months later.

Despite patients with pre-stroke dementia being excluded from this study, a high percentage of the participants (55%) had memory impairment. This frequency is lower than that found by Riepe, Riss, Bittner, and Huber (2003) who concluded that the frequency of memory impairment was 73.2% during the acute phase of stroke, whereas the corresponding percentage reported by Duits et al. (2008) was much lower at 38%. However, the reason behind this much lower percentage can traced back to the use of the Checklist for Cognitive and Emotional Consequences solely, rather than the use of any specific neuropsychological measure or scale. However, Nøkleby et al. (2008) found a similar percentage to the present study, namely, 53% of stroke patients had memory impairment. This heterogeneity in the percentages may be due to the types of screening tools used to assess memory impairment. Nøkleby et al. (2008) reported results based on the measures of the following three screening tests: the Cognistat, the Screening Instrument for Neuropsychological Impairments in Stroke (SINS), and the Clock Drawing Test. The selection of

screening tools affects the prevalence rates among the patients due to differences in the specificities and sensitivity of these tools (Blake et al., 2002).

Fluency and language difficulties were found to have a 36% and 46% prevalence rate among the post-stroke patients, respectively. These difficulties included aphasia along with the other language disorders. These rates were lower than those of the previous study by Morris et al. (2012) who reported a prevalence rate for fluency disorder of 66.3%. However, these rates were similar to the findings of Chahal et al. (2010) and Camoes-Barbosa et al. (2012) who reported a significant relationship between aphasia and language disorders.

Another frequent deficit in this study is visuospatial perception disorder. Assessed by ACE-R, this showed a prevalence rate of 29% among participants. The effects of demographic factors can be used to trace the reasons behind this relatively low prevalence rate. The literature has also not recognised visuo-spatial disorders as a common or prevailing condition after stroke. In contrast, the current study identified a notably higher rate of executive dysfunctions (69%). This is similar to European studies which reported prevalence rates for executive dysfunctions of 18.5-52%. These findings confirm that executive dysfunctions are a common condition in the post-stroke period.

Interestingly, differences can be observed when we compare our findings with those of Morris et al. (2012) who used the ACE-R to assess the frequency of cognitive dysfunctions post stroke. The authors found that overall cognitive impairment ranged between 58.4 % and 92.1% in 101 patients with stroke. Most of

the cognitive deficits were in the following domains: orientation/attention (53.5%), visuospatial ability (65.3%), fluency (66.3%) and memory (58.4%). The heterogeneity of the present study's findings can be attributed to the cut-off scores applied. In Morris et al. (2012), cut-off points were applied to each participant according to age (50-59 years, 60-69 years, ≥ 70 years); while in the Saudi-based literature, cut-off scores were applied according to age (50-59 years, 60-69 years, ≥ 70 years) and literacy (literate *vs.* illiterate) (Al Salman, 2013). This further confirms that detailed analysis of patient characteristics can result in variable findings, depending on whether a broader or narrower analysis of the patients' characteristics is applied.

Another reason behind the heterogeneity (that is, the differences between the current study and Morris et al. (2012)) is 'time elapsed since stroke'. Morris et al. (2012) assessed patients within the acute phase of stroke (median = 15 days); while the time since stroke in the present investigation extended from 1 to 48 months (median = 3 months).

From the Apple Cancellation Test, it was found that 35.7% of the sample demonstrated visual neglect. This finding was similar to those of Becker and Karnath (2007), Chechlacz et al. (2012) and Ringman et al. (2004). In terms of the visual neglect subtypes, our findings showed that the egocentric neglect was more prevalent in the stroke patients within the age group of 61 years and older, in the illiterate group, in those ≤ 6 months of stroke, and in the left side weakness group. Allocentric neglect was significantly more prevalent among patients with left side

weakness after stroke while other variables of age, gender, literacy, time since stroke and treatment setting were shown no significant differences in allocentric neglect. A noteworthy point examined in the current study was the association between visual neglect and left side weakness. It was found that visual neglect as well as both subtypes was significantly prevalent among patients with left side weakness compared to those with right side weakness. This has been explained that the visual neglect disorder is following right-hemisphere strokes. It is probable that patients with left-sided weakness had a stroke in the right-side of the brain which may affect the physical abilities in the opposite side of the body. The findings of the present study correspond to those of Bowen et al. (1999) who in a systematic review reported that unilateral spatial neglect occurs more frequently after right-brain damage than after left-brain damage, in 16 out of 30 studies reviewed. Lindén, Samuelsson, Skoog, and Blomstrand (2005) found also that most the patients with visual neglect showed left-sided weakness (71%). Our finding was also correspond with Becker and Karnath (2007), and Chechlacz et al. (2012) who found that 24.3% to 33.3% of patients with right hemisphere strokes, while 3.6% and 10.9% of patients with left hemisphere stroke had neglect.

Results of the TMT Part A showed that 58.4% of participants had visual-motor skills dysfunction. Four factors – age, ‘level of literacy’, ‘time since stroke’, and ‘side of weakness’ – showed significant differences between their subgroups. It was found that the rate of visual-motor skills dysfunction post stroke increased with age (61 years and over), among patients within 6 months or less of suffering a stroke, and among those with ‘right side of weakness’. Van Zandvoort, Kessels,

Nys, De Haan, and Kappelle (2005) also substantiated the significant results (52%), confirming the impact of stroke on motor-skill deficiencies in the post-stroke period.

In terms of the TMT test, it is unsurprising that only 77 of the 100 and 29 of the 100 completed Part A and Part B respectively. A reason for such a low response rate for Part-B could be the task complexity involved in the TMT-B compared to that of the TMT-A; the TMT-B contains both alphabets and digits while the TMT-A is based only on digits.

Part B showed that the disability might be related to the severity of their post-stroke executive dysfunctions. Results of the TMT Part B showed that 69% obtained lower than the standard cut-off scores. Executive functions are comprised of complex cognitive abilities, including conceptual reasoning, cognitive flexibility, planning, and problem-solving (Stuss & Knight, 2013). This may explain the high rate of stroke patients reported in the present study as having executive dysfunctions. The literature found that executive dysfunctions were diagnosed in 26.4-52% of stroke patients (Blake et al., 2002; Nys, et al., 2006: Patel et al., 2002). Using the TMT for stroke patients, Van Zandvoort, Kessels, Nys, De Haan, and Kappelle (2005) also reported lower results to the present study: they found that 52% and 57% of patients scored lower than the cut-offs points on Part A and B, respectively. A reason for the relatively high rate in the present study could be the demographic factors of the Saudi population which differ from those of western countries, specifically in terms of literacy rates.

7.2.4 Factors found to be related to dysfunction in cognitive domains

Age (≤ 60 *vs.* ≥ 61 years):

The findings were the comparison between six demographic characteristics in terms of cognitive dysfunctions, assessed using the ACE-R. A crucial aspect examined was 'age of patient', as some of the Western studies showed the influence of older age on post-stroke cognitive dysfunctions. Similarly, age was analysed in the Saudi Arabian population. The current study confirmed that stroke patient aged 61 years and over had higher cognitive impairments in orientation/attention, memory, fluency, language and executive function than those aged 60 years and under. Thus, the present study supports the impact of age the cognitive dysfunctions among post-stroke patients. The older the patient, the more likely they are to suffer from some type of cognitive dysfunction after stroke. The previous literature explained this increase by reporting that the prevalence of cognitive dysfunctions after stroke remains high as stroke-patients age, with variations being predominantly explained by the socio-demographic characteristics of the patients (Douiri, Rudd, & Wolfe, 2013; Patel, Coshall, Rudd, & Wolfe, 2002).

Gender (Male *vs.* Female):

This study found significant differences between males and females in two cognitive domains (orientation/attention, and fluency) and overall cognitive function. However, such differences can arguably be attributed to bias because previous studies such as Patel et al. (2002) did not find any significant differences between males and females in post-stroke cognitive dysfunction. As mentioned above, a limitation of the present study is the relatively small number of females in

the sample. This finding is likely due to a bias towards males in the present study in that 76% of the sample was male and only 24% was female (n=100). In the smaller sample, a greater dispersion in the results of the sample participants is likely. It is important to discuss the reasons behind inclusion of more men in this study relative to female. There are several reasons behind it. One of the major causes is related with the cultural issues prevailing in Saudi Arabia. In Saudi Arabia, the traditional dressing of the female forces them to wear face-coverings in front of strangers. Therefore, traditionally restricted women to prevent themselves to take part in any of such activities that is against their cultural factors such as neuropsychological assessment and participation in research such as this study. On the other side, the neuropsychological assessment in the current study was designed in a way that asked the females to move the veil. The most impact of veil in this study occurs with losing any degree of visual or hearing ability which can affect negatively on performance of neuropsychological tests. Coverage of both eyes and ears during assessment may cause weakly psychometric test performance, and failure to take this into account can result in a false impression of neuropsychological impairment. This was the main reason why most of the females refused to take participation in the current study. Despite this, Islamic Hijaab never becomes an impediment for the women's participation in any kind of medical assessment experiences but the over influencing traditional national culture still pressurises the Saudi Women to steer away from strangers. Similarly, another reason behind the lower female participation is related with the fact that the male

researcher conducted the present study while normally the female psychologists carry out neuropsychological assessment with female patients in Saudi Arabia.

The third reason for lower women participation in this study is the lower percentage of the female wards in Saudi Arabian hospitals. The personal experience within the Prince Sultan bin Abdulaziz Humanitarian City (SBAHC) can be examined to justify the lower outcomes. Currently, SBAHC has three stroke wards, two of which are dedicated to men and one to women. All these aforementioned factors can be deemed as probable reasons behind the lower percentage of female participants in the current study. On the other hand, in the smaller sample, it is possible that some key characteristics are overlooked that have the potential to change the results. The findings in the current study are nevertheless important because of the absence of any confounding effects in considering gender with age and with literacy.

Literacy (Literate *vs.* Illiterate):

Aside from age and gender, the present study also found that 'level of literacy' (categorised into literate vs. illiterate) determined the occurrence of post-stroke cognitive dysfunctions. The performance of the illiterate patients (28% of the sample) was significantly worse than that of the literate group (72% of the sample) in six cognitive domains: orientation/attention, memory, fluency, language, visuospatial ability, and visual neglect. This is consistent with the findings of Ostir, Raji, Ottenbacher, Markides, and Goodwin (2003) who found in a sample of Mexican American stroke patients that patients with MMSE scores of less than 21

were more likely to be less educated. Another investigation, by Madureira et al. (2001), confirmed that stroke patients with memory impairment were less educated than those without memory impairment. Literacy might be related to the memory domain because people with memory disorders are not able to learn and retain knowledge and information for a long period of time.

Time since stroke (≤ 6 *vs.* ≥ 7 months):

Another variable impacting upon the prevalence of cognitive-domain dysfunction in the Saudi stroke population was 'time elapsed since stroke' (≤ 6 vs. ≥ 7 months). The presence of impairments in orientation/attention, memory, fluency, language and executive functions were significantly greater among patients within 6 months or less of suffering a stroke compared to those who had suffered a stroke 7 months ago or longer. This finding suggests that the effectiveness of cognitive rehabilitation depends critically on 'time since stroke' only when patients have received treatment for a long period of time and, as a result of rehabilitation, their condition is improved. Above, it was mentioned that, in some cases, patients with longer stays in rehabilitation centres receive special cognitive training while those with shorter stays are neglected (Lincoln et al., 2012). Moreover, due to the lack of cognitive training within the first 6 months after stroke, the first 6 months after the stroke are highly significant for the prevalence of cognitive dysfunctions (Saxena et al., 2008).

Side of weakness (Right *vs.* Left):

A potential variable influencing the Saudi population of stroke patients is 'side of weakness'. The current study also showed that the prevalence of cognitive dysfunctions after stroke was higher depending on 'side of weakness'. Impaired cognitive domains were found in 35.3-60.8% of participants with right-side weakness while they were found in 22.4-49% of participants with left-side weakness. This finding corresponds with those of Påhlman, Sävborg, and Tarkowski (2012) who reported that patients with impaired cognitive and executive functions after stroke are at risk of developing physical impairment. According to authors, factors that appeared to predict low level of physical activity at the acute phase were impaired global cognition before stroke, visual neglect and impaired logical deductive ability, and impaired global cognition, executive function, and visual memory 1 year after stroke.

The present study found also that those with left-side weakness showed more visual neglect disorder than did those with right-side weakness. The findings showed that patients with left-side weaknesses suffered from egocentric and allocentric neglect disorders. A possible explanation is that the right hemisphere is an important brain area for both creative use of visual perception (Bowen et al., 1999). Thus, damage in the right hemisphere may lead to significant impairment of visual perception, and may disable the left side of the body as well. Consequently, patients with left-side weakness experience visual neglect as a result of lesion after stroke in the opposite area of the cerebrum.

7.2.5 Summary of the findings of post-stroke cognitive dysfunction in Saudi Arabia

The findings in Chapter 4 can be summarised that more than half of stroke patients in this sample from Saudi Arabia (52%) had overall cognitive dysfunction assessed using the Arabic ACE-R. The prevalence of cognitive dysfunctions pertaining to orientation/attention, memory, fluency, language, visuospatial ability, and overall cognitive dysfunction increased with the age (≥ 61 years), time since stroke (≤ 6 months) and illiteracy. The clinical evidence gathered in this study through assessment by the Arabic ACE-R, Apple Cancellation Test, and TMT (Parts A and B) confirmed the findings about other cohorts in this field. These three characteristics of the Saudi Arabian population were identified as significantly related with prevalence of the cognitive dysfunctions. A high frequency of dysfunction was reported in illiterate patients and in those patients within 6 months or less of suffering a stroke. Additionally, the older age subgroup was found to be most affected by executive dysfunctions. The results of the other cognitive domains indicated that older age-groups are associated with a higher prevalence of cognitive dysfunctions in the post-stroke period.

These findings may be relevant to clinical practitioners, medical researchers as well as patients. They suggest that focusing on age, ‘level of literacy’ and ‘time since stroke’ in the post-stroke period could help patients to deal with their cognitive dysfunctions and improve their quality of life. For example, cognitive impairments such as executive dysfunction have been found to be highly associated with age in the post-stroke period and therefore effective preventive

strategies and post-stroke surveillance can help older stroke-survivors to manage their daily lives.

The findings also present a multi-dimensional view by highlighting the role played by selected tools and the timing of measurements in bringing about variable results. Thus, it is important to take into account the specificity and sensitivity of the chosen instrument. For example, the Arabic ACE-R was found to be effective in assessing all cognitive dysfunctions. In comparison, MMSE used in the global studies did not report high effectiveness in assessing all the cognitive dysfunctions (a 50% prevalence rate for overall cognitive impairments on the MMSE and a 75% prevalence rate on the ACE-R, according to Morris et al. (2012)). It can be argued that the Apple Cancellation Scale was designed to detect the rate of visual neglect only. Likewise, the TMT tests facilitate the measurement of visual-motor skills and executive dysfunctions. The effectiveness of different tools varies with their internal psychometric properties. The specific use of different tools provides a standard base for the clinical studies. Lincoln et al. (2011) reported some barriers against using the MMSE for assessment before the initial screening test. Morris, Hacker, and Lincoln (2012) found that the ACE-R was highly effective and reliable in screening cognitive functions among the acute stroke patients.

The present findings in Chapter 4 have several strengths. It is the first study to investigate cognitive dysfunctions after stroke in Saudi Arabia. The lack of valid psychometric tools is a key reason behind this gap in the literature. Thus, the present findings can be used for establishing a standard related to the use of the

ACE-R, Apple Cancellation Test and TMT including their cut-off scores. These findings also showed that medical documentation, patient records and medical files can be used for screening patients with cognitive dysfunctions, with and without dementia. This may contribute to the representativeness of the data in different categories such as health control and previously-sick patients suffering from some sort of disability such as Mild Cognitive Impairment (MCI) or dementia of the Alzheimer's type (DAT). Another advantage of the present findings is its multi-dimensional nature in terms of the examination of the rate of cognitive dysfunctions through the 'lens' of six demographic subgroups. Distinguishing between literate and illiterate patients was especially helpful to the current research. Likewise, the study analyses a mixture of internal factors (age, gender, literacy, time since stroke, side of weakness) and external factors (treatment setting) that may contribute to the prevalence of cognitive dysfunctions after stroke.

Despite these strengths, five limitations of these findings may be identified. First, a small number of total stroke patients (n=100), used proportionately in different tests, were administered the neuropsychological tests. Generally, a sample size of 100 is regarded as small, considering the thousands of post-stroke patients suffering annually from stroke and the resulting cognitive and mood disorders. Despite the sample size, the potential for estimating population prevalence was vital in the present study. The chosen sample was helpful in estimating the prevalence of disease in a population at the specific point of time when the baseline assessment and follow-up assessments were conducted. The use of the small sample was effective in the current research because it was based on the

point prevalence i.e. single assessment of a fixed point in time. The sample size was not used for identifying the period prevalence that looks at the percentage prevalence of the population at any time within a stated period. Therefore, it can be stated that the sample chosen in the present study was representative of the population. The point sample of 100 for identifying point prevalence at baseline and follow-up assessments therefore did not lack precision. Additionally, literature review has confirmed that the prevalence of anxiety and depression disorders as well as cognitive dysfunctions have not been examined in the post stroke patients in Saudi Arabia, therefore there was no need for a large sample for making statistical inferences.

Aside from the neuropsychological assessment, a systematic review was also undertaken to resolve this issue. A second limitation is that this was not a population-based study because participants were recruited from hospitals and rehabilitation centres; it therefore omitted patients in communities. There is the possibility that a significant number of cases are not reported in Saudi hospitals which would affect the prevalence figures of the current study, making it higher than that reported due to identifying a relationship between certain socio-demographic characteristics and cognitive dysfunctions. These possible weaknesses may adversely affect the generalisation of the results to general clinical practice in Saudi Arabia. Thirdly, the present findings focused on the prevalence of cognitive dysfunctions at baseline assessment and did not include a follow-up assessment. Baseline results normally show a higher prevalence than follow-up because follow-up studies normally embody the effects of treatment, care

and interventions offered to the post-stroke patients in the hospitals and rehabilitation centres.

The main limitation of these findings was the use of only a brief measure to assess the severity of impairment in cognitive domains. The Arabic ACE-R gives no more than a brief screening of the cognitive consequences of a stroke, which leaves us with the problems of questionable reliability and validity. A more detailed assessment of post-stroke cognitive dysfunction in Saudi Arabia is necessary to provide more valid data about cognitive abilities than the present scanning task used. For example, the Arabic ACE-R does not contribute to the identification of patients with different types of attention deficit (e.g., selective and divided) or memory disorder (e.g., long term and working memory). As such, a neuropsychological battery is required to identify patients with subdivisions of cognitive dysfunction after stroke. To use neuropsychological batteries in future studies, it would be necessary to categorise the attention deficits and memory disorders into subcategories that are likely to raise the prevalence rate of impairments in cognitive domains in Saudi patients. Finally, the study aimed to examine only six demographic factors, while others factors, such as location of stroke, were not considered. Factors such as gender, age, literacy,' time since stroke', 'side of weakness' and settings have been considered in relation to cognitive dysfunctions in previous studies.

After discussing the comparative findings for prevalence of cognitive dysfunctions within Saudi Arabian stroke patients, the next section discusses the findings of Chapter Five, on the prevalence of post-stroke mood disorders in Saudi Arabia.

7.3 Discussion of findings of post-stroke mood disorders in Saudi Arabia

The following section addresses rate of post-stroke mood disorders (anxiety and depression) and factors found to be associated with mood disorders (anxiety and depression).

7.3.1 Frequency of post-stroke mood disorders

At the initial assessment, out of the total sample of 100 patients who took part in the study, anxiety and depression were identified in 36% and 44% of participants, respectively. This suggests that anxiety and depression are frequently found among stroke patients. It should be noted that mood disorders prevalence rate in Saudi Arabia was slightly higher than that found in past Western-based studies (Burton et al., 2013; Hackett et al., 2014). Hackett et al. (2014) in their review reported depression prevalence rates of 28-31% while Burton et al. (2013) in their systematic review reported anxiety prevalence rates of 20 - 25%. A possible reason for the difference between the Saudi and Western-based samples is educational level differences in that 19% of the Saudi population over 60 years old was identified as illiterate. Lack of awareness and knowledge about mood disorders might lead to severe mood disorders in post-stroke patients. Using a western sample, two studies (Merriman, Norman, & Barton, 2007; Sagen et al.,

2010) considered in the current study also found a significant association between 'level of literacy' and the moods of post-stroke patients.

According to a literature review in Saudi Arabia, only two studies – Hamad et al. (2011) and Abdul-Sattar and Godab (2013) – have researched depression in Saudi settings. The prevalence of depression in the present study was found to be inconsistent with that of past studies. In the present study, the prevalence of depression was higher than that found by Hamad et al. (2011), who identified a rate of 17% for depression prevalence in stroke survivors in Saudi Arabia. In contrast, the rate in the present study was lower than that reported by Abdul-Sattar and Godab (2013) who found that 63.3% of stroke patients in Saudi Arabia had depression symptoms. These inconsistences between Saudi studies might be due to three methodical factors: the sample size, the nature of the psychological assessment used, and the medical setting in which patients were studied. While Hamad et al. (2011) compared symptoms of depression using the Hamilton Depression Rating Scale (HDRS) in 60 patients admitted to the acute stroke unit, Abdul-Sattar and Godab (2013) evaluated 180 stroke patients using the Geriatric Depression Scale-15 (GDS-15) in a rehabilitation-based setting. The present study assessed depression disorder using the Hospital Anxiety and Depression Scale (HADS) among 100 stroke patients admitted to both hospital-based and rehabilitation-based settings. It should be noted that a higher depression rate was found among patients in the rehabilitation-based setting. Relatedly, Hamad et al. (2011) and Abdul-Sattar and Godab (2013) did not address demographic factors such as age, gender, level of literacy, 'time since stroke', treatment setting and

'side of weaknesses' in relation to depression. In contrast, the present study addressed these characteristics for understanding the frequency and severity of depression among Saudi patients.

7.3.2 A comparison of the findings post-stroke mood disorders in Saudi Arabia with those of Western-based studies

The findings in the current study showed that Saudi Arabia has higher rates of anxiety compared to Western countries. In their systematic review, Burton et al. (2013) reported a 20-25% prevalence rate for anxiety at any time since stroke. This range is similar to the figure determined in the recent study of D'Aniello et al. (2014) who reported rates of 20%, 23% and 24% for anxiety. However, results from the literature review confirmed that, in Western countries (specifically, English, Portuguese, Spanish and Italian studies), the prevalence of anxiety depends on the range of risk factors. Burvill et al. (1995) found that women are more inclined to show anxiety disorder than are men. They found the prevalence to be 5% in men and 19% in women when measured separately. The influence of gender on the rate of anxiety was not confirmed by the present Saudi Arabia-based study. Possible reasons behind this are the culture and environmental attributes of the Middle East in general and of Saudi Arabia in particular. Culturally, Islam teaches people that Allah created disease and they must accept and submit to Allah's will in all matters of life and death: "And no soul can die except by Allah's permission and at an appointed time" (Al-Imran: 145). The Prophet Muhammed said, "There is no disease that Allah has created, except that He also has created its treatment" (Sahih al-Bukhari 5678: Book 76, Hadith 1). Patients in Saudi Arabia

use fatalistic beliefs as a coping strategy to relieve anxiety symptoms after stroke. Likewise, stroke patients, whether male or female, often live with their large families even if they are divorced or widowed. Saudi people generally have a feeling of responsibility towards their parents and relatives especially after a serious disease like stroke. As a result, they often support the physical and psychological needs of the patient. This social support may alleviate some of the anxiety problems of men and women after stroke. Past studies have also provided enough evidence to show that lack of social support or social isolation is also one of the major causes behind the anxiety disorders in other countries of the world. Ng et al., (2015) in investigating the correlation between the depression, anxiety and quality of life for the Malaysian stroke patients highlighted that social support has positive impacts on anxiety and distress. It was reported that social support in the form of communication, physical or psychological assistance could help the individual in gaining better self-control during the difficulties times. Changes in social support can have direct consequences on the recovery level. Likewise, in another study published by World Health Organisation (WHO), European authorities have confirmed that experiments suggest significance of good social relations in reducing the psychological response to stress. People needs sociable environments, support from family and friends for dealing with the depression, drug use, anxiety, hostility and feelings of hopelessness, all of which are highly associated with the physical health issues such as stroke, cancer or other chronic and painful diseases (Wikinson & Marmot, 2003). In another global research, Åström, (1996) reported reliance in activities of daily living and concentrated social

network as highly connected with GAD at all follow-up periods apart from at the acute stage when investigated for the anxiety disorders.

In terms of the prevalence of depression and age, the present study found different results from those of European settings. For example, Sampson et al. (2003) found that the prevalence of depression was 63% for stroke patients in the UK with a mean age of 72.50 years. A similar rate of depression was reported in a Netherlands-based study: 50% for stroke patients with a mean age of 62.9 years (Bour et al., 2011), and in a Norway-based study: 54% for stroke patients with a mean age of 75 years old (Farner et al., 2010). These results corresponded with the findings of the present study: 48.9% of the Saudi population age ≥ 61 years had depression. Although lower than the rates found in western studies, these relatively high rates (approximately 50% for the total sample chosen) might be due to the lack of proper care offered by the KSA healthcare system, which means that there is little prevention of depression disorder in elderly patients before and after the onset of stroke (Robert & Zamzami, 2014).

A low level of literacy was found to be a highly significant factor in the Saudi population. Whereas previous studies have not specifically considered illiteracy as a risk factor for an increased prevalence of anxiety and depression after stroke, the present study recognised and considered illiteracy to be a risk factor for increased prevalence of these disorders among the Saudi population. Assessing the relationship between ‘level of literacy’ and experiencing depression, researchers in Western-based studies found that depression was more frequent in lower educated

compared to higher educated. Due to the lack of published evidence on the impact of illiteracy on the development of depression after stroke, it would be difficult to explain the role of illiteracy in depression in a clear way. A potential explanation is that illiterate patients in Saudi Arabia have difficulty accessing, understanding, and using basic healthcare information, which may serve as coping strategies for post-stroke depression disorder. This finding was confirmed by some past studies which showed that there is a significant relationship between depression and lower education levels (e.g., Nys et al., 2006; Paul et al., 2015).

Aside from 'level of literacy', 'time since stroke' was also found to have an impact on mood disorders (anxiety and depression). This relationship was significant in those who suffered a stroke 7 months ago or longer and among 70% of participants who were in the 3-months follow-up assessment. Rates of mood disorders in those who suffered a stroke 7 months ago or longer were found to be significantly lower than in those within 6 months or less of suffering a stroke. Likewise, some of participants who took part in the follow-up assessment showed significant improvement in mood disorders while some of the still-depressed patients did not complete the follow-up assessment. These may be reasons why the rates of mood disorders decreased to 18.6% at the 3-month follow-up. Multiple reasons might underpin this improvement, including family support, self-recovery, and pharmacological treatment for post-stroke mood disorders in Saudi Arabia. In this regard, Western-based studies such as Nys et al. (2006) found that antidepressant treatment reduced depression symptoms and functional problems after stroke. Similarly, Hackett and Pickles (2014) indicated the role of

pharmacotherapy in reducing the prevalence of depressive symptoms among stroke patients.

7.3.3 Factors found to be related to post-stroke mood disorders

This section addresses those factors that were found to be significantly associated with mood disorders. The results were gathered using the Arabic HADS as a measurement scale. The figures showed anxiety to be significantly more prevalent in the following sub-groups: aged 61 years group and over; illiterate; within 6 months or less of having a stroke. The Mann-Whitney results also confirmed that the scores of post-stroke anxiety are significantly higher for these sub-categories of participants. This can be further substantiated from the fact that 'level of literacy' and 'time since stroke' were found to be statistically significant factors in both the anxious and non-anxious groups.

For depression, the Mann-Whitney results also confirmed that the mean of scores of post-stroke depression is higher among the illiterate sub-group of patients. These results also highlighted that the mean of scores post-stroke depression is also higher in those who are within 6 months or less of suffering a stroke. This can be further substantiated from the fact that 'level of literacy' and 'time since stroke' were found to be statistically significant factors in both the depressive and non-depressive groups.

Age (≤ 60 *vs.* ≥ 61 years):

Although participants in the present study ranged in age from 36 to 85 years, anxiety and depression prevalence among those aged 61 or older was found to be

disproportionately high. In the Western-based studies too, age is recognised as the significant predictor of anxiety and depression after stroke (Spalletta et al. 2002; Lamb, Anderson, Saling, & Dewey 2013; Allan et al. 2013). In their review, Robert and Zamzami (2014) also indicated that older age is a risk factor for psychiatric disorders after stroke in the Saudi population

This age-effect might be attributable to the fact older people tend to suffer from greater levels of depression due to a greater likelihood of losing their physical capacities and social support (Ayerbe et al., 2011). Contributing to an increase in mood disorders within this age group are distance from family, a lack of understanding of procedures, and deteriorating mental capacities with the passage of time all (Hama et al., 2011). In light of the literature review (Chapter One), Saudi patients aged 60 and over can be said to be more susceptible to strokes and older patients have a greater likelihood of suffering from post-stroke mood disorders (Al-Eithan, Amin, & Robert, 2011). While the findings about age frequency in the present study differ from those reported by Al Rajeh et al. (1993), this can be attributed to differences in the sample sizes and evaluation methods. Al Rajeh et al. (1993) studied records of first-ever stroke patients admitted between December 1982 and June 1992 in a hospital that exclusively serves the Saudi Arabian National Guard community. The results are different from current study because they were based on mere review of clinical, radiological and laboratory records. In contrast, the current research is an empirical study with primary research participants included in the investigation. Moreover, the timeframe of the Al Rajeh et al. (1993) study contributes to the unreliability of the results; they report that, at

the time (1982-1993), stroke incidence was lower in Saudi Arabia compared to that of Western countries, which is not the case at present.

Moreover, the sample in the present study was hospital-based, and participants were recruited from either stroke units or rehabilitation centres. However, most stroke survivors are more likely to be living in the community. Primary investigation is capable of revealing the indirect and hidden aspects of strokes in the process of data collection from the responses of participants. This is not possible in a secondary-data-based study, whose findings can differ considerably, as argued above.

