Depression, Personality and Stroke

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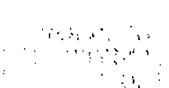

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She was always encouraging, never complaining
and thought more of me than I deserved.

Abstract

Depression is considered to be the most common psychiatric sequelae of stroke and is known to impede rehabilitation and recovery. If it was possible to identify factors present in the acute phase of stroke, which could identify patients at risk of developing affective disorder in the post-stroke period, then early intervention could be implemented to potentially alleviate the symptoms and improve recovery.

The main factors being considered in this study, were the patients' personality characteristics and affective status at the onset of the stroke. Other factors that were considered as potential influences were, age, gender, disability, risk factors, laterality of the CVA and blood measurements recorded in the acute phase of stroke.

The personality and affective status of one hundred and twelve patients and thirty-four co-habiting carers were assessed on three occasions within six months from the onset of stroke. Assessments were carried out within 48 hours of stroke and at 6 weeks and 6 months after stroke, and were performed using standard depression and personality questionnaires: viz. the Beck Depression Inventory (BDI), the Eysenck Personality Scales (EPS) and the Faschingbauer Abbreviated Minnesota Multiphasic Personality Inventory (FAM).

The results demonstrated that similar levels of affective disorder were present in patients and carers at each of the assessments. The percentage of patients and carers whose affective status remained unchanged over the six months was also similar. The study identified a small number of patients who were not depressed in the acute phase of the stroke, and who became depressed during the 6 months after stroke. The onset of depression was associated with being female generally, and being female with a right CVA. No significant association was found between affective status and disability, age or blood measurements.

The outcomes also demonstrated that for patients and carers, depression and certain personality scores, in the acute phase of the stroke, were significant predictors of depression scores at 6 months. There were significant changes in the personality characteristics of patients over the 6 months of the study, which were not replicated in carers. A significant association between the affective status of patients and their carers was also demonstrated, but the association was significant for male patients and female carers only. There was no association between the affective status of female patients and male carers.

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Chapter 1. Introduction

1.1 Physical and psychological effects of stroke

A stroke can result in a number of physical, psychological and social disturbances. The neurological impairments of stroke, which can include hemiplegia, speech and language problems, sensory loss and cognitive deficits, constitute a major burden for stroke patients and their families, as one third of all stroke patients remain functionally dependent for the rest of their lives (House,1987). The psychological features can include denial, anxiety, indifference, emotional lability, shame, anger and affective disorders. These impairments can result in social isolation, decreased community involvement, economic strain, loss of role or status at home or at work, and disruption to family life (Sandin and Mason,1996). Additionally the situation can be aggravated when these emotional difficulties are not admitted to, or not recognized by the patient or the carer.

As with many other illnesses, the effects of stroke can affect how individuals perceive and interpret their situation, their hopes for recovery and how they cope. In the case of stroke in particular, while some studies have shown a relationship between the neurological impairment and resultant functional disability of stroke, and depression (Singh et al.,2000; Herrmann et al.,1998; Sharpe et al.,1994; Ebrahim et al.,1987), others have not shown this association (Thomson et al.,1989; Eastwood et al.,1989; Sinyor et al.,1986). It is also known that the functional disability of stroke can be aggravated by the onset of depression. This can affect the speed of recovery and can have a detrimental effect on the quality of life, not only on the stroke patient but also on their carers. It is also likely that once depression has occurred, additional factors for its maintenance include low socio-economic status, pre-existing social and financial difficulties, poor social support and premorbid depressed mood (Astrom et al.,1992).

Until the mid 1980`s most investigations into the effects of stroke tended to focus on the obvious physical impairments of the patient, and little attention was paid to the psychological sequelae. Reasons for this were that mood disorders, particularly clinical depression, were considered to be understandable responses to the traumatic and disabling effects of stroke. It was also considered that psychological disorders recovered spontaneously after several months and did not merit antidepressant treatment. This approach is surprising, since the results of studies have shown that psychiatric disturbance can be a direct or indirect result of brain damage, and may relate to the amount of brain damage involved (Prigatano,1992; Jennett and Teasdale,1981). It is also known that depression and altered personality, sometimes lasting for many months, can occur as a result of brain injury (Brooks and McKinlay,1983; Aloia et al.,1995).

Since the mid 1980's many studies have indicated that depressed mood and symptoms of depression are prevalent after stroke, and can occur in 20%-60% of patients (Robinson et al.,1981;1982; 1984; Castillo et al.,1993; MacHale et al.,1998). Unfortunately there has been a lack of consensus regarding the classification, aetiology, prevalence and duration of these disorders. This has mainly been due to methodological flaws, such as investigating small cohorts of patients, using inadequate criteria for identifying depression, and failing to follow up original patient cohorts due to high attrition rates.

1.2 Research into post-stroke depression

A main focus of research into post-stroke depression has been to establish a link between the location and size of the brain lesion involved in the stroke, and the incidence of depression. Previous studies on non-stroke patients suffering from clinical depression have shown associations with reduced blood flow in a number of brain regions (Mathew et al.,1980; Chabrol et al.,1986; Sackheim et al.,1990).

In keeping with this approach, the main work in the field of post-stroke depression has been done by Robinson and co-workers from the John Hopkins School in Baltimore in the USA. This group of workers has consistently suggested that patients with left-sided cerebral lesions have a higher incidence of major depression after stroke compared with patients with lesions in other locations (Robinson et al.,1981; 1982; 1984; 1985). While this theory has been confirmed in some studies (Starkstein et al.,1987; Eastwood et al.,1989; Castillo et al.,1993), other studies have found no association between depression and the location of the stroke infarct (Folstein et al.,1977; Sinyor, 1986; Wade et al.,1987; Ebrahim et al.,1987; Kotila et al.,1998). In contrast, the study by McHale et al.(1998) found an association with lesions in the right hemisphere while studies by Yamaguchi(1992) and Grasso et al.(1994) found correlations between depression after stroke and other brain sites, such as subcortical lesions and bilateral hemispheric lesions. Other factors such as gender, age and social class have also been implicated in the prevalence of depression (Sharpe et al.,1994; Sandin and Mason,1996; Herrmann et al.,1998).

Overall, the results of these studies are inconclusive and a recent review and meta-analysis of relevant studies has demonstrated that there is little definitive evidence to support an association between the risk of depression after stroke and the location of the brain lesion (Carson et al.,2000). To-date, the aetiology of the depression has not been properly established, and research has shown that most depression cannot be explained simply as a natural response to neurological or physiological impairment, disability, social isolation or discrimination (Robinson and Price,1982; Wade et al.,1987).

1.3 Background to the current study

The idea that the psychological status of the patient at the onset of the stroke may be a relevant factor in the prevalence of depression after stroke is based on a number of factors. These factors include evidence that there is a considerable level of undiagnosed depression in the community (Bridges and Goldberg,1984;Goldberg,1985) and also in the elderly, and in patients with comorbid medical or psychiatric disorders (Sherbourne et al.,1994; Kessler et al.,1994). There is also evidence from the psychological and psychiatric literature that individuals who are prone to develop clinical depressive illnesses, display certain personality characteristics, which distinguish them from individuals who are not so pre-disposed (Chodoff, 1972; Akiskail et al.,1983; Hirshfield et al.,1983).

In this regard the personality characteristic of neuroticism, which has been shown to increase the vulnerability to depression in non-stroke patients, is associated with the core constructs of dependency and obsessionality, which are also important in depression (Eysenck, 1970; Charney et al.,1981; Hirschfield et al.,1983; Shea et al.,1987). High levels of neuroticism have also been shown to be present in prospective studies, to predict first onset of major depression among the carers of patients suffering from depression, and to predict depression following major stressful events such as hysterectomy and childbirth (Boyce et al.,1991). Furthermore, studies of the personality profiles of recovered depressives have been shown to be different from normals, in that they have demonstrated higher levels of neuroticism, social introversion and dependency and lower levels of extroversion (Hirshfield et al.,1989).

Although few studies have been designed specifically to assess the impact of the baseline psychological status of stroke patients, an interesting factor has recently emerged from the work of Robinson and colleagues, who have maintained for many years that post-stroke depression is related to the location of the brain infarct. In a recent study, Morris and Robinson (1995) have suggested that the personality characteristic of neuroticism may be a risk factor for depression following stroke. Cullum and Bigler (1988;1991) also proposed from their studies that higher depression scores after stroke may be associated with elevations in other clinical personality scales such as paranoia and social introversion, and Thomson et al.(1989) suggest that a depressive or other personality style prior to the onset of stroke may be related to depression after stroke.

It is has also been suggested that the psychological status of the carer may be implicated and may be a contributing factor in the prevalence of depression after stroke. Previous studies have demonstrated that levels of depression in the carers of stroke patients are significantly higher than a control population, and are related to the level of disability and dependence of the patient (Carnwarth and Johnstone,1987; Tomkins et al.,1988; Kotila et al.,1998). In keeping with this finding Kotila et al.(1998) demonstrated that the level of depression in the

carer was significantly associated with the severity of the depression in the patient, while Dennis et al.(1998) demonstrated a relationship with the level of emotional distress in the patients. Although Evans et al.(1988) demonstrated that depression levels in patients were reduced after the carers had received counselling, the significance of the affective status of carers on the prevalence of depression in stroke patients has not been systematically evaluated. In a review paper, House (1996) commented that `some unsatisfactory quality of the survivor - carer relationship - stroke induced or not - leads the stroke victim to a sense of unsupportedness that causes depression ... evidence from work in physical illness would suggest that this is likely to be important`.

In an ideal world the method of assessing the impact of stroke on the personality and depression status of the patients would be to evaluate their premorbid psychological status and conduct a longitudinal study. In view of the fact that the incidence of stroke is approximately 3/1000 of the population, the difficulty of conducting such a study would be immense. Nevertheless a potential association between premorbid affective status and stroke has been indicated in two prospective studies. The results of the `Established Populations for Epidemiologic Studies of the Elderly`, which studied more than 10,000 persons aged 65 years and over for a period of 6 years, demonstrated that rates of stroke were almost 3 times higher in persons designated with `high` versus `low` levels of depressive symptoms (Simonsick et al.,1995). In a smaller prospective study of 901 Japanese men and women over a period of 10 years, Ohira et al.(2001) demonstrated that persons with depressive symptoms had approximately twice the risk of developing stroke. These findings suggest that there may be a predisposition to the onset of stroke in patients who have a depressive disorder. An alternative approach to evaluating the pre-stroke personality or depression status of the patients has been to ask the main carer of the patient to give an assessment of the patient prior to the stroke (Brooks and McKinley,1983; Nelson et al.,1994). However, since studies have shown evidence of significant depression levels in the carers, this makes the value of their assessments questionable.

Although the personality and depressive status of the patients at the onset of the stroke, are being evaluated in this study, as potential predictors of the affective status at a later stage, other factors have also been included to complete the baseline predictive profile of the stroke patient. These factors include gender, age, domestic and social status, neurological impairment and disability, laterality of the brain lesion and baseline blood measurements.

1.4 Hypotheses

(a) The measurement of personality and depression in the acute post-stroke period and at 6 weeks may be predictors of the affective status of patients at 6 months post-stroke.

(b) The gender, age, domestic status, presence of known risk factors, neurological impairment, physical disability and location of the cerebral infarct may be associated with levels of affective disorder in patients after stroke.

(c) The psychological status of the carer may be related to the psychological status of the patient after stroke.

(d) Baseline, endocrinological, haematological and biochemical blood measurements may be associated with the affective status of patients after stroke.

1.5 Aims and objectives

The purpose of the study was to test the stated hypotheses by measuring the psychological status of the patients on three occasions over a period of 6 months from the onset of stroke. These measurements would assess the longitudinal psychological status of patients for a period of 6 months from the onset of the stroke, and would demonstrate if any changes in psychological status had occurred during that time. Analysis of the data would determine if the changes were associated with the following:-

(a) Baseline psychological measures of personality and depression.
(b) Baseline scores of disability, biochemistry, haematology and endocrinology.
(c) The clinical diagnosis of the type and site of the stroke infarct.
(d) The gender, age and social status of the patient and the presence of known risk factors.
(e) The personality and depression status of the carers, measured at the same time intervals as the patients after stroke.

1.6 Methodology

The specific aims of the study were to test the hypotheses by:-

1. Assessing the depression and personality characteristics of patients within 48 hours, at 6 weeks and at 6 months from the onset of the stroke.
2. Assessing the depression and personality characteristics of the carers at the same time intervals as the patients, and relating the results to those of the patients.
3. Relating the baseline blood measurements to (1.) above.
4. Relating the type and location of the stroke infarct to (1.) above.
5. Relating the gender, age, social status and presence of risk factors to (1.) above.

The assessments of depression and personality were done using standard questionnaires. The neuropathology of the patient in terms of the type of stroke and the site of the brain infarct were obtained from radiological reports, and the clinical diagnosis from case records. Demographic details, measurement of disability, presence of risk factors and base-line blood analyses were also obtained from the patients` case records.

1.7 The significance of testing the hypotheses

Clinical depression, or the presence of depressive symptoms, might impede recovery after stroke, in terms of physiological improvement, independence in performing activities of daily life, resumed social interaction and general improvement in quality of life. It is reasonable to consider that early detection and treatment of these depressive symptoms could alleviate the situation and subsequently improve the patient`s recovery. It is also relevant to consider that if the affective status of the carer is shown to be compromised, and is likely to affect the recovery of the patients, then treatment could also be offered to carers at an early stage.

It has been shown in a number of studies, that the prevalence of depression in patients and carers after stroke is similar, although whether the depression existed prior to, or was a consequence of the stroke, is not known. If there is a psychological interaction between the patients and the carers, then the psychological effects (ie. onset of depression) of the neurophysiology of the stroke (ie. laterality effects), could become diluted by this pre-existing psychosocial scenario. This effect may be a reason for the poor consensus to-date on the results of studies, which have attempted to relate the onset of affective disorder after stroke to the location of the cerebral infarct.

The relevance of analysing the blood measurements of the patients, which are done on admission to hospital, is based on the premiss that there may be an underlying, but unrecognized, clinical state in the patient which could be related to depression. For instance hypothyroidism and hyperparathyroidism are conditions that are known to relate to depression. Although they may not be clinically obvious in patients for some time, they can be identified haematologically or endocrinologically in their early stages. That being the case, their identification in the acute stages of stroke may be shown to be associated with levels of affective disorder after stroke.

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Chapter 2. Stroke

2.1 Introduction

A stroke occurs when the blood supply to an area of the brain is cut off, either as a result of the blockage of a blood vessel or a haemorrhage, with the result that the brain is starved of oxygen and other essential substances, resulting in the death of brain tissue (Bamford, 1991;1992). The word `stroke` applies to both ischaemic and haemorrhagic cerebrovascular disease with either permanent or transient symptoms (Sandin and Mason, 1996). Ischaemia describes the impact of decreased blood flow, which leads to infarction of tissue and cell injury, whereas haemorrhage describes cellular injury secondary to extravasation of blood into brain tissue.

An accepted clinical definition of stroke as stated by The World Health Organisation, is that it is a condition of `rapidly developing clinical signs of focal or global disturbance of cerebral function, with symptoms lasting 24 hours or more, or leading to death, and with no apparent cause other than of vascular origin` (WHO, ICD 1977).

2.1.1 Cerebral blood flow

The nerve cell tissue of the brain comprises nearly 40% of the total brain volume and has a high energy requirement which is supplied by the cerebral blood flow. The rate at which cerebral blood flow is controlled, is dependent on the concentration levels of carbon dioxide and oxygen in the brain: 95% of the normal energy requirements of the brain are met by the oxidation of glucose to water and carbon dioxide. Since glucose and oxygen are carried in the blood, the brain's supply of these two components is therefore critically dependent on the maintainance of a constant blood flow.

Cerebral blood flow is maintained by four arteries in the neck, 2 carotid arteries located one at each side of the neck and 2 vertebral arteries which are located at the back of the neck. The carotid arteries supply the anterior and middle cerebral arteries and the vertebral arteries supply the visual cortex and the under surfaces of the temporal lobes: from these arteries the blood supply terminates in a very fine network of capillaries which extend throughout the brain. The four major arteries are joined in a linked support system called the Circle of Willis. The importance of maintaining the blood supply to the brain is reflected in the fact, that although the average brain weighs only 1/30th of the total body weight, one quarter of the blood output from the heart goes to the brain. Consequently if that output is interrupted even for only a few minutes, highly vulnerable neurons will degenerate, and if the interruption is sustained, brain cells in the blood-deprived area will die within hours.

2.1.2 Types of Stroke

There are two major types of stroke: those caused by blood clots that block blood flow and are called ischaemic strokes and account for approximately 80% of all strokes, and those caused by bleeding, called haemorrhagic strokes. Ischaemic strokes are divided by pathophysiological mechanisms into thrombotic and embolic types (Sandin and Mason,1996; Stroke Clinical Update,1993; Beckson and Cummings,1991). Thrombotic strokes, which are more common, develop in narrowed cerebral vessels, while embolic strokes are caused by the migration of material from some distant source to the blood vessels in the brain, causing vascular occlusion and ischaemia.

Although it is usually possible to identify whether a stroke is haemorrhagic or ischaemic from a CT scan, it is not possible to determine from CT scans whether an ischaemic stroke has been caused by an embolism or is the result of atherosclerotic vascular disease. Since it is not always possible to determine the origin of an ischaemic stroke, the term thrombo-embolic stroke is often used to describe the continuum seen in cerebral infarction. However, recent advances in neuroradiology and ultrasound techniques, combined with informed judgements based on the National Institute of Neurological Diseases and Stroke (NINDS) data bank criteria, have made it possible in a number of cases to differentiate embolic occlusion from thrombotic occlusion (Yamaguchi et al.,1987; Gladman,1992; Petty et al.,2000).