Literacy (Literate *vs.* Illiterate):

Besides age, illiteracy was found to be relevant factor in mood disorders in the present study. Further, the literature review drew attention to the significance of 'level of literacy' as a principal risk factor in the occurrence of mood disorders (Merriman, Norman, & Barton, 2007; Sagen et al., 2010), a finding confirmed by the results of the present study. In particular, it can be seen from the Mann-Whitney test for anxiety and depression that 'level of literacy' is one of the most crucial contributors to either increasing or decreasing the likelihood of post-stroke mood disorders. This study's findings highlight the role of illiteracy in the prevalence of such disorders. The Western-based studies reviewed did not confirm the role of 'illiteracy' among the stroke patients. The current study aims to bridge this gap by highlighting the importance of 'illiteracy' as a predictor of mood disorders. It is likely that those patients who have complete awareness of the

stroke, its causes, and post-stroke outcomes, may be capable of maintaining their quality of life after stroke treatment, and that they are able to control their emotions and work independently. The findings of this chapter highlight the significance of a lower level of literacy in depression in stroke survivors. These findings may be of value to the Ministry of Health in Saudi Arabia for enhancing the quality of psych-education offered to stroke survivors through special programmes and awareness campaigns, where such initiatives would need to be tailored towards those with low levels of literacy.

Similarly, baseline outcomes and follow-up results for anxiety disorder, as well as those for depression disorder, confirmed that the patient's level of literacy played a much more significant role during the follow-up period, compared to the initial baseline, in predicting the likelihood of mood disorders. This may be the case because, by the time of the follow-up results, almost all the participants have become aware of the post-stroke impact on mood disorders and ways to deal with them. Education helps participants to share more detailed and specific information about their mood disorders in follow-up assessments (Merriman et al., 2007).

Time since stroke (≤ 6 *vs.* ≥ 7 months):

The findings also revealed that 'length of time after stroke' was a strong predictor of anxiety and depression after stroke in the Saudi population. The findings of the present study highlighted that the more time that passes after a stroke (≥ 7 months after stroke), the lower the risk of mood disorders. The frequency of depression disorder revealed that the ≤ 6-months subgroup is more likely to have mood

disorders (39.6%). Period less than 6 months after a stroke were also found to be significant for predicting anxiety disorder prevalence (34.5%). The findings of the present study showed that the period of less than 6 months since the stroke is an important period in the severity of anxiety and depression after stroke. However, there is a possibility that sub-categorisation of months into 6 months or less and 7 months or more can result in larger differences in the rates of anxiety and depression. This is arguably due to the fact the more time that has elapsed since the stroke, the more attenuated its effects will be on the patient's physical and mental condition and, as such, the severity of post-stroke mood disorders will be reduced (Hamad et al., 2011). Burton et al. (2013) also confirmed that mood disorders seem to be associated with a greater impairment of physical and cognitive abilities during the acute phase of the post-stroke period. In addition, there is evidence that, with the passage of time, treatment and care also start having positive, visible effects on the patients in rehabilitation units or community centres, which are working to improve the quality of life of post-stroke survivors (Barker-Collo 2007; Farner et al., 2010).

7.3.3 Factors found not related to mood disorders

No evidence was found in the present study to confirm the effect of patient treatment-setting on the prevalence of mood disorders in the three selected hospital settings in Saudi Arabia. This finding was corresponded with (Altieri et al., 2012; D'Aniello et al., 2014; Hamad et al., 2011). The lack of differences between hospital settings in the present study might be due to the lack of differences in the type of facilities and treatment offered to such patients in different care settings.

There is also a possibility that, due to effective support in different settings, these settings cannot be deemed a risk factor for mood disorders and do not affect the prevalence rate of both anxiety and depression after stroke.

7.3.5 Summary of the findings of post-stroke mood disorders in Saudi Arabia

The findings revealed that both anxiety and depression were highly prevalent in Saudi post-stroke patients. A Saudi sample offered relatively different results for the prevalence of post-stroke mood disorders from those of the Western-based studies. The prevalence rate of depression disorder (44%) was reported to be higher than that of anxiety disorder (36%).

It can be concluded that the prevalence of mood disorders increased with the age, illiteracy, and 'time since stroke'. This study also confirmed that physical dependence after stroke rated by BI was a predictive factor in the severity of anxiety and depression. The findings found variations in results between the baseline results and the 3-months follow-up. Illiterate patients were found to be the most affected, in the age group of 61 years and over, and being within 6 months or less of having a stroke. It may be concluded that there is a high prevalence of anxiety and depression after stroke among the population of Saudi Arabia compared to Western-based studies.

The discussion has highlighted several strengths of the current findings. Whereas past studies have prioritised depression while neglecting anxiety disorder, a notable strength of the present findings is the focus on anxiety disorder prevalence. The current findings have provided an effective platform for analysing anxiety and

depression, both individually and in relation to each other, based on the six patient characteristics considered. By doing so, the findings added new knowledge to the current literature. Moreover, the location of the investigation in Saudi Arabia also contributes to the literature as no other recent, detailed, empirical study identifying the prevalence of anxiety and depression in the country exist.

These findings have considered illiteracy as an important predictor of mood disorders – a factor which has not been taken into account much by past researchers. With the help of these findings, government authorities and clinical practitioners may be motivated to improve the educational level of the population regarding stroke and post-stroke predictors and treatments. In addition, the psychological measurement tools in the current evaluation enables clinical researchers to assess how different evaluation methods can help in predicting different mood disorders by using different patient characteristics.

The present findings do however have some methodological limitations. Most notably, a number of important demographic factors were not considered. These include: the site of the stroke; the extent of cognitive dysfunctions; the degree of social support; the type/nature of psychiatric treatment; and the presence of physical and psychiatric diseases. Such characteristics can have an impact on the prevalence of anxiety and depression among stroke patients. Furthermore, for aphasic patients, or those suffering from severe cognitive impairments, appropriate psychological scales should be used instead of the HADS. The HADS has some limitations in terms of being a brief screening measure and possibly over-detecting

problems, relative to the clinical interview. Therefore, by using a range of psychological scales, the study attempted to corroborate the diagnosis.

Finally, the anxiety and depression prevalence levels observed in this study may have been biased by the particular exclusion criteria adopted. Consideration of specific demographic characteristics limits the investigation, for example by including ‘site of research’, whether hospitals or rehabilitation centres, the prevalence rate is restricted to the examination of the circumscribed setting only. Similarly, there is a possibility that prevalence rates differ according to ‘time since stroke’ as mentioned above; that is, whether the study examines patients within or after 3 months of having a stroke.

7.4 Discussion of the findings of the relationship between post-stroke cognitive dysfunctions and mood disorders in Saudi Arabia

The findings have confirmed that demographic variables and cognitive dysfunctions after stroke were associated with the severity of mood disorders. The quantitative findings revealed that the severity of anxiety post stroke was significantly associated with ‘level of literacy’ and ‘time since stroke’. They confirmed that the shorter the time since the stroke, the higher the probability of anxiety disorders, while the lower the level of literacy, the higher the probability of anxiety disorders. On the other hand, the age of the patient, their level of literacy and the time since the stroke were significantly correlated with the severity of post-stroke depression disorder.

It follows that the mood of the patient tends to become depressive if the person is aged 61 years and over, those within 6 months or less of suffering a stroke, and those who are illiterate. This conclusion partly supports the results of Nys et al. (2006) who found that in the long-term (6 to 10 months after stroke), depression symptoms were significantly associated with a lower level of literacy. Similarly, Paul, Das, Avij'it Hazra, Ghosal, and Ray (2015) found that older patients and a lower level of literacy were significantly associated with depressive disorder after stroke. Although these three demographic factors play a role in stroke-patients' depression, other studies have found no concrete relationship between post-stroke depression and demographic factors (i.e., age, 'time since stroke' and 'level of literacy'). Nys et al. (2005) found no significant association between the severity of depressive symptoms and demographic factors (age, literacy and gender). In contrast, Nys et al. (2006) found that post-stroke depression was predicted by being the female sex. A reason behind the differences between the findings of the current investigation and those of other studies like Nys et al. (2006) is sample size. The findings of the current study may also differ from those of others because it is based on a Saudi Arabian sample. The literature review showed that the Saudi Arabian population is mostly comprised of men and there is a high level of illiteracy. This is not the case in Western-based studies. In addition, the sample selected by Nys et al. (2006) might have a greater proportion of females.

Additionally, the overall results of the linear regression analysis further confirmed overall cognitive dysfunction, ACE-R-Memory, ACE-R-Fluency, ACE-R-Visuospatial ability and the Apple Cancellation Test (ACT) as significant cognitive

predictors in the severity of anxiety and depression disorders after stroke in Saudi stroke population. From the results, it is clear that the extent of the relationship also depends on the assessment test used. The effectiveness of the ACE-R and Apple Cancellation Test over the TMT-B showed that all the tests were capable of identifying the relationship between mood disorders and cognitive dysfunctions in the post-stroke period. However, it is noteworthy that some cognitive abilities were more related to mood in some tests than in others.

The regression analysis found a significant association between *mood disorders* (i.e., anxiety and depression) and *cognitive dysfunctions* (i.e., orientation/attention, memory, fluency, language, visuospatial ability, visual neglect and executive functions) after stroke. These relationships between mood disorders and cognitive domains are discussed further below. The predictability of anxiety and depression post stroke for the cognitive dysfunctions studied is also discussed. The discussion of the findings below is categorised into individual cognitive domains and examined in further detail below. In each section, the specific cognitive domain is discussed in the context of the associated mood disorders.

7.4.1 Orientation/attention deficit and mood disorders

To investigate the relationship between orientation/attention and mood disorders after stroke, the differences between patients with and without mood disorders in terms of orientation/attention deficit were examined. Furthermore, the regression analysis was used to identify associations between orientation/attention deficit and independent variables including anxiety and depression. The findings of this study

contribute to the literature by identifying clear dimensions for the subgroups of patients suffering from anxiety and depression disorders. The subgroups were: anxious, non-anxious, depressed, and non-depressed. Both types of analysis were necessary for assessing differences in the prevalence rates of cognitive dysfunctions in both groups, that is, patients suffering from mood disorders and patients not suffering from such disorders after stroke. The differences highlighted the extent to which mood disorders are related to the presence of orientation/attention deficits in the post-stroke patients. The findings showed that orientation/attention deficits were most prevalent in anxious and depressed patients. However, it cannot be assumed that all the patients suffering from orientation/attention deficits in the post-stroke period are also suffering from mood disorders. The difference in sample size between these two groups is likely to have impacted the significance level among the anxious and non-anxious and depressed and non-depressed patients. Thus, the findings of the current research confirm that orientation/attention deficits can be used for investigating their association with mood disorders in both groups, that is, patients with and without mood disorders.

Significantly lower scores were found for the ACE-R- Orientation/attention subscale scores in both anxious and depressed patients compared to non-anxious and non-depressed patients. This means that orientation/attention deficits are associated more strongly with anxiety and depression among the anxious and depressed groups than among the non-anxious and non-depressed groups. However, this cannot be confirmed from the collinearity statistics where VIF values confirmed that

there is no collinearity between these mood disorders and impairment in orientation/attention domain. This finding is inconsistent with the results of Barker-Collo (2007) who examined the relationship between attention deficit and both post-stroke anxiety and post-stroke depression, and found that attention difficulties were significantly related with both anxiety and depression symptoms 3 months after stroke. Similarly, it inconsistent with a study by Hosking, Marsh, and Friedman (2000) who found that higher depression scores on the Geriatric Depression Scale (GDS) significantly correlated with impairments in simple and complex attention after stroke.

Likewise, findings of the regression analysis also did not support the hypothesis that attention deficit is a predictor of mood disorders. The ACE-R-Orientation/attention subscale score in this study was a non-significant predictor of both anxiety and depression. The findings based on a Saudi sample in current study, also confirmed the findings of Bugarski et al. (2009) who found that attention deficit was not a significant predictor of depressive symptoms after stroke.

7.4.2 Memory disorders and mood disorders

The cognitive domain of memory was negatively correlated with anxiety and depression post stroke where significant differences were also found between anxious and non-anxious patients in the ACE-R-Memory subscale. This difference was also significant when depressed and non-depressed patients were compared in the ACE-R memory domain. It can be concluded from the negative relationship that the presence of anxiety and depression was associated with a decrease in

memory ability. It confirms that memory disorders are more prevalent within the subgroup of anxious and depressed patients, and that memory disorders have a greater likelihood of predicting the severity of mood disorders. The present study supports results from previous work by Chahal, Barker-Collo, and Feigin (2010) who found that depressive mood after stroke was significantly associated with impairment in visual memory. Similarly, Nys et al. (2005) investigated 126 patients and found that those with visual memory impairment in the first weeks after stroke demonstrated a high risk of depression disorder after 6 months.

In terms of post-stroke anxiety, Barker-Collo (2007) examined the relationship between memory and post-stroke anxiety 3 months after stroke. The results indicated that memory difficulties were significantly related with post-stroke anxiety. This significant relationship between mood disorders and memory impairment can be explained in that both emotional life and memory function are largely stored in the limbic system, therefore dysfunction in the memory may be followed by an anxious or depressive mood. As discussed in the literature review (Chapter 1), Snaphaan and Leeuw (2007) confirmed the increased prevalence of memory dysfunctions within 6 months after stroke (a 13% to 55% chance). Researchers have categorised memory disorders into short-term and long-term disorders. The long lasting impact of long-term memory disorders are probably associated with post-stroke mood disorders where patients are unable to recall, remember, comprehend, problems-solve and reason (Campos et al., 2010).

Although past studies have recognised age (< 50 years) as an important factor in predicting memory disorders, the current study excluded age due to its lack of collinearity in predicting cognitive domains. The new findings of the present study confirm the association between overall memory disorders (not merely visual memory) and mood disorders in the Saudi Arabian population. No previous Saudi study has attempted to investigate this. Moreover, the current study offers a new direction in terms of using the ACE-R to investigate the relationship between memory and mood disorders effectively, rather than any other scale. The current study also showed how concentrating on different aspects can help medical practitioners in treating simultaneously the cognitive dysfunctions as well as mood disorders of the post-stroke patients through preventive programmes and through training in the skills of concentration, memorising, writing, reading, comprehension, perceptual abilities and physical skills.

7.4.3 Language disorders and mood disorders

The neuropsychological assessment undertaken in this study further indicated that there were significant differences between anxious and non-anxious post stroke patients in terms of fluency and language disorders. Significant *t*-score differences in depressed and non-depressed groups confirmed that fluency and language disorders were more prevalent in depressed patients than in non-depressed patients. This finding corresponds with that of Chahal et al. (2010) who found that depression disorder was significantly associated with language disorder post stroke. Camoes-Barbosa et al. (2012) examined the relationship between aphasia and depression among 111 stroke patients and concluded that the presence of

aphasia showed a significant association with depression. From the examination of the results of the regression analysis of the present study, it was concluded that language disorders (i.e., language) were not significant predictor of mood disorders after stroke. The present results diverged from those of Bugarski et al. (2009) who found that poorer performance in the domain of language predicted more severe depression after stroke. In this study, the authors assessed the presence of depressive symptoms through the use of the self-reported Beck's Depression Inventory (BDI), whereas cognitive status was evaluated using a comprehensive neuropsychological testing battery measuring performance in different cognitive domains. Furthermore, executive function, language, immediate recall, delayed recall, attention, divergent reasoning, and visual-constructive performance were assessed in terms of cognitive domains. The inconsistency between the current and past findings is due to the different evaluation methods and different types of cognitive domains assessed, relative to the Saudi sample studied in the current research.

Another investigation, by Nys et al. (2006), also reported that patients with language disorder in the first few weeks after stroke had a high risk of showing depression disorder after 6 months. The inconsistent findings between the present study and the literature may be due to the use of different evaluation scales, such as ACE-R-Language subscale in the present study while other researchers have used a valid test or battery for the assessment of language disorders after stroke. The different specificity and sensitivity of the tests, along with the other

psychometric properties, influences their capacity to detect the disorders and dysfunctions effectively.

7.4.4 Visual perception disorders and mood disorders

Visual neglect and visuospatial disorder showed significant differences between anxious and non-anxious patients in the Apple Cancellation Test and ACE-R-Visuospatial subscale. Similar results were found when depressed and non-depressed patients were compared on the same subscales. From the results of the regression analysis, it was found that visual neglect significantly predicted the level of depressive symptoms after stroke. Although a relationship exists between both disorders, neither visual neglect nor visuospatial disorder was found to predict the severity of post-stroke anxiety. In contrast, the results showed that visual perception disorders predicted post-stroke depression in Saudi sample. These results are corroborated by Nys et al. (2006) and Nys et al. (2005) who provided evidence for the severity of depression in post-stroke patients with visual neglect. Nys et al. (2006) found that visual neglect predicted depression disorder 6 months after stroke. Another investigation by Nys et al. (2005) found that the effectiveness of the visual perception scale is high ($R^2 = 0.60$) in predicting post-stroke depression symptoms. However, there is a lack of research on identifying the relationship between visual neglect and post-stroke mood disorders. On the other hand, visual perception deficits and visual neglect resulting from stroke have not been recognised as a common or prevailing condition in the literature. Patients themselves are unable to have insight into the severity of their their visual perception problem. Although the literature revealed that the incidence of visual

neglect after stroke varies from 13 to 85% (Azouvi et al., 2002;Bowen, McKenna, & Tallis, 1999; Menon-Nair, Korner-Bitensky, Wood-Dauphinee, & Robertson, 2006); such a large variation is a limitation of studies examining the correlations between visual neglect and visuospatial disorder in predicting mood disorders. The current study has aimed to bridge this gap by limiting the variation through measurement of correlation between visual neglect and the severity of the mood disorders. It also narrows the focus for a better understanding of this relationship by categorising mood disorders into four different subgroups: anxious, non-anxious, depressed and non-depressed.

7.4.5 Executive dysfunctions and mood disorders

An analysis of the differences in means revealed that TMT-B is highly responsive for investigating anxious and depressed patients. However, the present study did not confirm the association between executive dysfunction and mood disorders, unlike Bour et al. (2011) who found that depressive symptoms after stroke were a significant predictor for executive dysfunctions.

The absence of significant relationship between executive dysfunctions and depression disorder in the current study can be explained through that the more time that passes, the smaller the likelihood of executive dysfunctions in the stroke sample. This receives support from a longitudinal investigation by Allan et al. (2013) who found that there was no significant relationship between the executive dysfunctions rated by CAMCOG and depression rated by the Geriatric Depression Scale at 1, 4 and 8 years after stroke.

Another reason behind the absence of the relationship the evaluation methods and neuropsychological test used in the current study. Only 29% of participants in this study took the TMT-B because it required a certain level of cognitive ability; participant are required to draws lines to connect the circles, which include both numbers and letters (A-L), in an ascending pattern with the added task of alternating between numbers and letters (i.e., 1-A-2-B-3-C, etc.). As mentioned above, the sample of the current study consisted of Saudi Arabian patients, who are mostly illiterate. Accordingly, approximately 71% of the participants in this study were excluded because they were either illiterate or unable to participate in the study due to physical impairment. Addition to this, the complexity and diversity of domain in the executive dysfunctions might make it difficult for the TMT-B to examine this disorder in Saudi stroke patients. The literature shows that executive dysfunctions usually work in connection with the other cognitive abilities like memory and language and, therefore insufficient neuropsychological tests such as TMT-B cannot be traced. Another reason behind the lack of evidence of relationship between impairment in executive functions and depression disorder was given in (Bour et al., 2010) who showed impact of time on reducing the severity of executive dysfunctions. Therefore, declining severity of the executive dysfunctions among the stroke patients might not lead to mood disorders. Therefore, we need to exercise caution in concluding that executive dysfunctions can predict mood disorders after stroke.

7.4.6 Summary of the findings of the relationship between post-stroke cognitive dysfunctions and mood disorders in Saudi Arabia

The findings of this neuropsychological study provide some evidence that cognitive dysfunctions are associated with mood disorders. An investigation of a Saudi sample revealed that the anxious group had a greater chance of showing dysfunctions in all cognitive domains considered in this study, compared to the non-anxious patients. Relatedly, those patients who were identified as depressed were more likely to have cognitive disorders in all domains, compared to the non-depressed patients. The regression analysis suggested that specific cognitive domains have an effect on the severity of stroke patient's mood status. Likewise, 'time ≤ 6 months since stroke' and 'illiteracy' were identified as significant predictors of mood disorders (anxiety and depression) after stroke. However, other variables such as 'age', 'gender', 'treatment setting' and 'side of weakness' were not found to predict the severity of post-stroke anxiety or post-stroke depression. The results indicated that the memory disorder was found to be an independent predictor of anxiety, whereas memory disorder and visual neglect was independent predictors of post-stroke depression.

The current findings were significant compared to those of other Saudi studies due to its focus on the predictability and strength of the relationship between cognitive domains and mood disorders, which has not previously been investigated. However, the methodological limitations of these findings should be addressed in future research. The neuropsychological assessment methods used in this investigation were brief screening measures that are commonly used; however,

there is the possibility that using other, multiple neuropsychological assessment methods would change the strength of the association between the variables in the results.

Because the current study investigated the Saudi context for the first time, future investigations can replicate it in an effort to substantiate the validity of the research findings for assessing the relationship between cognitive dysfunctions and mood disorders. Furthermore, since the current findings adds to the literature by highlighting the importance of illiteracy in predicting the relationship between cognitive dysfunctions and mood disorders, future studies could identify ways of increasing psych-education levels among post-stroke patients residing in different medical settings such as hospitals, clinics and rehabilitation centres.

Moreover, because the current investigation is based on three Saudi Arabian hospitals, this could lead to ceiling effects, that is, results may have been based on the only information that was available. The findings of this Saudi-based study could be used for assessing patient characteristics other than the six considered here to identify the effectiveness in predicting the occurrence of the cognitive dysfunctions or mood disorders post stroke. Furthermore, relationships between the internal causes (such as lesion location) and external causes (such as neuro-rehabilitation) of cognitive dysfunctions need to be identified for investigating their relationship with cognitive performance after stroke. These limitations should be considered in future studies to verify or refine the findings of present study.

7.5 Methodological issues

In different themes discussed in various chapters of the current study, different measures and scales were used to assess the individual prevalence rates of cognitive dysfunctions and mood disorders after stroke, as well as the relationship between the two. The selection of these different tools was based on the particular methodological framework used, which warrants further evaluation.

7.5.1 Methodologies used

Analysis of the Western-based studies revealed that most of the studies used a cross-sectional design. Therefore the current study has also adopted this method, aligned with the research purpose of this study. A cross-sectional measure was effective in assessing the relationship and severity of the cognitive dysfunctions and mood disorders at a single point in time. Apart from enabling a thorough observation of the cases, the use of a cross-sectional design also enabled the researcher to recruit percipients simultaneously in the three different Saudi hospitals: King Abdulaziz Medical City, King Fahad Medical City, and Sultan bin Abdulaziz Humanitarian City.

Case controls are generally considered a sound methodological application after a cross-sectional investigation. However, case controls were not used in the present study. There is a possibility that, as in Western-based studies, had the current study used case-control methodology, the outcomes would have been different. There is a possibility that results would have been similar in terms of pre-stroke and post-stroke patients in the Saudi Arabian population. The impact of

methodology cannot be underestimated in its effect on the association between cognitive dysfunctions and mood disorders.

Other strengths of a cross-sectional design were its relative cost-effectiveness and the relatively short time required to achieve the research objectives. It can be used to effectively evaluate a large sample size and identify associations between the characteristics of the stroke patients in Saudi Arabia. However, as a cross-sectional study is carried out at one time-point only, it is unable to indicate the sequence of events and therefore cannot be used to establish causality, and alternative explanations cannot be ruled out.

In selecting the specific cognitive dysfunctions and mood disorders to focus upon in the present study, the Western-based studies served as a useful guide. Cognitive dysfunctions identified in past studies include: apraxia, visuoperceptual disorder, visual agnosia, visuospatial disorder, body perception disorder, visual neglect, memory impairment, executive dysfunction, social and emotional perception disorder, attention impairments, and aphasia. In the case of mood disorder, most studies are limited to depression and anxiety. In the light of these common cognitive dysfunctions and mood disorders, the presence of general cognitive impairment was considered.

Included in this assessment was a consideration of patient characteristics, specifically: age, gender, level of literacy, ‘time since stroke’, ‘side of weaknesses’ and treatment setting. Both in-patient and outpatient recruitment was considered for identifying suitable participants for the study. Eligible patients were selected

with the support of ward staff and consultant neurologists. As in Western-based studies, the present research took into account methodological limitations. One limitation is that only six patient characteristics were examined, whereas a wider range of characteristics may be found in the literature, for example: ‘site of stroke’, the extent of cognitive dysfunctions, the degree of social support, the type/nature of psychiatric treatment, as well as the presence of physical and psychiatric diseases. Time and resource constraints in the present study meant that only a limited set of patient characteristics could be taken into account.

Having provided an existing literature of the general methodology adopted for the current study, the next section presents an examination of the psychological aspects of assessment.

7.5.2 Neuropsychological assessment issues

Both the current study (comprised of observation studies undertaken in different chapters) and the systematic review of past studies confirmed that a range of assessments have been used by clinical researchers investigating the neuropsychological aspects of stroke patients. Cognition and emotions are interlinked and somehow associated with the each other in stroke patients.

Measures for cognitive dysfunctions

For the assessment of cognitive dysfunctions among the Saudi population, the following neuropsychological tests were used: The Arabic Addenbrooke’s Cognitive Examination-Revised (ACE-R), The Trial Making Test (TMT), and the Apple Cancellation Test.

The Arabic ACE-R was chosen due to its suitability for the Saudi population. In addition, it considers all those domains which are not specifically targeted in the MMSE. The review of Saudi-based protocols revealed that most clinical practitioners have used the Arabic ACE-R to assess cognitive impairment ensuing from a degenerative neurological condition for both literate and illiterate participants. Salman (2013) has substantiated the use of this measure, and its specificity and sensitivity have been demonstrated. The reasons behind using the Arabic revised version of this cognitive tool were its accuracy in targeting those diagnostic aspects which were not targeted by the original ACE-R cognitive screening tool. The use of the language-based Arabic version of the ACE-R helped in assessing the exact cut-off points for this measuring tool. It mainly facilitates the assessment of orientation/attention, memory, fluency, language and visuospatial ability. Another advantage of using the Arabic ACE-R in the present study was its independence from patients' characteristics. Mathuranath et al. (2000) reported that, in using the ACE-R, age, gender and level of literacy have no influence on the study's predictive outcome, compared to other screening measures such as the MMSE. Further motivation for using this tool was that the internal reliability of the measure was found to be above 0.90 points in past studies.

The second measure used for the assessment of cognitive functions in the present study was the Apple Cancellation Test. The test was a measure of different forms of neglect, associated with visuospatial deficits. Western-based studies also used similar measures like star collection (Farner, 2010). The measure was chosen for its effectiveness in identifying different forms of neglect (Chechlacz et al., 2012).

However, one of the problems of using the Apple Cancellation Test is the fact that 16% of current sample did not complete it. Incomplete assessments are likely to affect the association found between cognitive disorders and mood disorders.

Likewise, the third assessment measure, the Trail Making Test, was chosen after confirming its effectiveness in targeting visual-motor skills and executive functions. Bugarski et al. (2009) and Pohjasvaara et al. (2002) have used the TMT test effectively with stroke patients. The current study used the Arabic version of the TMT test. After confirming its efficacy in past studies, the measure was used for examining how visual-motor skills and executive functioning are affected among the post-stroke Saudi population. The measure highlighted the errors simultaneously when these errors occurred. Similar to the Apple Cancellation Scale, the TMT test has the same problem, that is, 23% and 71% of participants did not complete the TMT-A and TMT-B, respectively. Incomplete results are likely to affect the strength of the association found.

Measures for mood disorders

For mood disorders, the Hospital Anxiety and Depression Scale (HADS) was selected. Motivating the use of this tool was its effectiveness in targeting both anxiety and depression at the two points of time after stroke. The Arabic version of this was used due to its sensitivity and specificity scores as well as validated cut-off points (El-Rufaie & Absood, 1995; Malasi, Mirze & EI-Islam, 1991). The literature recommends the use of this tool in different settings all across the globe. While two UK studies have used the HADS (Ayerbe et al., 2011; Sampson et al., 2003), this

tool has not previously been used in the Saudi region to examine the mood disorders after stroke.

Despite the HADS being a useful screening measure for detecting anxiety and depression disorders after stroke, it also has some limitations. The literature provides a large range of cut-off scores for distinguishing between cases and non-cases. The significant role played by 'different cut-off scores' was apparent from the differences in the frequency of anxiety and depression in previous studies that used the HADS to examine these mood disorders. Another limitation was given by Lincoln et al. (2012) who showed the impact of excluding the physical indicators of psychological distress on reducing the severity of mood disorders in stroke patients. According to these authors, some items in the HADS can result in errors, when mood responses arise as a direct result of the physical or cognitive problems rather than reflecting a low mood. For instance, items such as *'I can enjoy a good book or radio or TV programme*' may reflect language disorder, while *'I feel as if I am slowed down'* may reflect cognitive disorder rather than depression. Based on these limitations, it is recommended that separate anxiety and depression scales be used (Lincoln et al., 2012).

A significant challenge of the present study is the inclusion of illiterate Saudi stroke patients in the sample, who acted as a significant barrier for collecting data about anxiety and depression using the HADS. The HADS is self-administered with instructions on the printed form. Participants were asked to choose one response from the four given for each item. Due to the lack of reading skills, the researcher

read all items to the illiterate patients and asked them to choose the appropriate response. This can carry significant bias in that illiterate patients may interpret the items differently from literate patients, due to their culture, which may result in inaccurate results. It can be assumed that illiterate patients taking this test distort their answers due to lacking knowledge about mood disorders or having damage in those areas of the brain related to hearing or speaking. Therefore, using alternative measures can be more useful for exploring anxiety and depression disorders after stroke in those unable to complete the HADS due to lacking reading skills or having communication problems. Measures such as the Stroke Aphasic Depression Questionnaire (SADQ) (Sutcliffe & Lincoln, 1998) have been developed to examine depression disorder in patients with aphasia and to allow people with language problems to be included in research (Thomas & Lincoln, 2008). The advantage of using the SADQ with illiterate people is that the observational scale is based on behaviours and includes visual analogue scales in which items are presented non-verbally.

Similarly, an advantage of using structured and semi-structured interviews to assess the prevalence of mood disorders among illiterate patients is that they do not need to a specific reading and writing skills, thereby contributing to the consistency of estimations. However, some of the interview schedules may need to be validated to assess mood disorders in stroke patients in the KSA.

Measures for activities of daily living

The Barthel Index (BI) to measure performance in activities of daily living (ADL) was selected due to its effectiveness in measuring the level of dependence in personal day-to-day activities. Although no Saudi study has specifically adopted the BI, the general literature has confirmed its usefulness in targeting routine life activities after stroke such as mobility, bathing, walking, hygiene, feeding, toileting, personal grooming, negotiating stairs, and bladder and bowel control. These aspects are specifically designed to consider rehabilitation patients with stroke and other neuromuscular or musculoskeletal disorders. The BI was found to be feasible for the current study for determining the effective of stroke on the functional daily living. However, this finding cannot be confirmed in Saudi Arabia due to the assessment of functional daily living after stroke in Saudi Arabia still lagging behind that of developed countries. In other words, there is a lack of appropriate adaptation and modification of the scoring guidelines for a standardised assessment using the BI. To discuss this issue, most medical centres in Saudi Arabia still use the English version of the BI, despite the fact that it ignores routine movements among Saudi people. For example, Muslim prayer is a physical and mental act of worship that is observed five times a day at prescribed times. In this ritual, the worshiper performs different body movements such as standing and raising hands and being prostrate on the ground. For this reason, it is necessary to ascertain whether the patient is capable of performing the prayer tasks after stroke. It was also observed during this study that stroke survivors who lose the ability to perform worship are likely to get mood disorders more frequently than those who

are able to perform their daily prayers. Therefore, this study suggests that using only the English version of the BI is not adequate in Saudi Arabia. An Arabic version of the BI needs be used, with its measurement properties assessed to ensure it is valid and reliable for use in clinical practice in Saudi Arabia.

On other hand, the complexity and diversity of the functional activities might make it difficult for the BI to examine this disorder in Saudi stroke patients. Daily functional activities usually work in conjunction with other cognitive abilities like memory and language, therefore scales such as the BI are insufficient for measuring daily functional activities compared with other measurements such as the Functional Independence Measure (FIM) Instrument which is designed for measuring disability in daily motor skills as well as communication and cognitive functions. Furthermore, the effectiveness of the BI is limited to the assessment of disability after acute stroke rehabilitation, in clinical trials and in following rehabilitation programmes, while the Nottingham Extended ADL Scale is superior to the BI in the community-based population (Yohannes et al., 1998). This is because the Nottingham Extended ADL Scale was developed to provide a brief measure of four daily activities: mobility, kitchen, domestic and leisure.

Have discussed the effectiveness of the chosen measures in terms of specificity and sensitivity, the next section discusses the sample size and recruitment process deployed in the present research.

7.6 Sample size and recruitment issues

As for other aspects of methodology in the present study, the choice of sample size and selection of recruitment methods was undertaken after reviewing the general literature and examining those methods used in Western-based studies.

The majority of past studies have used large sample sizes: Downhill and Robinson (1994) used a sample size of 309 for measuring cognitive impairment and depression; Madureira et al. (2000) used 237 for measuring the association between dementia and cognitive impairment; Saxena et al. (2008) used 200 for assessing depression with cognitive impairment; and Ayerbe et al. (2011) used 3,689 for assessing depression predictors five years after stroke. Examination of the sample sizes in past studies also revealed some smaller sample sizes: Nys, Zandvoort, Kort, Jansen, Kappelle, and Haan, (2005) used a sample size of 26, Zerfass et al. (1992) used 30 patients. This diversity of sample sizes in Western studies may be attributable to differences in the resources available to the researchers, including the funds available and policy for funding in their respective countries. The year in which the studies took place may also be important in highlighting dissimilarities in the socio-demographic characteristics of the patients. Ayerbe et al. (2011) might have used UK as research location, which has different socio-demographic characteristics compared to the Netherlands, used as a research location by Nys, Zandvoort, Kort, Jansen, Kappelle, and Haan (2005). It follows that the results of studies based on a small sample can be generalised to other small populations while those of studies based on large samples can be generalised to larger countries. Conversely, for assessing a large territory, a large

sample is required. A limitation of the current study is its sample size which affects the power calculation. This is because including only hospitals and rehabilitation units meant that other post-stroke patients, such as those residing in Saudi communities, are omitted from the sample.

In the present study, it was important to determine a sufficient sample size for assessing the prevalence of cognitive dysfunctions and mood disorders, and the relationship between them, after stroke in Saudi Arabia. A sample size of 100 was determined to be feasible for studying Saudi stroke patients because there are only four established stroke units in medical centres in Riyadh, the capital city of Saudi Arabia. On average, 700 stroke patients are admitted to these centres every year. To be representative, the sample would need to be more than 10% of first-ever stroke patients in Saudi Arabia; thus a sample size of 100 was used.

7.7 Strength and weakness of this study

The purpose of the prospective hospital-based study was to assess the extent of the relationship between different cognitive domains and two mood disorders (anxiety and depression). The comparison with Western-based studies helped to identify a research gap in the existing Saudi studies. Prior to the current study, no Saudi study had empirically investigated the relationship between cognitive dysfunctions and mood deficits in stroke patients as well as systematically reviewed simultaneously and cross-validated both the findings to reach sufficient conclusion. The cross-referencing further validated the research findings of the current study because the 17 international studies reviewed focused on multiple

regions in the form of a systematic review. The countries included: the US, the UK, Canada, Italy, Finland, China, Portugal, the Netherlands, New Zealand, Serbia, Singapore, South Korea, and Norway. The inclusion of European and Asian countries in the systematic review helped to minimise any biased findings.

The review of international studies enabled a broader comparative perspective of methodological issues in stroke studies. This review facilitated the use of a strong methodological framework and a strong base for validating the research findings. The selection of clinical measurement scales, statistical techniques, methods, recruitment process, data collection method and data analysis methods also contributed to the analysis, both individually and collectively, of the rate of prevalence of cognitive domains and mood disorders (anxiety and depression). The measuring instruments used in the current study were interlinked because of their ability to investigate the relationship between mood disorders and cognitive dysfunctions in more than one domain. Therefore, effective for obtaining accurate results, due to their consistency and compatibility with each other.

The present study focused on those problems faced by the post-stroke survivors in Saudi Arabia. Most patients after stroke are unaware of the association between cognitive status and mood disorders affecting their mood and ultimately their quality of life. An implication of this study is that it points to the need for an increased understanding of stroke and psycho-education among the stroke population. The study revealed a multitude of factors (e.g., age, ‘level of literacy’ and ‘time since stroke’) whose relationship with post-stroke mood disorders and

post-stroke cognitive dysfunctions was previously unknown or understood only to a limited extent. The findings lead to recommendations for improving the neuropsychological assessment of post-stroke patients in Saudi Arabia, discussed below in Section 7.9.

In addition, the study's context was unique in that Saudi Arabia has a relatively high rate of illiteracy, and the study identified illiteracy as a key risk factor in the relationship between cognitive dysfunction and mood disorders in the Saudi stroke population. It is possible that illiterate patients lack information about the symptoms and outcomes of stroke and that this lack of knowledge exacerbates mood disorders. Moreover, they lack coping strategies for mood disorders after stroke. This is the reason why illiteracy was recognised to be a vital factor in predicting the relationship between the post-stroke cognitive dysfunctions and anxiety and depression.

The time period of 'six months after stroke' showed significant differences for assessing the prevalence of cognitive dysfunctions and mood disorders. This may be because patients need to gain some information and knowledge about the stroke and treatment for its neuropsychological consequences. It is therefore urgent that the Saudi authorities make efforts towards designing strategies and frameworks for raising awareness and improving treatment of neuropsychological disorders within the first six months post stroke.

Methodological strengths of the present study include a relatively large sample size (n=100). The selection of stroke patients from three Saudi medical centres further

meant that each eligible participant was given a chance to take part in this study. Moreover, the size of the sample had enough statistical power to determine and assess the accuracy of responses gathered from the sample.

However, a weakness of the study is that the sample size is small in relation to the questions investigated in the study. In other words, the relatively broad focus of this study required a larger sample size. This was primarily due to the time constraints of the study. An implication is that it may not be possible to generalise the research findings to the entire country; their efficacy may be limited to the selected settings only, that is, the three Saudi hospitals chosen.

Apart from sample size, recruitment methods were critical for obtaining accurate research results. Included in this study were only those patients who had been diagnosed by neurologists as having ischemic or haemorrhagic stroke according to either CT scans or MRI results. Prior to admitting these participants, it was confirmed that they had been treated for at least one month following their first-ever stroke, either in out-patient clinics or in stroke units based at one of three medical centres in Riyadh. This recruitment method was selected so as to retain focus on ischemic and haemorrhagic stroke patients, since the literature has already confirmed these as the most common type of stroke in Saudi Arabia: about 300 stroke patients are admitted annually to the King Abdul-Aziz Medical City's National Guard stroke programme, of which 85% of cases of ischemic or haemorrhagic stroke. However, it is notable that CT scans are also not accurate in detecting all strokes and therefore there is the possibility that some very mild

strokes may not have been included. As a result, some proportion of post-stroke patients in the selected settings may not have been included in the current study.

Having confirmed the presence of stroke in the potential participants, the recruitment process moved towards the recruitment of outpatients and in-patients, after obtaining informed consent from the research participants. The clinical staff verified that the clinical patients were ready to take part in the overall observational study based on the study criteria stipulated at the beginning of the research. The exclusion and inclusion criteria of the present study were moreover informed by those in past studies. Only those patients who were assessed to be conscious, oriented and sufficiently able to comprehend and communicate informed consent were included. It also needed to be established that the patients understood the Arabic versions of the neuropsychological and mood measures undertaken. Blind and deaf patients were excluded to maintain the credibility of the research findings. As in past studies, a pre-designed recruitment protocol was used for the current investigation. Involving different individuals and multiple-level checks, the recruitment procedure adopted helped in filtering the patients according to the inclusion criteria. However, there is a possibility that some of the eligible participants were omitted during the in-patient or outpatient recruitment. The selection in the current study as well as the assessment methods may have led to exclusion of those with severe aphasia. Additionally, these findings might not be representative of all stroke patients in Saudi Arabia.

The timing of assessment was also significant in the current study. Prior to selecting a feasible period for the assessment, the time periods used in Western-based studies were assessed. Time-points for assessing first-ever stroke patients included: 12 months (Robinson & Price, 1982), 2 weeks, and 3, 6, 12, 24 months (Parikh et al., 1987), 4 months (Eastwood et al., 1989), 3, 6, 12, 24 months (Downhill Jr& Robinson 1984), and 9 months (Chatterjee et al., 2010). Ayerbe et al. (2011) selected a longer time interval for the assessment of the relationship between cognitive dysfunctions and mood disorders; their time interval was spread over 1, 3, 6, 12, and more than 12 months after stroke. The reason behind selection of more than one time interval in most Western-based studies is the finding that the outcomes of baseline assessments tend to differ from those at follow-up assessment. Generally at follow-up assessments, improvements in the condition of post-stroke patients are observed, as the patients have generally undergone treatment. Time intervals were also critical in the present study for measuring mood disorders. The initial assessment was taken to be the baseline assessment while the follow-up assessment was conducted three months later. There is a possibility that follow-up assessments undertaken in the longer term may bring different results. The findings gathered for the follow-up assessment in the current study are therefore limited to a single time point only, that is, 3 months.

The strength of choosing two different time-points (the baseline and 3 months) for the assessment of PSA and PSD can be observed from the effective outcomes of present study. Not only did follow-up study clarify the rates of mood disorders, it also confirmed the effectiveness of choosing time-point of three months after

stroke. The most useful time-points have been found to be within six months after stroke with follow-up assessment within three months. The current study has selected both the intervals. A follow-up assessment at three months only is a vital limitation of this study as there is the possibility that important changes that occur at 12 months after stroke were missed.

Concerning statistical techniques, this study used the Mann-Whitney test for post-hoc analysis for identifying whether the distribution are significant or not for the different groups and subgroups is based on the obtained *Z*-value and the critical *Z*-value. If the absolute value of the obtained *Z*-value is less than the critical value, then the value of *p* is less than the value of *alpha = 0.05*, and the result is said to be significant. Regression analysis used for assessing the relationship between different post-stroke mood disorders and cognitive dysfunctions. Descriptive statistics have been used to measure the variation between the samples.

The latter was used for assessing the differences in percentiles (25^{th}, 50^{th} and 75^{th} percentiles). This test was found to be more competent than the t-test for non-normal distributions, such as a combination of normal distributions. The statistical measure was also found to be as effective as the t-test on normal distributions used in quantitative studies. The Mann-Whitney test was used for assessing the influence of participant characteristics on the cognitive domains and mood disorders. It was also used to compare HADS scores between the different subgroups. Its significance for assessing differences between sub-groups for all

the domains of dysfunction, based on median, percentile range, *z*-value and *p*-value, cannot be underestimated.

Another limitation of the study was the use of the Mann-Whitney test because of the inclusion of the ordinal measurements and non-normal distributions, whereas t-tests are more powerful. However, due to the distribution design chosen in current study, the Mann Whitney test was used.

Regression coefficients (beta) and collinearity statistics for the multiple regression models for HADS-Anxiety scores and HADS-Depression scores were calculated to cross-check the results of the correlations with the regression. The chosen linear regression analysis was undertaken to determine whether demographic characteristics and their dependency predicted the occurrence of mood disorders, whether post-stroke anxiety or post-stroke depression. The dependent variables were mood disorders, while independent variables were patient characteristics (age, gender, 'level of literacy', 'time since stroke', 'side of weakness', and treatment setting).

Some of the Western-based studies also used regression analysis in their baseline and follow-up assessments for comparison of cognitive dysfunctions and mood disorders. For example, Zerfass (1992), Sampson (2003) and Bugarski, (2009) used a regression model for their baseline assessment. Examples of follow-up assessment are as follows: Rasquin (2005) used regression models for comparing cognitive dysfunction and depression after 1, 6, 12 and 24 months of stroke; Saxena (2008) used regression models for examining cognitive dysfunction and

depression at 1 and 6 months after stroke; Ayerbe (2011) used the same statistical technique for the assessment of cognitive dysfunction and depression at 3, 12, 36 and 60 months after stroke.

The most common statistical analysis used in this study (in almost every chapter) was frequency analysis. This is a descriptive statistical approach which can show the occurrence of cognitive dysfunctions and mood disorders in the post-stroke period. Frequency analysis also enabled the examination of the impact of patient characteristics on particular dysfunctions and disorders. With the help of the well-constructed frequency analysis, it was possible to understand the structure of the relationships between different variables and the sub-categories among them. A final reason for using a frequency distribution in the present study was its efficacy for represented frequencies in tabular or graphic form. As in many other studies, frequency analysis was used in the present study in conjunction with the other prominent statistical techniques.

All the four statistical techniques – the Mann-Whitney Test, Regression Analysis and Frequency Analysis – were found to be effective for quantifying the results gathered from the neuropsychological and mood-disorder assessment scales. A limitation of the chosen statistical techniques is that they emphasised only the most prominent results, based on the recognised quantitative figures. They were unable to provide an in-depth examination of the issues. It is recommended that for a more powerful analytic method for assessing the strength of association, more statistical techniques should be used.

Have reflected on the statistical techniques used in this study, the next section highlights the factors that were not included in this study.

7.8 Factors not included in the study

As mentioned above, six patient characteristics were included in this study, while several factors were not included. It is possible that, had these factors been included, the results and findings may have been different from the ones as observed in the current research. Some of the vital factors discussed in the present study are identified below.

7.8.1 Lesion of stroke in the brain

Localisation of the lesion – such as whether the stroke is on the right or left side of the brain – is a significant determinant of the type of cognitive dysfunction that develops. These lesions are also clinically recognised to be a significant factor associated with the development of mood disorders among patients. However, it is important to note that the present study was not concerned with the physical causes behind the cognitive dysfunctions or mood disorders. Rather, the focus of present study was on the patient characteristics, which are not physical but helped in linking the prevalence rates, dependency and predictability of these cognitive and mood disorders after stroke within the Saudi population.

7.8.2 Social support

Another factor that was not included in the current study was the level of social support that post-stroke patients receive from family, relatives and friends. Those patients who receive such support are less likely to develop mood disorders,

despite having problems within one or more cognitive domains. The inclusion of the variable ‘social support’ might have led to different results within the present study, Past studies (Gottlieb et al., 2001; Tsouna-Hadjis et al., 2000) have confirmed that increased social support for stroke survivors can expedite recovery and enable more widespread recovery of functional status after stroke. Conversely, socially isolated patients are at a greater risk of poor outcomes (Scott et al., 2012), which can result in a deteriorating mood status due the poor functional and cognitive recovery. The main reason was that the researcher could not assess any more variables as he did not have time to assess all aspects. In addition, the measures available are not necessarily psychometrically robust and may not have been validated on Saudi patients. It has been observed that, despite strong family support, some post-stroke patients still fail to recover their functional and mood status and suffer intense depression and anxiety after stroke. Similarly, some studies have found that social support is highly associated with post-stroke educational and counselling interventions, strengthening patients’ social networks and supportive relationships. The complexity surrounding the effectiveness of social support in post-stroke survivors restricts its usage in the present research.

7.8.3 Aphasia

Another factor not considered in the current study is aphasia, an impairment of language, caused by the stroke that affects the production or comprehension of speech and the ability to read or write. The measurement scales used for testing neuropsychological status and the mood status of the patients require verbal communication abilities to provide the response. Because aphasia acts as a barrier

when verbal tests are used, any patients showing the condition were excluded from the study. Had aphasia been used as a variable in the present study, measurement scales that are not based on verbal reasoning would need be used to accommodate patients with mild or moderate aphasia. There is a possibility that in selecting aphasia for measuring the relationship between the cognitive dysfunctions and mood disorders, their association would be intensified.

The strength of not including the above-mentioned factors in the present study is that the research remains focused and aligned with the research objectives. Their exclusion was necessary for the timely and successful accomplishment of the overall research aim and the different research objectives specified in each chapter. Their exclusion also helped to eliminate imprecise and vague predictions based on uncertain factors. In considering only six patient characteristics, the reliability of the research was maximised. In addition, these six patients characteristic were verified through examination of the Western-based studies.

In contrast, it may be argued that the exclusion of too many relevant factors from the inclusion criteria is a significant weakness of the study as it restricted the potential sample population, leading to problematic interpretations of the findings. In sum, while the exclusion of factors helps in filtering the study so as to achieve its key aim and objectives simultaneously, this exclusion can adversely affect the quality of the research and validity of the research outcomes.

Apart from these factors, other factors that were excluded by the current study included: severe dementia, quality of the life, the length of stay in the hospital, level

of consciousness, and consideration of other types of stroke (e.g., subarachnoid haemorrhage).

Having considered the strengths and limitations of the study, the following section addresses clinical implications and recommendations for future research.

7.9 Clinical implications and recommendations for future research

In this section, clinical implications and recommendations for future research are considered. The confirmation in this study of relationship between the post-stroke anxiety and post-stroke depression with the cognitive domains gives rise to several clinical implications for dealing with the post-stroke problems in Saudi Arabia. Although the findings of this study show the dependency of mood disorders on the loss of a cognitive function, the association is still correlational and cannot be confirmed as causal. The findings of current study suggest that the regulatory and clinical staff should work collaboratively with physiotherapists, psychiatrists and psychologists in order to design effective awareness programmes and rehabilitation units. A collaborative design would facilitate the targeting of each physical and mental ability of the ischemic or haemorrhagic stroke patients.

Furthermore, it can be argued that the ACE-R, Apples Cancellation Test and Trail Making Test (TMT) should be used routinely as screening measures in Saudi settings as part of the neuropsychological assessments and interventions designed for post-stroke patients. The HADS should also be used practically for detecting mood anxiety and depression through clinical interviews with the stroke patients. Additionally, like the Arabic version of the ACE-R and TMT, other

neuropsychological scales also need to be translated into Arabic for better assessment as well as to increase awareness of neuropsychological assessment among the Saudi professionals and patients. Such tests could include the Apple Cancellation Test.

Despite its limitations, Saudi professionals have tended to use the MMSE, which is the most commonly used screening measure for stroke even though it was developed to detect dementia only and not cognitive impairment after stroke. Therefore, their findings cannot be generalised to the broader context. There are other tests which were developed to detect post-stroke cognitive impairment, such as the Oxford Cognitive Screen, which need to be translated into Arabic and validated for a Saudi sample, before they can be usefully used.

The lack of clinical research, mainly cross-sectional and case control studies, in Saudi Arabia further underscores the contribution of the present study. A similar type of study is needed to substantiate the findings of the present research and to control the increasing prevalence rates of stroke, cognitive dysfunctions and mood disorders before and after stroke incidences. The present research underscores the importance of cross-sectional and observational studies for understanding the deteriorating neuropsychological conditions among Saudi stroke patients. Clinical authorities can use the findings and conclusions of the present study to justify to the Saudi authorities their need for regulatory support.

Additionally, the findings of the present study suggest the following set of recommendations for future research. Future studies should concentrate on the

individual use of multiple measurement scales as used in global studies. Because stroke patients are likely to be medically, physically and psychologically unstable, future researchers should use different cognitive and mood scales to assess their impact.

Furthermore, future studies should also consider the set of factors that were not included in the present study due to its limited focus. Factors such as lesion of stroke, social support and aphasia can be considered in future studies in order to identify the extent of their influence on the association between the post-stroke cognitive dysfunctions and mood disorders. Much effort is yet required to fully investigate the prevalence rate of post-stroke anxiety and depression among the Saudi Arabian population. It is also worth noting that the current study has assessed the relationship between cognitive dysfunction and mood disorders, but it has still not been established which one ‘causes’ the other. Therefore, a strong recommendation of current study is to investigate the effect of cognitive rehabilitation on mood, and to investigate the effect of treating mood disorders on cognition.

The examination of past studies concluded that stroke patients residing in different settings are likely to have different outcomes. To ensure adequate results, it is recommended that various types of settings be taken into account, including hospitals, rehabilitation settings, community centres and other informal care units in Saudi Arabia. While informal centres and care units can help in obtaining more informed findings in comparison to the formal hospitals and rehabilitation centres, it

is suggested that, in future, a mix of settings could help to maximise the validity of the findings.

7.10 Conclusion

The three key research objectives of this study were achieved. The first research objective was to investigate whether a statistically significant relationship exists between the cognitive dysfunctions and mood disorders in stroke patients. A statistically relationship was found for most of the cognitive domains investigated and the mood disorders. The findings suggested that the impact of cognitive dysfunctions on the mood disorders could only be identified as correlational and not causal. We can therefore accept the notion that post-stroke survivors who are suffering from the cognitive dysfunctions are likely to suffer from the mood disorders too. The findings of the present study confirm those of past studies (Western-based studies including some Asian studies) and indicate that there is a relationship between the cognitive dysfunctions and mood disorders among the ischemic or haemorrhagic stroke patients in Saudi Arabia.

The second research objective was to examine whether there are significant differences between stroke patients with and without mood disorders in terms of their cognitive functions. The results of current study confirm visible differences among the anxious, non-anxious, and depressed and non-depressed patients in Saudi Arabia. Further, the different dysfunctions within the cognitive domains are evident among patients without disorders.

Finally, the third research objective was to identify whether the severity of mood disorders can be predicted by assessing cognitive functions. It was found that cognitive dysfunctions were able to predict the severity of the mood disorders among Saudi stroke patients.

Analysis of the relationship between cognitive dysfunctions and mood disorders in the different chapters of this study confirms that Saudi Arabia has increasing prevalence rates of stroke and associated functional and mood disorders. This is evident from the rising percentage of anxiety and depression diagnosed among the Saudi Arabian population, which is higher than that in previous national studies. Due to the lack of regulatory focus on stroke and post-stroke rehabilitation programmes like those in Western countries, Saudi stroke patients experience adverse outcomes from their functional impairments, mental impairments and ultimately impairments of their mood status. The current study has also highlighted the strong influence of six patient characteristics on the differences in the results of patients both with and without mood disorders. Age was found to be a highly significant factor in both the present and past studies. In Saudi Arabia, as in most Western countries, post-stroke patients aged 61 years and over were found to be more affected by neuropsychological disorders and mood disorders than younger patients. The reason behind this is the decreased functional capacity of patients in this age group and the reduced or lack of social support provided. However, unlike Western countries, females were found to be more influenced than males by different cognitive dysfunctions. These differences may be attributable to the cultural bias and male domination in Middle Eastern countries like Saudi Arabia.

Additionally, ‘time since stroke’ was recognised to be an important factor in identifying the relationship between cognitive dysfunctions and mood disorders. As in Western studies, current research in Saudi settings also confirms that stroke, cognitive dysfunctions and mood disorders are most prevalent within the first six months after stroke. The current study showed that ‘time since stroke’ is important because, the more time that passes since the stroke, the more some cognitive domains start recovering, while others deteriorate. The role of ‘level of literacy’ should also not be underestimated in assisting Saudi post-stroke patients in recovering their cognitive functions in order to control depression and anxiety levels. Additionally, in Western countries, the level of literacy is high compared to that in Saudi Arabia. This is the main reason why the group of illiterate patients in all three Saudi hospitals showed a high prevalence rate of cognitive dysfunctions and mood disorders in comparison to the literate group. The study also concluded that ‘level of literacy’ contributes to differences in the baseline results and follow-up assessments. Clinical support, such as raising clinical awareness, can help post-stroke patients to identify ways to recover from their mood disorders even if they are not able to improve their cognitive impairments. Thus, it may be concluded that post-stroke cognitive dysfunctions and the post-stroke mood disorders are related to each other but cognitive dysfunctions cannot be treated as predictors of or dependent factors for the mood disorders.

The findings of this study suggest that the Saudi Health Ministry should take the matter seriously and, as a matter of urgency, adopt a precautionary rather than reactionary policy (Kamran et al., 2006, Robert & Zamzami, 2014). Stroke cases in

Western countries confirm that the costs incurred to control the prevalence of the disease before onset are much lower than healthcare costs post-stroke. Thus, to equal their Western counterparts, Saudi Arabian healthcare authorities must focus on modifiable as well as non-modifiable risk factors.

References

Abdul-sattar, A. B., & Godab, T. (2013). Predictors of functional outcome in Saudi Arabian patients with stroke after inpatient rehabilitation. *NeuroRehabilitation, 33*(2), 209-216.

Aben, I., Verhey, F., Lousberg, R., Lodder, J., & Honig, A. (2002). Validity of the Beck Depression Inventory, Hospital Anxiety and Depression Scale, SCL-90, and Hamilton Depression Rating Scale as screening instruments for depression in stroke patients. *Psychosomatics, 43*(5), 386-393.

Ahmad, V. U., Kousar, F., Khan, A., Zubair, M., Iqbal, S., & Tareen, R. B. (2005). A new ketone and a known anticancer triterpenoid from the leaves of Onosma limitaneum. *Helvetica chimica acta, 88*(2), 309-311.

Al-Eithan, M. H., Amin, M., & Robert, A. A. (2011). The effect of hemiplegia/hemiparesis, diabetes mellitus, and hypertension on hospital length of stay after stroke. *Neurosciences, 16*(3), 253-256.

Al-Kawi, A., (2013). Endovascular Stroke Treatment in the Developing World. http://www.svin.org/files/15_Alkawi.pdf

Al-Jadid, M. S., & Robert, A. A. (2010). Determinants of length of stay in an inpatient stroke rehabilitation unit in Saudi Arabia. *Saudi medical journal, 31*(2), 189-192.

Allison, P. (2012). *When Can You Safely Ignore Multicollinearity?* Retrieved September 09, 2015, from Statistical Horizons: http://statisticalhorizons.com/multicollinearity

Al-Qazzaz, N. K., Ali, S. H., Ahmad, S. A., & Islam, S. (2014). Cognitive assessments for the early diagnosis of dementia after stroke. *Neuropsychiatric disease and treatment, 10*, 1743.

Al-Rajeh, S., Larbi, E., Al-Freihi, H., Ahmed, K., Muhana, F., & Bademosi, O. (1989). A clinical study of stroke. *East African medical journal, 66*(3), 183-191.

Al-Rajeh, S., Larbi, E., Bademosi, O., Awada, A., Ismail, H., Al-Freihi, H., & Al-Ghassab, G. (1991). Stroke in a tertiary hospital in Saudi Arabia: a study of 372 cases. *European neurology, 31*(4), 251-256.

Al-Rajeh, S., Larbi, E. B., Bademosi, O., Awada, A., Yousef, A., Al-Freihi, H., & Miniawi, H. (1997). Stroke register: experience from the eastern province of Saudi Arabia. *Cerebrovascular Diseases (Basel, Switzerland), 8*(2), 86-89.

Al Khathaami, A. M., Algahtani, H., Alwabel, A., Alosherey, N., Kojan, S., & Aljumah, M. (2011). The status of acute stroke care in Saudi Arabia: an urgent call for action! *International Journal of Stroke, 6*(1), 75-76.

Al Rajeh, S., & Awada, A. (2002). Stroke in Saudi Arabia. *Cerebrovasc Dis, 13*(1), 3-8.

Al Rajeh, S., Awada, A., Niazi, G., & Larbi, E. (1993). Stroke in a Saudi Arabian National Guard community. Analysis of 500 consecutive cases from a population-based hospital. *Stroke, 24*(11), 1635-1639.

Al Salman, A. S. A. (2013). *The Saudi Arabian adaptation of the Addenbrooke's Cognitive Examination–Revised (Arabic ACE-R).* University of Glasgow.

Allan, L. M., Rowan, E. N., Thomas, A. J., Polvikoski, T. M., O'Brien, J. T., & Kalaria, R. N. (2013). Long-term incidence of depression and predictors of depressive symptoms in older stroke survivors. *The British Journal of Psychiatry, 203*(6), 453-460.

Altieri, M., Maestrini, I., Mercurio, A., Troisi, P., Sgarlata, E., Rea, V., . . . Lenzi, G. (2012). Depression after minor stroke: prevalence and predictors. *European Journal of Neurology, 19*(3), 517-521.

Alway, D., & Cole, J. W. (2009). *Stroke Essentials for Primary Care: A Practical Guide*: Springer Science & Business Media.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders, fifith edition.* Washington, DC.

American Stroke Association, (2015). Available at: http://www.strokeassociation.org/STROKEORG/

Anderson, C. A., Arciniegas, D. B., & Filley, C. M. (2014). Treatment of acute ischemic stroke: does it impact neuropsychiatric outcome?