2.1.3 Clinical classification of stroke

Although strokes are generally classified by the major definitions of ischaemic or haemorrhagic, for clinical purposes they have been further classified by the judged location of the main lesion, based on the symptoms which the patient exhibits (NINDS,1990; Bamford,1991). These categories are briefly described below.

Total Anterior Circulation Infarction (TACI) - patients exhibit a complete spectrum of symptoms including motor and sensory deficit, ipsilateral hemianopia and disturbance of the cerebral cortex. Approximately 17% of strokes are classed as TACIs.

Partial Anterior Circulation Infarct (PACI) - exists if any two of the features of TACI are present or if there is an isolated disturbance of higher cerebral function, i.e. involvement of the cerebral cortex. Approximately 34% of strokes are classed as PACIs.

Posterior Circulation Infarct (POCI) - occurs if there is evidence of unequivocal signs of brainstem disturbance, in terms of consciousness, autonomic functions, eye movements and the formation of words. Approximately 24% of strokes are classed as POCIs.

Lacunar Infarction (LACI) - is considered to be a pure motor stroke, or a pure sensory stroke, or a sensori-motor stroke. Lacunar strokes result from disease of the very small perfusing vessels deep within the brain most often in the motor pathways or thalamus. Approximately 25% of strokes are classed as LACIs.

2.1.4 Secondary damage

The effect of stroke on the neurophysiology of the brain is complicated and difficult to completely assess, due to the fact that although some brain cells die directly from a loss of energy caused by the loss of blood supply, other neurons are killed by chemical interactions in the area surrounding the infarction. For example, one mechanism of secondary damage is through the release of glutamate. Under normal circumstances, neurons release glutamate at synapses in order to stimulate or `excite` other neurons. During a stroke, excess glutamate is released with the result that neighbouring neurons are overstimulated and respond by opening channels in their membranes, which let calcium ions and sodium ions flood in. This results in a build-up of calcium which damages the neurons` internal structure and activates enzymes that degrade DNA, proteins and phospholipids. These in turn block healthy vessels and produce a vicious circle in which ischaemic injury promotes further ischaemia (Pulsinelli,1992; Brown,1992). Consequently what may start as a small restricted area of reduced blood flow, can expand and involve a considerable area of the brain which is not necessarily in the immediate vicinity of the stroke infarct.

2.2 Epidemiology of stroke

Stroke is the third most common cause of death in the developed world and is the most common cause of serious adult physical disability in the United Kingdom. Stroke can affect any age group and in the UK 25% of males and 20% of females over 45 years of age can expect to have a stroke if they live to be 85 years of age (CHSA 1996). This holds true for Scotland where a quarter of stroke deaths occurs under the age of 65 years. Furthermore, about 50% of stroke survivors will have some level of functional disability at 6 months from the onset of the stroke (SIGN,1998).

In recent times one of the most important studies of stroke has been the Oxford Community Stroke Project (OCSP) (Bamford et al.,1988). This study was important because it did not depend on hospital admission criteria alone, but was based on a community sample of 105,000 people. The results of the study showed an annual incidence of stroke of 1.6 per 1000 for women and 2.0 per 1000 for men. These figures compare with studies in Europe and North America that have shown crude annual incidence rates of first-ever stroke of between 1.5 and 2.5 per 1000 with incidence increasing with age.

Although statistics show that mortality from acute stroke is higher in Scotland than in the rest of the UK, the outcome of epidemiological studies probably underestimates the total level of cerebrovascular disease (CHSA,1996). Hospital based record linkage studies in Scotland, suggest that the annual incidence is approximately 3 per 1000 of the population and that the prevalence is 10 per 1000 of the population; however, these are also considered to be underestimates (SIGN,1997). These figures suggest that the incidence and prevalence of stroke in Scotland are also higher than other parts of the UK.

It is estimated that in the United Kingdom every year 100,000 people will suffer a first-ever stroke and of these, one third will remain functionally dependent for the rest of their lives. It is also known that the prevalence of stroke is 1/200 of the UK population, which means that at any one time, 250,000 people will suffer from the effects of stroke (Warlow,1993).

2.2.1 Age and gender differences

The OCSP also demonstrated that the age and gender specific incidences for people suffering a first-ever stroke showed a steep rise with age for both sexes. In their study, the incidence of first stroke increased from 2/1000 for the age group 55-64 years to 20/1000 for those aged >85years. In an overview of the epidemiology of stroke, Wolf (1990) gives a `rule of thumb` assessment and states that when considering all strokes combined, the incidence increases with age, and doubles in each successive decade. Stroke is the commonest cause of disability in middle-aged and elderly people, and those who have had several strokes are more likely to develop a dementing illness with progressive decline in mental abilities (Beckson and Cummings,1991)..

With reference to gender, the incidence of brain infarction is 1.3 times higher in men than in women. However, this should be compared with the onset of myocardial infarction, which is four times more frequent in men below the age of 65 years. Bonita (1992) states that although the lifetime risk of having an acute stroke is higher in men, the converse is true for the lifetime risk of dying of a stroke. This is due to the higher mean age of women at the onset of stroke and to their longer life expectancy.

2.2.2 Risk factors for stroke

The major risk factors for stroke have been identified as high blood pressure, a history of coronary heart disease, diabetes, smoking, high lipid levels, inactivity, obesity, a positive family history of stroke and age (Bonita,1992; Marmot and Poulter,1992).

Observational studies have all demonstrated hypertension to be the single most important risk factor for stroke (Reid,1994), although in the British Regional Heart Study, the relationship between blood pressure and stroke appeared to be predicted by systolic blood pressure alone (Shaper et al.,1991). It has also been shown that for the borderline hypertensive person, the risk is twice as great, and for persons with higher blood pressure the risk is four times as great (Wolf,1990). Although hypertension is the most significant risk factor for stroke, it is relevant to consider that once it has been diagnosed, it is a factor over which a person has some control (McGill,1988).

Cardiac diseases in terms of left ventricular hypertrophy and atrial fibrillation are known risk factors for stroke, as is diabetes. The fact that high blood pressure is more common in diabetics also aggravates the situation. Smoking continues to be associated with stroke risk

and if a person with high blood pressure is also a smoker the combination of smoking and hypertension increases the risk of having a stroke twenty-fold (Bonita et al.,1986). Although not identified as an acknowledged risk factor as such, House et al.(1990) looked at the effects of life events in people who had suffered a stroke, and concluded that severe life events may also be one of the determinants of stroke onset.

2.2.3 Consequences of stroke

What does stroke mean in terms of neurological impairment and subsequent physical disability for the patient? Neurological impairment refers to an exteriorized loss or abnormality of physiological or psychological function arising as a result of the stroke - eg. hemianopia, sensory loss, muscle weakness (ICIDH,1980). The description of disability in the context of the stroke, refers to changes that take place in the interaction between the patient and the environment as a result of the neurological impairment, ie. it is the behavioural consequences within the environment of the patient which have been altered, or are no longer able to be executed as a result of the stroke. The combination of impairment and disability tends to result in handicap, which is described as a disadvantage for an individual resulting from an impairment or disability, limiting the fulfilment of a role for an individual (Orgogozo,1994).

The extent to which the neurological impairment or subsequent disability suffered by the patient will be manifest, will depend not only upon the area of the brain involved but also on the size and location of the stroke infarct in that area. Although in general terms, it can be assumed that a stroke involving the left hemisphere of the brain will affect the right side of the body and vice versa, in reality the situation is more complex. For instance, if the area of infarction is restricted to a particular part of the cerebral cortex, in either hemisphere, then the stroke may affect sensory and/or motor loss alone. If however, the stroke is in the Broca or Wernicke area of the left hemisphere, then the interpretation and/or production of speech and language may also be affected. Should the stroke affect the cerebellum and brainstem, then the functions of swallowing and balance may be involved, or in more serious cases, the autonomic control of breathing and consciousness.

Psychological changes in patients who suffer from stroke, are less obvious than physical impairment or disability, but have been demonstrated as denial, anxiety and depressive disorders, indifference, emotionalism, anger, shame and dependence. Although the neuropsychological literature has traditionally linked emotional processing to the limbic system (Papez,1937; Plutchik and Kellerman,1986), in a review of the literature, Borod (1992) claims that emotional processing has been attributed to neocortical structures (Borod and Koff,1989; Kolb and Taylor,1990). It has also been suggested that specific types of cognitive processing of self-related material, constitute a major factor in the maintenance of depression (Martin,1985).

In contrast to theories which stress the role of cognitive processes in affecting emotional processing (Lazarus,1982; Zanjonc,1984), biological theories postulate that separate systems for cognition and emotion exist (Ekman,1984). Furthermore the inter-hemispheric role in emotional processing is considered by Gardner et al.(1983) and Heilman et al.(1983), who suggest that the right hemisphere is important. Although Tucker and Williamson (1984) propose that the right hemisphere is more involved in emotional processing, they also consider that the left hemisphere is more involved in cognitive and linguistic processing. Stuss et al.(1992) proposed that abnormalities of mood are associated with the limbic system, and that depression produces changes in this system, so that the threshold for displaying affective behaviour is lowered.

2.3 Summary

Stroke is a multifactorial condition, the incidence of which increases with age. There are a number of types and classifications of stroke, and there are known comorbid factors which are usually associated with the onset of stroke. Although sophisticated methods of imaging stroke are commonly used to establish the location and type of the cerebral infarct, (each of which has its own advantages and disadvantages), there is as yet no routine method of predicting the total neuronal damage which has accrued as a result of the stroke. It is also known that while the physical outcome of stroke can be predicted with a certain degree of accuracy, the psychological changes, particularly depression, which are reported to occur as a consequence of stroke are as yet not fully understood.

Chapter 3. Depression and Personality

3.1 Depression - Introduction

In a consensus statement on the `Recognition and management of depression in general practice`, Paykel and Priest (1992) stated that the term depression describes `a continuum of phenomena from a normal mood which is common, and affects everyone from time to time, to a severe disorder`. This somewhat general description highlights the difficulties that can be encountered in recognizing depression as an illness. At present there is no specific diagnostic test for depression and this often makes detection difficult, because somatization of symptoms may reduce the chance of the correct diagnosis being made. This is particularly true in elderly people, partly because of the ageing process, and also because depressive symptoms and physical illness may overlap.

To clarify this situation, the ICD-10 (WHO,1991) have produced definitions of clinical depressive disorders which are largely based on the presence of certain symptoms or signs. These are detailed in the Diagnostic and Statistical Manual of the American Psychiatric Association (3rd edition revised) (DSM-III-R), which has become the most widely used assessment instrument in the diagnosis of major depression (DSM-III-R has now been updated to DSM-IV). In this manual an essential feature of a major depressive episode is either the presence of a depressed mood, or a loss of interest in almost all activities, together with associated symptoms, for a period of at least two weeks. The associated symptoms include sleep and appetite disturbance, loss of energy, psychomotor retardation, agitation, feelings of guilt, reduced concentration, plus recurrent thoughts of death or suicidal ideation. An important feature of the assessment is that no organic cause should have initiated the disturbance, and that it should not be the reaction to a natural loss, such as bereavement.

3.2 Epidemiology of depression

Affective disorders are the most common psychiatric disorders, and their frequency in clinical and community populations has been the subject of considerable research. Although it is difficult to determine the true prevalence of depression in the community, studies have estimated that a one-year prevalence of major depression is 5-8% while estimates of a lifetime prevalence are 17-20%. The prevalence of minor depression is about 5%, and 10% suffer some depressive symptoms (Hirshfield and Cross,1982; Paykel et al.,1992). It is also estimated that the proportion of patients who present to the clinician with psychological

symptoms may only be about a quarter of all patients with a major depressive disorder, and that about 50% of depressive illnesses are not recognized by the general practitioner, particularly when the depression accompanies a physical disease (Feldman et al.,1987; Sherbourne et al.,1994). Recent studies have also shown that the community prevalence of depression in the elderly is 12-15% and twice that figure among people who are physically ill (Katona,1996; Katona and Livingston,2000). Despite this, the majority of elderly people with depression in the community remain untreated. This may be due to the fact that the elderly tend to complain more of physical symptoms than depression.

Reviews of studies have indicated that the ratio of depression in women to men in the community is approximately 2:1 (Blacker and Clare,1987; Kendler et al.,1993) and 3:2 in the elderly (Katona,1996). It has also been established that this male/female difference is real and does not simply reflect a measure of women seeking help more readily than men (Weissman and Klerman,1977; Hirshfield and Cross,1982; Surtees et al.,1986). It was also demonstrated in the National Comorbidity Survey that females exhibited twice the prevalence of somatic depression compared with males, but not a higher prevalence of pure depression Silverstein (1999). In this context the authors defined somatic depression as major depression associated with somatic symptoms of sleep and appetite disturbance, fatigue, body aches and anxiety. Major depression in the absence of these symptoms was classified as `pure depression`.

Studies have also shown that although depressive symptoms are more often found in the lower socio-economic classes, bi-polar illness has been found more often in those in the upper socio-economic classes (Smith and Weissman,1992; Regier et al.,1988). While reports conflict on the effects of marital status, it is generally recognized that separated and divorced people have higher rates of depression compared with single or married people (Hirshfield et al.,1982). Research has also shown recurrence in 50% who experience an episode of depression and that about 12% of these cases become chronic (Priest,1994; Bridges and Goldberg,1984; Hirschfield and Cross,1982). It has also been determined that the average age of onset is the late 20`s and that the illness is 2-3 times more common among those with a first degree biological relative affected with the disorder (Hirshfield et al.,1982).

These surveys have shown that while a considerable percentage of the community suffers from some form of depression not all of these people may present with a major depressive disorder. A number of people may suffer from subthreshold depression, which means that they have symptoms of depression secondary to other psychiatric or physical illnesses

.3.3 Comorbidity of depression

Comorbidity of depression can occur either psychiatrically or medically, and the association between physical illness and depressive illness in primary care is a common occurrence. Studies have shown that levels of depression comorbid with physical illnesses can range from 20% to 46% (Stewart et al.1965; Moffic and Paykel,1975; Neilson and Williams,1980; Popkin et al.,1985). Two large USA studies which looked at these concepts in detail, were the National Institute of Mental Health Comorbidity Study and the Medical Outcomes Study.

3.3.1 Psychiatric comorbidity studies

The National Institute of Mental Health Comorbidity Survey (National Comorbidity Study) was a nation-wide study of 8098 subjects in the USA between 1990 and 1992 (Kessler et al.,1994; Blazer et al.,1994). The results of the study concluded that there was a prevalence of major depression in the community of 4.9% and a lifetime prevalence of depression of 17.1%. Furthermore, of the depressed subjects identified, 79% had comorbid psychiatric disorders. An important feature of the results of this study was that they differed considerably from the Epidemiologic Catchment Area Study (Regier et al.,1988), which had shown that levels of major depression in the USA were 1.6% in men and 2.9% in women. However, when the results of the original data from the Epidemiologic Catchment Area Study were analysed retrospectively using the criteria of the National Comorbidity Study, the resultant percentages were almost doubled (Blazer et al.,1994). This raises an important point about the difficulty in assessing depression, in terms of what it means, and how it is measured. It also highlights the difficulties of comparing the results of different research studies which use different measurement criteria to assess depression

3.3.2 Medical comorbidity studies

The National Care Outcomes Study of Medical Care (Medical Outcomes Study), was another large USA study of 22,399 adult outpatients in three different health care systems. Although the remit of this study was to consider the effectiveness of treatment for patients with depressive illness, it also assessed the levels and the effects of comorbid medical conditions on depression. The results of this study showed that approximately 70% of depressed patients had comorbid medical conditions (Wells et al.,1991; 1992) and that there was a significantly higher prevalence of hypertension, arthritis, diabetes and chronic lung disease in depressed patients compared with non-depressed patients who were attending medical practitioners.

A further study by Sherbourne et al.(1994) showed that medical comorbidity was also higher among patients with subthreshold depression. The results of this study demonstrated that approximately 30% of patients with depression or subthreshold depression had hypertension, approximately 12% of both groups had diabetes and that 9% of depressed patients and 6% of patients suffering from subthreshold depression had some form of heart disease. These comorbid illnesses are recognized risk factors for stroke.

3.3.3 Depression and cardiac illness

There is evidence that depression commonly reported after coronary artery bi-pass graft (CABG) and other cardiac surgery is associated with the pre-operative status of the patients. In a study by McKhann et al.(1997), patients were assessed before and after CABG and the results demonstrated that 22% of the patients were depressed prior to surgery, and of these patients 53% were depressed after surgery. In contrast 18% of the patients who were not depressed prior to surgery were depressed after surgery, while 32% of patients were depressed at some time after surgery. The results also showed 47% of patients undergoing cardiac surgery were depressed before surgery and 61% were depressed on discharge. The factors associated with post-operative depression were female gender and the affective status of the patients prior to surgery (Burker et al.(1995). In a longitudinal study of cardiac patients over a period of 18 months, Frasure-Smith (1995) also demonstrated that there was a significant relationship between the depression scores at 7 days post MI and the subsequent mortality of the patients.

3.4 Neuroimaging - clinical depression

To-date, the results of neuroimaging techniques which have been used to demonstrate the relationship between the neuroanatomy and neurophysiology of depression, have been inconclusive. Although the most widely available and probably most important modality for diagnostic brain imaging is CT, it has not been routinely used to investigate clinical depression. The reason for this is, that although CT can demonstrate morphological changes in the brain, this is not a common occurrence in clinical depression or personality disorder and consequently CT imaging is of little clinical value in this context. The imaging techniques most frequently used in studies of depression are magnetic resonance (MR), and the radionuclide techniques of ^{133}Xenon inhalation, Single Photon Emission Computed Tomography (SPECT) using ^{99m}Tc HMPAO, and Positron Emission Tomography (PET) using ^{18}F Fluorodeoxyglucose (FDG).

3.4.1 MR imaging studies in clinical depression

MR imaging has been used in a limited research capacity in depression studies.

A study by O`Brien et al.(1996) demonstrated that both the prevalence and severity of Deep White Matter Lesions (DWML) were significantly greater in depressed subjects, when compared with age-matched controls or patients with Alzheimer's disease. In similar studies, Baxter et al.(1989) and Matsubayashi et al.(1992) commented that DWML are strongly associated with advancing age and other cerebrovascular risk factors. They also comment that the presence of DWML may pre-date the depression and may therefore act as a risk factor for the development of the illness. In a brief overview of the literature on structural imaging in biological psychiatry, Lewis (1996) states that `in late life depression, appearances of atrophy as well as an increased rate of subcortical white matter lesions have been shown`.

Although there is no definite evidence of generalized atrophy in depressed patients, MR imaging studies by Coffey et al.(1993) have shown some loss of brain volume in the temporal and frontal lobes of some subjects, and in the previously mentioned study by O'Brien et al.(1996), the significant brain regions involved in depression was the left basal ganglia. This finding of basal ganglia/frontal circuit dysfunction confirmed the results of Rabins et al.(1991) who found basal ganglia lesions to be more common in depressed subjects.

3.4.2 Radionuclide imaging studies in clinical depression

Radionuclide imaging is a recognized method of assessing cerebral blood flow but is less suitable for evaluating deep regions of the brain such as the thalamus or basal ganglia, due to gamma ray absorption and scattering. Nevertheless, the results of studies which have used radionuclide imaging show a relationship between depression and regional cerebral blood flow (rCBF) in a number of brain regions.

A study by Mathew et al.(1980) showed global reduction in rCBF in depression that was particularly significant in the bilateral frontal regions. The authors suggest that this appearance may be associated with neural hypoactivity, in view of the fact that depression is a reversible illness unassociated with brain tissue loss. In a methodologically similar study, Uytdenhoeff et al.(1983) showed left frontal hypervascularisation and right posterior hypovascularisation in major depressives compared with the other groups. In a study of depressed adolescents, Chabrol et al.(1986) demonstrated reduced bilateral frontal rCBF during the depressed stage, which returned to normal during antidepressant therapy. These authors commented that the disturbance in cerebral blood flow is state rather than trait

dependent because it is not found in bipolar patients when they are in remission. In contrast, Delvenne et al.(1990) demonstrated that although global, right and left hemispheric blood flow did not differ between major depressed and normal subjects, there was a significant left-right asymmetry due to left hypoperfusion, for cortical cerebral blood flow.

In keeping with these results, a similar study by Yazici et al.(1992) showed that both sides of the temporal region had significantly reduced blood flow when compared with the controls. In a somewhat larger study by Austin et al.(1992), the depressed group showed reduced uptake in the majority of cortical and sub-cortical regions, most significantly in the temporal inferior frontal and parietal areas. Studies by Sackeim et al.(1990;1993) also demonstrated a marked reduction in cortical blood flow in a number of brain regions while Mayberg et al.(1994) demonstrated decreases in rCBF values across all brain regions in depressed patients compared with control subjects: the most significant decreases being in the inferior frontal, anterior temporal cortex and anterior cingulate gyrus.

Although the outcome of these studies are inconclusive in identifying the relationship between depression and blood flow to a particular area of the brain, they have demonstrated that depression appears to be related to a reduction in regional cerebral blood flow. The significance of these findings with respect to affective status after stroke, is that the neuro-physiological impact of stroke results in a decrease in cerebral blood flow to different areas of the brain depending upon the location and extent of the cerebral infarct.

3.4.3 PET imaging studies in clinical depression

Although the evidence that underlying biochemical mechanisms contribute to mood disorders appears to be strong, and studies have reported a relationship between cerebral biochemistry and the severity of symptoms, there have been very few neuroimaging studies using PET to support this observation.

In a study to evaluate cerebral metabolic rates (CMR) in depressed patients, Baxter et al. (1985) used PET and the labelled glucose tracer ^{18}F Fluorodeoxyglucose. The results showed that in patients suffering from bi-polar depression, the whole brain metabolic rate increased from the states of depression through euthymia to mania, whereas there were no significant differences in the left/right asymmetries of unipolar patients compared with controls. In 1989 however, the same authors showed an association between left anterolateral prefrontal cortex abnormality and major depression.

One method of demonstrating the efficacy of drugs used in treating patients for depression is by imaging the patients using PET before and after treatment. Results of the limited studies which have been done to-date, have shown that the basal ganglia and the anterior cingulate cortex areas of the brain are involved in depressed patients.

In a review of imaging and depression, Goodwin (1996) considers that tomographic methods of imaging have usually localised the greatest hypoperfusion to be in frontal, temporal and parietal areas. The author comments that the inferior frontal cortex, in particular, tends to be more involved in depression than the dorso lateral prefrontal cortex

3.5 Summary

Depression covers a wide-range of mood disorders and, although clinical depression has been defined according to specific criteria, epidemiological studies have shown that there is a considerable level of undetected and untreated depression in the community. Studies have also shown that depression is significantly associated with medical illnesses such as hypertension, myocardial infarction and diabetes, which are commonly associated with the onset of stroke. The aetiology of depression is as yet unknown and although studies have shown an association with certain neurotransmitters and certain organic areas in the brain, replication of results has been difficult due to the effects of previous treatment regimes.

The results of studies on the neurophysiology of depression have also been inconclusive, due mainly to methodological factors such as difficulties of replication of imaging techniques, patient group selection, the drug status of patients, analysis protocols, selection of depression scales and the application of cut-off points for depression. Despite these problems, there is some consensus from studies that depression may be related to reduced blood flow in certain areas of the brain in depressed patients when compared with controls. The demonstrations of improved cerebral blood flow on remission from depression, using antidepression therapy, also suggest that there may be a neuronal component involved, and that the rCBF may reflect a state versus trait discrimination. This also suggests that the depression is not primarily associated with cerebral tissue loss.

The significance of the above factors in relation to the onset of depression after stroke is difficult to determine, since they suggest that the depression experienced by patients after stroke may not be totally related to the impact of the stroke on the neurological structure of the brain, but may relate more to the effect of reduced regional cerebral perfusion. It is also

relevant to consider that there may be a relationship between the premorbid psychological status of the patient and the prevalence of depression after stroke. In support of this theory, studies of patients who have undergone CABG surgery and have demonstrated that the level of depression after surgery is associated with the depression status of the patients prior to surgery. Comorbidity studies have also shown significant levels of depression in patients who have diabetes, high blood pressure and cardiac illness, which are known risk factors for stroke. Furthermore the results of neuroimaging studies of depression, although variable, suggest that depression is associated with reduced rather than enhanced levels of cerebral blood flow. Since stroke is primarily associated with reduced blood flow, it would not be unreasonable to suggest, that the onset of a stroke with its attendant reduction in cerebral blood flow might aggravate an existing level of unrecognized depression.

3.6 Personality - Introduction

Personality is a difficult concept to evaluate because there is no simple definition of personality. A composite definition is given by Stuss et al.(1992) `Personality is the sum of characteristics or qualities that make an individual a unique self. These characteristics are stable and predictable behavioural response patterns of a person interacting with his or her environment. Personality includes mood, affect, drive, and other psychological functions such as self-reflectiveness. It represents a dynamic balance of internal drives, needs and desires, and internal or external forces that regulate the expression of these internal states in conformity with culturally given norms`. Personality can be considered to be a more or less stable and enduring organization of a person's character and temperament, which can determine how an individual accommodates to the environment and responds to situations.

3.6.1 Genetic component of personality

Trait theorists have supported the view that many important personality traits have a strong genetic component and that these inherited differences are based in biological functioning. In keeping with this approach, Eysenck considered that `genetic factors contribute something like two-thirds of the variance in major personality dimensions, but the genetic input to personality is merely a predisposing factor in the way that people behave` (Eysenck,1982). The remainder of the differences in personality traits Eysenck maintained, was due to environmental factors. Over the past decade there has been a considerable amount of evidence to support the view that many important personality traits have a strong genetic component. The results of studies of fraternal and identical twins, suggest that heredity plays

an important part in accounting for differences in personality characteristics (Pervin,1989), while factors such as the education and social class of the family, their attitudes and values, even styles of child rearing have no real effect on personality. Studies of criminal families have also demonstrated that there is clear evidence for a genetic role in criminality and that there is a physiological basis for violent behaviour (Di Lalla and Gottesman,1991). In a review of the literature on the `nature-nurture `debate, Revelle (1995) considered that the evidence suggests that practically any major personality trait of interest has a substantial genetic component and shows strong evidence for heritability.

3.6.2 Eysenck's theory

A review of the literature by Eysenck (1970) demonstrated that there was strong support among psychologists for two main dimensions of personality called extroversion-introversion, and neuroticism (stability-instability). Modern research into the biological basis of personality began with Eysenck's personality theory, which considers that there is a link between the introversion-extroversion dimension and the connections between the ascending reticular activating system (ARAS) and the cerebral cortex.

Eysenck postulates a biological basis for dimensions of personality with strong hereditary influences. In this theory, individuals inherit a particular type of nervous system that predisposes them in one direction or another; the final `shape` of the personality being determined by interaction between the person`s biological predisposition and the environmental conditions encountered. In the case of the extroversion-introversion dimension, the position of the individual rests in the first instance on the balance between excitation and inhibition processes within the central nervous system, and more specifically on the RAS which is located in the core of the brainstem, and which maintains an optimum level of alertness for the individual. In achieving this, it can either boost the transmission of incoming sensory data to the cerebral cortex through excitation of the neural impulses or it can damp down the transmission through the inhibition of these impulses.

Eysenck considers that there are two fundamental states of neurons or neuronal networks,
(a) The excitory state - in which neurons, neuronal networks or the whole cerebral cortex, are conditioned and ready for action.
(b) The inhibitory state - in which neurons, neuronal networks or the whole cerebral cortex are quiescent and less easily activated.

The basis of this theory is that introverts have a basal cortical arousal level which is chronically high and therefore introverts should have an intrinsically high cortical blood flow. Consequently to maintain equilibrium and homeostasis, introverts tend to avoid stimulus-seeking situations. Extroverts on the other hand are considered to have an under-aroused basal cortical level, and in an effort to increase their arousal levels to achieve an optimal level, extroverts therefore tend to need stimulus seeking situations. In this theory, the personality trait of extroversion is considered to be directly related to the reticular activating system (RAS), with collaterals from the ascending sensory pathways exciting cells within the RAS, which then transmits that excitation to various sites in the cerebral cortex.
With regard to the personality dimension of neuroticism (stability-instability), Eysenck considers that the reactivity of the autonomic nervous system is the biological basis of the neuroticism dimension and he traces this relationship to differences in the limbic system.

Eysenck is a trait theorist and as such considers that human behaviour and personality can be organized into a hierarchical structure, in which responses can be linked together to form habits. Habits can then be linked together to form traits, and traits can be linked together to form types. Trait theorists believe that people behave consistently over time and over a range of situations, rather than over all situations. Criticisms of the theory however, are that traits are a reflection of our conceptions of the personality characteristics that go together, rather than being a representation of actual behavioural patterns. An important consideration with this theory is that traits are not really `there` in terms of physical attributes - traits are abstractions - they are inferred on the basis of behaviour. This being the case there is no real `right way` to look at personality, no one `correct` perspective.

In researching the concept of personality traits, Eysenck has used psychometric modelling based on the use of factor analysis of psychological measures, to identify basic traits in the field of individual differences.

3.6.3 Neuroimaging - personality

There have been few neuroimaging studies to identify the neurophysiological correlates of personality traits in normal subjects. Most of the research into the neurophysiology of personality has been done on patients who have suffered from some form of brain damage.

Mathew et al.(1984), using the ^{133}Xenon inhalation method, demonstrated a significant inverse correlation between cerebral blood flow and extroversion - but no correlation

between neuroticism and rCBF. This suggested to the authors that there was involvement of a central factor, such as diffuse brain arousal mediated by the reticular activating system.

In a technically similar study, Stenberg et al.(1990) demonstrated that there were no significant differences in general arousal between introverts and extroverts as measured by the mean cerebral blood flow, averaged over all of the brain regions. The results however showed that introverts had higher blood flow in bi-lateral temporal lobes when compared with extroverts. The authors argue that the differences shown in the study were compatible with current theories about cortical function, in that the frontal and temporal lobes are the cortical areas most likely to participate in emotional processes underlying personality differences. There was no association between rCBF and neuroticism in this study.

In a study of 51 healthy volunteers, Ebmeier et al.(1994) used SPECT imaging with ^{99m}Tc HMPAO to evaluate regional cerebral blood flow. The results showed that extroversion was significantly associated with increased tracer uptake in the anterior and posterior cingulate areas bilaterally, whereas there was no significant association between rCBF and neuroticism or psychoticism. These results are in agreement with the results of PET studies by Haier et al.(1987) who found that extroversion was associated with increased glucose metabolism in the cingulate area.

The results are confirmed in a PET study by Johnson et al.(1999) in which the authors demonstrated that extroversion was associated with uptake in the anterior cingulate gyrus, the temporal lobes and the posterior thalamus, whereas introversion was associated with increased blood flow in the frontal lobes and in the anterior thalamus. These authors suggest that differences in introversion and extroversion may be related to differences in the fronto-striato-thalamic circuit.

In a review of the literature, Zuckermann (1991) noted that cingulotomy operations tend to affect neuroticism and its related mood states of anxiety and depression, but had no effect on extroversion. However, the author concluded that the biological determinants of extroversion are unlikely to lie in a single brain area, and it is known that the cingulate gyrus may be involved in a number of psychological processes.

3.6.4 Personality and brain damage

An alternative method of searching for an organic basis of personality is to study the effects of brain damage. The evidence accrued from brain damage studies suggests that there may be a relationship between personality and brain integrity. The term `brain damage` covers a number of states, including Traumatic Brain Injury (TBI) and Cerebrovascular Accident (CVA) or stroke. Although injuries of this nature can change the biological state of the brain, they can also produce changes in the control or the expression of emotions and motivational responses. In this regard, injury to the brain is believed to alter pre-existing patterns of personality, by disrupting certain neuronal systems involved in personality, and this effect is frequently seen in injuries to the frontal lobes and associated neocortical structures. When these changes are permanent and alter pre-existing patterns of emotional and motivational behaviour, the personality changes are considered to be the result of the brain damage (Prigatano,1992; Kwentus et al.,1985; Jennett and Teasdale,1981).

In a review of studies, Burns et al.(1994) demonstrated that although psychopathological factors correlated with measures of brain injury, few differences were found between patients with traumatic brain injury and those with other brain injuries. A number of studies have demonstrated this effect: Lishman et al.(1968) found that 87% of penetrating head injuries caused a degree of personality breakdown and Hecaem et al.(1962) demonstrated that 21% of cerebral tumour cases suffered some kind of personality change, while a study of patients who had suffered Traumatic Brain Injury (TBI) showed that the personality profiles of the subjects, particularly females, indicated acute distress (DiCesare,1990).

In a study of patients with blunt head injury, Brooks and McKinlay (1983) demonstrated increased temper and irritability in the head injured patients, while studies of patients with Closed Head Injuries (CHI), showed that the depression scale was the most frequently elevated clinical scale and that this was associated with both location of lesion and with a premorbid history of psychiatric disorder (Alfano et al.,1992; Fedoroff et al.,1992).

One of the most striking changes after frontal lobe pathology is a disorder of personality. This is not surprising in view of the importance of the anatomical link between the frontal lobes and emotional behaviour. The reason for this is that the prefrontal cortex is a final collection point for information related to the internal limbic system and consequently the involvement in motivation, organization and integration (Nauta,1973).

In a review paper, Stuss et al.(1992) concluded that symptoms of frontal lobe damage may be classified as disorders of drive and motivation or mood and affect. A striking example of altered personality and emotions following frontal lobe damage was the case of Phineas Gage, who suffered severe frontal lobe injury when an iron bar was propelled through his left maxilla, exiting through the mid-frontal regions of his brain. Although Phineas survived and demonstrated good physical recovery, and preserved many of his cognitive abilities, his emotional behaviour and personality were significantly changed (Harlow,1868).

It has also been recognized that left and right sides of both brain and body have connections with different aspects of human experience and as a result, lesions to the left and right hemispheres give rise to different kinds of personality dysfunction. An early example of this was shown by Gainotti (1972) who noted that left-hemispheric disease was frequently associated with profound depression - what was termed the catastrophic reaction, whereas right-hemispheric disease was more associated with indifference.

3.6.5 Personality and Depression

The importance of personality characteristics in the aetiology of depression has been emphasised in various theories of depression (Eysenck,1970; Coppen and Metcalfe,1965; Kendell and Di Scipio,1968) and it has also been shown that personality abnormality is common among those who develop depression (Charney et al.,1981). A survey of the psychiatric literature on the depressive personality indicates that many psychiatrists believe that individuals prone to develop clinical depressive illnesses, display certain personality features which distinguish them from others not so predisposed (Chodoff,1972). Eysenck describes these features as being anxious, worrying, moody and frequently depressed, and he classifies them as the personality characteristic of neuroticism (Eysenck and Eysenck,1975).