Arnett, J. A., & Labovitz, S. S. (1995). Effect of physical layout in performance of the Trail Making Test. *Psychological Assessment, 7*(2), 220.

Åström, M. (1996). Generalized anxiety disorder in stroke patients a 3-year longitudinal study. *Stroke, 27*(2), 270-275.

Awada, A., & Rajeh, S. (1999). The Saudi Stroke Data Bank Analysis of the first 1000 cases. *Acta Neurologica Scandinavica, 100*(4), 265-269.

Ayerbe, L., Ayis, S., Rudd, A. G., Heuschmann, P. U., & Wolfe, C. D. (2011). Natural history, predictors, and associations of depression 5 years after stroke the South London Stroke Register. *Stroke, 42*(7), 1907-1911.

Ayerbe, L., Ayis, S., Wolfe, C. D., & Rudd, A. G. (2013). Natural history, predictors and outcomes of depression after stroke: systematic review and meta-analysis. *The British Journal of Psychiatry, 202*(1), 14-21.

Ayers, C. R., Sorrell, J. T., Thorp, S. R., & Wetherell, J. L. (2007). Evidence-based psychological treatments for late-life anxiety. *Psychology and Aging, 22*(1), 8.

Azouvi, P., Samuel, C., Louis-Dreyfus, A., Bernati, T., Bartolomeo, P., Beis, J., . . . Martin, Y. (2002). Sensitivity of clinical and behavioural tests of spatial neglect after right hemisphere stroke. *Journal of Neurology, Neurosurgery & Psychiatry, 73*(2), 160-166.

Baddeley, A. (1998). The central executive: A concept and some misconceptions. *Journal of the International Neuropsychological Society, 4*(05), 523-526.

Baddeley, A. D., Kopelman, M., & Wilson, B. A. (2004). *The essential handbook of memory disorders for clinicians*: John Wiley & Sons.

Ballard, C., Stephens, S., Kenny, R., Kalaria, R., Tovee, M., & O'Brien, J. (2003). Profile of neuropsychological deficits in older stroke survivors without dementia. *Dementia and geriatric cognitive disorders, 16*(1), 52-56.

Bamford, J., Sandercock, P., Dennis, M., Warlow, C., & Burn, J. (1991). Classification and natural history of clinically identifiable subtypes of cerebral infarction. *The Lancet, 337*(8756), 1521-1526.

Barker-Collo, S., Feigin, V., Lawes, C., Senior, H., & Parag, V. (2009). Natural history of attention deficits and their influence on functional recovery from acute stages to 6 months after stroke. *Neuroepidemiology, 35*(4), 255-262.

Barker-Collo, S., Starkey, N., Lawes, C. M., Feigin, V., Senior, H., & Parag, V. (2012). Neuropsychological profiles of 5-year ischemic stroke survivors by Oxfordshire stroke classification and hemisphere of lesion. *Stroke, 43*(1), 50-55.

Barker-Collo, S. L. (2007). Depression and anxiety 3 months post stroke: prevalence and correlates. *Archives of Clinical Neuropsychology, 22*(4), 519-531.

Bartczak, E., Marcinowicz, E., & Kochanowski, J. (2011). Cognitive function disorders in cerebellum stroke versus crossed diaschisis - Case report. [Polish]

Barthel, D., & Mahoney, F. (1965). Functional evaluation: the Barthel index. *Md State Med J, 14*, 61-65.

Bays, C. L. (2001). Older adults' descriptions of hope after a stroke. *Rehabilitation Nursing, 26*(1), 18-27.

Becker, E., & Karnath, H.-O. (2007). Incidence of visual extinction after left versus right hemisphere stroke. *Stroke, 38*(12), 3172-3174.

Bederson, J. B., Connolly, E. S., Batjer, H. H., Dacey, R. G., Dion, J. E., Diringer, M. N., . . . Rosenwasser, R. H. (2009). Guidelines for the management of aneurysmal subarachnoid hemorrhage a statement for healthcare professionals from a special Writing Group of the Stroke Council, American Heart Association. *Stroke, 40*(3), 994-1025.

Beekman, A. T., de Beurs, E., van Balkom, A. J., Deeg, D. J., van Dyck, R., & van Tilburg, W. (2000). Anxiety and depression in later life: co-occurrence and communality of risk factors. *American journal of psychiatry, 157*(1), 89-95.

Beeson, P., Bayles, K., Rubens, A., & Kaszniak, A. (1993). Memory impairment and executive control in individuals with stroke-induced aphasia. *Brain and language, 45*(2), 253-275.

Berg, A., Palomäki, H., Lehtihalmes, M., Lönnqvist, J., & Kaste, M. (2003). Poststroke depression an 18-month follow-up. *Stroke, 34*(1), 138-143.

Bernstein, D. (2013). *Essentials of psychology*: Cengage Learning.

Bhogal, S. K., Teasell, R., Foley, N., & Speechley, M. (2004). Lesion location and poststroke depression systematic review of the methodological limitations in the literature. *Stroke, 35*(3), 794-802.

Bickerton, W. L., Samson, D., Williamson, J., & Humphreys, G. W. (2011). Separating forms of neglect using the Apples Test: validation and functional prediction in chronic and acute stroke. *Neuropsychology, 25*(5), 567.

Blake, H., McKinney, M., Treece, K., Lee, E., & Lincoln, N. B. (2002). An evaluation of screening measures for cognitive impairment after stroke. *Age and ageing, 31*(6), 451-456.

Bogousslavsky, J., & Cummings, J. L. (2000). *Behavior and mood disorders in focal brain lesions*: Cambridge University Press.

Bokura, H., & Robinson, R. G. (1997). Long-term cognitive impairment associated with caudate stroke. *Stroke, 28*(5), 970-975.

Bolla-Wilson, K., Robinson, R. G., Starkstein, S. E., Boston, J., & Price, T. R. (1989). Lateralization of dementia of depression in stroke patients. *American journal of psychiatry, 146*(5), 627-634.

Bour, A., Rasquin, S., Aben, I., Boreas, A., Limburg, M., & Verhey, F. (2010). A one-year follow-up study into the course of depression after stroke. *The journal of nutrition, health & aging, 14*(6), 488-493.

Bour, A., Rasquin, S., Boreas, A., Limburg, M., & Verhey, F. (2010). How predictive is the MMSE for cognitive performance after stroke? *Journal of neurology, 257*(4), 630-637.

Bour, A., Rasquin, S., Limburg, M., & Verhey, F. (2011). Depressive symptoms and executive functioning in stroke patients: A follow-up study. *International journal of geriatric psychiatry, 26*(7), 679-686.

Bowen, A., McKenna, K., & Tallis, R. C. (1999). Reasons for variability in the reported rate of occurrence of unilateral spatial neglect after stroke. *Stroke, 30*(6), 1196-1202.

Brainin, M., & Heiss, W.-D. (2014). *Textbook of stroke medicine*: Cambridge University Press.

Brodaty, H., Withall, A., Altendorf, A., & Sachdev, P. S. (2007). Rates of depression at 3 and 15 months poststroke and their relationship with cognitive decline: the Sydney Stroke Study. *The American journal of geriatric psychiatry, 15*(6), 477-486.

Broderick, J. P., Adams, H. P., Barsan, W., Feinberg, W., Feldmann, E., Grotta, J., . . . Tilley, B. (1999). Guidelines for the management of spontaneous intracerebral hemorrhage a statement for healthcare professionals from a special writing group of the Stroke council, American Heart Association. *Stroke, 30*(4), 905-915.

Broderick, J. P., Adams, H. P., Barsan, W., Feinberg, W., Feldmann, E., Grotta, J., . . . Zuccarello, M. (1999). Guidelines for the Management of Spontaneous Intracerebral Hemorrhage. *Stroke*, 905-975.

Broe, G., Jorm, A., Creasey, H., Grayson, D., Edelbrock, D., Waite, L. M., Casey, B. (1998). Impact of chronic systemic and neurological disorders on disability, depression and life satisfaction. *International journal of geriatric psychiatry, 13*(10), 667-673.

Bugarski, V., Semnic, M., & Slankamenac, P. (2009). Relationship between depressive symptoms and cognitive status in acute ischemic stroke. *Psihologija, 42*(4), 479-489.

Burton, C., Murray, J., Holmes, J., Astin, F., Greenwood, D., & Knapp, P. (2013). Frequency of anxiety after stroke: a systematic review and meta-analysis of observational studies. *International Journal of Stroke, 8*(7), 545-559.

Burton, E. J., Kenny, R. A., O'Brien, J., Stephens, S., Bradbury, M., Rowan, E., . . . Ballard, C. (2004). White matter hyperintensities are associated with impairment of memory, attention, and global cognitive performance in older stroke patients. *Stroke, 35*(6), 1270-1275.

Burvill, P., Johnson, G., Jamrozik, K., Anderson, C., Stewart-Wynne, E., & Chakera, T. (1995). Anxiety disorders after stroke: results from the Perth

Community Stroke Study. *The British Journal of Psychiatry, 166*(3), 328-332.

Caeiro, L., Ferro, J. M., Santos, C. O., & Figueira, M. L. (2006). Depression in acute stroke. *Journal of psychiatry and neuroscience, 31*(6), 377.

Camoes-Barbosa, A., Sequeira-Medeiros, L., Duarte, N., Morais, J., Mendes, M., & Meneses, C. (2012). Afasia y depresión post-ictus: una relación predictiva. *Rehabilitación, 46*(1), 36-40.

Campbell Burton, C., Holmes, J., Murray, J., Gillespie, D., Lightbody, C. E., Watkins, C. L., & Knapp, P. (2011). Interventions for treating anxiety after stroke. *The Cochrane Library*.

Campbell Burton, C., Murray, J., Holmes, J., Astin, F., Greenwood, D., & Knapp, P. (2013). Frequency of anxiety after stroke: a systematic review and meta-analysis of observational studies. *International Journal of Stroke, 8*(7), 545-559.

Campos, T. F., Barroso, M. T. M., & de Lara Menezes, A. A. (2010). Encoding, storage and retrieval processes of the memory and the implications for motor practice in stroke patients. *NeuroRehabilitation, 26*(2), 135-142.

Caplan, L. R. (2013). *Navigating the Complexities of Stroke*: Oxford University Press.

Carod-Artal, F., Ferreira, C. L., Trizotto, D. S., & Menezes, M. C. (2008). Burden and perceived health status among caregivers of stroke patients. *Cerebrovascular Diseases (Basel, Switzerland), 28*(5), 472-480.

Carota, A., Staub, F., & Bogousslavsky, J. (2002). Emotions, behaviours and mood changes in stroke. *Current opinion in neurology, 15*(1), 57-69.

Carson, A. J., MacHale, S., Allen, K., Lawrie, S. M., Dennis, M., House, A., & Sharpe, M. (2000). Depression after stroke and lesion location: a systematic review. *The Lancet, 356*(9224), 122-126.

Centers for Disease Control and Prevention (2005). Regional and racial differences in prevalence of stroke--23 states and District of Columbia, 2003. *MMWR. Morbidity and mortality weekly report, 54*(19), 481.

Centre for Reviews and Dissemination (2009). Systematic Review: CRD's guidance for undertaking review in health care. University of York. Available at: https://www.york.ac.uk/media/crd/Systematic_Reviews.pdf

Chahal, N., Barker-Collo, S., & Feigin, V. (2010). Cognitive and functional outcomes of 5-year subarachnoid haemorrhage survivors: comparison to matched healthy controls. *Neuroepidemiology, 37*(1), 31-38.

Chatterjee, K., Fall, S., & Barer, D. (2010). Mood after stroke: a case control study of biochemical, neuro-imaging and socio-economic risk factors for major depression in stroke survivors. *BMC neurology, 10*(1), 125.

Chechlacz, M., Rotshtein, P., Roberts, K. L., Bickerton, W.-L., Lau, J. K., & Humphreys, G. W. (2012). The prognosis of allocentric and egocentric neglect: evidence from clinical scans. *PloS one, 7*(11), e47821.

Chen, H.-C., Koh, C.-L., Hsieh, C.-L., & Hsueh, I.-P. (2009). Test-re-test reliability of two sustained attention tests in persons with chronic stroke. *Brain Injury, 23*(9), 715-722.

Cobley, C. S., Thomas, S. A., Lincoln, N. B., & Walker, M. F. (2011). The assessment of low mood in stroke patients with aphasia: reliability and validity of the 10-item Hospital version of the Stroke Aphasic Depression Questionnaire (SADQH-10). *Clinical rehabilitation, 26*(4), 372-381.

Cooper, R., & Shallice, T. (2000). Contention scheduling and the control of routine activities. *Cognitive neuropsychology, 17*(4), 297-338.

Cornoldi, C., & Vecchi, T. (2004). *Visuo-spatial working memory and individual differences*: Psychology Press.

Cossi, M.-J., Gobron, C., Preux, P.-M., Niama, D., Chabriat, H., & Houinato, D. (2011). Stroke: prevalence and disability in Cotonou, Benin. *Cerebrovascular Diseases (Basel, Switzerland), 33*(2), 166-172.

Critical Appraisal Skills Programme (CASP) Cohort Study Checklist (2013): available at: http://www.casp-uk.net/#!casp-tools-checklists/c18f8

Cullen, B., O'Neill, B., Evans, J. J., Coen, R. F., & Lawlor, B. A. (2007). A review of screening tests for cognitive impairment. *Journal of Neurology, Neurosurgery & Psychiatry, 78*(8), 790-799.

Cumming, T. B., Marshall, R. S., & Lazar, R. M. (2013). Stroke, cognitive deficits, and rehabilitation: still an incomplete picture. *International Journal of Stroke, 8*(1), 38-45.

Cumming, T. B., Tyedin, K., Churilov, L., Morris, M. E., & Bernhardt, J. (2012). The effect of physical activity on cognitive function after stroke: a systematic review. *International Psychogeriatrics, 24*(04), 557-567.

D'Aniello, G. E., Scarpina, F., Mauro, A., Mori, I., Castelnuovo, G., Bigoni, M., Molinari, E. (2014). Characteristics of anxiety and psychological well-being in chronic post-stroke patients. *Journal of the neurological sciences, 338*(1), 191-196.

Dagenbach, D., Kubat-silman, A. K., & Absher, J. R. (2001). Human verbal working memory impairments associated with thalamic damage. *International Journal of Neuroscience, 111*(1-2), 67-87.

Dark, J., & Sander, R. (2014). An overview of communication, movement and perception difficulties after stroke. *Nursing older people, 26*(5), 32-37.

Dennis, M., O'Rourke, S., Lewis, S., Sharpe, M., & Warlow, C. (2000). Emotional outcomes after stroke: factors associated with poor outcome. *Journal of Neurology, Neurosurgery & Psychiatry, 68*(1), 47-52.

Desmond, D., Moroney, J., Paik, M., Sano, M., Mohr, J., Aboumatar, S., Remien, R. (2000). Frequency and clinical determinants of dementia after ischemic stroke. *Neurology, 54*(5), 1124-1131.

Devido-Santos, M., Gagliardi, R. J., & Mac-Kay, A. P. M. G. (2012). Language disorders and brain lesion topography in aphasics after stroke. *Arquivos de Neuro-psiquiatria, 70*(2), 129-133.

Dewarrat, G. M., Annoni, J.-M., Fornari, E., Carota, A., Bogousslavsky, J., & Maeder, P. (2009). Acute aphasia after right hemisphere stroke. *Journal of neurology, 256*(9), 1461-1467.

Dong, Y., Sharma, V. K., Chan, B. P.-L., Venketasubramanian, N., Teoh, H. L., Seet, R. C. S., Chen, C. (2010). The Montreal Cognitive Assessment (MoCA) is superior to the Mini-Mental State Examination (MMSE) for the

detection of vascular cognitive impairment after acute stroke. *Journal of the neurological sciences, 299*(1), 15-18.

Douiri, A., Rudd, A. G., & Wolfe, C. D. (2013). Prevalence of poststroke cognitive impairment South London stroke register 1995–2010. *Stroke, 44*(1), 138-145.

Downhill, J. E., & Robinson, R. G. (1994). Longitudinal assessment of depression and cognitive impairment following stroke. *Journal of Nervous and Mental Disease, 182*(8), 425-431.

Duits, A., Munnecom, T., van Heugten, C., & van Oostenbrugge, R. J. (2008). Cognitive complaints in the early phase after stroke are not indicative of cognitive impairment. *Journal of Neurology, Neurosurgery & Psychiatry, 79*(2), 143-146.

Eastwood, M., Rifat, S., Nobbs, H., & Ruderman, J. (1989). Mood disorder following cerebrovascular accident. *The British Journal of Psychiatry, 154*(2), 195-200.

Egelko, S., Gordon, W. A., Hibbard, M. R., Diller, L., Lieberman, A., Holliday, R., Orazem, J. (1988). Relationship among CT scans, neurological exam, and neuropsychological test performance in right brain-damaged stroke patients. *Journal of Clinical and Experimental Neuropsychology, 10*(5), 539-564.

El-Rufaie, O., & Absood, G. (1987). Validity study of the Hospital Anxiety and Depression Scale among a group of Saudi patients. *The British Journal of Psychiatry, 151*(5), 687-688.

El-Rufaie, O., & Absood, G. (1995). Retesting the validity of the Arabic version of the Hospital Anxiety and Depression (HAD) scale in primary health care. *Social psychiatry and psychiatric epidemiology, 30*(1), 26-31.

El Sayed, M. M., Adeuja, A. O. G., El-Nahrawy, E., & Olaish, M. A. (1999). Characteristics of stroke in Hofuf, Saudi Arabia. *Annals of Saudi medicine, 19*, 27-31.

Emam, A. T., Ali, A. M., & Babikr, M. A. (2009). Childhood stroke in Eastern Province, KSA: pattern, risk factors, diagnosis and outcome. *Acta Paediatrica, 98*(10), 1613-1619.

Fan, Q. Y., Qu, Q. M., Zhang, H., Liu, J. J., Guo, F., & Qiao, J. (2011). [The evolution of cognition and its influence factors after stroke]. [Chinese]. *Zhonghua nei ke za zhi [Chinese journal of internal medicine], 50*(9), 750-753.

Farner, L., Wagle, J., Engedal, K., Flekkøy, K. M., Wyller, T. B., & Fure, B. (2010). Depressive symptoms in stroke patients: A 13month follow-up study of patients referred to a rehabilitation unit. *Journal of affective disorders, 127*(1), 211-218.

Field, A. (2013). Discovering statistics using IBM SPSS statistics. Sage.

Forsström, E., Hakko, H., Nordström, T., Räsänen, P., & Mainio, A. (2009). Suicide in patients with stroke: a population-based study of suicide victims during the years 1988-2007 in northern Finland. *The Journal of neuropsychiatry and clinical neurosciences, 22*(2), 182-187.

Fure, B., Bruun Wyller, T., Engedal, K., & Thommessen, B. (2006). Cognitive impairments in acute lacunar stroke. *Acta Neurologica Scandinavica, 114*(1), 17-22.

Fure, B., Wyller, T. B., Engedal, K., & Thommessen, B. (2006). Emotional symptoms in acute ischemic stroke. *International journal of geriatric psychiatry, 21*(4), 382-387.

Gaber, T. A. Z., Parsons, F., & Gautam, V. (2011). Validation of the language component of the Addenbrooke's Cognitive Examination–Revised (ACE-R) as a screening tool for aphasia in stroke patients. *Australasian journal on ageing, 30*(3), 156-158.

Gaete, J. M., & Bogousslavsky, J. (2008). Post-stroke depression.

Gainotti, G. (1989). Disorders of emotions and affect in patients with unilateral brain damage. *Handbook of neuropsychology*, *3*, 345-361.

Gialanella, B., & Ferlucci, C. (2009). Functional outcome after stroke in patients with aphasia and neglect: assessment by the motor and cognitive functional independence measure instrument. *Cerebrovascular Diseases (Basel, Switzerland), 30*(5), 440-447.

Girard, T. D., Jackson, J. C., Pandharipande, P. P., Pun, B. T., Thompson, J. L., Shintani, A. K., . . . Bernard, G. R. (2010). Delirium as a predictor of long-term cognitive impairment in survivors of critical illness. *Critical care medicine, 38*(7), 1513.

Godefroy, O., Roussel, M., Leclerc, X., & Leys, D. (2009). Deficit of episodic memory: anatomy and related patterns in stroke patients. *European neurology, 61*(4), 223.

Goldstein, L., & McNeil, J. (2012). *Clinical Neuropsychology: A Practical Guide to Assessment and Management for Clinicians*: Wiley.

Gottesman, R. F., & Hillis, A. E. (2010). Predictors and assessment of cognitive dysfunction resulting from ischaemic stroke. *The Lancet Neurology, 9*(9), 895-905.

Gottlieb, A., Golander, H., Bar-Tal, Y., & Gottlieb, D. (2001). The influence of social support and perceived control on handicap and quality of life after stroke. Aging Clinical and Experimental Research, 13(1), 11-15.

Gray, R., & Lindsay, B. (2009). Depression and stroke: a common but often unrecognized combination. *British Journal of Nursing, 18*(6), 365-369.

Gurcay, E., Bal, A., & Cakci, A. (2009). Health-related quality of life in first-ever stroke patients. *Annals of Saudi medicine, 29*(1), 36.

Gurr, B. (2011). Stroke mood screening on an inpatient stroke unit. *British Journal of Nursing, 20*(2), 94.

Hachinski, V., Donnan, G. A., Gorelick, P. B., Hacke, W., Cramer, S. C., Kaste, M., . . . Lo, E. H. (2010). Stroke: working toward a prioritized world agenda. *International Journal of Stroke, 5*(4), 238-256.

Hackett, M. L., & Anderson, C. S. (2005). Predictors of depression after stroke a systematic review of observational studies. *Stroke, 36*(10), 2296-2301.

Hackett, M. L., & Pickles, K. (2014). Part I: frequency of depression after stroke: an updated systematic review and meta-analysis of observational studies. *International Journal of Stroke, 9*(8), 1017-1025.

Hackett, M. L., Yapa, C., Parag, V., & Anderson, C. S. (2005). Frequency of depression after stroke a systematic review of observational studies. *Stroke, 36*(6), 1330-1340.

Hama, S., Yamashita, H., Shigenobu, M., Watanabe, A., Kurisu, K., Yamawaki, S., & Kitaoka, T. (2007). Post-stroke affective or apathetic depression and lesion location: left frontal lobe and bilateral basal ganglia. *European archives of psychiatry and clinical neuroscience, 257*(3), 149-152.

Hama, S., Yamashita, H., Yamawaki, S., & Kurisu, K. (2011). Post-stroke depression and apathy: Interactions between functional recovery, lesion location, and emotional response. *Psychogeriatrics, 11*(1), 68-76.

Hamad, A. M., Siddiqui, K. A., & AI-Mansoor, N. (2011). Post stroke depression in acute stroke: correlating with site and stroke severity. *Neurosciences, 16*(4).

Hankey, G. J. (2006). Potential New Risk Factors for Ischemic Stroke What Is Their Potential? *Stroke, 37*(8), 2181-2188.

Haring, H.-P. (2002). Cognitive impairment after stroke. *Current opinion in neurology, 15*(1), 79-84.

Harris, J. E., Eng, J. J., Marigold, D. S., Tokuno, C. D., & Louis, C. L. (2005). Relationship of balance and mobility to fall incidence in people with chronic stroke. *Physical Therapy, 85*(2), 150-158.

Heilman, K. M., Watson, R. T., & Valenstein, E. (1993). Neglect and related disorders. *Clinical neuropsychology, 3*, 279-336.

Herrmann, N., Black, S. E., Lawrence, J., Szekely, C., & Szalai, J. P. (1998). The Sunnybrook stroke study a prospective study of depressive symptoms and functional outcome. *Stroke, 29*(3), 618-624.

Heruti, R. J., Lusky, A., Dankner, R., Ring, H., Dolgopiat, M., Barell, V., Adunsky, A. (2002). Rehabilitation outcome of elderly patients after a first stroke: effect of cognitive status at admission on the functional outcome. *Arch Phys Med Rehabil, 83*(6), 742-749.

Hilari, K., Northcott, S., Roy, P., Marshall, J., Wiggins, R. D., Chataway, J., & Ames, D. (2010). Psychological distress after stroke and aphasia: the first six months. *Clinical rehabilitation, 24*(2), 181-190.

Hosking, S. G., & Marsh, N. V. (2013). Predictors of depression at one year post-stroke in older adults. *Brain Impairment, 14*(3), 381-391.

Hosking, S. G., Marsh, N. V., & Friedman, P. J. (2000). Depression at 3 months poststroke in the elderly: predictors and indicators of prevalence. *Aging, Neuropsychology, and Cognition, 7*(4), 205-216.

Hosseini, A. A., Sobhani-Rad, D., Ghandehari, K., & Benamer, H. T. (2010). Frequency and clinical patterns of stroke in Iran-Systematic and critical review. *BMC neurology, 10*(1), 72.

House, A., Dennis, M., Warlow, C., Hawton, K., & Molyneux, A. (1990). The relationship between intellectual impairment and mood disorder in the first year after stroke. *Psychological medicine, 20*(04), 805-814.

Humphreys, G. W., Bickerton, W. L., Samson, D., & Riddoch, M. J. (2012). The Birmingham Cognitive Screen (BCoS). Psychology Press: London.

Hurford, R., Charidimou, A., Fox, Z., Cipolotti, L., & Werring, D. J. (2013). Domain-specific trends in cognitive impairment after acute ischaemic stroke. *Journal of neurology, 260*(1), 237-241.

Hyndman, D., & Ashburn, A. (2003). People with stroke living in the community: Attention deficits, balance, ADL ability and falls. *Disability & Rehabilitation, 25*(15), 817-822.

Hyndman, D., Pickering, R. M., & Ashburn, A. (2008). The influence of attention deficits on functional recovery post stroke during the first 12 months after discharge from hospital. *Journal of Neurology, Neurosurgery & Psychiatry, 79*(6), 656-663.

Johnston, K. C., Li, J. Y., Lyden, P. D., Hanson, S. K., Feasby, T. E., Adams, R. J., Haley, E. C. (1998). Medical and neurological complications of ischemic stroke experience from the RANTTAS trial. *Stroke, 29*(2), 447-453.

Jokinen, H., Kalska, H., Ylikoski, R., Hietanen, M., Mäntylä, R., Pohjasvaara, T., Erkinjuntti, T. (2004). Medial temporal lobe atrophy and memory deficits in elderly stroke patients. *European Journal of Neurology, 11*(12), 825-832.

Jonkman, E., Weerd, A. d., & Vrijens, N. (1998). Quality of life after a first ischemic stroke. *Acta Neurologica Scandinavica, 98*(3), 169-175.

Juarez-Cedillo, T., Sanchez-Arenas, R., Sanchez-Garcia, S., Garcia-Pena, C., Hsiung, G. Y. R., Sepehry, A. A., Jacova, C. (2013). Prevalence of mild cognitive impairment and its subtypes in the Mexican population. *Dementia and geriatric cognitive disorders, 34*(5-6), 271-281.

Kamran, S., Bener, A., Deleu, D., Khoja, W., Jumma, M., Al Shubali, A., Al Khabouri, J. (2006). The level of awareness of stroke risk factors and symptoms in the Gulf Cooperation Council countries: Gulf Cooperation Council stroke awareness study. *Neuroepidemiology, 29*(3-4), 235-242.

Kauhanen, M., Korpelainen, J., Hiltunen, P., Määttä, R., Mononen, H., Brusin, E., Myllylä, V. (1999). Aphasia, depression, and non-verbal cognitive impairment in ischaemic stroke. *Cerebrovascular Diseases (Basel, Switzerland), 10*(6), 455-461.

Kauhanen, M. L., Korpelainen, J. T., Hiltunen, P., Brusin, E., Mononen, H., Maatta, R., Myllyla, V. V. (1999). Poststroke depression correlates with cognitive impairment and neurological deficits. *Stroke, 30*(9), 1875-1880.

Kellogg, R. T. (2011). *Fundamentals of cognitive psychology*: Sage.

Khedr, E. M., Hamed, S. A., El-Shereef, H. K., Shawky, O. A., Mohamed, K. A., Awad, E. M., Eltahtawy, M. A. (2009). Cognitive impairment after cerebrovascular stroke: Relationship to vascular risk factors. *Neuropsychiatr Dis Treat, 5*(2), 103-116.

Kim, P., Warren, S., Madill, H., & Hadley, M. (1999). Quality of life of stroke survivors. *Quality of Life Research, 8*(4), 293-301.

Kootker, J. A., Fasotti, L., Rasquin, S. M., van Heugten, C. M., & Geurts, A. C. (2012). The effectiveness of an augmented cognitive behavioural intervention for post-stroke depression with or without anxiety (PSDA): the Restore4Stroke-PSDA trial. *BMC neurology, 12*(1), 51.

Lamb, F., Anderson, J., Saling, M., & Dewey, H. (2013). Predictors of subjective cognitive complaint in postacute older adult stroke patients. *Arch Phys Med Rehabil, 94*(9), 1747-1752.

Lee, B. H., Kim, E.-J., Ku, B. D., Choi, K. M., Seo, S. W., Kim, G.-M., Na, D. L. (2008). Cognitive impairments in patients with hemispatial neglect from

acute right hemisphere stroke. *Cognitive and Behavioral Neurology, 21*(2), 73-76.

Leppävuori, A., Pohjasvaara, T., Vataja, R., Kaste, M., & Erkinjuntti, T. (2001). Insomnia in ischemic stroke patients. *Cerebrovascular Diseases (Basel, Switzerland), 14*(2), 90-97.

Leppävuori, A., Pohjasvaara, T., Vataja, R., Kaste, M., & Erkinjuntti, T. (2003). Generalized anxiety disorders three to four months after ischemic stroke. *Cerebrovascular Diseases, 16*(3), 257-264.

Leśniak, M., Bak, T., Czepiel, W., Seniow, J., & Członkowska, A. (2008). Frequency and prognostic value of cognitive disorders in stroke patients. *Dementia and geriatric cognitive disorders, 26*(4), 356-363.

Lezak, M. (1982). The problem of assessing executive functions. *International Journal of Psychology, 17*(1-4), 281-297.

Lezak, M. D. (2004). *Neuropsychological assessment*: Oxford university press.

Lim, C., & Alexander, M. P. (2009). Stroke and episodic memory disorders. *Neuropsychologia, 47*(14), 3045-3058.