Research has also shown that specific types of cognitive processing of self-related material constitute a major factor in the maintenance of depression, and that individuals with high levels of neuroticism exhibit consistent idiosyncrasies in the processing of emotional information (Martin,1985). There is also evidence that neuroticism is a good predictor of clinical depression and other emotional disorders, and that high neuroticism `scorers` have an increased probability of becoming depressed (Hirshfield et al.,1989; Boyce et al.,1991).

It is also proposed that the diagnosis of reactive, as opposed to endogenous depression, can be made on the basis of a poorly adjusted premorbid neurotic personality (Chodoff, 1972;

Charney et al.,1981). It has also been shown that female patients with premorbid neurotic personalities have a higher risk of developing chronic major depression (Scott,1988), and that personality abnormalities may also lead to an earlier age of onset in depression (Charney et al.,1981). In women, twin studies of personality and depression have demonstrated that the onset of major depression could be largely genetic in origin (Kendler et al.,1993).

Despite the considerable theoretical and clinical interest in the role of personality characteristics in depression, relatively few controlled investigations have been conducted in this area. Although no systematic studies have been undertaken to examine personality characteristics associated with high levels of depressive symptoms, the results of studies of the background characteristics of depressives are consistent with major personality theories of depression. The traits that have been found to be associated with depression are neuroticism, introversion, obsessionality, guilt and dependency. It is also suggested that depressives are more worrisome, less socially adept, more insecure, more sensitive, and more likely to break down under stress (Chodoff,1972; Eysenck,1970; Charney,1981).

However, much of this work to date has been done on populations of treated patients rather than patients drawn randomly from the community. As such, these investigations create their own selection bias by evaluating depressed patients who are more likely to demonstrate higher levels of personality characteristics known to be associated with depression, than might be present in a random selection of the community. It is also known that certain anti-depressant drugs can alter personality characteristics and as such could produce associations between depression and personality which might not be evident in the absence of the anti-depressant treatment.

3.6.6 Neuroticism and depression

There is evidence to suggest that certain personality characteristics are good predictors of clinical depression and other emotional disorders. Research has shown that neuroticism and depression are highly correlated, not only within patient populations (Christie and Venables,1973), but also in normal populations (Costa and McCrae,1980; Martin,1985). The results of Hirshfield and Klerman(1979) demonstrated that depressed patients had higher neuroticism, introversion and obsessionality scores compared with non-depressed subjects, while studies of depressed and recovered patients, demonstrated that neuroticism scores decreased significantly on recovery (Hirshfield et al.,1983; Garside,1970). Although Kendell

and Di Scipio(1968) and Peselow et al.(1994) showed decreases in neuroticism, they also demonstrated increases in extroversion when depression levels had diminished.
It has also been reported that neuroticism and depression occur at higher levels in women than in men, and that women are more likely to take longer to recover from depression. In a follow up study of women who had undergone treatment for acute depression, Weissman et al.(1978) showed that it was not the patients who had been the most depressed who had the poorest outcome from depression, it was the patients with the highest levels of neuroticism.

3.6.7 Longitudinal studies in personality and depression

Longitudinal studies have consistently shown that the impact of life events on depression is soon lost, and that personality factors assume a greater importance in reactive depression (Andrews et al.,1981). Studies have also shown that neuroticism is predictive of poor outcome in depression (Paykel et al.,1976;Weissmann et al.,1978; Hirschfield et al.,1983).

The results of a 15-year longitudinal study by Andrews et al.(1990) demonstrated a relationship between the number of depressive illnesses experienced by patients and the characteristic of neuroticism. A similar study by Duggan et al.(1990) over 18 years, showed significant increases in extroversion and decreases in neuroticism scores with improvement in the patient's depression state. In a large study of female twins, Kendler et al.(1993) also showed that while neuroticism was strongly related to a lifetime prevalence of major depression, extroversion was unrelated to major depression. Hirschfield et al.(1989) demonstrated that the personality features associated with the onset of depression were less emotional stability and less ability to react to stressful situations. The authors suggest that these observations raise the issue as to whether premorbid personality measures are not really premorbid, but may simply reflect subthreshold long-term affective states.

3.6.8 The neurophysiology of emotions

Although Eysenck has not formulated a biochemical basis for differences in levels of arousal, it could be suggested that there might be a biochemical relationship with the concept of arousal. Calcium ions in the brain participate in the release of many types of neurotransmitters, and calcium levels in cerebrospinal fluid (CSF) appear to be inversely related to behavioural and brain excitability (Ballenger,1983). CSF calcium is lower in manic phases than in depressed phases of affective disorders, and when calcium is lowered in humans, excitement, irritability, paranoia and cyclic mood disorders are observed. In keeping

with this, hyperparathyroidism produces abnormally high calcium levels and is associated with lethargy and depression in humans. The data suggest that CSF calcium, and possibly serum calcium levels may provide one biochemical correlate for the construct of arousal which is central to Eysenck`s theory.

Goodwin(1996) considers that the syndrome of major depression is associated with impairment of neurological function,,and that this has been demonstrated in two large studies of young depressives (Austin et al.,1992; Bench et al.,1993). These studies found a correlation between cognitive impairment and brain perfusion in the posterior cingulate cortex and basal nuclei. Other studies by Gardner et al.(1983), Heilman et al.(1983) and Tucker et al.(1981;1989), suggest that the right hemisphere plays a critical role in emotional processing and that the right hemisphere is associated with subcortical systems, which are important for attention and arousal. Tucker et al.(1981;1989) also suggested that the right hemisphere is more involved in non-verbal processing, i.e. emotional processing, while the left hemisphere is involved in cognitive and linguistic processing. In a review paper, Borod (1992) describes the differences between and within the hemispheres of the brain, and concludes that there is dominance from the right cerebral hemisphere for the control of emotion and for perception.

3.7 Summary

Psychobiologists believe that the basic personality traits of humans have evolved, and are therefore based to some significant degree on inherited variations in crucial biological structures. These concepts are essentially the basis of Eysenck's theories, that individual differences in personality depend ultimately, on specific underlying physiological processes. Results of family, twin and adopted studies have shown that personality is to a considerable extent inherited, but modified in life by socialization practices.

Although it is assumed that the basis of personality must lie in the anatomy and physiology of the brain, there has been little research into the neurophysiology of personality. Nevertheless, the neuroimaging studies of cerebral blood flow which have been done, have shown that there may be a relationship between introversion, extroversion and cerebral blood flow which would be in keeping with some of Eysenck`s biological theories. Results of the studies of brain-damaged patients have also shown that damage to the structure of the brain, particularly to the frontal lobes, can alter personality. Although it is interesting that there has

been no evidence in any of the studies to show that neuroticism is related to cerebral blood flow, this is also in keeping with Eysenck`s theories that neuroticism may be related to the autonomic nervous system and to the limbic system.

Studies have also shown an association between depression and the personality characteristic of neuroticism and to a lesser extent extroversion. Premorbid studies of non-stroke subjects have also demonstrated that neuroticism may be related to reactive rather than endogenous depression. Since depression has been shown to be associated with neurophysiology, neurochemistry and neuroanatomy, it is reasonable to conclude that, if depression is associated with certain personality characteristics, then there may be a neuroanatomical/ neurophysiological link between them. However, since brain damage does not always result in depression, it may be that it is only brain damage in certain areas that causes depression to occur, or that it is only in certain subjects with a pre-disposed personality/depression status who are affected. It may also be the results of a combination of factors from both sets of conditions. To-date there has been insufficient research on this to allow any firm conclusions to be drawn.

The remit of the current study will address some of these issues by assessing the personality and affective status of the patients and their carers from the onset of the stroke and for a period of six months thereafter. These assessments will be considered with reference to the gender, age, social and domestic status of the patients, in keeping with the associations which these factors have been shown to have on depression. The neurological impact and neuroanatomy of the stroke will also be considered in relation to the personality and affective assessments and also to changes in these assessments over time. Baseline blood measurements will be incorporated in the analysis and will be correlated with psychological measurements. In summary the results will be used collectively to determine if there are predictive factors which may be associated with the affective status of patients after the onset of stroke.

Chapter 4. Post-stroke depression

4.1 Introduction

Stroke is a complex condition of the brain that can affect the physical, psychological and social well-being of the patient. Although the basic cause of stroke is an interruption of blood supply to a particular part of the brain, the impact on the brain can be more extensive than might be suggested by the apparent localization of the infarct.

Stroke is also a common condition, and depression is the most commonly reported psychiatric sequelae of stroke. Despite a considerable amount of research by various groups into the causes and reasons for this depression, there have been no convincing characteristics, which would identify a particular group as being at risk from developing depression after stroke.

4.2 Brief overview of studies in depression after stroke

In a review of the history of the psychological consequences of stroke, Starkstein and Robinson(1989) noted that in early psychiatry, depression was frequently associated with cerebrovascular disease. In their review they refer to Meyer(1904), who commented that insanity in brain injured patients was dependent on the specific causes and sites of the brain injury. The authors also refer to Kraepelin(1921), who noted that the diagnosis of depression was complicated by atherosclerotic disease, and to Babinski(1922) who found an association of indifference and anosognosia in patients who had suffered right hemisphere damage. They also note that Goldstein(1939;1948) reported that patients with left hemisphere damage suffered more episodic distress, tearfulness and irritability, which he termed catastrophic reactions, whereas Fisher(1961) considered that the depression was a normal response to brain injury which causes severe physical and cognitive difficulties.

The first study undertaken to assess indifferent reactions of patients with right-hemispheric injury was done by Gainotti(1972). The results of this study confirmed that depressive-catastrophic reactions were significantly more frequent among left hemispheric patients and that indifference reactions were more common in patients with right-sided lesions. In contrast to these observations, and to the theories of Goldstein(1948) and Fisher(1961), Folstein et al.(1977) claimed to demonstrate that severity of depression was not closely related to the level of physical impairment caused by the stroke.

To date, studies of the prevalence of post-stroke depression have been inconsistent with the highest reported prevalences of depression coming from studies of stroke patients who have been admitted to hospitals (Johnson,1991), while the lowest reported figures have come from two community based studies (Wade et al.,1987; House et al.,1991). With respect to the aetiology of post-stroke depression, the results of studies have also been inconclusive.

While some researchers have placed considerable emphasis on establishing the location of the brain infarct as the cause of the depression (Robinson et al., 1981;1984;1984b;1985), others have shown no significant association (House et al.,1991; Magni et al.,1984). A recent review and meta-analysis of studies has shown no conclusive evidence to support an association between lesion location and affective disorder after stroke (Carson et al.,2000).

4.3 The John Hopkins Group (JHG)

In view of the fact that Robinson and colleagues from the Johns Hopkins University School of Medicine in Baltimore, USA, have been the major contributors to research into post-stroke depression since 1981, this literature review will begin with a detailed summary of their research and conclusions to date. The outcomes of their studies and theories will be evaluated in the light of work done by other groups.

In all of their studies, the JHG has used a standard set of measurement scales for the assessment of post-stroke depression. To prevent the necessity of detailing their methodology in each of their papers, it can be assumed that the scales used on each occasion are as follows; The Zung Self Rating Depression Scale, the Hamilton Rating Scale for Depression, the Present State Examination and the General Health Questionnaire. DSM-III-R was used by these researchers to obtain a psychiatric diagnosis by converting the symptoms elicited by the Present State Examination. It should also be assumed that CT imaging was used when the location of the stroke lesions is specified. In view of the number of studies and the fact that there are a number of principal authors, the studies have been identified in this review by the abbreviation JHG plus the date of publication.

(a) JHG 1981

In a study by Robinson and Szetela (1981), the authors compared 18 patients who had left-hemispheric strokes with 11 patients with traumatic brain injury. Results showed that approximately 60% of the stroke patients were significantly depressed in comparison with 20% of patients with traumatic brain injury. The results also showed that the severity of the depression correlated with the closeness of the lesion to the left frontal pole.

There are significant weaknesses in this study, viz. the cohorts of patients investigated were small, over 80% of both groups were aphasic and 50% of the stroke group had previous alcohol problems in comparison with 27% of the head injury group. Furthermore, the location of the infarcts in the stroke group were fronto-parietal, whereas those of the brain injured group were parieto-occipital.

(b) JHG 1982

In a study by Robinson and Price (1982), the authors evaluated the status of 103 stroke patients attending an outpatient clinic. From their results, the authors concluded that the natural progression of depression after stroke occurred over a period of 7-8 months and was

predominant in patients with left hemispheric strokes. In this study, 30% of the patients interviewed were found to be clinically depressed, with approximately 60% suffering from generalized depression (i.e. including dysthymia).

The weaknesses of this study related to the unspecified times of the patient assessments, in that patients were initially assessed within 12 months of the onset of the stroke and were followed up at periods between <6 months and >10 years from the onset of the stroke. Although it was not possible to determine time differences between the assessments from the data presented in their paper, the authors concluded that left hemisphere involvement and a post-stroke period of <2 years was significant in the onset of depression after stroke. These results were in accordance with their previous research (Robinson and Szetela,1981).

(c) JHG 1983

In a second study of 103 stroke patients (an apparently different cohort from the above), the patients were assessed in the `acute` stage, i.e. (1-21 days) following the stroke, then again at 3 months, 6 months, 1 year and 2 years (Robinson et al.,1983). The cohort included 10% of patients with a family history of psychiatric illness and 25% with a history of stroke.
The results demonstrated that approximately 50% of `acute` stroke patients had clinically significant mood disorders and 25% had symptom clusters associated with major depression (Robinson and Price,1982). The results of this study showed no difference in the severity of depression among patient groups with right or left hemisphere, or brainstem strokes.

Further analysis of the data locating the stroke lesions to either frontal or parietal-occipital lobes, demonstrated that patients with left frontal lobe lesions had significantly greater mean depression scores when compared with patients who had lesions in any other location. The authors commented that anterior-posterior differences in lesion location might now be more important than right-left differences, in determining the severity of depression.

(d) JHG (1984; 1985)

Following on from the `acute` study (Robinson et al.,1983), forty of the original cohort of 103 patients were assessed at 3 months from the onset of the stroke, 50 of the original group were assessed at 6 months, and 29 patients were interviewed on all three occasions (Robinson et al.,1984;1985). Results of these data showed that the association between the location of the lesion in the left hemisphere and the level of depression remained unchanged from the `acute` post-stroke phase. However, it was noted that the strength of the association between functional physical impairment, intellectual impairment, and social functioning, with depression, which had been noted in the `acute` phase had increased. It was also noted at these follow-up stages, that patients with lesions farthest from the right frontal pole were now the most depressed, and the authors could not explain this outcome since it was contrary to their previous experience. It is difficult to determine from their data if the follow-up groups were representative of the initial cohort of patients.

(e) **JHG 1987**

Using this same cohort of 103 patients (JHG 1982), follow-up studies were done at 1and 2 years from the onset of the stroke (Robinson et al.,1987). The results obtained were based on follow-up assessments on 38 patients at 1 year and 48 patients at 2 years. Of the follow-up patients at 1 year, 14% had symptoms of major depression, 19% had dysthymic symptoms and 67% were not depressed. The 2-year follow-up study demonstrated that 21% had major depression, 21% had dysthymic depression and 58% were not depressed.
Although these figures were not significantly different from those found at the time of the initial assessment, (ie.14%, 18% and 68%), it was noted that the composition of the depression groups had changed.

The authors make the point that the major uncertainty of their results is whether or not the follow-up population is representative of the initial group and whether generalizations can be made from their data to a general stroke population. Reasons for this are that of the 103 patients initially assessed, 40 patients were assessed at 3 months, 50 patients at 6 months, 29 patients were interviewed at both follow-up intervals and only 22 were interviewed on all 4 follow-up assessments. The most important overall finding from this study was the poor prognosis of patients with an in-hospital diagnosis of dysthymic depression.

(f) **JHG 1987(b)**

In a further analysis of the data from this two-year longitudinal study, Parikh et al.(1987) state that while lesions in the left hemisphere accounted for more of the variation in depression than any other variable, this association was sustained for only one year and that the association had disappeared by the 2 year follow-up study. The authors commented that this probably reflects the natural course of major depression, which they state spontaneously remits between 1 and 2 years after stroke. The authors also maintain that the relationship between lesion location and mood disturbance could have been adversely affected by the possibility that small or developing lesions may have been missed on the original CT scans.

(g) **JHG 1983(b)**

In a study of 15 bilateral hemispheric brain injured patients, who were a mixture of CVA and focal traumatic brain injury, Lipsey et al.(1983) showed that depression was associated with single left frontal lobe lesions, irrespective of the location of other pathology. Although this result is in keeping with previous results from this group, it is difficult to determine the true significance of the outcome of this study. This is due to the fact that the authors have selected a group of 15 patients from a cohort of 123 patients, of whom 103 patients were part of the original study by Robinson et al.(1983). It is therefore difficult to assess just how many of the original cohort were included in this study.

(h) JHG 1984(b)

In a study by Robinson and Kubos et al.(1984b), the authors studied 36 acute stroke patients (i.e. within 3 weeks of the onset of the stroke), who had single stroke lesions on either hemisphere. The results showed that for patients with left hemispheric lesions the severity of depression was significantly higher in patients with left frontal lesions, whereas for patients with right hemispheric lesions, the severity of the depression was related to right posterior lesions. The problem in comparing the significance of this result with previous results from this group, is the fact that this evaluation was done on the same group of patients as those in the study by Lipsey et al.(1983) above, together with another group of patients totalling 128 patients in all. From this total cohort, the authors selected 36 acute stroke patients.