Liman, T. G., Heuschmann, P., Endres, M., Flöel, A., Schwab, S., & Kolominsky-Rabas, P. L. (2011). Changes in cognitive function over 3 years after first-ever stroke and predictors of cognitive impairment and long-term cognitive stability: the Erlangen Stroke Project. *Dementia and geriatric cognitive disorders, 31*(4), 291-299.

Lin, H.-C., Lin, Y.-J., Liu, T.-C., Chen, C.-S., & Chiu, W.-T. (2007). Urbanization and stroke prevalence in Taiwan: analysis of a nationwide survey. *Journal of Urban Health, 84*(4), 604-614.

Lincoln, N. B., Kneebone, I. I., Macniven, J. A., & Morris, R. C. (2012). *Psychological management of stroke*: John Wiley & Sons.

Lindén, T., Samuelsson, H., Skoog, I., & Blomstrand, C. (2005). Visual neglect and cognitive impairment in elderly patients late after stroke. Acta Neurologica Scandinavica, 111(3), 163-168.

Lipsey, J. R., Robinson, R., Pearlson, G., Rao, K., & Price, T. (1983). Mood change following bilateral hemisphere brain injury. *The British Journal of Psychiatry, 143*(3), 266-273.

Liu, C. Q., Xie, C. H., & Sun, S. G. (2003). Post-stroke depression and its related factors. *Chinese Journal of Clinical Rehabilitation, 7*(28), 3840-3841.

Lu, Y. L., Qian, L. H., Zhou, B. D., Zhu, W., & Shen, M. Q. (2005). Relation of depression with cognitive impairment and neurological deficits in elderly people at the recovery phase after cerebral infarction. [Chinese]. *Chinese Journal of Clinical Rehabilitation, 9*(1), 14-15.

Ma, J., Zhang, W., & Peng, L. Y. (2005). Comparison of factors related to the characteristics of neuropsychological changes in stroke patients. *Chinese Journal of Clinical Rehabilitation, 9*(28), 240-242.

MacHale, S. M., O'Rourke, S. J., Wardlaw, J. M., & Dennis, M. S. (1998). Depression and its relation to lesion location after stroke. *Journal of Neurology, Neurosurgery & Psychiatry, 64*(3), 371-374.

Madureira, S., Guerreiro, M., & Ferro, J. (2001). Dementia and cognitive impairment three months after stroke. *European Journal of Neurology, 8*(6), 621-627.

Magistris, F., Bazak, S., & Martin, J. (2013). Intracerebral hemorrhage: pathophysiology, diagnosis and management. *MUMJ, 10*(1), 15-22.

Makin, S. D. J., Dennis, M. S., & Wardlaw, J. M. (2013). Cognitive impairment after lacunar stroke. *Cerebrovascular Diseases, 35*, 504.

Malasi, T., Mirza, I., & El-Islam, M. F. (1991). Validation of the hospital anxiety and depression scale in Arab patients. *Acta psychiatrica scandinavica, 84*(4), 323-326.

Mariani, E., Monastero, R., Ercolani, S., Mangialasche, F., Caputo, M., Feliziani, F., . . . Mecocci, P. (2006). Vascular risk factors in mild cognitive impairment subtypes. Findings from the ReGAl project. *Dementia and geriatric cognitive disorders, 24*(6), 448-456.

Mathuranath, P., Nestor, P., Berrios, G., Rakowicz, W., & Hodges, J. (2000). A brief cognitive test battery to differentiate Alzheimer's disease and frontotemporal dementia. *Neurology, 55*(11), 1613-1620.

McAvinue, L., O'Keeffe, F., McMackin, D., & Robertson, I. H. (2005). Impaired sustained attention and error awareness in traumatic brain injury: Implications for insight. *Neuropsychological Rehabilitation, 15*(5), 569-587.

Meier, T. B., Naing, L., Thomas, L. E., Nair, V. A., Hillis, A. E., & Prabhakaran, V. (2011). Validating age-related functional imaging changes in verbal working memory with acute stroke. *Behav Neurol, 24*(3), 187-199.

Melcon, C. M., & Melcon, M. O. (2005). Prevalence of stroke in an Argentine community. *Neuroepidemiology, 27*(2), 81-88.

Menlove, L., Crayton, E., Kneebone, I., Allen-Crooks, R., Otto, E., & Harder, H. (2015). Predictors of Anxiety after Stroke: A Systematic Review of Observational Studies. Journal of Stroke and Cerebrovascular Diseases, 24(6), 1107-1117.

Menon-Nair, A., Korner-Bitensky, N., Wood-Dauphinee, S., & Robertson, E. (2006). Assessment of unilateral spatial neglect post stroke in Canadian acute care hospitals: are we neglecting neglect? *Clinical rehabilitation, 20*(7), 623-634.

Merriman, C., Norman, P., & Barton, J. (2007). Psychological correlates of PTSD symptoms following stroke. *Psychology, Health and Medicine, 12*(5), 592-602.

Middleton, L., Lam, B., Fahmi, H., McIlroy, W., Black, S., & Turner, G. (2012). *Cognitive recovery over 2 years post-stroke.* Paper presented at the Stroke.

Mioshi, E., Dawson, K., Mitchell, J., Arnold, R., & Hodges, J. R. (2006). The Addenbrooke's Cognitive Examination Revised (ACE-R): a brief cognitive test battery for dementia screening. *International journal of geriatric psychiatry, 21*(11), 1078-1085.

Mok, V., Wong, A., Wong, K., Chu, W., Xiong, Y., Chan, A., Tang, W.-K. (2009). Executive dysfunction and left frontal white matter hyperintensities are correlated with neuropsychiatric symptoms in stroke patients with confluent

white matter hyperintensities. *Dementia and geriatric cognitive disorders, 30*(3), 254-260.

Morris, K., Hacker, V., & Lincoln, N. B. (2012). The validity of the Addenbrooke's Cognitive Examination-Revised (ACE-R) in acute stroke. *Disability and rehabilitation, 34*(3), 189-195.

Morris, P. L., Raphael, B., & Robinson, R. G. (1992). Clinical depression is associated with impaired recovery from stroke. *Medical Journal of Australia, 157*(4), 239-242.

Morris, P. L. P., Robinson, R. G., & Raphael, B. (1990). Prevalence and course of depressive disorders in hospitalized stroke patients. *International Journal of Psychiatry in Medicine, 20*(4), 349-364.

Mukhopadhyay, A., Sundar, U., Adwani, S., & Pandit, D. (2012). Prevalence of stroke and post-stroke cognitive impairment in the elderly in Dharavi, Mumbai. *The Journal of the Association of Physicians of India, 60*, 29-32.

Murata, Y., Kimura, M., & Robinson, R. G. (2000). Does cognitive impairment cause poststroke depression? *The American journal of geriatric psychiatry, 8*(4), 310-317.

Narushima, K., Chan, K.-L., Kosier, J. T., & Robinson, R. G. (2003). Does cognitive recovery after treatment of poststroke depression last? A 2-year follow-up of cognitive function associated with poststroke depression. *American journal of psychiatry, 160*(6), 1157-1162.

Ng, Y. S., Astrid, S., De Silva, D. A., Tan, M. L. D., Tan, Y. L., & Chew, E. (2013). Functional outcomes after inpatient rehabilitation in a prospective stroke cohort. *Proceedings of Singapore Healthcare, 22*(3), 175-182.

Nicoletti, A., Sofia, V., Giuffrida, S., Bartoloni, A., Bartalesi, F., Bartolo, M. L., Salazar, E. (2000). Prevalence of stroke a door-to-door survey in rural Bolivia. *Stroke, 31*(4), 882-885.

Nøkleby, K., Boland, E., Bergersen, H., Schanke, A.-K., Farner, L., Wagle, J., & Wyller, T. B. (2008). Screening for cognitive deficits after stroke: a comparison of three screening tools. *Clinical rehabilitation, 22*(12), 1095-1104.

Nowakowska, K., Adamiak, G., Jablkowska, K., Lewandowska, A., Stetkiewicz, A., & Borkowska, A. (2009). Cognitive deficits and depressive disorders in cerebral stroke patients. [Polish]

Nys, G., Van Zandvoort, M., De Kort, P., Jansen, B., De Haan, E., & Kappelle, L. (2006). Cognitive disorders in acute stroke: prevalence and clinical determinants. *Cerebrovascular Diseases (Basel, Switzerland), 23*(5-6), 408-416.

Nys, G., Van Zandvoort, M., De Kort, P., Jansen, B., Kappelle, L., & De Haan, E. (2005). Restrictions of the Mini-Mental State Examination in acute stroke. *Archives of Clinical Neuropsychology, 20*(5), 623-629.

Nys, G. M. S., van Zandvoort, M. J. E., van der Worp, H. B., de Haan, E. H. F., de Kort, P. L. M., Jansen, B. P. W., & Kappelle, L. J. (2006). Early cognitive impairment predicts long-term depressive symptoms and quality of life after stroke. *Journal of the neurological sciences, 247*(2), 149-156.

Nys, G. M. S., Van Zandvoort, M. J. E., Van Der Worp, H. B., De Haan, E. H. F., De Kort, P. L. M., & Kappelle, L. J. (2005). Early depressive symptoms after stroke: Neuropsychological correlates and lesion characteristics. *Journal of the neurological sciences, 228*(1), 27-33.

O'Bryant, S. E., Humphreys, J. D., Smith, G. E., Ivnik, R. J., Graff-Radford, N. R., Petersen, R. C., & Lucas, J. A. (2008). Detecting dementia with the mini-mental state examination in highly educated individuals. *Archives of Neurology, 65*(7), 963-967.

Oder, W., Hufgard, J., Binder, H., Zeiler, K., & Deecke, L. (1991). Depression, nonverbal intellectual impairment and quality of life following left-brain ischemic insult--results of a catamnestic study. [German]

Ogunniyi, A., Daif, A., Al-Rajeh, S., AbdulJabbar, M., Al-Tahan, A., Al-Bunyan, M., & Shamina, A. (1998). Dementia in Saudi Arabia: experience from a university hospital. *Acta Neurologica Scandinavica, 98*(2), 116-120.

Ong, K. L., Cheung, B. M., Man, Y. B., Lau, C. P., & Lam, K. S. (2007). Prevalence, awareness, treatment, and control of hypertension among United States adults 1999–2004. *Hypertension, 49*(1), 69-75.

World Health Organization, W. H. (2006). *Neurological disorders: public health challenges*: World Health Organization.

Ostir, G. V., Raji, M. A., Ottenbacher, K. J., Markides, K. S., & Goodwin, J. S. (2003). Cognitive function and incidence of stroke in older Mexican Americans. *Journals of Gerontology - Series A Biological Sciences and Medical Sciences, 58*(6), 531-535.

Ouimet, M., Primeau, F., & Cole, M. (2001). Psychosocial risk factors in poststroke depression: A systematic review. *The Canadian Journal of Psychiatry / La Revue canadienne de psychiatrie, 46*(9), 819-828.

Owolabi, M. (2012). Taming the Burgeoning Stroke Epidemic in Africa: Stroke Quadrangle to the Rescue (P01. 002). *Neurology, 78*(Meeting Abstracts 1), P01. 002.

Påhlman, U., Sävborg, M., & Tarkowski, E. (2012). Cognitive dysfunction and physical activity after stroke: the Gothenburg cognitive stroke study in the elderly. *Journal of Stroke and Cerebrovascular Diseases, 21*(8), 652-658.

Parikh, R. M., Lipsey, J. R., Robinson, R. G., & Price, T. R. (1987). Two-year longitudinal study of post-stroke mood disorders: dynamic changes in correlates of depression at one and two years. *Stroke, 18*(3), 579-584.

Park, K.-C., Yoon, S.-S., & Rhee, H.-Y. (2011). Executive dysfunction associated with stroke in the posterior cerebral artery territory. *Journal of clinical neuroscience, 18*(2), 203-208.

Passier, P., Visser-Meily, J., Van Zandvoort, M., Post, M., Rinkel, G., & Van Heugten, C. (2009). Prevalence and determinants of cognitive complaints after aneurysmal subarachnoid hemorrhage. *Cerebrovascular Diseases (Basel, Switzerland), 29*(6), 557-563.

Passier, P. E. C. A., Visser-Meily, J. M. A., Van Zandvoort, M. J. E., Post, M. W. M., Rinkel, G. J. E., & Van Heugten, C. (2010). Prevalence and determinants of cognitive complaints after Aneurysmal Subarachnoid Hemorrhage. *Cerebrovascular Diseases, 29*(6), 557-563.

Patel, M. D., Coshall, C., Rudd, A. G., & Wolfe, C. D. (2002). Cognitive Impairment after Stroke: Clinical Determinants and Its Associations with Long-Term

Stroke Outcomes. *Journal of the American Geriatrics Society, 50*(4), 700-706.

Paul, N., Das, S., Avij'it Hazra, M., Ghosal, M. K., & Ray, B. K. (2015). Depression Among Stroke Survivors: A Community-based, Prospective Study. *Am J Geriatr Psychiatry, 21*, 821.

Pendlebury, S. T., Mariz, J., Bull, L., Mehta, Z., & Rothwell, P. M. (2012). MoCA, ACE-R, and MMSE Versus the National Institute of Neurological Disorders and Stroke–Canadian Stroke Network Vascular Cognitive Impairment Harmonization Standards Neuropsychological Battery After TIA and Stroke. *Stroke, 43*(2), 464-469.

Perlmutter, M. S., Bhorade, A., Gordon, M., Hollingsworth, H. H., & Baum, M. C. (2010). Cognitive, visual, auditory, and emotional factors that affect participation in older adults. *American Journal of Occupational Therapy, 64*(4), 570-579.

Philipose, L. E., Alphs, H., Prabhakaran, V., & Hillis, A. E. (2007). Testing conclusions from functional imaging of working memory with data from acute stroke. *Behav Neurol, 18*(1), 37-43.

Pohjasvaara, T., Erkinjuntti, T., Vataja, R., & Kaste, M. (1997). Dementia three months after stroke Baseline frequency and effect of different definitions of dementia in the Helsinki Stroke Aging Memory Study (SAM) cohort. *Stroke, 28*(4), 785-792.

Pohjasvaara, T., Leskela, M., Vataja, R., Kalska, H., Ylikoski, R., Hietanen, M., Erkinjuntti, T. (2002). Post-stroke depression, executive dysfunction and functional outcome. *Eur J Neurol, 9*(3), 269-275.

Pohjasvaara, T., Vataja, R., Leppävuori, A., Kaste, M., & Erkinjuntti, T. (2002). Cognitive functions and depression as predictors of poor outcome 15 months after stroke. *Cerebrovascular Diseases, 14*(3-4), 228-233.

Poungvarin, N. (1998). Stroke in the developing world. *The Lancet, 352*, S19-S22.

Pustokhanova, L., & Morozova, E. (2013). Cognitive impairment and hypothymia in post stroke patients. *Journal of the neurological sciences, 325*(1-2), 43-45.

Radman, N., Staub, F., Aboulafia-Brakha, T., Berney, A., Bogousslavsky, J., & Annoni, J.-M. (2012). Poststroke fatigue following minor infarcts: A prospective study. *Neurology, 79*(14), 1422-1427.

Rajashekaran, P., Pai, K., Thunga, R., & Unnikrishnan, B. (2013). Post-stroke depression and lesion location: A hospital based cross-sectional study. *Indian journal of psychiatry, 55*(4), 343-348.

Raju, R. S., Sarma, P. S., & Pandian, J. D. (2010). Psychosocial problems, quality of life, and functional independence among Indian stroke survivors. *Stroke, 41*(12), 2932-2937.

Ramasubbu, R. (1999). Psychobiology of stroke: a neglected area. *CMAJ: Canadian Medical Association Journal, 160*(6), 779.

Rasquin, S., Lodder, J., & Verhey, F. (2005). Predictors of reversible mild cognitive impairment after stroke: a 2-year follow-up study. *Journal of the neurological sciences, 229*, 21-25.

Rasquin, S., Lodderb, J., Winkens, I., Jolles, J., & Verhey, F. R. (2004). Cognitive functioning after stroke: a one-year follow-up study. *Dement Geriatr Cogn Disord, 18*, 138-144.

Rasquin, S., Verhey, F., Lousberg, R., Winkens, I., & Lodder, J. (2002). Vascular cognitive disorders: memory, mental speed and cognitive flexibility after stroke. *Journal of the neurological sciences, 203*, 115-119.

Rastenyte, D., & Kranciukaite, D. (2007). Poststroke depression and its impact on quality of life. [Lithuanian]

Poinsultine depresija ir jos itaka gyvenimo kokybei. *Medicina (Kaunas, Lithuania), 43*(1), 1-9.

Rees, G., Wojciulik, E., Clarke, K., Husain, M., Frith, C., & Driver, J. (2000). Unconscious activation of visual cortex in the damaged right hemisphere of a parietal patient with extinction. *Brain, 123 (Pt 8)*, 1624-1633.

Reitan, R. (1955). The relation of the Trail Making Test to organic brain damage./. consult: Psychol.

Riepe, M. W., Riss, S., Bittner, D., & Huber, R. (2003). Screening for cognitive impairment in patients with acute stroke. *Dementia and geriatric cognitive disorders, 17*(1-2), 49-53.

Ringman, J., Saver, J., Woolson, R., Clarke, W., & Adams, H. (2004). Frequency, risk factors, anatomy, and course of unilateral neglect in an acute stroke cohort. *Neurology, 63*(3), 468-474.

Robert, A. A., & Zamzami, M. M. (2014). Stroke in Saudi Arabia: a review of the recent literature. *The Pan African medical journal, 17*.

Robinson, R., & Price, T. (1982). Post-stroke depressive disorders: a follow-up study of 103 patients. *Stroke, 13*(5), 635-641.

Robinson, R. G. (2006). *The clinical neuropsychiatry of stroke: Cognitive, behavioral and emotional disorders following vascular brain injury*: Cambridge University Press.

Robinson, R. G., Bolla-Wilson, K., Kaplan, E., Lipsey, J. R., & Price, T. R. (1986). Depression influences intellectual impairment in stroke patients. *The British Journal of Psychiatry, 148*(5), 541-547.

Robinson, R. G., & Spalletta, G. (2010). Poststroke depression: a review. *Canadian journal of psychiatry. Revue canadienne de psychiatrie, 55*(6), 341.

Robinson, R. G., Starr, L. B., Kubos, K. L., & Price, T. (1983). A two-year longitudinal study of post-stroke mood disorders: findings during the initial evaluation. *Stroke, 14*(5), 736-741.

Rovee-Collier, C., Hayne, H., & Colombo, M. (2000). *The development of implicit and explicit memory* (Vol. 24): John Benjamins Publishing.

Sachdev, P. S., Chen, X., Joscelyne, A., Wen, W., & Brodaty, H. (2007). Amygdala in stroke/transient ischemic attack patients and its relationship to cognitive impairment and psychopathology: the Sydney Stroke Study. *The American journal of geriatric psychiatry, 15*(6), 487-496.

Sagen, U., Finset, A., Moum, T., Mørland, T., Vik, T. G., Nagy, T., & Dammen, T. (2010). Early detection of patients at risk for anxiety, depression and apathy after stroke. *General hospital psychiatry, 32*(1), 80-85.

Sahni, R., & Weinberger, J. (2007). Management of intracerebral hemorrhage. *Vascular health and risk management, 3*(5), 701.

Saka, Ö., McGuire, A., & Wolfe, C. (2009). Cost of stroke in the United Kingdom. *Age and ageing, 38*(1), 27-32.

Sampson, M. J., Kinderman, P., Watts, S., & Sembi, S. (2003). Psychopathology and autobiographical memory in stroke and non-stroke hospitalized patients. *International journal of geriatric psychiatry, 18*(1), 23-32.

Santos, C. O., Caeiro, L., Ferro, J. M., Albuquerque, R., & Figueira, M. L. (2006). Denial in the first days of acute stroke. *Journal of neurology*, *253*(8), 1016-1023.

Santos, M., Gold, G., Kövari, E., Herrmann, F. R., Bozikas, V. P., Bouras, C., & Giannakopoulos, P. (2009). Differential impact of lacunes and microvascular lesions on poststroke depression. *Stroke, 40*(11), 3557-3562.

Santos, M., Kövari, E., Gold, G., Bozikas, V. P., Hof, P. R., Bouras, C., & Giannakopoulos, P. (2009). The neuroanatomical model of post-stroke depression: towards a change of focus? *Journal of the neurological sciences, 283*(1), 158-162.

Saxena, S., Ng, T., Yong, D., Fong, N., & Koh, G. (2008). Subthreshold depression and cognitive impairment but not demented in stroke patients during their rehabilitation. *Acta Neurologica Scandinavica, 117*(2), 133-140.

Schaapsmeerders, P., Maaijwee, N. A., van Dijk, E. J., Rutten-Jacobs, L. C., Arntz, R. M., Schoonderwaldt, H. C., de Leeuw, F.-E. (2013). Long-term cognitive impairment after first-ever ischemic stroke in young adults. *Stroke, 44*(6), 1621-1628.

Schielke, E., Busch, M. A., Hildenhagen, T., Holtkamp, M., Kuchler, I., Harms, L., & Masuhr, F. (2005). Functional, cognitive and emotional long-term outcome of patients with ischemic stroke requiring mechanical ventilation. *Journal of neurology, 252*(6), 648-654.

Schouten, E. A., Schiemanck, S. K., Brand, N., & Post, M. W. (2009). Long-term deficits in episodic memory after ischemic stroke: evaluation and prediction

of verbal and visual memory performance based on lesion characteristics. *Journal of Stroke and Cerebrovascular Diseases, 18*(2), 128-138.

Scott, C. L., Phillips, L. H., Johnston, M., Whyte, M. M., & MacLeod, M. J. (2012). Emotion processing and social participation following stroke: study protocol. *BMC neurology, 12*(1), 56.

Sharpe, M., Hawton, K., House, A., Molyneux, A., Sandercock, P., Bamford, J., & Warlow, C. (1990). Mood disorders in long-term survivors of stroke: associations with brain lesion location and volume. *Psychological medicine, 20*(04), 815-828.

Sibolt, G., Curtze, S., Melkas, S., Pohjasvaara, T., Kaste, M., Karhunen, P. J., . . . Erkinjuntti, T. (2013). Post-stroke depression and depression-executive dysfunction syndrome are associated with recurrence of ischaemic stroke. *Cerebrovascular Diseases, 36*(5-6), 336-343.

Sienkiewicz-Jarosz, H., Milewska, D., Bochyńska, A., Chełmniak, A., Dworek, N., Kasprzyk, K., . . . Zyluk, B. (2010). Predictors of depressive symptoms in patients with stroke–a three-month follow-up. *Neurologia i neurochirurgia polska, 44*(1), 13-20.

Sinanović, O., Mrkonjić, Z., Zukić, S., Vidović, M., & Imamović, K. (2011). Post-stroke language disorders. *Acta clinica Croatica, 50*(1), 79-93.

Singh, A., Herrmann, N., & Black, S. E. (1998). The importance of lesion location in poststroke depression: a critical review. *Can J Psychiatry, 43*(9), 921-927.

Sinyor, D., Amato, P., Kaloupek, D., Becker, R., Goldenberg, M., & Coopersmith, H. (1986). Post-stroke depression: relationships to functional impairment, coping strategies, and rehabilitation outcome. *Stroke, 17*(6), 1102-1107.

Sirven, J. I., & Malamut, B. L. (2008). *Clinical Neurology of the Older Adult*: Wolters Kluwer Health/Lippincott Williams & Wilkins.

Snaphaan, L., & de Leeuw, F.-E. (2007). Poststroke Memory Function in Nondemented Patients A Systematic Review on Frequency and Neuroimaging Correlates. *Stroke, 38*(1), 198-203.

Solfrizzi, V., D'Introno, A., Colacicco, A. M., Capurso, C., Del Parigi, A., Caselli, R. J., Capurso, A. (2007). Incident occurrence of depressive symptoms among

patients with mild cognitive impairment–the Italian longitudinal study on aging. *Dementia and geriatric cognitive disorders, 24*(1), 55-64.

Sorokina, N., Selitskii, G., & Kositsyn, N. (2004). A neuropsychological and neurophysiological study of memory impairments in patients with left-hemispheric stroke during rehabilitation. *Human Physiology, 30*(5), 516-520.

Spalletta, G., Guida, G., De Angelis, D., & Caltagirone, C. (2002). Predictors of cognitive level and depression severity are different in patients with left and right hemispheric stroke within the first year of illness. *Journal of neurology, 249*(11), 1541-1551.

Stanczak, D. E., Stanczak, E. M., & Awadalla, A. W. (2001). Development and initial validation of an Arabic version of the Expanded Trail Making Test: Implications for cross-cultural assessment. *Archives of Clinical Neuropsychology, 16*(2), 141-149.

Stapleton, T., Ashburn, A., & Stack, E. (2001). A pilot study of attention deficits, balance control and falls in the subacute stage following stroke. *Clinical rehabilitation, 15*(4), 437-444.

Starkstein, S. E., Robinson, R. G., Honig, M. A., Parikh, R. M., Joselyn, J., & Price, T. R. (1989). Mood changes after right-hemisphere lesions. *The British Journal of Psychiatry, 155*(1), 79-85.

Starkstein, S. E., Robinson, R. G., Honig, M. A., Parikh, R. M., Joselyn, J., & Price, T. R. (1989). Mood changes after right-hemisphere lesions. *British Journal of Psychiatry, 155*(JUL.), 79-85.

Starr, J. M., Nicolson, C., Anderson, K., Dennis, M. S., & Deary, I. J. (2000). Correlates of informant-rated cognitive decline after stroke. *Cerebrovasc Dis, 10*(3), 214-220. doi: 16059

Stephens, S., Kenny, R., Rowan, E., Allan, L., Kalaria, R., Bradbury, M., & Ballard, C. (2004). Neuropsychological characteristics of mild vascular cognitive impairment and dementia after stroke. *International journal of geriatric psychiatry, 19*(11), 1053-1057.

Stroke Assoication (2016). *State of the Nation Stroke statistics - January 2016.* Available at: https://www.stroke.org.uk/sites/default/files/stroke_statistics_2015.pdf

Stuss, D. T., & Knight, R. T. (2013). *Principles of frontal lobe function*: Oxford University Press.

Sutcliffe, L. M., & Lincoln, N. B. (1998). The assessment of depression in aphasic stroke patients: the development of the Stroke Aphasic Depression Questionnaire. Clinical Rehabilitation, 12(6), 506-513.

Tang, W. K., Chan, S. S., Chiu, H. F., Ungvari, G. S., Wong, K. S., Kwok, T. C., Ahuja, A. T. (2006). Frequency and clinical determinants of poststroke cognitive impairment in nondemented stroke patients. *Journal of geriatric psychiatry and neurology, 19*(2), 65-71.

Tang, W. K., Chen, Y., Lu, J., Liang, H., Chu, W. C. W., Mok, V. C. T., Wong, K. S. (2012). Frontal infarcts and anxiety in stroke. *Stroke, 43*(5), 1426-1428.

Tang, W. K., Lu, J. Y., Chen, Y. K., Chu, W. C., Mok, V., Ungvari, G. S., & Wong, K. S. (2010). Association of frontal subcortical circuits infarcts in poststroke depression: a magnetic resonance imaging study of 591 Chinese patients with ischemic stroke. *Journal of geriatric psychiatry and neurology*, 0891988710392375.

Tatemichi, T., Desmond, D., Stern, Y., Paik, M., Sano, M., & Bagiella, E. (1994). Cognitive impairment after stroke: frequency, patterns, and relationship to functional abilities. *Journal of Neurology, Neurosurgery & Psychiatry, 57*(2), 202-207.

Taylor-Piliae, R. E., Hepworth, J. T., & Coull, B. M. (2013). Predictors of depressive symptoms among community-dwelling stroke survivors. *Journal of Cardiovascular Nursing, 28*(5), 460-467.

Teasell, R., Hussein, N., Viana, R., Donaldson, S., & Madady, M. (2014). *Clinical Consequences of Stroke*: EBRSR.

Terroni, L., Sobreiro, M., Conforto, A. B., Adda, C. C., Guajardo, V. D., de Lucia, M. C. S., & Fráguas, R. (2012). Association among depression, cognitive

impairment and executive dysfunction after stroke. *Dement Neuropsychol, 6*(3), 152-157.

Thomas, S. A., & Lincoln, N. B. (2006). Factors relating to depression after stroke. *British Journal of Clinical Psychology, 45*(1), 49-61.

Thomas, T., Stephen, B., & Colin, M. (2000). The global burden of cerebrovascular disease. *Global Burden Dis, 21*(06), 06.

Ting, D. S., Pollock, A., Dutton, G. N., Doubal, F. N., Ting, D. S., Thompson, M., & Dhillon, B. (2011). Visual neglect following stroke: current concepts and future focus. *Survey of ophthalmology, 56*(2), 114-134.

Tombaugh, T. N. (2004). Trail Making Test A and B: normative data stratified by age and education. *Archives of Clinical Neuropsychology, 19*(2), 203-214.

Tsouna-Hadjis, E., Vemmos, K. N., Zakopoulos, N., & Stamatelopoulos, S. (2000). First-stroke recovery process: the role of family social support. Archives of physical medicine and rehabilitation, 81(7), 881-887.

Townend, B., Whyte, S., Desborough, T., Crimmins, D., Markus, R., Levi, C., & Sturm, J. (2007). Longitudinal prevalence and determinants of early mood disorder post-stroke. *Journal of clinical neuroscience, 14*(5), 429-434.

Townend, E., Tinson, D., Kwan, J., & Sharpe, M. (2010). 'Feeling sad and useless': an investigation into personal acceptance of disability and its association with depression following stroke. *Clinical rehabilitation*.

Truelsen, T., Thudium, D., & Grønbæk, M. (2002). Amount and type of alcohol and risk of dementia The Copenhagen City Heart Study. *Neurology, 59*(9), 1313-1319.

Vallar, G. (1998). Spatial hemineglect in humans. *Trends in cognitive sciences, 2*(3), 87-97.

van Rijsbergen, M. W., Mark, R. E., de Kort, P. L., & Sitskoorn, M. M. (2014). Subjective cognitive complaints after stroke: a systematic review. *Journal of Stroke and Cerebrovascular Diseases, 23*(3), 408-420.

Van Zandvoort, M., Kessels, R., Nys, G., De Haan, E., & Kappelle, L. (2005). Early neuropsychological evaluation in patients with ischaemic stroke provides valid information. *Clinical neurology and neurosurgery, 107*(5), 385-392.