(i) JHG 1984 (c)

In a double-blind study on the effects of the tricyclic antidepressant, nortriptyline, in the treatment of post-stroke depression, Lipsey et al.(1984) claimed that the results showed a significantly greater improvement in patients treated with nortriptyline than in a similar group of placebo treated patients. However, it is noted that of the 39 patients who were recruited to the study (19 nortriptyline and 20 placebo), the results were based on 26 patients who completed the study (11 nortriptyline and 15 placebo). It is also noted that there were considerable differences in the construction of the two groups in that, the placebo group had a 10% history of alcohol abuse, a higher past history of life-threatening illnesses and a shorter duration since the onset of the stroke.

(j) JHG 1986

In a study by Lipsey et al.(1986), the authors compared 43 patients who had post-stroke depression with 43 patients who had clinical depression of unknown origin. The results showed that both groups of patients presented with similar depressive symptoms which the authors suggest indicates that post-stroke depression is an important secondary affective disorder and may prove helpful in identifying the relevant brain areas or mechanisms involved in affective disorders in general. They particularly suggest that there may be a clinico-pathological relationship between the left frontal lobes of the brain and post-stroke depression.

(k) JHG 1987(c)

In a study by Starkstein et al.(1987) using a cohort of 184 patients, (which included the first cohort of 103 patients together with another 68 patients attending a rehabilitation unit), the authors compared the effect of cortical and subcortical lesions on depression after stroke. From this total group, 45 patients met the inclusion criteria of being less than 2 months from the onset of the stroke and had a single lesion (either cortical or subcortical) as demonstrated by CT. The results of this study showed that left anterior cortical and subcortical groups had significantly higher depression scores compared with groups with lesions in other areas.

In this study the authors themselves raise the question of biased methodology in their selection of patients, since they had excluded patients with comprehension deficits which they presumed were due to posterior defects.

(l) JHG 1988

In a comparative study of patients with and without post-stroke depression, Starkstein et al. (1988) compared 13 patients who had developed major depression and 13 patients who did not become depressed during the same 2-year period following stroke. Both groups of patients were matched neurophysiologically for the size and location of the stroke lesion. According to the authors, the differences demonstrated in depression status between the groups, were due to the presence of subcortical atrophy preceding the stroke and a degree of cognitive impairment in the depressed group.

(m) JHG 1989

In a slight change of emphasis to recognize that anxiety may be a contributing factor in depression after stroke, Starkstein et al.(1989) evaluated the nature of the relationship between anxiety and depression in male patients with acute stroke (i.e. approx. 5-25 days post-stroke). The cohort of male patients included 24 major depressed patients, 6 patients with generalized anxiety only, 23 patients who met the criteria for both anxiety and depression and 45 patients who had no symptoms of either depression or anxiety. The results of this study demonstrated that the anxious/depressed patients had a significantly higher frequency of left cortical (primarily involving the frontal cortex) lesions while the major depression group only showed a significantly higher frequency for left subcortical (mainly basal ganglia) lesions. There were no significant results for the anxiety group alone due to the fact that the number of patients in this group was too small.

(n) JHG 1993(a)

In a further study on generalized anxiety disorder after stroke, Castillo et al.(1993) also demonstrated that anxiety plus depression was associated with left cortical lesions while anxiety alone was associated with right hemispheric lesions. The authors confirm that anxiety was significantly present in depressed patients who had right or left hemispheric lesions (>60% in both). However, anxiety was not a significant factor in patients with right or left sided lesions who were not depressed.

The authors conclude that depression and anxiety are associated after stroke and that this association is in keeping with previous literature on the relationship between depression and anxiety in patients without demonstrable brain lesions. Although they were not able to explain the level of anxiety as a response to the brain injury experienced in stroke patients, they suggest that it may be related to the premorbid personality of the patients, or could be a consequence of the pathophysiological processes produced by the brain injury.

As in previous studies it is difficult to establish the true impact of the results of this study, since the cohort of patients in this study included 94 patients from the previous study (Starkstein et al.,1989), together with 215 patients not previously reported on.

(o) JHG 1993(b)

In 1993, as a conclusion to their original study in 1981, Morris et al.(1993) evaluated the effects of depression on mortality,10 years after the onset of the stroke, and concluded that patients who were depressed were 3.4 times more likely to have died during the follow-up period than were non-depressives. The authors did not specify if there were differences in mortality rates in relation to the severity of the depression, but did acknowledge that the depressed patients who died, may also have had comorbid medical conditions which could have contributed to their mortality, but which the authors were unaware of.

(p) JHG 1993(c)

To evaluate the effect of depression and the personality characteristic of introversion on mortality following stroke, Morris et al.(1993) assessed 94 patients two months after the onset of stroke. The purpose of the study was to assess the pre-stroke personality characteristics of neuroticism and extroversion, the questions in the Eysenck Personality Inventory were referenced to the adult life of the patients well before the onset of the stroke.

Fifteen months after the initial evaluation the results demonstrated a significant relationship between mortality and the pre-stroke extroversion-introversion scores. While this result is consistent with reports linking increased mortality with depression in medically ill patients, the authors state that it supports their previous finding of a more than three fold increase in mortality risk for depressed patients in their 10 year follow-up study of stroke patients.

(q) JHG 1995

Using the same group of patients as in the previous study, Morris and Robinson (1995), assessed the effects of the personality traits of neuroticism and extroversion on depression after stroke. The same initial evaluation at approximately 2 months post-stroke was used and 64 of the original cohort of 94 patients were assessed again 15 months later. The results showed that neuroticism was associated with post-stroke depression, but that extroversion was not associated with either measure of depression.

A considerable weakness in this study was that 33% of the cohort of patients had a history of psychiatric disorder. The authors also acknowledged the limitations of the study in using as a baseline assessment, a two-month retrospective assessment of personality which may have been biased by the mental state of the patients.

4.3.1 Summary of JHG studies

Despite the fact that they have been prolific in their investigation of the concept of post-stroke depression, it is difficult to evaluate the actual significance of the results of the JHG studies since it is uncertain in many of their studies as to what this group was measuring and on whom. Despite this emphasis of an association between post-stroke depression and lesions in the left hemisphere, their results are somewhat varied.

A brief overview of the results of their studies suggests that the incidence of post-stroke depression varies from 30-60%, that their studies include patients with histories of alcohol abuse and psychiatric illness, and that the construction of the groups has been shown to be highly selective. Furthermore, the association between the location of the stroke lesion and the onset of post-stroke depression, which they have always maintained exists, has been shown to be variable.

For instance, in the study by Robinson and Szetela(1981) the association between post-stroke depression and location of infarct was the distance from the left frontal pole while Robinson and Price(1982) demonstrated an association between depression and the left hemisphere in general. In 1983, studies by Robinson et al. and Lipsey et al. showed that post-stroke depression was associated first with the left hemisphere, then it was subsequently not related to either hemisphere, then on re-analysis was associated with the right frontal parietal lobe and the left frontal lobe, and finally the authors concluded that laterality was not important but that the anterior/posterior location of the infarct was important.

In 1984, studies by Robinson et al. demonstrated associations with lesions in the left hemisphere generally, then left frontal lesions and finally right posterior lesions. In 1985, Robinson et al. demonstrated that lesions in the right hemisphere farthest from the frontal pole were associated with depression while Robinson et al.(1987) highlighted that the left anterior cortical and subcortical lesions were associated, together with left dorso-lateral-cortical and left basal ganglia lesions. Adopting a different approach, Starkstein et al.(1988) proposed that the presence of subcortical atrophy preceding the stroke was associated with the presence of depression. However, by 1989 Starkstein et al. considered that left sub-cortical lesions were associated with depression, while left cortical and subcortical lesions were associated with anxiety and depression.

In contrast to their previous anatomical associations with post-stroke depression, Castillo et al.(1993) introduced the possibility of a pre-morbid personality association with the onset of post-stroke depression. This association was confirmed by Morris and Robinson(1995). Although the authors acknowledge the weaknesses in the studies which reached these conclusions, this outcome is a considerable change of emphasis for this research group.

4.4 Community Stroke Studies

In contrast to the JHG studies of depression after stroke, which included mainly hospital in-patients or patients attending rehabilitation centres, community studies include all types of patients who have suffered from stroke. In view of the labour intensive nature of these studies, only a few of these studies have been done in recent years.

4.4.1 The Oxford Community Stroke Project (OCSP)

(a) Epidemiology

In 1988, the results of the Oxfordshire Community Stroke Project (OCSP) were published (Bamford et al.,1988). This was the largest and most comprehensive, prospective community study of stroke patients that had ever been done. During the period 1981-1986, from a community of 105,000 people, six hundred and seventy five cases of first ever stroke, or transient ischaemic attack (TIA), were registered in the study. Of these patients, 91% were examined by a neurologist in a median time of 4 days after the onset of the stroke and 88% had cerebral CT or necroscopy.

(b) Psychological assessments

Follow-up psychological data were obtained on an initial cohort of 116 patients, 95 patients were followed up at 1 month, 91 patients at 6 months, and 84 patients at 12 months from the onset of the stroke. In the interim period, a further 33 patients were included in the study of whom 31 survived to 12 months, and so a total of 128 patients were seen at least once in the year after their stroke. A control group of subjects from the same geographical area was also included for comparison with the stroke patients.

(c) OCSP - Results

Using the data from the OCSP, House et al.(1989) showed a significant association between persistent emotionalism and anterior lesions in the left hemisphere. Further analysis of this data showed that, although there was no overall significant association between major depression and lesion location (House et al.,1990; 1991), there was an association between depression scores and the distance of the anterior border of the stroke lesion from the anterior pole of the hemisphere in which it lay. Although this result was in keeping with the results of Robinson et al.(1984b), it was a much weaker correlation.

In the OCSP study, 23% of patients exhibited signs of major depression at some time during the 6 months follow-up period and 28% at one-year follow-up. Only 3% were diagnosed as major depression for the whole of the year. There were no significant differences in the depression scores between the patients and the controls. With regard to the effects on the personality of the patients, the authors commented that, although relatives of the patients complained of a change in the personality of the patients, this was a status which the authors found difficult to quantify.

(d) OCSP - Long-term follow-up

In the long-term follow-up study of the survivors of the original cohort of patients from the OCSP, 60 patients were assessed at 3-5 years (mean 45 months) after the stroke, together with a control group of 109 healthy elderly volunteers. The prevalence of major depression in the long-term stroke group was similar to that in the control group, but the prevalence of depressions in the stroke patients was 18% compared with 8.5% in the controls.

In contrast to major depression, however, anxiety disorders appear to be relatively common at this stage, and were demonstrated as 20% in the presence of a depressive syndrome and 13% when diagnosed alone, and this was considerably higher than the 3% found in the control group. There was no association with site or side of lesion for anxiety and/or depression in this long-term follow-up group. However, this study showed that the various levels of depression, which amounted to 18%, were associated with impaired physical and cognitive function, greater age, and a larger original brain lesion.

(e) Comparison of results of OCSP with the JHG

The authors of the OCSP suggest that the discrepancy in their findings with that of Robinson and colleagues could be due to the selection of patients. In the first instance, Robinson and Price.(1982) evaluated patients who had been admitted to hospital, and it is assumed that these patients may have been more seriously impaired overall than the community sample studied in the OCSP. The authors also acknowledge the difference in the social construction of the groups involved, in that the Robinson cohorts consisted of mainly black, urban, lower social class patients whereas the OCSP subjects were white, rural and fairly affluent.

4.4.2 Bristol Community Stroke Project (BCSP)

(a) Epidemiology

In another large community study of stroke patients, Wade et al.(1987), evaluated 976 acute cases of stroke patients who were registered with 96 general practitioners in Bristol. Each patient was seen as soon as possible after the onset of the stroke, at 3 weeks post-stroke 379 patients were interviewed, at 6-7 months post-stroke 432 patients were seen and at 12-13 months post-stroke 484 patients were assessed.

(b) Psychological assessment

On each occasion, the neurological, functional, emotional and social status of the patients was assessed. Of the original cohort of patients, 255 patients were assessed on each of the three occasions. Depression was measured using the Wakefield Self-assessment Depression Inventory (Snaith et al.,1971). Although the authors comment that this scale has not been validated in the elderly or in stroke patients, it was derived from the Zung scale which has been validated in stroke research (Robinson and Price,1982). The results, however, tend to measure the extent of any feelings of depression rather than clinically defined depression.

(c) BCSP Results

The results of the study showed that, at each assessment, 25-30% of the patients were depressed, and that 17% of the patients were consistently depressed at all three assessments. Of the patients who had been initially depressed, 15% had recovered 12 months later, but 25% of those not initially depressed became so 6-12 months later. At three weeks post the onset of stroke, there was a significant association between depression and left hemispheric lesion, however, this was not evident at 6 months or 1 year after the stroke. CT imaging was not done on the patients at any time and therefore detailed information about the location of the infarct was not available. The results of the data also demonstrated that there was a significant association at each of the assessments between the level of depression and being female and the loss of functional independence as a result of the severity of the stroke. However, the authors considered that these factors could not in themselves account for the level of depression seen in this group.

4.4.3 The Perth Community Stroke Project (PCSP)

(a) Epidemiology

The Perth Community Stroke Project (PCSP) was a population-based study of patients in an area of Perth, Australia, with a population of 140,000 (Burvill et al.,1995). During the 18-month period of the project, 492 patients were recorded as having suffered from a stroke, and of these patients, 311 had an initial clinical assessment carried out, with follow-up clinical assessments at 4 months and 12 months later.

(b) Psychological assessments

In this study psychological assessments were only performed on 294 of the patients at 4 months post-stroke, of whom 69 (23%) patients were assessed as being depressed. At 12 months post-stroke, psychological assessments were only carried out on the 69 patients who had been seen to be depressed at 4 months post-stroke. Psychological assessments were also carried out on 108 control subjects on one occasion.

(c) PCSP Results

At four months after stroke, the results showed that 15% of the patients assessed had major depression and 8% had minor depression. Although not assessed at the onset of the stroke, retrospective enquiries at 4 months suggested that 9% of the patients had been depressed at the time of the stroke. At 12 months post-stroke, only the 69 patients who had been diagnosed as being depressed at the 4 months assessment were reassessed psychiatrically. Of these patients, 22% had major depression and 19% had minor depression, however, control subjects were not reassessed at 12 months.

In this study, the authors comment that the design of their study did not include a quantitative measure of depression, and although many of the cases of major depression fulfilled DSM-III criteria, in most instances the severity of the depression was not great. They also comment that if the patients who had apparent depression at the onset of the stroke, had been removed from the data, then a truer estimate of post-stroke depression might have been obtained. This is an incomplete community study of post-stroke depression.

4.4.4 The FINNSTROKE study

(a) Epidemiology

In 1998 the results of a population based stroke record of 594 patients (from a total population of 134,108) with first ever strokes was published (Kotila et al.,1998). The patients were recruited from four different districts of Finland over a 2-year period. The main purpose of this study was to compare the incidence and severity of depression after stroke, in patients and their carers, in relation to the presence or absence of after-care programs.

(b) Psychological assessment

Assessments were done on 321 stroke patients and 195 caregivers at 3 months, and on 311 patients and 184 carers at 12 months after the onset of stroke. Depression was assessed using the BDI with a cut-off score of 10 to signify depression, which the authors maintained had been used previously in the evaluations of patients with somatic illnesses.

(c) Results

The results of this study demonstrated that, in regions where after-care programmes were set-up, approximately 40% of patients and carers were depressed at 3 and 12 months after the onset of the stroke. This was in contrast to 55% of patients and 40% of carers who were depressed in the regions with no after-care programmes. The results also showed that the severity of the patients' depression at 3 months was positively associated with the severity in the carers. The outcome also demonstrated significant associations between depression, female gender and severity of the stroke at the 3 months assessment.

Although it is not absolutely clear from the results presented in their paper, if the same patients were depressed at 3 and 12 months assessments, the authors comment that the percentages of depression which were recognized, came within the mild - moderate category, and that only 9% had severe depression. They also highlight the association that was demonstrated between the depression status of the carer and patients, particularly at 3 months, and suggest that identifying and treating stroke carers for depression might be beneficial to the patients.

4.4.5 The Sunnybrook Stroke Study

(a) Epidemiology

In 1998 the results of the Sunnybrook Stroke Study were published (Herrmann et al.,1998). The purpose of this prospective study was to assess the prevalence of depressive symptoms and their effects on stroke recovery over a period of 12 months. The cohort of patients included a consecutive series of stroke patients who were admitted to the regional stroke centre in Toronto from a catchment population of 250,000.

(b) Psychological assessment

Of 436 patients diagnosed with stroke, 150 patients were followed up at 3 months and 136 patients at 12 months. Patients were assessed for depressive symptoms using the self-administered Zung Self-Rating Depression Scale (SDS) and the observer rated Montgomery Asberg Depression Rating Scale (MADRS).

(c) Results

At 3 months post stroke, depressive symptoms were noted in 22% of patients using the SDS and 27% using the MADRS, and at 1-year post stroke 21% demonstrated depressive symptoms using the SDS and 22% using the MADRS. Of the patients who demonstrated depressive symptoms at 3 months, 45% were also depressed at 1 year. Factors associated with depressed symptoms were, a greater degree of neurological impairment, being female, and having a previous history of depression. Depressive symptoms were shown to be negatively associated with functional outcome at 3 months and 1 year, but there was no association between depressive symptoms and location or volume of the stroke lesion.

The results of this study relate mainly to patients classified as having mild depressive symptoms, and only a small percentage had scores at 3 months and 1 year which were representative of moderate depression. The significance of the results is also complicated by the fact that 19-24% of patients who demonstrated depressive symptoms at 3 months and 1 year were taking antidepressant medications, while 10% of patients who did not demonstrate depressive symptoms were also taking antidepressant medications during this time. The only significant predictor of depression was the history of previous depression.