Vataja, R., Pohjasvaara, T., Leppävuori, A., Mäntylä, R., Aronen, H. J., Salonen, O., Erkinjuntti, T. (2001). Magnetic resonance imaging correlates of depression after ischemic stroke. *Archives of general psychiatry, 58*(10), 925-931.

Verhoeven, C. L. M., Post, M. W. M., Schiemanck, S. K., Van Zandvoort, M. J. E., Vrancken, P. H., & Van Heugten, C. M. (2011). Is cognitive functioning 1 year poststroke related to quality of life domain? *Journal of Stroke and Cerebrovascular Diseases, 20*(5), 450-458.

Wang, Y., Li, P., Zhang, M., Zhang, H. H., Liu, S., & Zhou, Y. Y. (2013). Cross-sectional analysis of cognitive Impairment and relative factors after acute ischemic stroke. [Chinese]. *Chinese Journal of Contemporary Neurology and Neurosurgery, 13*(4), 279-285.

Warlow, C., Dennis, M., & Gijn, J. (1998). Stroke; A practical guide to management: London, Blackwell Science2007.

Warlow, C. P., Dennis, M. S., van Gijn, J., Hankey, G. J., Sandercock, P. A., Bamford, J. M., & Wardlaw, J. M. (2001). *Stroke: a practical guide to management*: Wiley-Blackwell.

Wehling, E., Tyvoll, H., Hofstad, H., Lundervold, A., Gramstad, A., Skouen, J. S., Sorensen, L. (2012). *Attention Deficit In Stroke Patients 12 Months After Discharge From Hospital.* Paper presented at the Brain Injury.

Weismer, S. E., Evans, J., & Hesketh, L. J. (1999). An examination of verbal working memory capacity in children with specific language impairment. *Journal of Speech, Language, and Hearing Research, 42*(5), 1249-1260.

Whelan-Goodinson, R., Ponsford, J., & Schönberger, M. (2009). Validity of the Hospital Anxiety and Depression Scale to assess depression and anxiety following traumatic brain injury as compared with the Structured Clinical Interview for DSM-IV. Journal of affective disorders, 114(1), 94-102.

Wilz, G., & Barskova, T. (2007). Predictors of psychological and somatic components of poststroke depression: a longitudinal study. *Topics in stroke rehabilitation, 14*(3), 25-40.

Withall, A., Brodaty, H., Altendorf, A., & Sachdev, P. S. (2011). A longitudinal study examining the independence of apathy and depression after stroke: the Sydney Stroke Study. *International Psychogeriatrics, 23*(02), 264-273.

Wityk, R. J., & Llinas, R. H. (2007). *Stroke*: American College of Physicians.

Wong, G. K. C., Lam, S. W., Ngai, K., Wong, A., Siu, D., Poon, W. S., & Mok, V. (2013). Cognitive domain deficits in patients with aneurysmal subarachnoid haemorrhage at 1 year. *Journal of Neurology, Neurosurgery and Psychiatry, 84*(9), 1054-1058.

World Health Statistics. (2012). (W. H. Organisation Ed.).

Yaqub, B. A., Shamena, A. R., Kolawole, T. M., & Patel, P. J. (1991). Cerebrovascular disease in Saudi Arabia. *Stroke, 22*(9), 1173-1176.

Yen, C. H., Yeh, C. J., Wang, C. C., Liao, W. C., Chen, S. C., Chen, C. C., Lee, M. C. (2010). Determinants of cognitive impairment over time among the elderly in Taiwan: results of the national longitudinal study. *Archives of gerontology and geriatrics, 50 Suppl 1*, S53-57.

Yohannes, A. M., Roomi, J., Waters, K., & Connolly, M. J. (1998). A comparison of the Barthel index and Nottingham extended activities of daily living scale in the assessment of disability in chronic airflow limitation in old age. Age and ageing, 27(3), 369-374.

Yoo, S., Jeong, Y., & Kim, D. (2009). The relationship between poststroke depression and cognitive impairment in the patients of subacute stroke. *Journal of the neurological sciences, 283*(1), 296-297.

Zerfass, R., Kretzschmar, K., & Forstl, H. (1992). Depressive symptoms after brain infacts are related to frontal localisation, cortical atrophy and cognitive impairment. [German]

Zerfass, R., Kretzschmar, K., & Förstl, H. (1992). Depressive disorders after cerebral infarct. Relations to infarct site, brain atrophy and cognitive deficits. *Der Nervenarzt, 63*(3), 163-168.

Zhang, C. Q., Fang, X. H., Liu, H. J., Li, S. T., Li, N. Y., Zheng, Y., & Tang, Z. (2009). Prevalence and influent factors of post-stroke depression among

patients with ischemic stroke living in a community of Beijing. [Chinese]. *Chinese Journal of Cerebrovascular Diseases, 6*(2), 57-60.

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta psychiatrica scandinavica, 67*(6), 361-370.

Zuccarello, M. (2015). *Intracerebral hemorrhage (ICH)*. Retrieved August 25, 2015, from Mayfield Clinic : http://www.mayfieldclinic.com/PE-ICH.HTM#.VdvzBiWqpBc

Appendices

Appendix 1: List of keywords and search strategy used in the Medline (Ovid)

	Terms	KEY WORDS	COMBINATION
Stroke	Stroke	1. exp Stroke, Lacunar/ or exp Stroke/	9. (stroke or Lacunar or "Basal Ganglia Cerebrovascular Disease" or "Cerebrovascular Trauma" or "Cerebrovascular Disorders" or "Cerebral Hemorrhage" or Hemorrhage or "Brain Stem Hemorrhage" or "Subarachnoid Hemorrhage, Traumatic" or "Brain Hemorrhage, Traumatic" or "Cerebral Hemorrhage, Traumatic" or "Subarachnoid Hemorrhage" or "Intracranial Hemorrhage, Hypertensive" or "Brain Ischemia" or Ischemia or "Ischemic Attack, Transient" or "Infarction, Middle Cerebral Artery" or "Brain Infarction" or "Infarction" or "Infarction, Posterior Cerebral Artery" or "Cerebral Infarction" or "Infarction, Anterior Cerebral
	Cerebrovascular	2. exp Basal Ganglia Cerebrovascular Disease/ or exp Cerebrovascular Trauma/ or exp Cerebrovascular Disorders/	
	Hemorrhage OR Heamorrhage	3. Cerebral Hemorrhage/ or Hemorrhage/ or Brain Stem Hemorrhage, Traumatic/ or Subarachnoid Hemorrhage, Traumatic/ or Brain Hemorrhage, Traumatic/ or Cerebral Hemorrhage, Traumatic/ or Basal Ganglia Hemorrhage/ or Subarachnoid Hemorrhage/ or Intracranial Hemorrhage, Hypertensive/	
	Ischemia OR ischaemia OR ischemic	4. exp Brain Ischemia/ or exp Ischemia/ exp Ischemic Attack, Transient/	
	Infraction	5. exp Infarction, Middle Cerebral Artery/ or exp Brain Infarction/ or Infarction/ or exp Infarction, Posterior Cerebral Artery/ or exp Cerebral Infarction/ or exp Infarction, Anterior Cerebral Artery/	

			Artery" or Geriatrics or Embolism or "Intracranial Embolism" or Thromboembolism or Thrombosis).ti. **Total: 122192** Limit to (humans and yr="1980 - 2013" and "all adult (19 plus years)")
	Geriatric	6. exp Geriatrics/	
	emboli*	7. exp Stroke/ or exp Embolism/ or exp Intracranial Embolism/	
	Thrombo*	8. exp Thromboembolism/ or exp Thrombosis/	
Cognitive dysfunction	Cognitive	10. exp Delirium, Dementia, Amnestic, Cognitive Disorders/ or exp Mild Cognitive Impairment/	16. (Delirium or Dementia or Amnestic or "Cognitive Disorders" or "Mild Cognitive Impairment" or "Cognition Disorders" or Cognition or "Alzheimer Disease" or "Neuropsychological Tests" or Neuropsychiatry or "Psychiatric Status Rating Scales" or "Mental Disorders" or "Vascular dementia" or Multi-Infarct or "Frontotemporal Dementia").ti. **Total: 33283** limit to (humans and yr="1980 - 2013" and "all adult (19 plus years)")
	Cognition	11. exp Cognition Disorders/ or exp Cognition/	
	Neuropsych*	12. exp Dementia/ or exp Cognition Disorders/ or exp Alzheimer Disease/ or exp Neuropsychological Tests/ or exp Neuropsychiatry/	
	Mini Mental State Examination	13. exp Psychiatric Status Rating Scales/ or exp Alzheimer Disease/ or exp Dementia/ or exp Neuropsychological Tests/ or exp Mental Disorders/ or exp Cognition Disorders/	
	Dementia	14. exp Delirium, Dementia, Amnestic, Cognitive Disorders/ or exp Dementia, Vascular/ or exp Dementia, Multi-Infarct/ or exp Dementia/ or exp Frontotemporal Dementia/	
	Alzheimer	15. exp Alzheimer Disease/	

		17. (#9 AND 16 AND #23) limit to (humans and yr="1980 - 2013" and "all adult (19 plus years)")	**Total: 1062**
Depression	Depression	18. exp Depression/	25. (Depression or "depressive disorder" or "Major depressive disorder" or "Treatment-Resistant" or "Psychological Tests" or Stress or "psychological stress" or "Brief Psychiatric Rating Scale" or "Psychiatric Status Rating Scales" or Emotions or "Affective Symptoms" or "psychological Questionnaires" or effect or "poststroke" or "post-stroke" or "post stroke").ti. **Total: 196543** limit to (humans and yr="1980 - 2013" and "all adult (19 plus years)")
	Depressive	19. exp Depressive Disorder, Major/ or exp Depressive Disorder/ or exp Depressive Disorder, Treatment-Resistant/	
	Psychological	20. exp Psychological Tests/ or exp Stress, Psychological/	
	Psychiatric	21. exp Brief Psychiatric Rating Scale/ or exp Psychiatric Status Rating Scales/	
	Emotional	22. exp Emotions/ or exp Stress, Psychological/ or exp Affective Symptoms/ or exp Questionnaires/	
	mood	23. exp Affect/	
	Poststroke OR post-stroke OR post stroke	24. (poststroke or post-stroke or post stroke)[ti]	
		26. (#9 AND 16 AND #25).ab. (humans and yr="1980 - 2013" and "all adult (19 plus years)")	**Total: 685**

Appendix 2: List of keywords and search strategy used in the EMBASE

	Terms	KEY WORDS	COMBINATION
Stroke	Stroke	1. exp cerebrovascular accident/	9. (stroke or "cerebrovascular accident" or "cerebrovascular disease" or "cerebrovascular accident" or bleeding or "brain ischemia" or ischemia or "transient ischemic attack" or "brain infarction" or geriatrics or embolism or "brain embolism" or thrombosis or thromboembolism).ti. **Total: 17321** limit to (human and yr="1980 - 2013" and (adult <18 to 64 years> or aged <65+ years>))
	cerebrovascular	2. exp cerebrovascular disease/ or exp cerebrovascular accident/	
	Hemorrhage OR haemorrhage	3. exp bleeding/	
	Ischemia OR ischemic OR ischaemia	4. exp brain ischemia/ or exp ischemia/ exp transient ischemic attack/	
	Infraction	5. exp brain infarction/	
	Geriatric	6. exp geriatrics/	
	Emboli*	7. exp embolism/ or exp brain embolism/	
	Thrombo*	8. exp thrombosis/ or exp thromboembolism/	
Cognitive dysfunction	Cognitive	10. exp mild cognitive impairment/ or exp cognitive rehabilitation/ or exp Montreal cognitive assessment/ or exp cognitive defect/	16. ("mild cognitive impairment" or "cognitive rehabilitation" or "Montreal cognitive assessment" or "cognitive defect" or "cognition assessment" or cognition or "neuropsychological test" or neuropsychology or "psychological aspect" or "mental health" or "Mini Mental State Examination" or "psychological rating scale" or "mental disease" or dementia or "senile dementia" or "dementia assessment" or "multiinfarct dementia" or "presenile dementia"
	Cognition	11. exp cognition assessment/ or exp cognition/	
	Neuropsych*	12. exp cognitive defect/ or exp dementia/ or exp neuropsychological test/ or exp cognition/ or exp Alzheimer disease/ or exp neuropsychology/ or exp psychological aspect/	
	Mini Mental State Examination	13. exp Alzheimer disease/ or exp mental health/ or exp cognitive defect/ or exp Mini Mental State	

		Examination/ or exp cognition/ or exp psychological rating scale/ or exp mental disease/ or exp dementia/	or "mixed depression and dementia" or "frontal variant frontotemporal dementia" or "Cornell Scale for Depression in Dementia" or "Clinical Dementia Rating" or "semantic dementia" or "frontotemporal dementia" or "Alzheimer Disease Assessment Scale" or "Alzheimer disease").ti. **Total: 3655** limit to (human and yr="1980 - 2013" and (adult <18 to 64 years> or aged <65+ years>))
	Dementia	14. exp senile dementia/ or exp dementia assessment/ or expmultiinfarct dementia/ or exppresenile dementia/ or exp dementia/ or exp "mixed depression and dementia"/ or exp frontal variant frontotemporal dementia/ or exp Cornell Scale for Depression in Dementia/ or exp Clinical Dementia Rating/ or exp semantic dementia/ or expfrontotemporal dementia/	
	Alzheimer	15. exp Alzheimer Disease Assessment Scale/ or exp Alzheimer disease/	
		17. (# 9 AND # 16).ti. limit to (human and yr="2013" and (adult <18 to 64 years> or aged <65+ years>)	**Total: 1009**
Depression	Depression	18. exp depression assessment/ or exp Self-rating Depression Scale/ or exp late life depression/ or exp Beck Depression Inventory/ or exp Hamilton Depression Rating Scale/ or exp long term depression/ or exp "Hospital Anxiety and Depression Scale"/ or exp major depression/ or exp Geriatric Depression	24.(depression or "depression assessment" or "Self-rating Depression Scale" or "late life depression" or "Beck Depression Inventory" or "Hamilton Depression Rating Scale" or "long term depression" or "Hospital Anxiety and Depression Scale" or "major depression" or "Geriatric Depression

		Scale/ or exp Montgomery Asberg Depression Rating Scale/ or exp "mixed depression and dementia"/ or exp depression/ or exp depression inventory/ or exp Cornell Scale for Depression in Dementia/ or exp Zung Self Rating Depression Scale/ or exp Depression Anxiety Stress Scale/	Scale" or "Montgomery Asberg Depression Rating Scale" or "mixed depression and dementia" or "depression inventory" or "Cornell Scale for Depression in Dementia" or "Zung Self Rating Depression Scale" or "Depression Anxiety Stress Scale" or "psychological well being" or "psychological aspect" or "psychological distress assessment" or "psychological wellbeing assessment" or "psychological rating scale" or "Brief Psychiatric Rating Scale" or "Psychiatric Symptom Index" or "emotional stress" or "emotional disorder" or "Profile of Mood States" or "mood change" or "Mood Disorder Questionnaire" or mood or "mood disorder assessment" or "mood disorder" or hemiplegia or aphasia).ti. **Total: 3796** limit to (human and yr="1980 - 2013" and (adult <18 to 64 years> or aged <65+ years>))
	Psychological	19. exp psychological well being/ or exp psychological aspect/ or exp psychological distress assessment/ or exp psychological wellbeing assessment/ or exp psychological rating scale/	
	Psychiatric	20. exp Brief Psychiatric Rating Scale/ or exp Psychiatric Symptom Index/	
	Emotional	21. exp emotional stress/ or expemotional disorder/	
	Mood	22. exp "Profile of Mood States"/ or exp mood change/ or exp Mood Disorder Questionnaire/ or exp mood/ or exp mood disorder assessment/ or exp mood disorder/	
	poststroke OR post-stroke OR post stroke	23. exp depression/ or exp Stroke/ or exp cerebrovascular disease/ or exp cerebrovascular accident/ or exp hemiplegia/ or exp aphasia/	

Appendix 3: List of keywords and search strategy used in the PsycINFO (Ovid)

	Terms	KEY WORDS	COMBINATION
Stroke	Stroke	1. exp Cerebrovascular Accidents/ or exp Cerebral Ischemia/ or exp Brain Damage/ or exp Ischemia/	9. (stroke or "Cerebrovascular Accidents" or "Cerebral Ischemia" or "Brain Damage" or Ischemia or "Cerebrovascular Disorders" or Hemorrhage or "Cerebral Hemorrhage" or "Subarachnoid Hemorrhage" or "Cardiovascular System" or Geriatrics or "Alzheimer's Disease" or Embolisms or Thromboses).ti. **Total: 16616** limit to (human and adulthood <18+ years> and yr="1980 - 2013")
	Cerebrovascular	2. exp Cerebrovascular Disorders/ or exp Cerebrovascular Accidents/	
	Hemorrhage OR Haemorrhage	3. expHemorrhage/ or exp Cerebral Hemorrhage/ or exp Subarachnoid Hemorrhage/	
	Ischemia OR ischemic OR ischaemia	4. exp Ischemia/ or exp Cerebral Ischemia/ or exp Brain Damage/ or exp Cerebrovascular Disorders/ or exp Cerebrovascular Accidents/ or exp Cardiovascular System/	
	Infraction	5. exp Cerebrovascular Accidents/ or exp Cerebral Ischemia/ or exp Subarachnoid Hemorrhage/ or exp Cerebral Hemorrhage/	
	geriatric	6. exp Geriatrics/	
	emboli*	7. expThromboses/ or exp Cerebrovascular Disorders/ or exp Cerebral Ischemia/ or exp Alzheimer's Disease/ or exp Cerebrovascular Accidents/ or exp Embolisms/	
	Thrombo*	8. exp Cerebrovascular Accidents/ or expThromboses/ or exp Cerebrovascular Disorders/ or exp Embolisms/	

Cognitive dysfunction	Cognitive	10. exp Cognitive Ability/ or exp Cognitive Impairment/ or exp Cognitive Processes/ or exp Cognitive Psychology/ or exp Cognitive Appraisal/ or exp Cognitive Rehabilitation/ or exp Cognitive Neuroscience/ or exp Cognitive Assessment/	16.("Cognitive Ability .ti. OR Cognitive Impairment .ti. OR Cognitive Processes .ti. OR Cognitive Psychology .ti. OR Cognitive Appraisal .ti. OR Cognitive Rehabilitation .ti. OR "Cognitive Neuroscience" or "Cognitive Assessment" or Cognition or Neuropsychology or "Neuropsychological Rehabilitation" or "Neuropsychological Assessment" or "Mini Mental State Examination" or "Vascular Dementia" or Dementia or "Semantic Dementia" or "Presenile Dementia" or "Senile Dementia" or "Alzheimer's Disease").ti. **Total: 27164** limit 5 to (human and adulthood <18+ years> and yr="1980 - 2013")
	Cognition	11. exp Cognition/	
	Neuropsych*	12. exp Cognitive Ability/ or exp Neuropsychology/ or exp Neuropsychological Rehabilitation/ or exp Cognition/ or exp Neuropsychological Assessment/	
	Mini Mental State Examination	13. exp Mini Mental State Examination/	
	Dementia	14. exp Vascular Dementia/ or exp Dementia/ or exp Semantic Dementia/ or expPresenile Dementia/ or exp Senile Dementia	
	Alzheimer's	15. exp Cognitive Impairment/ or exp Alzheimer's Disease/ or exp Dementia/	
		17. (#9 AND #16).ti. limit 10 to (human and adulthood <18+ years> and yr="1980 - 2013")	**Total: 1157**

Depression	Depression	18. exp Major Depression/ or exp "Depression (Emotion)"/ or exp Beck Depression Inventory/ or expZungs Self Rating Depression Scale/ or exp "Long-term Depression (Neuronal)"/	24. ("Depression" or "Major Depression" or "Depression (Emotion)" or "Beck Depression Inventory" or "Zungs Self Rating Depression Scale" or "Long-term Depression (Neuronal)" or "Psychological Assessment" or "Psychological Screening Inventory" or "Psychiatric Evaluation" or "Psychiatric Symptoms" or "Emotional Disturbances" or "Emotional States").ti. **Total: 33759** limit 13 to (human and adulthood <18+ years> and yr="1980 - 2013")
	Psychological	19. exp Psychological Assessment/ or exp Psychological Screening Inventory/	
	Psychiatric	20. exp Psychiatric Evaluation/ or exp Psychiatric Symptoms/	
	Emotional	21. exp Emotional Disturbances/ or exp Emotional States/	
	Mood	22. exp Emotional States/	
	(poststroke OR post-stroke OR post stroke).	23. exp Major Depression/ or exp "Depression (Emotion)"/	
		24. (#9 AND #16 AND #24).ab. limit 16 to (human and adulthood <18+ years> and yr="1980 - 2013")	**Total: 416**

Appendix 4: Table of excluded studies for the systematic review

No	Authors and published year	Reasons for exclusion
1	Ayerbe et al. (2011)	Correlation analysis not reported. Study was limited to comparison of outcomes of stroke patients with depression and severe depression in the severity of cognitive impairment.
2	Bour, S. Rasquin, M. Limburg, & F. Verhey (2011)	Correlation analysis not reported. Study was limited to comparison between patients with cognitive dysfunction and without in severity of depressive symptoms.
3	Bugarski et al. (2009)	Overall cognitive dysfunction not included. Study was limited to 7 Cognitive domains.
4	Chatterjee, Fall, & Barer (2010)	Limited to the CT-scan abnormalities to compare between depressed and control groups.
5	Downhill & Robinson (1994)	Correlation analysis not reported. Study was limited to Comparison between patients with cognitive impairment and without in the severity of depressive symptoms.
6	Herrmann, S. E. Black, J. Lawrence, C. Szekely, & J. P. Szalai (1998)	Standardised neuropsychological tests not used.
7	M. Kauhanen et al. (1999)	Correlation analysis not reported. Study was limited to comparison between non-depressed, Minor, and Major depression in the severity of dysphasia.
8	Lipsey et al. (1983)	Correlation value not reported.
9	Madureira et al. (2001)	Overall cognitive dysfunction not included. Study was limited to memory impairment.
10	Mok et al. (2009)	Limited to comparison of neuroimaging features between depressive and non-depressive.
11	Murata et al. (2000)	Correlation analysis not reported. Study was limited to comparison between patients with major depression and with without in severity of cognitive impairment.
12	Van Zandvoort et al. (2005)	Study was limited to prevalence of cognitive impairments after stroke.
13	Nys et al. (2005)	Limited to correlations between depressive symptoms and lesion characteristics.
14	Pohjasvaara et al. (2002)	Limited to comparison between depressed and non-depressed in the severity of executive dysfunction.
15	Rasquin et al. (2005)	Correlation analysis not reported. Study was limited to differences between patients with mild cognitive impairment and without in severity depressive symptoms.
16	Robinson et al. (1986)	Correlation value (*r*) not reported.
17	Sampson, Kinderman, Watts, & Sembi (2003)	Overall cognitive dysfunction not included. Study was limited to autobiographical memory.
18	Saxena et al. (2008)	Correlation analysis not reported. Study was limited to comparison between depressed and non-depressed in the severity of cognitive impairment.

19	Barker-Collo (2007)	Overall cognitive dysfunction not included. Study was limited to associations between post-stroke depression and cognitive domains (memory, attention/impulsivity, cognitive speed)
20	Zerfass, Kretzschmar, & Forstl (1992)	Full text article available in German.
21	Yoo et al. (2009)	Full text article available in Chinese.
22	Yen et al. (2010)	Mixed participants.
23	Chahal et al. (2010)	Limited to correlations between neuropsychological and functional outcomes.
24	Sibolt et al. (2013)	Associations between post stroke depression and overall cognitive dysfunction not reported.
25	Camoes-Barbosa et al. (2012)	Full text article available in Spanish.
26	Rasquin et al. (2002)	Limited to examine the occurrence and course of post stroke cognitive disorders.
27	Abdul-sattar & Godab (2013)	Study was limited to examine the possible variables that influence the functional outcomes after stroke.
28	Perlmutter, Bhorade, Gordon, Hollingsworth, & Baum (2010)	Limited to associations between cognition and affect participations after stroke.
29	Nys, et al. (2006)	Overall cognitive dysfunction not included. Study was limited to specific cognitive domains (visual perception and construction, executive functioning, neglect, abstract reasoning, language, verbal memory and visual memory).
30	Patel et al. (2002)	Depression assessment not included.
31	Pohjasvaara, Vataja, Leppävuori, Kaste, & Erkinjuntti (2002)	Limited to examine whether cognitive decline and mood disorder predict functional outcomes after stroke.
32	Solfrizzi et al. (2007)	Limited to assess the possible role of sociodemographic variables in the new depression among mild cognitive impairment stroke patients
33	Farner et al. (2010)	Limited to investigate changes in post stroke depressive symptoms over the 13 months.
34	Wong et al. (2013)	Limited to examine the frequencies of impairments in cognitive domains at one year of stroke.
35	Ouimet, Primeau, & Cole (2001)	Systematic review.
36	Radman et al. (2012)	Limited to examine demographic and neurologic factors for the development fatigue after stroke.
37	Juarez-Cedillo et al. (2013)	Limited to frequencies of cognitive impairment.
38	Morris, Robinson, & Raphael (1990)	Limited to comparison of not depressed, minor depression and major depression in severity of cognitive impairment.
39	Egelko et al. (1988)	Overall cognitive dysfunction not included. Study was limited to cognitive domains.
40	Bolla-Wilson, Robinson, Starkstein, Boston, & Price (1989)	Overall cognitive dysfunction not included. Study was limited to investigate performance on the nine cognitive domains by comparing between depressed and non-depressed.
41	Fan et al. (2011)	Full text article available in Chinese.
42	Withall, Brodaty, Altendorf, & Sachdev (2011)	Study was limited to compare between apathetic and depressed patient after stroke.
43	Barker-Collo et al. (2009)	Limited to frequency attention deficit after stroke.
44	Barker-Collo et al. (2012)	Did not evaluate the relationship between cognitive dysfunction and depression disorder.

45	Ballard et al. (2003)	Depression measurement not included.
46	Aiman M Hamad et al. (2011)	Standardised neuropsychological assessment not included.
47	Liman et al. (2011)	Depression assessment not included.
48	Stephens et al. (2004)	Depression measurement not included.
49	Bokura & Robinson (1997)	Limited to compare the depression scores of these patients for the left caudate lesion group and the right caudate lesion group, for the left subcortical lesion group, and for the right subcortical lesion group.
50	Rastenyte & Kranciukaite (2007)	Full text article available in Lithuanian.
51	Schaapsmeerders et al. (2013)	Correlations between overall cognitive dysfunction and depression not reported.
52	Gialanella & Ferlucci (2009)	Depression assessment not included.
53	Sharpe et al. (1990)	Limited to examine the associations between mood disorders and brain lesion location and volume.
54	Verhoeven et al. (2011)	Correlations between overall cognitive dysfunction and depression scores not reported.
55	Pustokhanova & Morozova (2013)	Correlations between cognitive impairment and hypothermia were examined.
56	Berg, Palomäki, Lehtihalmes, Lönnqvist, & Kaste (2003)	Limit to memory impairment.
57	Cobley, Thomas, Lincoln, and Walker (2011)	Limit to aphasia domain.
58	Broe et al. (1998)	Mixed neurological disorders.
59	Bartczak, Marcinowicz, & Kochanowski (2011)	Full text article available in Polish.
60	Liu, Xie, and Sun (2003)	Full text article available in Chinese.
61	Lu, Qian, Zhou, Zhu, & Shen (2005)	Full text article available in Chinese.
62	Ma, Zhang, & Peng (2005)	Full text article available in Chinese.
63	Makin, Dennis, & Wardlaw (2013)	Systematic review.
64	Ng et al. (2013)	Limited to Identify factors associated with functional outcome
65	Nowakowska et al. (2009)	Full text article available in Polish.
66	Rajashekaran, Pai, Thunga, & Unnikrishnan (2013)	Limited to compare between post stroke and adjustment disorder in lesion locations.
67	Wang et al. (2013)	Full text article available in Chinese.
68	Zhang et al. (2009)	Full text article available in Chinese.
69	M. L. Kauhanen et al. (1999)	Limited to compare between non-depressive and depressive Patients with and without dysphasia in severity cognitive domains.
70	Morris, Raphael, & Robinson (1992)	Limited to examine the effect of clinical depression on recovery from stroke.
71	Oder, Hufgard, Binder, Zeiler, & Deecke (1991)	Full text article available in German.
72	Schielke et al. (2005)	Correlations between overall cognitive dysfunction and depression scores not included.
73	Brodaty, Withall, Altendorf, & Sachdev (2007)	Compared between depressed and non-depressed in dementia.

Appendix 5: The quality appraisal checklist

12 questions to help you make sense of cohort study

How to use this appraisal tool

Three broad issues need to be considered when appraising a cohort study:

- **Are the results of the study valid?** **(Section A)**
- **What are the results?** **(Section B)**
- **Will the results help locally?** **(Section C)**

The 12 questions on the following pages are designed to help you think about these issues systematically. The first two questions are screening questions and can be answered quickly. If the answer to both is "yes", it is worth proceeding with the remaining questions.

There is some degree of overlap between the questions, you are asked to record a "yes", "no" or "can't tell" to most of the questions. A number of italicised prompts are given after each question. These are designed to remind you why the question is important. Record your reasons for your answers in the spaces provided.

These checklists were designed to be used as educational tools as part of a workshop setting

There will not be time in the small groups to answer them all in detail!

(A) Are the results of the study valid?

Screening Questions

1. Did the study address a clearly focused issue? ☐ Yes ☐ Can't tell ☐ No

HINT: A question can be 'focused' In terms of

- The population studied
- The risk factors studied
- The outcomes considered
- Is it clear whether the study tried to detect a beneficial or harmful effect?

---

2. Was the cohort recruited in an acceptable way? ☐ Yes ☐ Can't tell ☐ No

HINT: Look for selection bias which might compromise the generalisibility of the findings:

- Was the cohort representative of a defined population?
- Was there something special about the cohort?
- Was everybody included who should have been included?

Is it worth continuing?

Detailed questions

3. Was the exposure accurately measured to minimise bias? ❑ Yes ❑ Can't tell ❑ No

HINT: Look for measurement or classification bias:

- Did they use subjective or objective measurements?
- Do the measurements truly reflect what you want them to (have they been validated)?
- Were all the subjects classified into exposure groups using the same procedure

---

4. Was the outcome accurately measured to minimise bias? ❑ Yes ❑ Can't tell ❑ No

HINT: Look for measurement or classification bias:

- Did they use subjective or objective measurements?
- Do the measures truly reflect what you want them to (have they been validated)?
- Has a reliable system been established for detecting all the cases (for measuring disease occurrence)?
- Were the measurement methods similar in the different groups?
- Were the subjects and/or the outcome assessor blinded to exposure (does this matter)?

5. (a) Have the authors identified all important confounding factors? ❑ Yes ❑ Can't tell ❑ No

List the ones you think might be important, that the author missed.

(b) Have they taken account of the confounding factors in the design and/or analysis? ❑ Yes ❑ Can't tell ❑ No

List:

HINT: Look for restriction in design, and techniques e.g. modelling, stratified-, regression-, or sensitivity analysis to correct, control or adjust for confounding factors

---

6. (a) Was the follow up of subjects complete enough? ❑ Yes ❑ Can't tell ❑ No

(b) Was the follow up of subjects long enough? ❑ Yes ❑ Can't tell ❑ No

HINT: Consider

- The good or bad effects should have had long enough to reveal themselves
- The persons that are lost to follow-up may have different outcomes than those available for assessment
- In an open or dynamic cohort, was there anything special about the outcome of the people leaving, or the exposure of the people entering the cohort?

(B) What are the results?

7. What are the results of this study?

HINT: Consider

- What are the bottom line results?
- Have they reported the rate or the proportion between the exposed/unexposed, the ratio/the rate difference?
- How strong is the association between exposure and outcome (RR,)?
- What is the absolute risk reduction (ARR)?

---

8. How precise are the results?

HINT: Look for the range of the confidence intervals, if given.

---

9. Do you believe the results?

❑ Yes ❑ Can't tell ❑ No

HINT: Consider

- Big effect is hard to ignore!
- Can it be due to bias, chance or confounding?
- Are the design and methods of this study sufficiently flawed to make the results unreliable?
- Bradford Hills criteria (e.g. time sequence, dose-response gradient, biological plausibility, consistency)

(C) Will the results help locally?

10. Can the results be applied to the local population? ❒ Yes ❒ Can't tell ❒ No

HINT: Consider whether

- A cohort study was the appropriate method to answer this question
- The subjects covered in this study could be sufficiently different from your population to cause concern
- Your local setting is likely to differ much from that of the study
- You can quantify the local benefits and harms

---

11. Do the results of this study fit with other available evidence? ❒ Yes ❒ Can't tell ❒ No

---

12. What are the implications of this study for practice?

HINT: Consider

- One observational study rarely provides sufficiently robust evidence to recommend changes to clinical practice or within health policy decision making
- For certain questions observational studies provide the only evidence
- Recommendations from observational studies are always stronger when supported by other evidence

Appendix 6: Approvals

The University of Nottingham

Direct line/e-mail
+44 (0) 115 8232561
Louise.Sabir@nottingham.ac.uk

Faculty of Medicine and Health Sciences

Research Ethics Committee
Division of Respiratory Medicine
D Floor, South Block
Queen's Medical Centre
Nottingham University Hospitals
Nottingham
NG7 2UH

16th December 2013

Sami Al-Arjan
PhD Student in Clinical Psychology
Division of Rehabilitation and Ageing
School of Medicine
B127, Medical School
QMC Campus
Nottingham University Hospitals
Nottingham
NG7 2UH

Dear Sami Al-Arjan

Ethics Reference No: D12122013 SoM Rehab & Age
Study Title: Relationships between cognitive dysfunctions and emotional disorders in ischemic stroke patients: a neuropsychological study.
Chief Investigators/Supervisor: Professor Nadina Lincoln, Professor of Clinical Psychology, Dr Shirley Thomas, Lecturer, Division of Rehabilitation and Ageing, School of Medicine.
Co-Investigator: Sami Al-Arjan, PhD Student in Clinical Psychology, Division of Rehabilitation and Ageing, School of Medicine.
Duration of Study: 01.12.2013-31.03.2014 **No of Subjects:** 100

Thank you for your recent application which was considered by the Committee at its meeting on 12th December 2013 and the following documents were received:

FHMS REC Application form version 1.0, 31.10.2013
Covering letter confirming intention to seek approval and permission from the King Abdulaziz Medical Centre for National Guard, King Fahad Medical City and Prince Sultan Humanitarian City, Riyadh, Saudia Arabia dated 31.10.2013.
Detailed Study proposal version 1.0, 31.10.2013
Information for Participant version 1.0, 09.06.2013 (with Arabic translation)
Patient Consent Form version 1.0, 19.06.2013
ACER III Questionnaire 2012
BCOS Examinees Booklet, Cognition Matters
The Barthel Index, provided by the Internet Stroke Center-www.strokecenter.org
HADS questionnaire

These have been reviewed and is satisfactory and the project proposal is approved.

Approval is given on the understanding that the Conditions of Approval set out below are followed.

1. A Favourable opinion is given on the understanding that all appropriate ethical and regulatory permissions are sought for each overseas project in accordance with all local laws, and that the host organisation involved also gives their permission where applicable.

2. Please submit copies of permission from the relevant Clinical Leads and Research Ethics approval from the King Abdulaziz Medical Centre for National Guard, King Fahad Medical City and Prince Sultan Humanitarian City, Riyadh, Saudia Arabia when these have been granted.

The University of Nottingham

3. You must follow the protocol agreed and inform the Committee of any changes using a notification of amendment form (please request a form).

4. You must notify the Chair of any serious or unexpected event.

5. This study is approved for the period of active recruitment requested. The Committee also provides a further 5 year approval for any necessary work to be performed on the study which may arise in the process of publication and peer review.

6. An End of Project Progress Report is completed and returned when the study has finished (Please request a form).

Yours sincerely

Dr Clodagh Dugdale
Chair, Nottingham University Medical School Research Ethics Committee

Health Affairs Executive Office | File # 13296/2013

Kingdom of Saudi Arabia
Ministry of National Guard - Health Affairs

المملكة العربية السعودية
وزارة الحرس الوطني - الشؤون الصحية

Institutional Review Board

14572 1515 14527 irb@ngha.med.sa

MEMORANDUM

Ref. #: IRBC/372/13

Date: **(G) 23 DECEMBER 2013**
(H) 20 Safar 1435

To: **SAMI SALEH AL-ARJAN**
Principal Investigator - SP13/018
University of Nottingham
Division of Rehabilitation and Ageing
Room B105, Medical School
Queens Medical Centre
Nottingham NG7 2UH UK

Subject: **PROTOCOL SP13/018 : "Relationships Between Cognitive Dysfunctions and Emotional Disorders in Ischemic Stroke Patients: Neuropsychological Study"**

This is in reference to your subject proposal, which has been reviewed by the IRB Office on the 23rd of December 2013 through the expedited review process. Upon recommendation of the Research Committee, and following the review of the IRB on the ethical aspects of the proposal, you are granted permission to conduct your study.

Your research proposal is **approved for one year** commencing from the above memo date with the following conditions:

TERMS OF APPROVAL:

1. **Annual Reports:** Continued approval of this project is dependent on the submission of Annual Report. Please provide KAIMRC with an Annual Report **determined by the date of your letter of approval.**
2. **Amendments to the approved project:** Changes to any aspect of the project require the submission of a Request for Amendment to KAIMRC and must not begin without an approval from KAIMRC. Substantial variations may require a new application.
3. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
4. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by KAIMRC at any time.
5. **Retention and storage of data:** The PI is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.

Prof. Amin Kashmeery
Chairman, Institutional Review Board (IRB)
National Guard Health Affairs

Dr. Ahmed Alaskar
Executive Director, KAIMRC
National Guard Health Affairs

Dr. Bandar Al Knawy
Chief Executive Officer
National Guard Health

AK/AS/jue

P.O. Box 22490, Riyadh 11426
Tel. 8011111
Telex : 403450 NGRMED SJ
KFH - MATERIALS 14574 (05/96) (ORACLE 29795)

ص. ب. ٢٢٤٩٠ الرياض ١١٤٢٦
تلفون ٨٠١١١١١
تلكس ٤٠٣٤٥٠

Kingdom of Saudi Arabia
Ministry of Health
King Fahad Medical City
(162)

وزارة الصحة
مدينه الملك فهد الطبية
King Fahad Medical City

المملكة العربية السعودية
وزارة الصحة
مدينه الملك فهد الطبية
(١٦٢)

IRB Registration Number with KACST, KSA: H-01-R-012
IRB Registration Number with OHRP/NIH, USA: IRB00008644
Approval Number Federal Wide Assurance NIH, USA: FWA00018774

December 18, 2013
IRB Log Number: 13-256E
Department: External
Category of Approval: EXEMPT

Dear Sami Al-Arjan:

I am pleased to inform you that your submission dated December 18, 2013 for the study titled **'Relationships between cognitive dysfunctions and emotional disorders in ischemic stroke patients: a neuropsychological study'** was reviewed and was approved.

You will be required to test the capacity of research subjects to consent and if they have no capacity to obtain consent from a proxy decision maker according to KFMC procedures. A copy of every 10th consent shall be sent to IRB for inspection.

We wish you well as you proceed with the study and request you to keep the IRB informed of the progress on a regular basis, using the IRB log number shown above.

If you have any further questions feel free to contact me.

Sincerely Yours,

Prof. Omar H. Kasule
Chairman Institutional Review Board--IRB.
King Fahd Medical City, Riyadh, KSA.
Tel: + 966 1 288 9999 Ext. 7540
E-mail: okasule@kfmc.med.sa

F M C
Approved
18 DEC 2013
I R B

مدينة سلطان بن عبد العزيز للخدمات الإنسانية
SULTAN BIN ABDULAZIZ HUMANITARIAN CITY

Date: *13th January 2014*

Mr. Samy Al-Arjan
PhD Student
School of Medicine
University of Nottingham
Room B105, Medical School
Queens Medical Centre
Nottingham N G7 2UH

Subject: **"Relationships between cognitive dysfunctions and emotional disorders in ischemic stroke patients: a neuropsychological study"**

Dear Mr. Al-Arjan:

The above mentioned research proposal has been reviewed by the appointed members of the Research and Ethical Committee of the Sultan Bin Abdulaziz Humanitarian City, Riyadh. I am pleased to inform you that this project has been approved by Research and Ethical Committee (Chairman Action).

Your research protocol has now been documented under:

Project Number : 01/2014

Series of 2014–13-01: Kindly quote the project number indicated herein in all transactions and communications. You are advised to submit a progress report this time after three (3) months from approval of your research proposal, in relation to this research schemed we need you to update the Committee of its progress.

I trust our research scheme proves fruitful and beneficial to you, the patients and this Institution.

Thank you.

Best regards,

Dr. Sadi Al Zahrani, M.D.
Chairman of Research & Ethics Committee
Director of Rehabilitation Center/Cons. SLP
Sultan Bin Abdulaziz Humanitarian City
Riyadh, Saudi Arabia

Appendix 7: Information form

بسم الله الرحمن الرحيم

The University of Nottingham

I-WHO Institute of Work, Health & Organisations

Form (1): Information for participant

Consent to participant in a study on:

Relationships between Cognitive Dysfunctions and Emotional Disorders in Ischemic Stroke.

Dear

You are invited to participate in a research study conducted by Sami Al-Arjan, a PhD student Clinical Psychology at the University of Nottingham in the Division of Rehabilitation, School of Medicine [lwxssal@nottingham.ac.uk], under the supervision of **Prof. Nadina Lincoln** [Nadinal.lincoln@nottingham.ac.uk] and **Dr. Shirley Thomas** [shirley.thomas@nottingham.ac.uk].

Please read the information below and feel free to ask questions about anything that is not clear, before deciding whether or not to participate.

A. purpose:

The purpose of this study is to examine how anxiety and depression affect cognitive functioning in a sample of hospital patients in Riyadh, Saudi Arabia, who have suffered a stroke at least one month previously. The type of stroke I am interested in is ischemic stroke. Additionally, to qualify for participation in my study, this needs to be your first stroke.

B. Procedure:

I am aiming to gather information from 100 patients. If you decide to participate, you will be asked to respond to four questionnaires in one session. This will take about one hour. The questionnaires will ask you to complete some cognitive tasks on paper concerning numbers, letters and shapes. In addition, one questionnaire will ask Some questions about your mood.

Each of the four questionnaires will take approximately 15 minutes to complete, using pencil and paper.

Finally, you will be asked to give some personal information such as your age, gender, marital status, and level of education.

النموذج (1): معلومات المشاركة في الدراسة

موافقة للمشاركة في دراسة بعنوان:

العلاقة بين الأضطراب الوظيفي المعرفي والأضطرابات المزاجية لدى مرضى الجلطات الدماغية

عزيزي:

ندعوك للمشاركة في دراسة علمية تُعد من قبل الباحث/ سامي العرجان (طالب دكتوراة في علم النفس الأكلينيكي، قسم التأهيل، كلية الطب في جامعة نوتنغهام في المملكة المتحدة.
lwxssal@nottingham.ac.uk
تحت أشراف البرفيسورة/ نادينا لينكلون
Nadinal.lincoln@nottingham.ac.uk
والدكتورة/ شيريلي توماس
Shirley.thomas@nottingham.ac.uk

مشاركتك في هذا البحث أختيارية ، وعليك قراءة المعلومات أدناه كاملة قبل أتخاذ قرارك، كما أن لك حرية طرح الأسئلة حول أي نقطة تحتاج منا الى توضيح أكثر.

الهدف من الدراسة:

تهدف الدراسة الحالية الى فحص العلاقة بين بين أضطرابات القلق والأكتئاب والأضطربات المعرفية الناتجة عن الجلطات الدماغية لدى عينة من المنومين أو المراجعين لمستشفيات مدينة الرياض بالمملكة العربية السعودية. يشارك في هذه الدراسة عينة مرضى مصابين بالجلطة الدماغية منذ شهر على الأقل بالأضافة الى أنها أول جلطة يصابون بها.

أجراءات الدراسة:

العينة المستهدفه في هذه الدراسة 100 مريض مصاب بالجلطة الدماغية. وفي حالة قررت المشاركة سوف يطلب منك الأجابة الى مجموعة من الأختبارات وعددها أربعة ويستغرق الوقت اللازم أنجازها حوالي ساعة واحدة. الأختبارات التي ستجيب عليها هي مقاييس نفسية تحتوي على أسئلة وأرقام وبعض الأشكال. بالأضافة الى أستبيان آخر يهدف الى قياس الحالة المزاجية، وكل واحد من تلك الأختبارات والأستبيانات قد يستغرق حوالي 15 دقيقة لأكماله، ونستخدم فيها الأوراق وأقلام الرصاص.

في نهاية الفحص سوف نقوم بملئ أستمارة خاصة تحتوي على بعض المعلومات الشخصية مثل العمر، الجنس، الحالة الأجتماعية والمستوى الدراسي.

1

C. Conditions:

Voluntary participation:
Your participation in the study is completely voluntary and you may choose to withdraw from the study at any time.

Withdrawal from the study:
You can stop participating in the study at any time, for any reason, if you so decide. Your decision to stop participating, or to refuse to answer particular questions, will not affect your relationship with the staff in the hospital, or anyone associated with this project. In the event that you withdraw from the study, all associated data collected from you will be immediately destroyed wherever possible.

Confidentiality:
All information you supply during the research will be held in confidence. Data will be used as a part of my research and may be published in academic journals. Your name will not appear in any report or publication of the research. Your data will be safely stored in a locked facility and only research staff will have access to this information.

Questions about the research:
If you have questions about the research in general or about your role in the study, please feel free to contact Sami Al-Arjan either by telephone at 00966504764409 or by e-mail (lwxssal@nottingham.ac.uk).

This research has been reviewed and approved by the Ethics Committee in School of Medicine, University of Nottingham.

D. Risks and discomforts:
We do not foresee any risks or discomfort from your participation in the research. However, due to responding to the questionnaires and participating in the study, some distress might be experienced; this is usually temporary, but if it is not, you may contact the researcher on 0504764409 or medical staff in the hospital.

E. signature
Please read conditions in the consent form attached and sign it if you agree to participate.

Thank you for your time.

Sincerely,
Sami Al-Arjan

الأشتراطات

المشاركة أختيارية:
مشاركتك في هذا البحث أختيارية وتطوعية ولك الحق في أتخاذ قرار عدم المشاركة أو الأنسحاب في أي وقت تراه.

الأنسحاب من الدراسة:
يستطيع المشارك أتخاذ قرار الأنسحاب من أكمال البحث في أي وقت يراه مناسب. وقرارك بعدم المشاركة أو التوقف عن أكمالها لن يؤثر بأي حال من الأحوال على علاقتك مع أعضاء الفريق المعالج في المستشفى أو أي شخص آخر له علاقة بالبحث. كما أنه في حالة أنسحابك سيتم التخلص مباشرة من كافة البيانات والمعلومات التي سبق وأعطيتها للباحث.

السـرية:
كل المعلومات التي تدلي بها خلال البحث سوف تكون سرية بالكامل ، والمعلومات لن تستخدم ألا لأهداف البحث العلمي ، كما أنه لن يتم الأشارة ألى أسمك ولن يظهر فيما لو تم نشر النتائج في أحد المجلات العلمية المتخصصه.
وكل المعلومات التي يتم الحصول سوف يتم الحفاظ عليها جيداً ولا يطلع عليها ألا الباحث والمشرفين والفريق الطبي المعالج.

الأسئلة حول البحث:
للمشارك كامل الحرية في طرح الأسئلة العامة أو المحددة حول موضوع البحث ، ولا تشعر أبداً بالحرج أو التردد بالتواصل مع الباحث/ سامي العرجان شخصياً أو من خلال الهاتف : 00966504764409 أو من خلال الأيميل:
lwxssal@nottingham.ac.uk

لقد تمت الموافقة على أجراءات هذا البحث من قبل لجنة البحوث والدراسات في كلية الطب ، جامعة نوتنغهام.

الخطورة والأنزعاج:
أجراءات البحث الحالي لا يترتب عليها أي خطورة أو أزعاج نفسي أو بدني، ولكن في حالة شعورك بأي ضغط نفسي ناتج عن مشاركتك بالبحث رجاءاً لا تتردد بالأتصال بالباحث مباشرة على الرقم 0504764409 أو التواصل مع أعضاء الفريق الطبي بالمستشفى.

التوقيع:
في حالة الموافقة على أجراءات وشروط البحث نتمنى منك التوقيع على النموذج المرفق.

ولكم جزيل الشكر والتقدير ,,,

الباحث/ سامي العرجان

Version (1) – Date 9 June 2013

Appendix 8: Consent form

بسم الله الرحمن الرحيم

University of Nottingham

United Kingdom

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

جـــامعة نوتنغهام

المملكة المتحدة

Form (2): Patient Consent

Title of the study: Relationships between Cognitive Dysfunctions and Emotional Disorders after Stroke.
Researcher: Sami Al-Arjan, PhD student Clinical Psychology
Supervisors: 1- Prof: Nadina Lincoln, Prof Clinical Psychology
2- Dr. Shirley Thomas , Lecturer in Rehabilitation Psychology.

After I discussed this research project with: ..... ; I reviewed the detailed information that is attached with consent form; I voluntarily agree to participate in this project.:

Patient`s name: .....
Relationship : .....

1- I understand that my participation in this study is CONFIDENTIAL.
2- I understand that I will be taking part in a study, which may, or may not benefit me directly, but it could benefit other patients with ischemic stroke in the future.
3- I understand that I have the right to withdraw from study at any time.
4- My decision to not participating will not affect my treatment.
5- I voluntarily give permission for the researcher to review my medical chart.
6- The researcher will explain the final results of my examination with me.
7- I understand that the data in this study may be published.
8- I agree to take part in this study.

Patient`s signature :.....
Date : .....

Investigator : .....

عنوان الدراسة: العلاقة بين الخلل الوظيفي المعرفي والأضطرابات المزاجية عند مرضى الجلطات الدماغية : دراسة نفسية عصبية

أسم الباحث: سامي صالح العرجان
المشرفين : 1- نادينا لينكولن / بروفيسور علم النفس الأكلينيكي
2- شيرلي توماس/ أستاذ مساعد علم النفس التأهيلي

بعد مناقشة مشروع البحث مع:
.....، وبعد مراجعة كل المعلومات المرفقة مع هذه الموافقة ، أوافق طواعياً على المشاركة في هذه الدراسة :

الأسم : .....
القرابة : .....

أولاً: جميع المعلومات سرية وتستخدم لأغراض البحث فقط.
ثانياً: لقد أطلعت على تفاصيل الدراسة وأستوعبت بأنه لا توجد فائدة مباشرة بالنسبة لي ، ولكن أنا أشارك لأن نتائج الدراسة الحالية قد تكون ذات فائدة لمرضى الجلطات الدماغية في المستقبل.
ثالثاً: أدرك بأنه لي كامل الحق أن أنسحب من أكمال الفحص النفسي في أي وقت أراه مناسباً .
رابعاً: قراري في عدم المشاركة أو الأنسحاب من أكمال البحث لن يؤثر بأي حال من الأحوال على سير علاجي أو علاقتي بالمعالجين.
خامساً: أعطي الأذن كاملاً للباحث بالأطلاع على ملفي الطبي .
سادساً : بعد نهاية الفحص سيقوم الباحث بشرح نتائج الفحص النفسي
سابعاً : النتائج التي يتم التوصل أليها يمكن نشرها على هيئة أرقام فقط.
ثامناً: أوافق طواعياً على المشاركة في الدراسة.

توقيع المريض: .....
التاريخ : .....

الفاحص : .....

Version (1) – Date 19 June 2013

Appendix 9: Psychological tests

اختبـــار أدنبروكـــس المعرفـــي (ACE-R)
النسخـــة المنقحـــة ج (2012)

الاسم:	تاريخ الاختبار: ...../...../.....
تاريخ الميلاد:	اسم الفاحص: .....
رقم الملف الطبي:	سن ترك التعليم: .....
هل الشخص يعتمد على اليد اليمنى أو اليسرى في العمل؟	الوظيفة: .....
.....	

التوجه

الانتباه والتوجه

- اسأل: ما هو — اليوم: ..... | التاريخ: ..... | الشهر: ..... | السنة: ..... | الفصل: ..... — [الدرجة 0–5] ☐
- اسأل: أي — مبنى: ..... | طابق: ..... | مدينة: ..... | المنطقة: ..... | الدولة: ..... — [الدرجة 0–5] ☐

التسجيل

- قل: "سأقوم بإلقاء ثلاث كلمات عليك وأود أن تقوم بتكرارها ورائي: ليمون – مفتاح – كرة". وبعد أن يقوم المفحوص بالتكرار، قل "حاول تذكر الكلمات لأنني سأطرح عليك الأسئلة فيما بعد". سجل فقط درجات المحاولة الأولى (كرر ثلاث مرات عند الضرورة).

سجل عدد المحاولات ..... — [الدرجة 0–3] ☐

الانتباه و التركيز

- اطلب من المفحوص: "هل يمكنك طرح 7 من 100؟ وبعد أن يجيب اطلب من المفحوص طرح 7 من إجمالي خمس عمليات طرح. وإذا قام المفحوص بأي خطأ قم بالمواصلة ثم تحقق من عدد الإجابات الصحيحة. مثلاً: لو كانت إجابات المفحوص على النحو التالي (93، **84**، 77، 70، 63 – سجل 4) فُقر دليل التعليمات.
- اسأل: "هل يمكنك تهجي كلمة **مفرسة** ؟ ثم اطلب من المفحوص القيام بتهجيها بالمقلوب.

.... ❀❀❀ ....

[الدرجة 0–5] ☐ بالنسبة لأفضل أداء للعمل

الذاكرة – الاسترجاع

الذاكرة

- اسأل: "أي ثلاث كلمات طلبت منك القيام بتكرارها وتذكرها؟"

....

[الدرجة 0–3] ☐

الذاكرة – ذاكرة تقدمية

- سأقوم بذكر اسم وعنوان عليك، وأود منك تكرارها ورائي – ستقوم بذلك ثلاث مرات لذا فإنه لديك الفرصة لتذكرها. وسأقوم بطرح أسئلة عليك فيما بعد.

سجل فقط درجات المحاولة الثالثة

	المحاولة الأولى	المحاولة الثانية	المحاولة الثالثة
ناصر سعد	.....	.....	.....
منزل 24	.....	.....	.....
حي السعادة	.....	.....	.....
ممر النور	.....	.....	.....
الدمام	.....	.....	.....

[الدرجة 0–7] ☐

الذاكرة – الذاكرة الرجعية

- ما هي عاصمة الدولة التي نقيم فيها .....
- ما هو اسم الحاكم السابق لبلدك .....
- اسم رئيس الولايات المتحدة الأمريكية .....
- اسم الحاكم الحالي لبلدك .....

[الدرجة 0–4] ☐

7/1

الطلاقة الشفهية – حرف "م" والحيوانات

الطلاقة اللفظية

الحرف

قل: سأقوم بإعطائكم حرف من الحروف الأبجدية وأود منك ذكر أكبر عدد من الكلمات التي يمكنك إعدادها والتي تبدأ بهذا الحرف، ولكن تذكر أنها ليست أسماء أشخاص أو أماكن. هل أنت جاهز؟ لديك دقيقة والحرف هو "م"

[الدرجة 0–7]

7	17<
6	17–14
5	13–11
4	10–8
3	7–6
2	5–4
1	3–2
0	2>
العدد الصحيح	الإجمالي

الحيوانات

قل: "هل يمكنك ذكر أكبر عدد من أسماء الحيوانات بقدر الإمكان؟ (يمكنك أن تبدأ بأي حرف تشاء).

(لديك دقيقة واحدة فقط).

[الدرجة 0–7]

7	21<
6	21–17
5	16–14
4	13–11
3	10–9
2	8–7
1	6–5
0	5>
العدد الصحيح	الإجمالي

اللغة – الإدراك

اللفظية

اظهر التعليمات المكتوبة:

[الدرجة 0–1]

أغلـق عينيـك

أمر مكون من ثلاث مراحل:

خذ الورقة بيدك اليمنى. قم بطي الورقة نصفين. وضع الورقة على الأرض

[الدرجة 0–3]

اللغة – الكتابة

اطلب من المفحوص إعداد جملة وكتابتها في الفراغ أدناه:

قم بتسجيل 1 إذا كانت الجملة تحتوي على بناء صحيح (انظر الدليل للأمثلة)

[الدرجة 0–1]

7/2

اللغة – التكرار

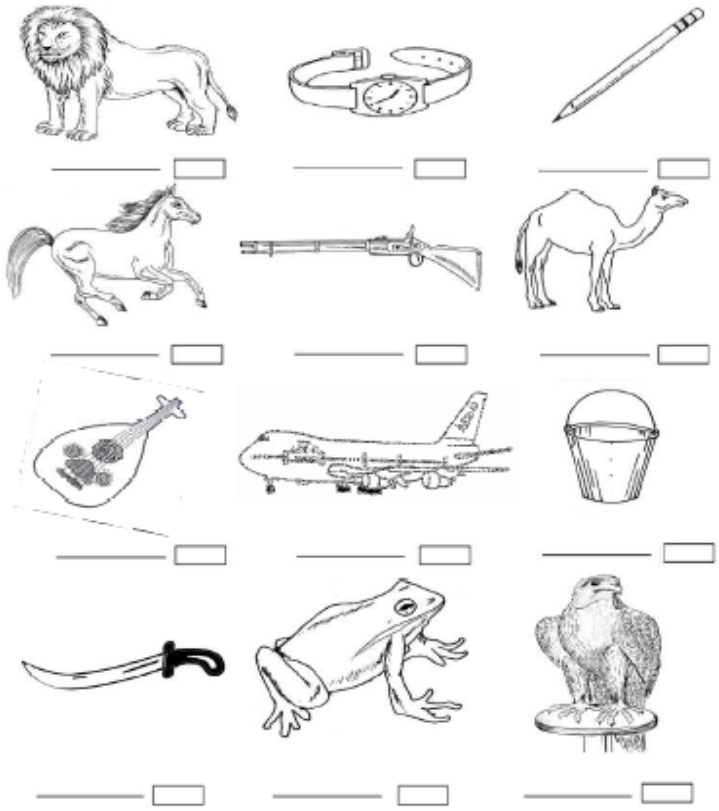
➢ **اطلب من المفحوص تكرار الكلمات التالية (ضيّعتُهيكم، أستلزمتموها، فأسقيناكموه، لتستخلفتهم)**
قم بتسجيل نتيجة كلمتين إذا كانت جميعها صحيحة وكلمة واحدة إذا كانت ثلاث كلمات صحيحة، ولا تقم بتسجيل أي نتيجة إذا كانت الكلمات الصحيحة اثنين أو أقل. [الدرجة 0–2]

➢ *** اطلب من المفحوص تكرار ما يلي: "فوق، إلى ما بعد، وأسفل"** [الدرجة 0–1]

*** اطلب من المفحوص تكرار "لا إذا أو و أو لكن"** [الدرجة 0–1]

اللغة – التسمية

➢ **اطلب من المفحوص تسمية الصور التالية:** [الدرجة 0–2] (قلم مرسم + ساعة)



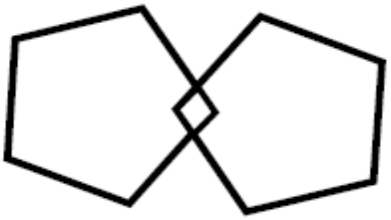
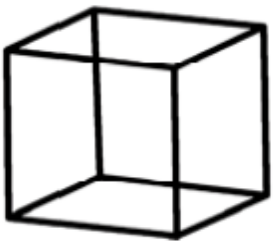
[الدرجة 0–10]