4.4.6 Summary of community studies

An advantage of community studies is that they are more representative of all types of strokes and not just the more severe strokes which tend to be dealt with in hospitals, and on which most stroke studies are based. Of the five community stroke studies which have been done, the OCSP is the most comprehensive, but has the weakness that the data collected is probably not representative of communities in general, since Oxford is a fairly affluent residential area. Nevertheless, the results did demonstrate that there was a significant association between emotionalism and left anterior lesion and a non-significant association

between major depression and the location of the infarct. The study also demonstrated associations between depression and level of physical impairment and cognitive abilities.

The Bristol study was a large comprehensive project which, although purporting to measure levels of post-stroke depression, used a depression inventory which measured feelings of depression rather than the clinically defined concept. Nevertheless the levels of reported depression in the Bristol study were consistent with other studies, and in agreement with the OCSP, found that the physical impact of the stroke was related to the onset of depression.

The Perth study was also a large community study of stroke patients. Although clinical assessments in this study were regularly performed at each of the stated assessment times, psychological assessment of the patients was incomplete throughout the study. This suggests that the authors may only have been marginally interested in the psychological input to the clinical outcome of the patient. Consequently it is difficult to compare the results of this study with those of other community studies.

The FINNSTROKE study was initially intended to assess the impact of after-care programs on the affective status of patients and their carers, and it succeeded in doing this. Although the assessment of depression using the BDI with a cut-off value of 10 was accepted by the researchers as reflecting mild-moderate depression, it did not truly represent levels of significant affective disorder at each assessment. It was also difficult to determine if the levels of depression which were measured at the 3 months and 12 months assessments, reflected levels of affective disorder at these times individually, or were representative of persistent levels of depression over the 12 months period. Nevertheless, the results demonstrated similar levels of mild-moderate depression in patients and carers and also a significant association between the level of affective disorder in carers and patients at 3 months.

The results of the Sunnybrook Stroke Study were possibly affected by the cohort of patients which included patients with a previous history of depression and patients on antidepressant medications. However the results demonstrated significant associations between functional dependence and depression, even when the depression was of a fairly minor nature.

4.5 Studies on post-stroke depression in relation to lesion location

(a) Magni et al. (1984)

In a study by Magni et al.(1984), 30 stroke patients and 30 control subjects were assessed for depression using the Symptom Distress Checklist (SCL-90). Of the thirty patients, 17 patients were assessed within 45 days of the stroke and 13 patients were assessed 8-12 months later. The results suggested that there was a high prevalence of depression in the stroke patients when compared with the controls, but there was no difference in depression

levels between patients with right or left hemispheric lesions. It is also noted that the level of depression appeared to increase with time following the stroke.

(b) Sinyor et al. (1986)

In a study by Sinyor et al.(1986), 64 stroke patients were assessed clinically and psychiatrically within one week of stroke. Results showed that 47% of patients demonstrated depression of which 22% was moderate to severe in nature while 25% had symptoms of mild depression. There were no depression differences between patients with right and left hemispheric lesions.

Between 5 and 11 weeks after onset, follow-up functional, but not psychological assessments, were done on 25 of the original cohort at discharge from the hospital. From this incomplete data, the authors concluded that depression was associated with greater functional impairment on admission and discharge. The authors acknowledged that they were making considerable assumptions as to the depression levels of the patients on their discharge from hospital.

In a further analysis of the same group of patients, based on CT results of 35 of the patients, Sinyor et al.(1986) confirmed that there was a significant correlation between lesion location and volume, and severity of depression. From their results the authors suggest that there was a linear relationship between severity of depression and proximity of the lesion to the frontal pole in either hemisphere, and that posterior lesions of the right hemisphere were also associated with higher depression scores.

(c) Ebrahim et al.(1987)

Using the General Health Questionnaire (GHQ) and a cut-off score of 12, Ebrahim et al.(1987) assessed 149 patients for depression six months after the onset of stroke and estimated that 23% were suffering from depression. Although the authors note that their results compare with those of Robinson and Price(1982), they qualify this comparison by noting that Robinson and Price used a cut off score of 6 in their study, which also included patients up to 10 years after the onset of stroke. There was no association between the hemispheric site of the lesion and the level of depression, although there was a strong relationship between the degree of physical disability and a high GHQ score.

(d) Yamaguchi et al.(1987)

In a study by Yamaguchi et al.(1987) using the ^{133}Xenon inhalation method of imaging, results demonstrated significant inverse correlations between the depression scores and regional cerebral blood flow (rCBF) in the right and left parieto-temporal regions, and the left fronto-temporal region. In follow up studies, improvement in depression scores correlated with an increase in rCBF in the caudal part of the right temporal region and in the rostral part of the left temporal region.

(e) Eastwood et al. (1989)

In a study of 87 stroke patients, Eastwood et al.(1989) initially assessed the patients for depression on presentation at the outpatient clinic (duration from onset of stroke is unspecified). Of these 87 patients, 47 patients were diagnosed as being depressed and were compared with 32 patients who were not depressed and who were considered as controls (8 patients had other psychiatric disorders). The results of this study suggested that while more than 50% of the initial sample were depressed, only 10% of this group had major depression symptoms. It was also noted that the depressed patients had greater functional disability and were of longer duration from onset of the stroke when compared with the controls. Although the authors demonstrated an association between lesions in the left hemisphere and depression, the results were based on the data from 4 patients. It was also noted that a prior psychiatric illness (25%) and a history of CVA (30%) were critical factors in accounting for the incidence of depression in this study.

(f) Schwartz et al.(1990)

In a pilot study of 14 stroke patients using the radionuclide ^{99m}Tc HMPAO and SPECT imaging methods, Schwartz et al.(1990) demonstrated an association between depression and the size but not the location of the cerebral lesion.

(g) Yamaguchi et al.(1992)

In a further study by Yamaguchi et al.(1992), again using the ^{133}Xenon inhalation method of imaging regional cerebral blood flow, the results showed that severity of depression inversely correlated with rCBF values in the right parieto-occipital regions and in the left anterior temporal region at the initial evaluation. Patients with lesions in the left frontal or right parieto-occipital regions were more depressed in comparison with those with other brain lesions. Although the follow-up study showed significant inverse correlations, between depression scores and changes in rCBF at all brain sites, higher inverse correlations were observed at the right parietal, parieto-occipital and left anterior temporal regions.

(h) Astrom et al. (1992; 1993)

In studies by Astrom et al.(1992;1993) of 80 patients in an acute stroke unit, assessments were done at 4-5 days, 3 months, 12 months and 2-3 years after the onset of stroke. The prevalence of major depression was 25% in the acute and 3 month stage decreasing to 16% at 12 months and increasing to 19% at 2 years and 31% at 3 years post onset.

The results of these studies suggest that important predictors of depression in the acute stage were left anterior brain lesion, dysphasia and living alone. In the longer duration assessments, dependence on others for activities of daily living and fewer social contacts were also relevant. Comparing the results of this study with other studies is difficult since 16% of the cohort had a previous psychiatric history and the study also included aphasic patients.

(i) Grasso et al.(1994)

In this study, clinical and neuropsychological assessments were performed on 15 stroke patients who presented with a single subcortical lesion. The results of the study showed that the severity of the depression which affected more than 50% of the patients, was not related to the size or location of the lesion, nor to the degree of neurological impairment. This study also included the evaluation of rCBF measurements using ^{99m}Tc HMPAO, the results of which demonstrated that the mesial temporal cortex ipsilateral to subcortical ischemia, was significantly less perfused in depressed patients when compared with non-depressed patients, irrespective of the site of the subcortical infarct.

(j) MacHale et al.(1998)

In this study 55 patients were assessed using the Schedule for Affective Disorders and Schizophrenia (SADS) to generate a DSM-IV psychiatric diagnosis of classifications of depression (major, not specified, adjustment disorder with depressed mood) or anxiety disorders. Patients were also assessed using the Hospital Anxiety and Depression Scale (HADS). The results demonstrated that patients with RHD were significantly more likely to have a depressive disorder at 6 months compared with LHD patients and that younger patients and those with greater disability were significantly more likely to be depressed. Although 6 (24%) patients with RHD and 2 (7%) patients with LHD had major depressive episodes at 6 months, the difference between RHD and LHD was not significant. It is not clear from this study if assessments of depression were done at the onset of the stroke to determine if there was an association between levels of depression at 6 months and at onset.

(k) Singh et al.(2000)

The Sunnybrook stroke study determined the functional and neuroanatomical correlates of post-stroke depression on 81 patients with a first ever stroke. Although the results demonstrated that 36% of patients (47% RHD and 17% LHD) displayed depressive symptoms at 3 months, there was no significant association between depressive symptoms and laterality of infarct. Lower Functional Independence Measure, inferior frontal lesion (irrespective of side) and living at home were significant risk factors for the onset of depression at 3 months after stroke in this study.

(l) Carson et al.(2000)

This was a review and subsequent meta-analysis of 35 studies from a possible 143 stroke studies which the authors identified. The purpose of the study was to evaluate the hypotheses that depression after stroke is associated with strokes affecting the left rather than the right hemisphere or with the left anterior brain lesion to a greater extent than any other lesion location. The authors concluded that the risk of post-stroke depression was not associated with the location of brain lesions. They also highlighted the complexities involved in interpreting and comparing the results of studies of post-stroke depression.

4.6 Studies in Post-stroke depression in relation to other factors

While most of the research into post-stroke depression to-date has focused on the association between depression and the location of the stroke lesion, other factors have been suggested as being relevant and these are summarized below.

(a) Folstein et al. (1977)

Folstein et al.(1977) evaluated mood disorder as a specific complication of stroke, by comparing 20 stroke patients with 10 orthopaedic patients who had a similar level of physical disability. The results showed that a significantly greater percentage of stroke patients were depressed compared with the orthopaedic patients and this suggested to the authors that the degree of physical impairment was irrelevant in the onset of depression after stroke. In reaching this conclusion however, the authors failed to take into consideration the fact that there were considerable differences in the assessment times between the two groups. The stroke patients were assessed 30 days from the onset of their stroke, while the orthopaedic patient group, which included hip fractures and arthritis had a mean duration of illness of 360 days from onset. In view of the fact that the time difference from the onset of illnesses is a relevant factor in the long-term adjustment to physical impairment, the direct comparison of these two groups of patients is of dubious significance.

(b) Fiebel and Springer (1982); Binder (1984)

Fiebel and Springer (1982) found that depression after stroke significantly correlated with failure to resume social activities while Binder (1984) considered that depression was associated with loss of mobility, occupation and cognitive abilities. The author also noted that anxiety was common after stroke and was frequently associated with periods when the patient was left alone.

(c) Evans and Miller (1984); Kotila et al.(1984)

Evans and Miller (1984) demonstrated that post-stroke depression was consistently found to be a function of psychological losses and brain pathology rather than physical impairment, while Kotila et al.(1984) showed that impairment of overall intelligence, memory and visuospatial perception had a negative effect on outcome, and that younger patients improved to a greater extent than older patients.

(d) Sinyor et al.(1986); Starkstein and Robinson (1989)

Sinyor et al.(1986) reported that depressed stroke patients in comparison with non-depressed patients showed greater functional impairment at both admission and discharge from hospital. Starkstein and Robinson (1989) claimed that physical impairment probably does not cause post-stroke depression, but that once depression occurs, the combination of depression and physical impairment can reduce a patient`s future social functioning.

(e) Wade et al.(1987)

As part of the community study by Wade et al.(1987), the authors demonstrated that factors associated with depression after stroke included loss of functional independence, a low level of other activities, being female and living with someone. The authors also commented that depression after stroke cannot be explained simply by physical or social disabilities and that the premorbid personal characteristics or social status of the patient may have an influence on the onset of post-stroke depression.

(f) Astrom et al.(1993)

In a study of psychosocial function and life satisfaction after stroke, Astrom et al.(1993) documented that patients who had a permanently reduced life satisfaction in terms of fewer social contacts and reduced leisure time activities tended to be older, were more anxious and dependant on others, and had a higher frequency of major depression.

(g) Sharpe et al.(1994); Angeleri et al.(1993)

Sharpe et al.(1994) concluded that depression in long-term survivors of stroke is more likely to occur in the old, the lonely, and the functionally and cognitively impaired, and
Angeleri et al.(1993) demonstrated that social activities, family stress and post-stroke depression are strongly related.

(h) Dennis et al.(2000)

Dennis et al.(2000) assessed the emotional outcome of 251 stroke patients at 6 months post stroke and related levels of emotional distress to levels of physical function. The results demonstrated that the degree of physical disability was more strongly associated with depression rather than with anxiety. Although the patients who were judged to be depressed on the basis of the results of the GHQ and the HADS questionnaires, were not assessed for depression using a structured psychiatric interview, the authors felt confident in assessing levels of depression using pre-determined cut-off points, on the basis that they had previously shown that the GHQ and HADS are reasonably valid indicators of psychiatric morbidity. They further admit that the potential influence of the pre-or baseline emotional or personality status of the patients was not considered in their results.

4.6.1 Summary of post-stroke depression and other factors

The results of studies are difficult to compare due mainly to the variability in their methodologies. Nevertheless, the studies described show that the prevalence of depression after stroke can range from 20-50%. Although many of the studies have demonstrated associations between the laterality of the cerebral infarct and depression, other studies have not. This is in keeping with the meta analysis by Carson et al.(2000), which showed that the outcomes of studies with respect to associations with laterality appear to be inconclusive. The studies have associated levels of depression after stroke with degrees of physical impairment and subsequent disability, a prior history of a psychiatric illness, being female, living alone and having fewer social contacts. The overall outcome from these studies is that no single variable can be considered to be the cause of the onset of depression after stroke

4.7 Post-stroke depression and personality

Despite the fact that personality is considered to be an important influence in depressive disorders, very little consideration has been given to the possibility that the presence of certain personality characteristics could influence the onset of depression after stroke. While references have occasionally been made to the possible impact of personality, few systematic studies have been undertaken to evaluate any association between personality and post-stroke depression. In this regard, House et al.(1991) commented that the relatives of stroke patients had observed personality changes in the patients, but the authors stated that it was a difficult area to quantify. Beckson and Cummings (1991) also considered that changes in personality associated with specific stroke syndromes were largely unexplored and stated that the most dramatic personality alterations appeared to occur in patients with infarctions of the frontal lobes. Robinson et al.(1987), in explaining the incidence of late-onset dysthymic depressions suggested that they might be related to premorbid personality vulnerabilities, while Thomson et al.(1989) suggested that a depressive or other personality style prior to the stroke may be a major cause of post-stroke depression.

4.7.1 Studies in post-stroke depression and personality

(a) Cullum and Bigler (1988)

In a cross-sectional study, Cullum and Bigler (1988) assessed a group of 153 patients, comprising 52 stroke patients (CVA) and 101 patients suffering from head injury (HI). In this cohort, 47 patients had LHD, and 47 patients had RHD. A further 59 patients had bilateral or diffuse brain damage and these patients were used as a control group. The groups were assessed between 2 months and 2.5 years (mean 16 months) from onset of their injury. Psychological assessment was done using the Faschingbauer Abbreviated MMPI (FAM) (Faschingbauer,1974) and the results demonstrated that LHD, RHD and diffuse damaged groups produced similar overall MMPI profiles. These outcomes were consistent with the majority of previous MMPI studies in patients with lateralized brain damage. Although their results did show slightly higher depression scale scores in LHD patients, and the presence of

a greater depressive symptomatology among the longer duration patients, ie. patients >7 months since onset, the authors admitted that this group might have included patients who had been depressed prior to the 7 months period.

(b) Cullum and Bigler (1991)

In a second cross-sectional study of 46 subjects in 1991, Cullum and Bigler confirmed the findings of their 1988 study. In this study the authors evaluated the psychological status of two groups of patients again using the FAM. In this study, the first group consisted of 21 patients who were in the range 2-6 months post-stroke and 25 patients in the longer duration group of 7-24 months post-stroke.

(c) Morris et al.(1993)

In this study, 94 patients were assessed 2 months after the onset of stroke. Depression was measured using the Montgomery and Asperg Depression Rating Scale (MADRS) and personality was measured using the short form of the Eysenck Personality Inventory (EPI). Since the purpose of the study was to assess the pre-stroke personality characteristics of neuroticism and introversion in the patients, the questions in the EPI were referenced to the majority of the patients' adult life well before the onset of the stroke. At 15 months after the initial assessment 84 patients were again assessed and results showed that mortality was associated with the severity of clinical depression and with pre-stroke introversion scores. Since the highest association was found to be between the severely depressed and introverted patients and mortality rate, the authors concluded that mortality was related to introversion. While this result is consistent with other reports linking increased mortality with depression in other medically ill populations (Shulman et al.,1989; Ruberman et al.,1984), the authors also state that it supports their previous finding of a more than three-fold increase in mortality risk for depressed patients in their 10 year follow-up study of stroke patients (Morris et al.,1993).

(d) Morris and Robinson (1995)

Using the same group of patients as in their previous study (Morris and Robinson,1993), the authors assessed the association between the personality traits of neuroticism and extroversion and post-stroke depression. The same initial evaluation at approximately 2 months post-stroke was used and 64 of the original cohort of 94 patients were assessed 15 months later. The results showed that pre-stroke neuroticism was associated with the onset and severity of post-stroke depression, but that extroversion was not associated with depression after stroke.

The authors acknowledge the limitations of the study in using as a baseline assessment, a retrospective assessment of personality that may have been biased by the post-stroke affective status of the patients. They also acknowledge that within the cohort a significant number of patients had a history of previous stroke and/or psychiatric disorder. These groups

had higher neuroticism scores than patients with a negative history. Nevertheless, patients without a past history but who were depressed also had higher pre-stroke neuroticism scores. No comment was made on the effects of the age or sex of the patients or on the side or site of the lesion, on the outcome of the results.

(e) Gass and Ansley (1994)

In a study of 130 male stroke patients who were an average of 16.7 months post-stroke, Gass and Ansley (1994) used the MMPI to assess personality profiles. The results demonstrated that patients with right and left hemispheric lesions had similar composite MMPI profiles. However, the authors noted that patients who had physical impairment as a result of left hemispheric strokes had higher levels of anxiety and worry than patients who were physically impaired as a result of right hemispheric strokes. The authors related this effect to the association between right hemispheric damage and indifference.

(f) Nelson et al.(1994)

This study investigated changes in the emotional status of 19 stroke patients at 2 weeks, 2 months and 6 months after the onset of stroke. The assessments of the patients were carried out by the relatives of the patients using the Neuropsychology Behaviour and Affect Profile. At each of the assessments, relatives were requested to assess the patients as they had been prior to the stroke and also as they were `now`. The results of the study demonstrated that, at 2 months post-stroke, there was a slower rate of recovery in patients with LHD compared with RHD but that by 6 months the emotional recovery of RHD patients was worsening, whereas the patients with LHD had stabilized.While this is an interesting outcome, it was noted that the results of the retrospective assessment of the pre-stroke depression status of the patients, which the relatives made at 2 weeks, 2 months and 6 months changed markedly (ie 33.7 at 2 weeks, 27.0 at 2 months and 21.6 at 6 months). Furthermore, the affective status of the relatives at the onset of the stroke suggested that a percentage of the relatives were suffering from affective disorder at that time. There was no indication as to whether the affective status of the relatives changed over the 6 months of the study.

4.7.2 Summary of studies on post-stroke depression and personality

The methodologies of the small number of studies which have evaluated the association between personality and post stroke affective status make it difficult to reach any definite conclusions. The composition of the patient groups which were studied, the small numbers of patients included in the studies and the cross-sectional assessments are not sufficiently robust to draw firm conclusions from the findings. The retrospective assessments by patients themselves and also by the relatives of the patients is also questionable.

4.8 Post-stroke Depression - Methodological problems

Although there is a certain amount of consensus in some of the research into the causes and degree of post-stroke depression, it is difficult to compare the outcomes of the studies involved due mainly to methodological differences. These difficulties have been considered in comprehensive reviews by House(1987;1996) and by Starkstein and Robinson(1989).

(a) House, 1987;1996

In this review, the author comments initially on the difficulty of determining what is actual clinical depression as opposed to a natural response to a serious illness. He states that symptoms such as insomnia, anorexia and retardation, which are included in the diagnosis of depression, are similar to the physical sequelae of stroke. He criticizes the use of assessment questionnaires which include somatic symptoms and which he maintains have not been validated for use with stroke patients. He criticizes studies with cohorts of less than 50 patients and cohorts based solely on hospital populations. He comments that none of the studies considered whether the depression had started before rather than after the stroke.

House is critical of the results of Robinson and colleagues relating depression and location of lesion and comments that three independent studies failed to corroborate their findings. He doubts that depression is more common after stroke than in any other illness, but considers that if there is a relationship between the severity of the stroke and depression that this is not unexpected since there is evidence linking life threatening events and depression. He suggests that there may be a relationship between the high level of depression among the carers of stroke patients and the depression status of the patients.

(b) Starkstein and Robinson, 1989

Starkstein and Robinson (1989) also comment on the methodological difficulties associated with assessing the incidence of post-stroke depression and agree with House (1987) that it is important to use appropriate methods for measuring depression. The authors make the further point that assessment of the size and site of brain lesions, which has usually depended on CT imaging is inadequate, and that the introduction of MR and PET imaging in more recent years should improve the diagnosis. They also comment on the problem of the effects of remote lesions, and that the effects of the remaining functioning brain tissue should also be considered in mood disorders. They consider that the inclusion of two types of depression after stroke should also be considered, viz. major and minor depression.

The authors conclude that several studies have demonstrated that post-stroke depression is a frequent consequence of cerebrovascular disease, occurring in up to 50% of stroke patients. That anterior lesions particularly those involving the left frontal cortex and left basal ganglia are strongly associated with major depression and that some studies have suggested that changes in the biogenic amines and limbic system input may play a role.

4.9 Summary

The literature review has shown that the main focus of research into depression after stroke has been the relationship between depression and the location of the stroke lesion. Other factors such as disability, impairment, gender, social status and the affective status of the carers have also been investigated, but to a lesser extent. The outcome of the review has shown that although associations between the various factors and levels of depression after stroke have been demonstrated, there is no convincing evidence that these associations are sufficient to explain the levels of depression that exist after stroke.

While there have been references in the review to the potential influence of personality as a contributing factor in the onset of post-stroke depression, the results of the few studies that have investigated this relationship have been inconclusive due mainly to poor methodologies, such as a biased selection of patients, mixed cohorts of CVA and HI patients, cohorts of < 50 patients, poor attrition rates and the use of retrospective evaluations.The literature review has also highlighted the fact that little consideration has been given to the depression status of patients prior to the stroke. This is an important ommission since community studies have identified significant levels of unrecognised depression in the community and large prospective studies have also demonstrated that depressed patients are more likely to suffer from stroke than those not so predisposed.

The current study will evaluate the association and potential influence of the personality and depression status of patients at the onset of the stroke, on the affective status of the patients in the subsequent 6 months following stroke. The study will investigate a consecutive series of >100 patients admitted to an Acute Stroke Unit and who have been diagnosed with clinical evidence of stroke. Patients who fulfill the study criteria will be assessed within 48 hours of the stroke, and again at 6 weeks and 6 months after stroke, using validated questionnaires. Factors such as location of lesion, gender, impairment, disability, social and risk factors, that have already been shown to be associated with post-stroke depression will be documented, and their input incorporated in the analyses. In light of the high levels of depression that have been shown to be present in the carers of stroke patients, the personality and affective status of the carers will also be evaluated, in parallel with the patients, to determine if there is a potential `cross-over` effect.

There is no previous evidence of any relationship between the blood characteristics of patients at the onset of stroke and the onset of depression. This will be addressed in this study.

Chapter 5 Questionnaires used to assess depression and personality

5.1 Introduction

In the English language more than 30 scales are used to assess the clinical construct of depression. This can make it difficult to select an appropriate rating scale for measuring and assessing depression. This is particularly relevant in the research field, where researchers may assume that all depression scales assess more or less the same construct. To alleviate this problem the major classificatory systems DSM-III-R and ICD-10 (WHO,1992) have produced definitions of clinical depressive disorders which are largely based on the presence of certain symptoms or signs. As a result of this, the most important assessment tool and perhaps the most widely recognized in clinical research is the Diagnostic and Statistical Manual of the American Psychiatric Association, commonly referred to as DSM III-R (3rd edition revised). In this manual, depression is assessed under the title of Mood Disorders, where mood refers to a prolonged emotion that colours the whole psychic life. Within this scale, mood disorders can be sub-classified into major depressive episodes and then mild, moderate and severe syndromes. There are also classifications of dysthymia and seasonal affective disorder.

5.2 The measurement of depression

5.2.1 DSM-III-R

In DSM-III-R the specific symptoms of the depressive episodes are clearly defined, and the essential classification features are, depressed mood or loss of interest in all or almost all activities, and associated symptoms for a period of at least two weeks. An important feature of the assessment is that no organic cause should have initiated or maintained the disturbance and it should not be the normal reaction to a natural loss such as bereavement. To enable a diagnosis of depression to be made with DSM-III-R involves the use of the Structured Clinical Interview for Depression (SCID). The SCID is administered by a clinician and includes an introductory overview followed by nine modules, seven of which represent diagnostic classes of major depression.

Although DSM-III-R is an extremely comprehensive instrument in the diagnosis of depression there are problems in its application. For instance, while it is user-friendly, with `skip outs` and separate diagnostic modules to eliminate irrelevant diagnosis, these user-friendly features are also potential sources of error, which can lower the reliability and

validity of the diagnostic evaluations (Spitzer et al.,1992). Furthermore, the DSM-III-R assessment is qualitative and does not give the degree of depression as a quantitative result. This lack of quantitation can make it difficult to objectively evaluate changes in the affective status of patients over time, and in research studies it also makes comparison of sequential assessments or direct comparison with other quantitative studies difficult.

Although DSM-III-R is widely used in diagnosing depression for clinical as well as research purposes, an overview of the current concepts of depression in the elderly by Blazer (1994) concluded that the majority of depressed older adults do not fit the definitions in DSM-III-R. Blazer makes an important point here when he states, that although DSM-III-R criteria for major depression is used worldwide for all age groups, the criteria were not standardized for an elderly population. He considers that it is important to take into account the possible interaction with physical symptoms which might affect a clinical diagnosis. He also maintains that although the criteria of DMS-III-R diagnose 1-2% as having major depression, other important symptoms of depression which do not fit the criterion of DSM-III-R, affect more than 10% of older persons in the community. This would suggest that it has a limited value in assessing changes in the affective status of stroke patients.

5.2.2 Hamilton Rating Depression Scale (HRDS)

The HRDS which is generally used to provide a quantitative outcome of the DSM-III-R was devised to be used only on patients already diagnosed as suffering from depression. It is used to quantify the results of an interview, and its value depends on the skill of the interviewer in eliciting the necessary information (Hamilton,1960). The scale consists of 17 variables, some of which are defined in terms of a series of categories of increasing intensity, while others are defined by a number of equal-valued terms. The author of the scale, Max Hamilton, suggests that two assessors should independently score a patient at the same interview.

The scale is criticized in a review article by Snaith (1993), on the basis that it does not have a score which distinguishes normality from morbidity, which makes a diagnosis of depression difficult, and the identification of changes in depression even more difficult. The scale also includes anxiety scores and has a high somatic content, which may be misleading in the setting of physical illness.

Despite the HRDS instruction that it is not to be used as a diagnostic instrument, many researchers have defined their patients as suffering from depression, on the basis of a certain score on the HRDS scale. In view of the above limitations and criticisms, this would suggest that the HDRS would be an inappropriate assessment tool in studies of stroke patients

5.2.3 The Beck Depression Inventory.(BDI)

The BDI is a quantitative, self-assessment scale that has been well-validated in research to assess the severity of depression. For many years now the BDI has become one of the most widely accepted instruments for assessing the intensity of depression in psychiatric patients and for detecting possible depression in normal populations (Beck et al.,1961;1979;1988).

The items included in the BDI inventory were primarily derived from clinical observations and descriptions of symptoms frequently given by depressed psychiatric patients, in contrast to those infrequently given by non-psychiatric patients (Beck et al.,1979). In the course of psychotherapy of depressed patients, the author made systematic observations and records of the characteristic attitudes and symptoms of depressed patients. From these observations, a group of attitudes and symptoms were selected which appeared to be specific for these patients, and which were particularly consistent with the description of depression in the psychiatric literature. Each category describes a specific behavioural manifestation of depression and consists of a graded series of statements, which are ranked to reflect the range of severity of the symptoms of depression.

The BDI is a quantitatively based instrument and works on cut-off scores, which operate between normal, through ranges of mild, moderate, severe and extremely severe levels of depression. The revised BDI should measure trait rather than state depression since it is asking the patients to assess their mood states for the previous week as well as now. The scale consists of 21 symptoms and attitudes which are rated on a 4-point scale, ranging from 0-3 in terms of severity. The 21 symptoms and attitudes assessed by the BDI are, Mood, Pessimism, Sense of failure, Self-dissatisfaction, Guilt, Punishment, Self- dislike, Self-accusations, Suicidal ideas, Crying, Irritability, Social Withdrawal, Indecisiveness, Body Image Change, Work Difficulty, Insomnia, Fatigability, Loss of Appetite, Weight Loss, Somatic Pre-occupation, Loss of Libido.

The cut-off scores that are generally used as guidelines for determining levels of depression in normal populations are as follows:-

0-9	normal limits
10-18	mild - moderate depression
19-29	moderate - severe depression
30-36	extremely severe depression.

Although it is recommended by the authors that BDI scores of greater than 15 may detect possible depression in a normal population, they also recommend that when using the BDI for research purposes, the cut-off score can be raised or lowered depending on the requirements of the hypothesis being tested. This would eliminate the possibility of the inclusion of false negative or false positive results.

In a comparative study of the relationship between the BDI and DSM-III-R, House et al.(1989) demonstrated that the BDI was better as a measure of psychiatric disorder than as a measure of `cases` which met DSM-III-R criteria for any depressive diagnosis. However, it was also demonstrated that to achieve the same levels of sensitivity as the DSM-III-R (PSE - Catego/ID system), in identifying true `cases` of patients over a period of time, the BDI cut-off score was reduced. This suggests that there is no universally accepted cut-off value to assess clinical depression and this is highlighted by the fact that although House et al.(1990) suggest that a cut-off score of 13 may denote `caseness` in a normal population, Kotila et al.(1998) used a cut-off score of 10 to denote levels of depression in stroke patients.

Studies of the internal consistency and stability of the BDI indicate a high degree of reliability, and the power of the inventory to discriminate between depression categories has demonstrated differences between categories to be significant at $p< 0.0004$ level. Correlation between the scores of the inventory and the clinical assessment of levels of depression, has been demonstrated at 0.65 ($p<0.01$), while meta-analysis demonstrated correlations between clinical ratings of depression and BDI scores of 0.72 for psychiatric and 0.6 for non-psychiatric subjects (Beck et al.,1988). Correlations of >0.55 between the BDI scores and the depression scales of the MMPI and the Zung Self-Rating Depression scale were demonstrated by Shaefer et al.(1985) and Edwards et al.(1984) while Lambert et al.(1986) concluded that the BDI is less over-reactive to changes in depression than the HDRS, and is therefore less likely to overestimate changes than the HDRS.

Criticisms of the validity of the BDI are that it reflects only six of the items of DSM-III-R, that it relates only to loss and not increases in appetite, that it concerns a loss but not an increase in sleeping patterns, and that it lacks items on psychomotor activity and agitation. Arguments against these criticisms are that the BDI deliberately excludes these items because they increase the false positive rate (Beck et al.,1979).

Since the BDI has been developed to provide a quantitative assessment of the intensity of depression it can reflect changes in the depth of depression over time and so provide an objective measure for judging improvement or deterioration. The BDI is the depression scale of choice in this study because it has been shown to be effective in determining levels of depression, it has a quantitative output and the questions in the inventory are short, unambiguous, and easy to complete. The BDI has been used previously in stroke studies (Kotila et al.,1998; House et al.,1990).

5.3 The measurement of personality

Although there are a number of methods of assessing personality, two scales which are commonly used are the Eysenck Personality Inventory (revised edition) (EPQ-R) and the Minnesota Multiphasic Personality Inventory (MMPI). The Eysenck personality scales have been used in this study to evaluate the concept of personality from the 'social' perspective while the Faschingbauer Abbreviated MMPI has been used to assess personality from a clinical perspective.

5.3.1 The EPS

Trait theory is based on the assumption that people possess a broad predisposition to respond in particular ways called traits. Although traits may not be directly observable, and may not be active at all times, they are persistent even when latent. Eysenck proposes that by grouping certain traits together, he has evolved the basic factors which underlie the traits, and these he has called types.

The main Eysenck personality questionnaire which is used in this study is the Eysenck Personality Questionnaire-Revised (EPQ-R). This questionnaire was developed from various earlier questionnaires and also through a lengthy series of about twenty factorial studies. The first questionnaire developed by Eysenck was the Maudsley Medical Questionnaire (Eysenck 1952) which measured Neuroticism. This was followed by the Maudsley Personality Inventory (MPI) which included Extroversion and Neuroticism scales (Eysenck,1959). The

MPI questionnaire was developed into the Eysenck Personality Inventory (EPI) by including the Lie scale (Eysenck and Eysenck, 1964), and it also provided two alternate forms for repeated testing of the same population. The current form of the EPQ-R introduced the variable Psychoticism (Eysenck and Eysenck,1975).

The EPQ-R consists of 100 questions to which the subjects have to answer `yes` or `no`. These questions are collated to measure the three main personality types of Extroversion, Neuroticism and Psychoticism and the questionnaire also includes the Lie scale. Although the Lie scale was initially intended to measure the tendency on the part of subjects to `fake good`, it is now considered to measure some stable personality factor such as social naivety or conformity. The different scales can be rated according to age and sex, and they have test-retest reliabilities one month between testing (alpha coefficient) of >0.76 for males and >0.80 for females. They also have construct and face validity values of >0.78 for males and >0.76 for females (Eysenck and Eysenck, 1991).

Since the inception of the EPQ-R further scales have been developed and these include the criminality scale (Eysenck and Eysenck,1971), the addiction scale (Gossop and Eysenck, 1980) and the Impulsiveness, Venturesomeness and Empathy scales (Eysenck et al.,1985). The current study includes these scales, which consist of 60 questions to which the subjects have to answer `yes` or `no`. While these scales are not so widely used in general personality assessments, they have been validated and have test-retest reliabilities of >0.76 for males and >0.80 for females.

Brief definitions of Eysenck`s main personality types are as follows:-
Extroversion - outgoing, impulsive, carefree, optimistic,
Introversion - quiet, introspective, does not like excitement, reliable, pessimistic.
Neuroticism - anxious, worrying, moody, depressed, overly emotional, irrational
Psychoticism - solitary, troublesome, cruel, inhumane, aggressive, unsocialized.