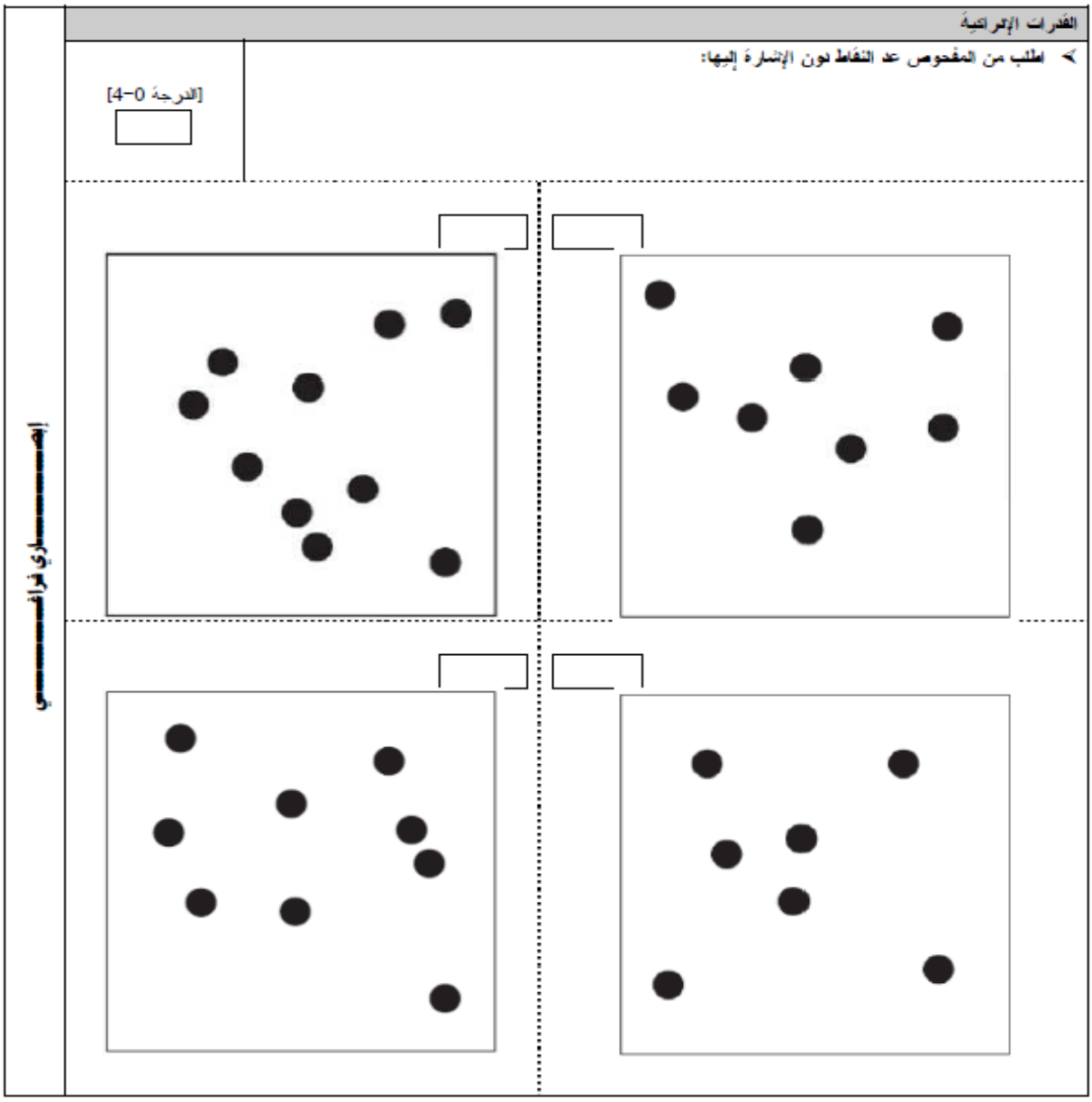
اللغة – الفهم

➢ **باستخدام الصور المذكورة أعلاه اطلب من المفحوص:** [الدرجة 0–4]

- أشر إلى الصورة المرتبطة بإحدى وسائل الحرب القديمة _____
- أشر إلى الصورة المرتبطة بالحيوان الصحراوي _____
- أشر إلى الصورة المرتبطة بالكائن الذي يستخدم للصيد _____
- أشر إلى الصورة المرتبطة بالشيء الذي يستخدم لنقل الماء _____

7/3

النفسية	اللغة – القراءة	
	➢ اطلب من المفحوص قراءة الكلمات التالية [قم بتسجيل درجات واحدة فقط إذا كانت جميعها صحيحة] ☆ فيمَ عمَّ يس طاوٗس إلٰه	[الدرجة 0–1]
إبصاري فسراني	القدرات الإبصارية الفراغية	
	➢ شكلين خماسية متداخلة: اطلب من المفحوص نسخ هذا الرسم 	[الدرجة 0–1]
	➢ متعب سلكي: اطلب من المفحوص نسخ هذا الرسم (لتسجيل الدرجات ، انظر دليل التعليمات) 	[الدرجة 0–2]
	➢ الساعة: اطلب من المفحوص رسم وجه ساعة بها أرقام وتوجد العقارب على الساعة الخامسة وعشر دقائق. (لتسجيل الدرجات انظر دليل التعليمات : الدائرة= 1، الأرقام = 2، العقارب = 2 إذا كانت جميعها صحيحة)	[الدرجة 0–5]


القدرات الإدراكية
اطلب من المفحوص عد النقاط دون الإشارة إليها:
[الدرجة 0-4]
إدراك بصري فراغي

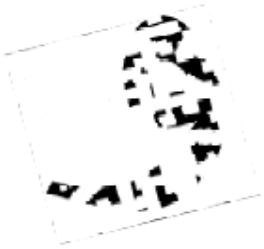
7/5

القدرات الإدراكية

إبصاري فراغي

➢ اطلب من المفحوص التعرف على الحروف:

[الدرجة 0–4]



الاسترجاع

الذاكرة

➢ اسأل "والآن أخبرني ما الذي تتذكره عن ذلك الاسم والعنوان اللذين كنا نكررهما في البداية"

[الدرجة 0–7]

ناصر سعد	.....
منزل 24	.....
حي السعادة	.....
ممر النور	.....
الدمام	.....

الإدراك

➢ يجب إجراء هذا الاختبار إذا أخفق المفحوص في تذكر عنصر أو أكثر. وإذا تم تذكر جميع العناصر تخطي الاختبار وقم بتسجيل 5. وإذا تم فقط تذكر جزء ابدأ بوضع العناصر التي تذكرها في الخانة المظللة على الجانب الأيمن. ثم قم بإجراء اختبار حول العناصر التي لم يتم تذكرها بقولك "حسناً" سوف أعطيك بعض التلميحات: هل كان الاسم اكس أو واي أو زد؟ وما إلى ذلك؟ وتكون نتيجة كل عنصر تم تذكره (1) والتي يتم إضافتها للنقطة التي تم الحصول عليها بالتذكر.

[الدرجة 0–5]

نادر عبد الله	ناصر سعد	تركي حمد	التذكر	
منزل 42	28	24	التذكر	
حي السعادة	حي الشهادة	حي النخل	التذكر	
ممر النور	شارع النصر	طريق الصخور	التذكر	
حائل	الدمام	ألبها	التذكر	

الدرجات العامة		
اختبار أدنبروكس المعرفي (المنقّح)	/100	
الدرجات الفرعية		
الانتباه والتوجيه	/18	
الذاكرة	/26	
الطلاقة	/14	
اللغة	/26	
القدرات الإبصارية الفراغية	/16	

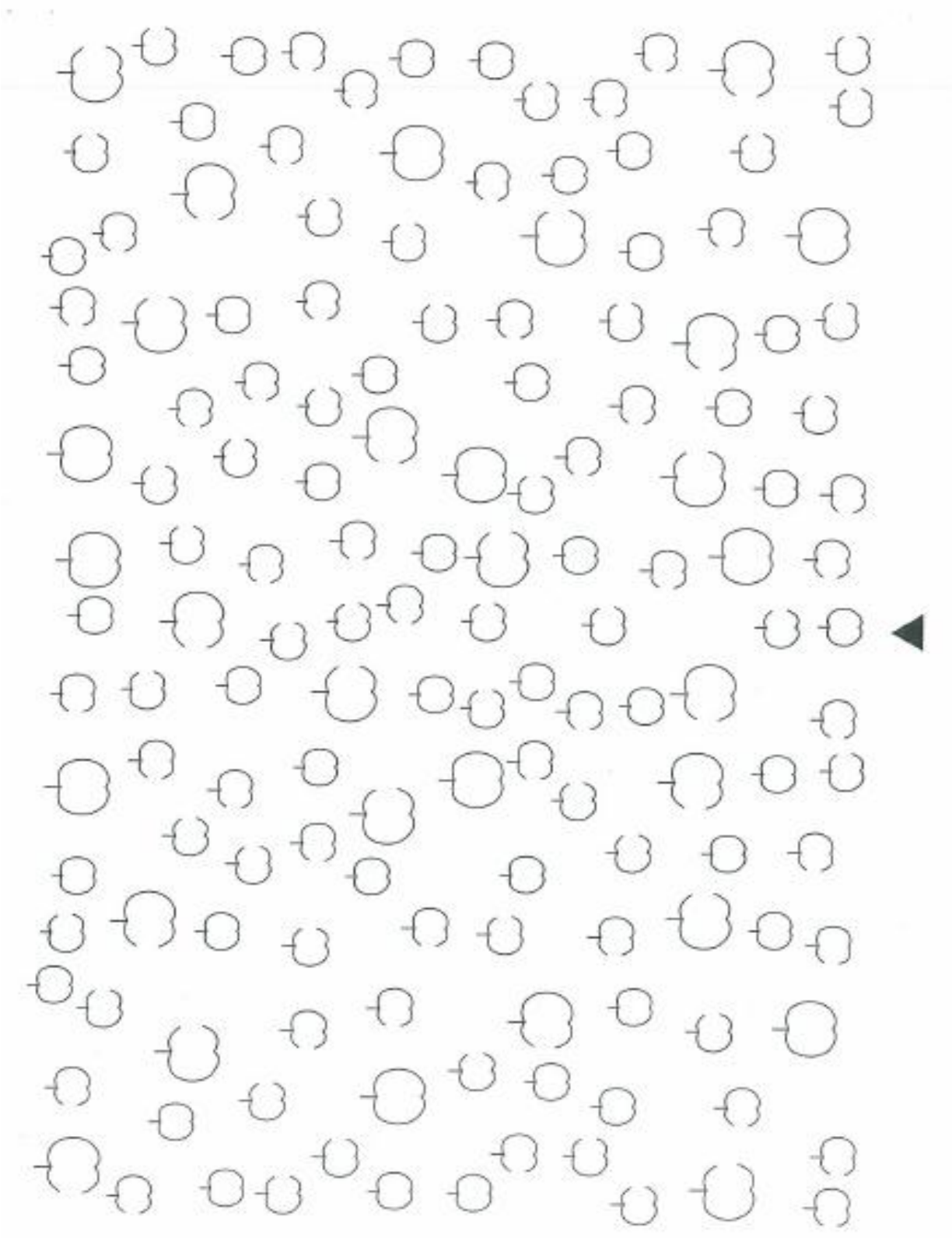
7/7

EXAMINEE'S BOOKLET

Apple Cancellation
Examinee's ID:
Date:

Cross out the full apples

Try this example



7. APPLE CANCELLATION

Examinee's Booklet and stopwatch.

"I will show you a page with apples. Sometimes, the apple is complete, sometimes incomplete. Please cross out the complete apples only. Try this example first." *Give the example and correct if necessary. Two practice trials can be presented (but not more).*
"I give you a few minutes to do the same on this page. Please don't move the page." *Place the test sheet in a landscape position with the black triangle nearest to the examinee's midline and start recording the time.*
- Do NOT give any cues for the test sheet.

- STOP if NO-RESPONSE is made on the practice sheet.
- Allow a MAXIMUM of 5 min. for the task.

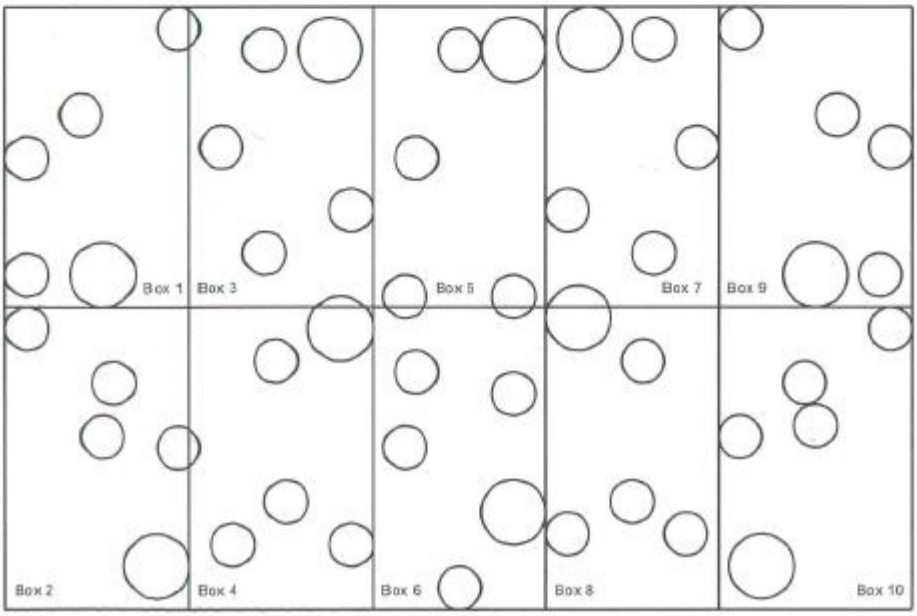
Scoring transparancy can be found in the Test Book.

Boxes as indicated on the template below:

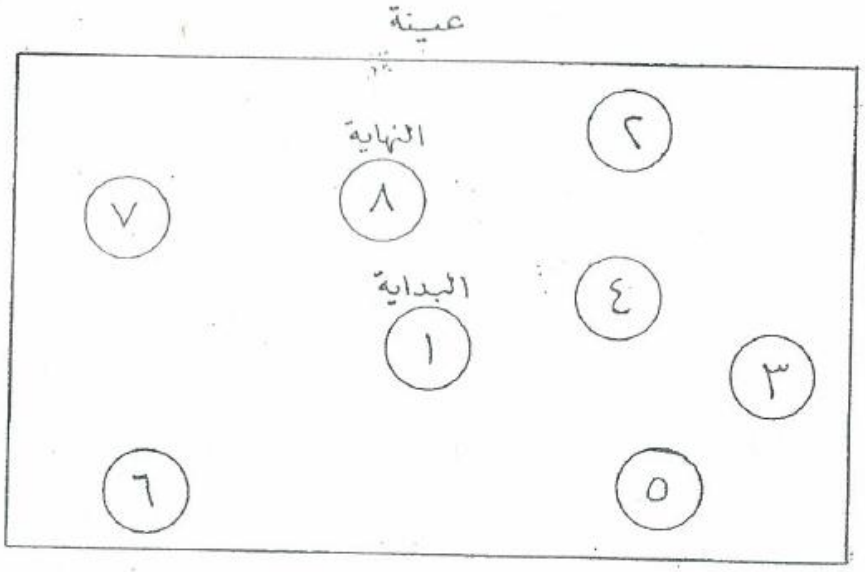
Box1 No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box3** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box5** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box7** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box9** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5
Box2 No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box4** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box6** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box8** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5	**Box10** No. correct: /5 No. false positives with Right opening: /5 with Left opening: /5

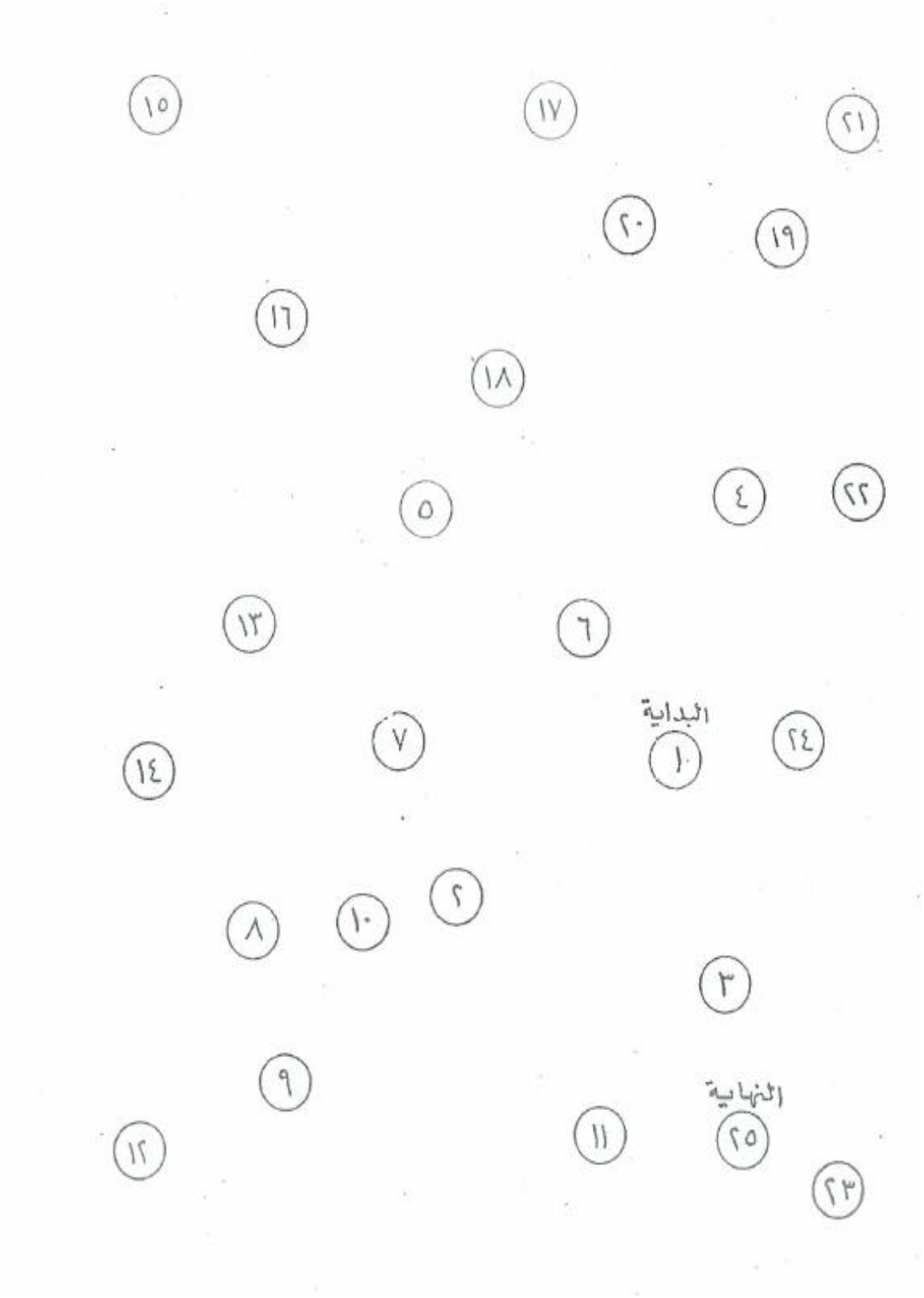
Condition of testing (1=normal; NT or stopped due to 2=aphasia; 3=visual/spatial; 4=confusion; 5=fatigue; 6=motor; 7=other.....)	_____
Total number of complete apples selected	_____/50
Total number of false positives with RIGHT opening	_____/50
Total number of false positives with LEFT opening	_____/50
Asymmetry score for the complete apple (no. correct in boxes 7 + 8 + 9 + 10) *minus* (no. correct in boxes 1 + 2 + 3 + 4)	_____
Asymmetry score for the incomplete apple (no. false positives with LEFT opening) minus (no. false positives with RIGHT opening)	_____

Template for scoring the Apple cancellation test (re-scaled):



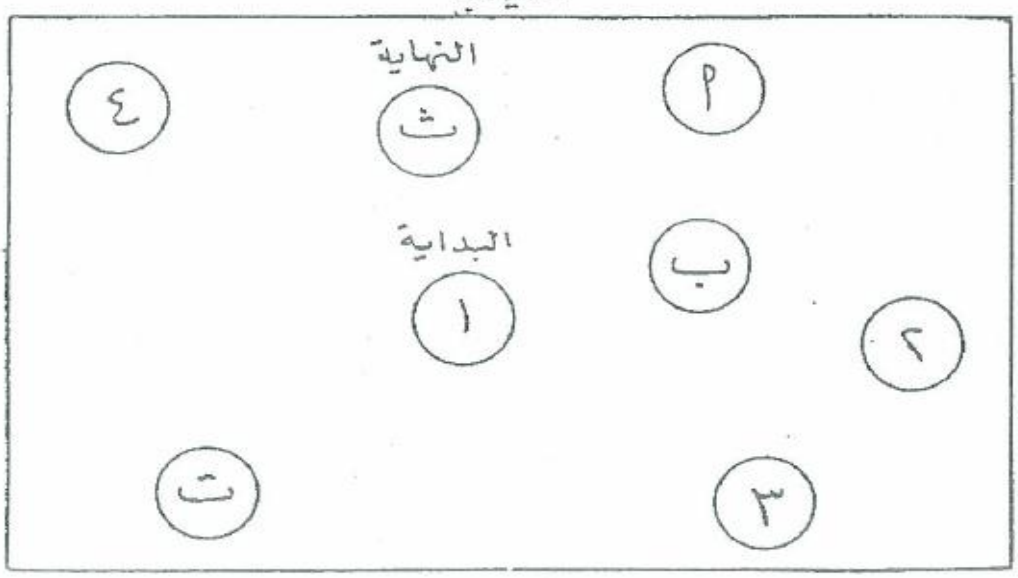
الجزء الأول

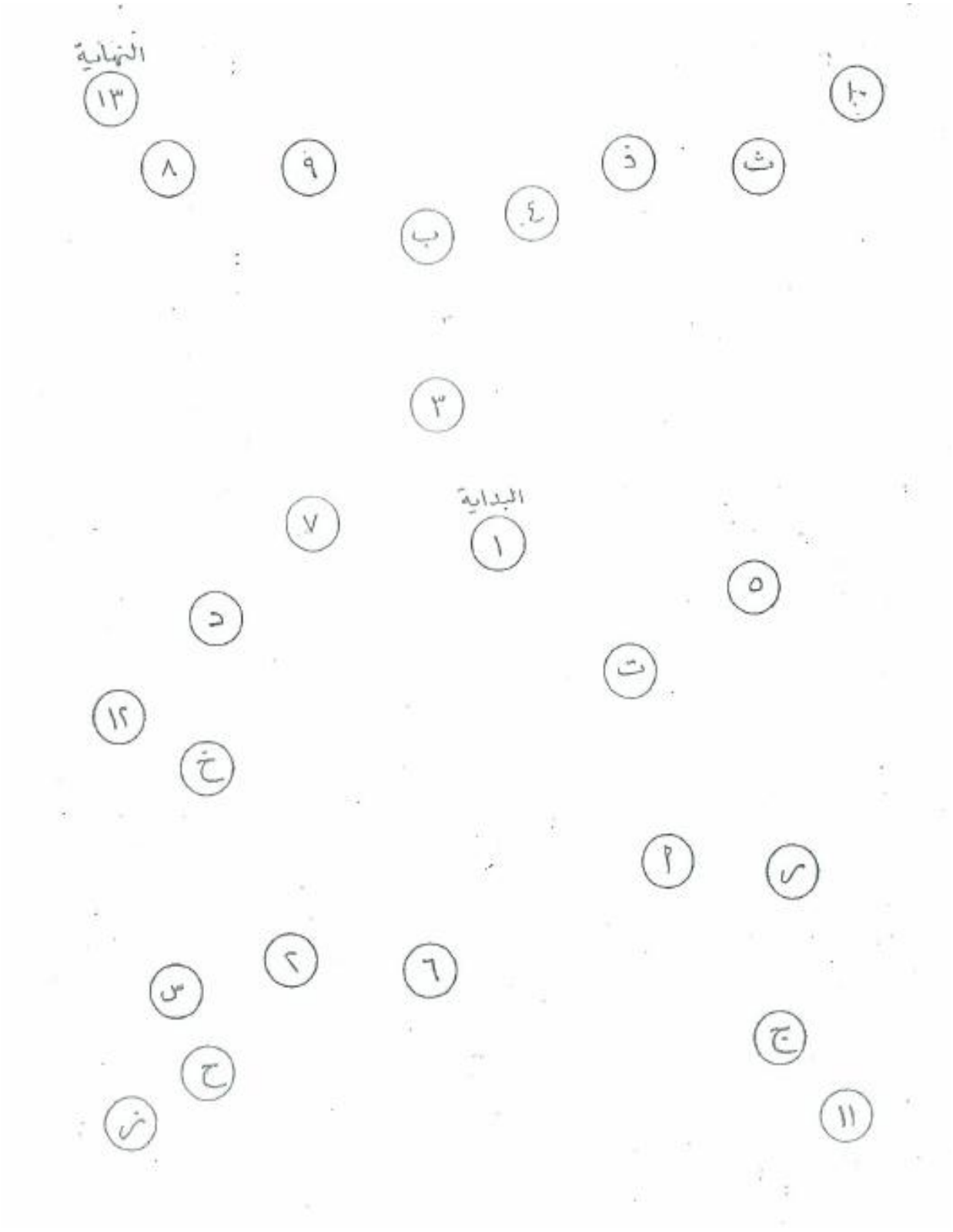



١٥
١٧
٢١
٢٠
١٩
١٦
١٨
٢٢
٤
٥
١٣
٦
البداية
٢٤
٧
١
١٤
٢
١٠
٨
٣
٩
النهاية
١١
٢٥
١٢
٢٣

الجزء الثاني

عينة




النهاية
١٣
١٠
٨
٩
ذ
ث
ع
ب
٣
البداية
٧
١
٥
د
ت
١٢
خ
ر
ز
٢
٦
س
ج
ح
١١
ن

مقياس القلق والاكتئاب (HADS)

يمر معظمنا بانفعالات نفسية مختلفة كنتيجة للظروف التي قد نمر بها، الرجاء اقرأ العبارات التالية **واملأ الدائرة بجانب البديل الذي يمثل إجابتك**، تذكر ليس هناك إجابة صحيحة وأخرى خاطئة، كما أن ليس هناك الإجابة الأفضل، الإجابة الأفضل هي التي تعبر عن ما تشعر به.

1- اشعر بحالة توتر وضيق:
- ○ معظم الوقت
- ○ كثيرا من الوقت
- ○ أحيانا
- ○ لا يحدث ذلك إطلاقا

2- ما زلت استمتع بالأشياء التي كنت استمتع بها من قبل:
- ○ بنفس الدرجة السابقة تماما
- ○ بدرجة اقل قليلا عن ذي قبل
- ○ بدرجة اقل كثيرا عن ذي قبل
- ○ لا أستطيع أن استمتع بأي شئ

3- ينتابني إحساس بالخوف وكأن شيئا سيئا على وشك أن يحدث:
- ○ أكيد وبصورة سيئة جدا
- ○ نعم ولكن ليس بصورة سيئة جدا
- ○ قليلا ولكنه لا يزعجني
- ○ لا إطلاقا

4- أستطيع أن أضحك وأن أرى الفكاهة في المواقف:
- ○ تماما كما كنت من قبل
- ○ بدرجة اقل من ذي قبل
- ○ بالتأكيد ليس مثلما كنت من قبل
- ○ لا إطلاقا

5- تنتابني نوبات من التفكير القلق المزعج:
- ○ معظم الوقت
- ○ كثيرا من الوقت
- ○ احيانا
- ○ قليلا جدا

6- أحس بالفرح والانشراح:
- ○ لا بالمرة
- ○ قليلا
- ○ أحيانا
- ○ في معظم الوقت

7- أستطيع أن أجلس بهدوء وارتياح وأحس بالاسترخاء:
- ○ بالتأكيد
- ○ عادة
- ○ ليس كثيرا
- ○ إطلاقا

8- اشعر وكأني اصبحت خاملا وبطيئا في حركتي:
- ○ في كل الأوقات تقريبا
- ○ في كثير من الأحيان
- ○ في بعض الأحيان
- ○ لا إطلاقا

9-ينتابني إحساس في المعدة كالشعور بالخوف أو وجود حركة بداخلها:
- ○ لا إطلاقا
- ○ أحيانا
- ○ كثيرا
- ○ كثيرا جدا

10- فقدت اهتمامي بمظهري:
- ○ بالتأكيد
- ○ أهتم بمظهري أقل مما ينبغي
- ○ لا أهتم بمظهري كما كنت سابقا
- ○ ما زلت اهتم بمظهري كما كنت

11- ينتابني شعور بالضجر والملل وعدم القدرة على الاستقرار:
- ○ بدرجة كبيرة جدا بالتأكيد
- ○ بدرجة كبيرة
- ○ بدرجة قليلة
- ○ لا إطلاقا

12- أتطلع الى الاستمتاع بالأشياء:
- ○ مثلما كنت دائما
- ○ أقل مما كنت سابقا
- ○ بالتأكيد أقل كثيرا
- ○ لا أتطلع لذلك على الإطلاق

13- تنتابني نوبات مفاجئة من الخوف والرعب والهلع:
- ○ كثيرا جدا
- ○ كثيرا
- ○ أحيانا قليلة
- ○ لا إطلاقا

14- أستطيع أن أستمتع بقراءة كتاب جيد أو الاستماع للراديو أو مشاهدة التلفزيون:
- ○ دائما
- ○ أحيانا
- ○ قليلا
- ○ نادرا

THE BARTHEL INDEX

Patient Name: _____

Rater Name: _____

Date: _____

Activity	Score
FEEDING 0 = unable 5 = needs help cutting, spreading butter, etc., or requires modified diet 10 = independent	_____
BATHING 0 = dependent 5 = independent (or in shower)	_____
GROOMING 0 = needs to help with personal care 5 = independent face/hair/teeth/shaving (implements provided)	_____
DRESSING 0 = dependent 5 = needs help but can do about half unaided 10 = independent (including buttons, zips, laces, etc.)	_____
BOWELS 0 = incontinent (or needs to be given enemas) 5 = occasional accident 10 = continent	_____
BLADDER 0 = incontinent, or catheterized and unable to manage alone 5 = occasional accident 10 = continent	_____
TOILET USE 0 = dependent 5 = needs some help, but can do something alone 10 = independent (on and off, dressing, wiping)	_____
TRANSFERS (BED TO CHAIR AND BACK) 0 = unable, no sitting balance 5 = major help (one or two people, physical), can sit 10 = minor help (verbal or physical) 15 = independent	_____
MOBILITY (ON LEVEL SURFACES) 0 = immobile or < 50 yards 5 = wheelchair independent, including corners, > 50 yards 10 = walks with help of one person (verbal or physical) > 50 yards 15 = independent (but may use any aid; for example, stick) > 50 yards	_____
STAIRS 0 = unable 5 = needs help (verbal, physical, carrying aid) 10 = independent	_____
TOTAL (0–100):	_____