The EPQ-R has been used in the standard and abbreviated form in numerous clinical studies of personality and depression. Although the main personality scales demonstrate no inter-correlations between the personality characteristics themselves, a significant correlation between depression and neuroticism has been demonstrated and a significant negative correlation between extroversion and depression (Eysenck,1959; Garside et al.,1970).

Some of the depression studies that have used the EPQ-R are detailed below:-

Kendler et al.(1993)	Bradley et al.(1993)
Martin (1985)	Weissman et al.(1978)
Hirschfield et al.(1983)	Duggan et al.(1990)
Kendell and DiScipio (1968)	Herbert and Powell (1989)

Studies of personality, stroke and depression which have used the Eysenck scales include Morris et al.(1993) and Morris and Robinson (1995) while Ebmeier et al.(1994) and Stenberg et al.(1990) used the Eysenck questionnaire to demonstrate associations between personality characteristics and cerebral blood flow.

5.3.2 The MMPI

The Minnesota Multiphasic Personality Inventory (MMPI) was developed more than 50 years ago and has become one of the most widely used personality instruments for evaluating emotional and personality functions of normal individuals (Hathaway and McKinlay,1951). It has also been used as a research tool in assessing psychological disturbance and personality in chronic illness and chronic pain populations (Naliboff et al.,1983). Although the MMPI was principally developed for psychiatric populations, it has also become a widely used and standardized method of evaluating the emotional and personality status of patients with neurological disorders. The MMPI has also played a major role in neuropsychological research and practice (Fordyce et al.,1983; Gass and Russell,1985;1986; Alfano et al.,1992). In a review of over 50 articles, correlating defects in neuropsychological performance secondary to brain injury with scales on the MMPI, Burns et al.(1994) noted that one of the most common pathological expressions of emotion associated with defects in neuropsychological performance was depression.

The MMPI scale was constructed by contrasting different psychiatrically ill patients with each other and selecting items which discriminate a particular group. The MMPI was initially constructed from 1000 items selected from psychiatric examination forms, text books of psychiatry and neurological examination procedures. The items were administered to neuropsychiatric patients, relatives, students and the residents of Minneapolis.

On the basis of frequency of endorsement of items which differentiated between normals and psychiatric subjects, and also between different diagnostic groups within the neuropsychiatric patients, 550 items were selected. The MMPI assessment groups individuals into psychiatric types on the basis of self-report signs or symptoms, tendencies or habits. The main guiding principle that governed the construction of the MMPI was the idea that any item was valuable if it differentiated statistically between one group of individuals and another.

The MMPI consists of questions to which the subject is requested to answer `true or false`. The scores are then summed and converted into 10 clinical scales and 3 validity scales. The 10 clinical scales have been developed by contrasting normal groups with carefully studied clinical cases, and the first three scales are used as assessments of the validity of the subjects` answers and also to convert the raw scores into `T`scores. The `T`score is a standard score derived from raw scores by reducing measurements to a common scale of units, where the mean value is 50 and the standard deviation is 10. The different scores, which are gender-dependent, are plotted as a scale profile for each subject. Scale values >70 have traditionally been used to identify psychopathology and patterns of emotional disturbance. Psychological evaluations using the MMPI are based on composite patterns or profiles of the individual scale elevations rather than on individual scale factors. The test-retest reliability coefficients of the different scales (alpha, at time intervals >1 month), varies from 0.5-0.9. The scales with low test-retest reliabilities are Hypomania, Hypochondriasis and Paranoia.

The commonly accepted criteria for the MMPI includes the following:-

(a) FAM scale profiles are described in terms of `T` scale scores where a `T` score of =>70 is considered to identify psychopathology and perhaps describe emotional disturbance.

(b) The pattern of the MMPI profile is usually described in terms of a two-point code defined as the two highest clinical scale elevations in the profile.

(c) Significant differences in scale scores are only considered if there are 5 or more mean `T`scale differences between the MMPI variables or between the assessments. Smaller differences are considered to be clinically insignificant.

The individual scale factors of the MMPI are as follows:-

L - Lying - inconsistent response

F - Infrequency - improbable responses

K - Defensiveness - Correction score for certain diagnostic scales

Hs - Hypochondriasis - pre-occupied with health and bodily functions

D - Depression - depressed state and feelings of hopelessness, guilt and uselessness

Hy - Hysteria -pre-occupied with physical illness, self-centred and socially immature

Pa - Paranoia - overly sensitive, angry, delusions of persecution and feels mistreated

Pd - Psychopathic Deviate - rebellious, egocentric, history of antisocial behaviour

MF - Masculinity/femininity - rejects traditional sex role behaviour

Sc - Schizophrenia - confused, disorganized thoughts, feels isolated.

Pt - Psychasthenia - anxious, restless, talkative, emotionally labile

Ma - Hypomania - overactive, excitable

Si - Social Introversion - socially introverted, shy, submissive, compliant

The MMPI has been used in numerous studies of neurologically impaired populations, and research has demonstrated that certain MMPI scales are constantly elevated in these patients (Fordyce et al.,1983). However, the relationship between specific MMPI profile patterns and lateralization of brain dysfunction or severity of neurological dysfunction remains uncertain. For instance, a study by Burns et al.(1994) reported no asymmetry of MMPI profiles in brain injured patients and Gass and Russell (1986) also failed to reveal any overall significant differences between LHD and RHD patients.

In contrast, Gass and Ansley (1994) demonstrated that the degree of neurobehavioural impairment correlated with MMPI depression and anxiety scales in patients with LHD but not RHD, while Aloia et al.(1995) demonstrated that MMPI profile scales could discriminate between levels of depression in head-injured people in comparison with non-head injured people. A further study by Naliboff et al.(1983) of three chronic illness populations which included low back pain, migraine and hypertensive patients, demonstrated that there were no differences in the MMPI profiles among the groups.

5.3.3 The FAM

The FAM scale is an abbreviated form of the MMPI and was developed by Thomas Faschingbauer in1974, using cluster analysis on a selection of 166 items from the original MMPI statement pool. The FAM scale is one of the most frequently used abridged forms of the MMPI (Skenazy and Bigler,1985) and has been considered to be a reliable substitute for the standard MMPI in screening the elderly (Smith et al.,1989). The FAM scale includes the original 13 scales of the MMPI and contains 46%-67% of the full MMPI scale items, arranged in the same order as in the standard MMPI. Correlations with the full MMPI scales range from 0.85-0.93 and the scale has test-retest reliabilities of 0.76 at intervals of one week. In a study to compare the reliability of the FAM with the MMPI in a normal elderly population, Smith et al.(1989) demonstrated that correlations of FAM and the MMPI ranged from 0.75 for mania to 0.93 for depression.

Studies that have used the FAM to evaluate the personality profiles of patients suffering from stroke and head injuries are Cullum and Bigler (1988;1991) and Skenazy and Bigler (1985). The authors of these studies used the FAM studies because of its brevity relative to the full MMPI, its high correlation with the standard MMPI scales and its usefulness in neurological populations. For the same reasons as those stated by Cullum and Bigler, the FAM is being used in the current study.

5.4 Summary

The depression and personality scales selected for this study give a comprehensive assessment of the psychological status of patients after stroke. It is acknowledged however, that as with any research methodology using assessment scales, there are advantages and disadvantages in their construction and in the results that they produce. For instance, an important feature of all of the questionnaires used in the study is that the format of the questions is unambiguous, which is an important feature with neurologically damaged patients. In this study, depression status is being assessed using the BDI scale and the depression scale of the FAM.

The positive aspect of the BDI is that it is well used and well validated, it has acceptable test-retest correlations and it has been used in studies of stroke patients. A disadvantage of the questionnaire in diagnostic studies is the application of cut-off points which determine specific criteria for depression. In this study however, the BDI is not being used to diagnose

clinical depression, but to reflect the affective status of the patients at specific times, and to determine if significant changes in affective status occur over a period of 6 months. To allow for comparison of the results of the current study with previous studies, the accepted BDI scoring categories will be used. The recommended cut-off score of 13 will also be used to represent `caseness` in a normal population.

The assessment of personality in this study is being approached from different perspectives by using two questionnaires the EPQ-R and the abbreviated MMPI. Although the format of the questionnaires are similar, in that they are self-report in style and depend on simple `yes/no or true/false` responses, the assessments are quite different in what they measure, in their construction, and in the interpretation of their analysis.

Advantages of the EPQ-R are that it has been extensively used and well validated in personality and depression studies, it is simple to complete, it provides quantitative measurements of individual characteristics of personality which allows longitudinal quantitative measurement and changes of characteristics to be assessed. A disadvantage of the EPQ-R from the point of view of this study is that it has been minimally used in stroke research.

An advantage of the MMPI personality questionnaire is that it is the most widely used of all of the personality questionnaires, both in clinical and research fields and it has also been used extensively in studies of neurological damage including stroke. The FAM, which is the abbreviated form of the MMPI, has also been used in studies of post-stroke depression. In contrast to the EPQ-R scales, `cut-off` `T` score values of the FAM scales can denote significant pathology, and as such allow descriptions, and changes in levels of characteristics to be noted. As with the Eysenck scales, the results are presented quantitatively and as such allow correlations and sequential differences to be measured.

These questionnaires are used in the current research to evaluate the psychological status of patients after stroke, with particular reference to personality and depression. The questionnaires are particularly relevant in relating to depression, since they comprehensively measure characteristics which have been shown to be associated with depression viz. neuroticism, introversion, anxiety, insecurity, social introversion and obsessionality.

Chapter 6. Pilot Study and Methodology for the Main Study

6.1 Introduction

The aim of the present research was to assess the personality and depression status of patients who had suffered from stroke. The assessments would be done as soon as possible after the onset of the stroke, and on two further occasions over a period of six months from the onset of the stroke. Depression and personality would be measured using standard and validated questionnaires, which would be completed by the patients themselves, in order to eliminate the influence of the presence of the researcher. The carers of the patients would also be requested to complete the same questionnaires as the patients, at the same time intervals. To determine the abilities of patients in the acute stage of stroke to participate in a study of this nature it was considered necessary to run a pilot study.

This chapter describes the methodology of the pilot study and discusses the results obtained. The chapter also describes the methodology of the main study. Prior to commencement of the study approval was sought, and given, for this project by the West Ethical Committee of the Greater Glasgow Health Board

6.2 Pilot Study

6.2.1 Aims of the pilot study

1. To assess the ability of stroke patients to complete self-administered questionnaires within a short time from the onset of the stroke.
2. To evaluate the patients over 6 months, using the same questionnaires, to demonstrate if changes in their affective or personality status had occurred.

6.2.2 Criteria for entry

The subjects recruited to the study were patients who were admitted to the Acute Stroke Unit (ASU), Western Infirmary Glasgow, during the period March-May, 1992. The Acute Stroke Unit is a designated self-contained unit with facilities to admit patients for intensive investigation and therapy soon after the onset of the stroke. At the time of this study, patients were retained in the unit for 72 hours during which time they were assessed by medical, nursing and paramedical staff for therapy and rehabilitation. Patients were not recruited to the study if they were unconscious or had a Glasgow Coma Score<15, were receptively aphasic, had a documented history of dementia or were being treated for clinical depression.

6.2.3 Methodology

Patients were not recruited to the study until 24 hours after the onset of the stroke, to allow them to have some rest after the period of intensive observation and investigation which takes place immediately after admission. Patients who fulfilled the clinical protocol criteria and gave their informed consent, in the presence of nursing staff, were assessed for cognitive impairment using the Mini Mental State Exam (Folstein at al.,1977; Illiffe et al.,1990). Patients who scored <24 on the MMSE were excluded from the study.

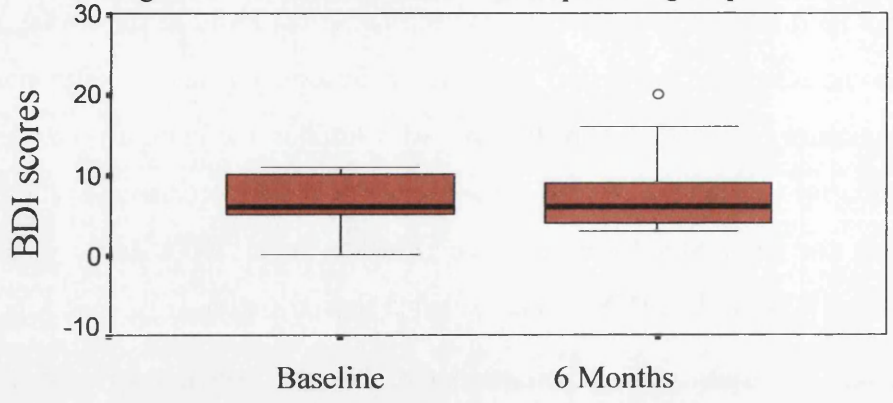
The recruited patients were given a questionnaire booklet which contained the Beck Depression Inventory (BDI) (Beck et al.,1961) and the short form of the Eysenck Personality Questionnaire-Revised (EPQ-R) (Eysenck and Eysenck,1991; Francis et al.,1992). The short form EPQ-R was used in this study in preference to the standardized version of the EPQ-R, as the abilities of the patients to complete a series of questionnaires within a short time of the onset of the stroke was unknown. The questionnaires were self-administered and were collected from the patients within 24 hours of their administration.

At six months after the onset of stroke, the EPQ-R and the BDI questionnaires were sent to the patients for completion in their own homes. The MMSE was not repeated and no other information was requested from the patients at this time. The data were collated from the questionnaires using standardized templates and were analysed using SPSS version 6.0. The data were checked for normality of distribution (Kolmogorov Smirnov) and subsequent correlation analyses were performed using Pearson 2-tailed tests of significance. One-way analysis of variance was used to demonstrate differences between groups and paired t-tests to demonstrate differences between pairs. Stepwise linear regression analysis was used to determine if the baseline depression and personality scores contributed to the variance of the BDI score at 6 months. Significance levels of 0.05 were applied to this exploratory analysis.

6.2.4 Subjects

Eighteen patients were assessed between 24 and 72 hours after the onset of stroke. The initial cohort included 9 males, mean age 62.5 years (sd 15.3) and 9 females mean age 71years (sd 10.4). At six months after the onset of stroke, fourteen patients completed a second assessment. The second cohort included 7 males, mean age 61.3 years (sd 16.7) and 7 females mean age 66 years (sd 11.7). Of the eighteen patients who were initially assessed, two patients had died, one patient had moved house and was unable to be contacted, and one patient was unable to complete the questionnaires.

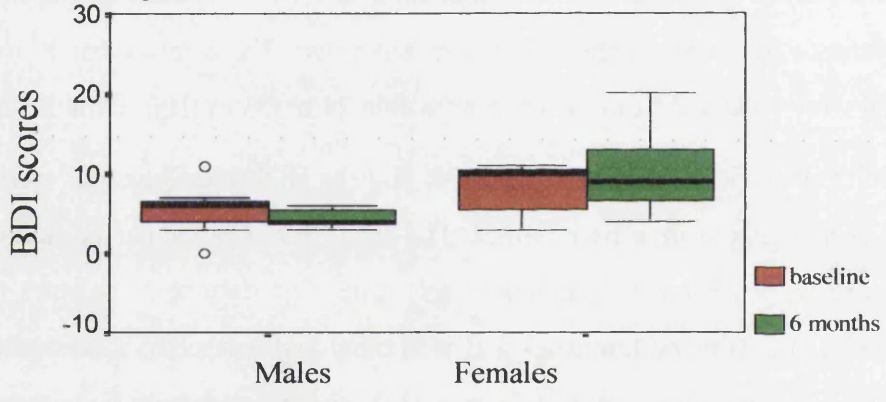
Figure 1. BDI scores - Total patient group



Box and whisker plot

Box=50% values, solid line=median, whiskers=range (excluding outliers)

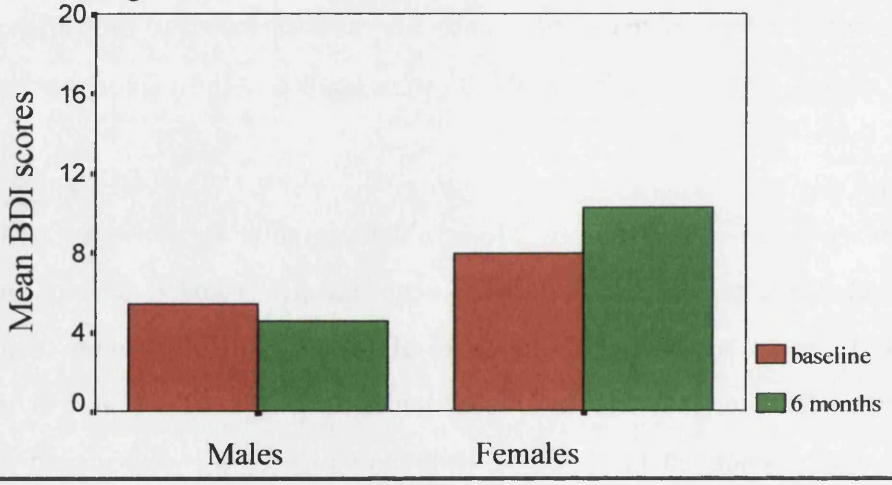
Figure 2. BDI scores



Box and whisker plot

box=50% values, solid line=median, whiskers=range (excluding outliers)

Figure 3. BDI scores



6.2.5 Results (a) Depression

The results of the baseline and 6 months BDI assessments are detailed in Table1(a) and demonstrated in Figures 1-3.

Table 1(a). Baseline and six months BDI scores

Baseline						6 Months					
Males		Females		Total group		Males		Females		Total group	
mean	std dev	mean	std dev	mean	std dev	mean	std dev	mean	std dev	mean	std dev
5.4	3.4	8.0	3.3	6.7	3.4	4.6	1.1	10.3	5.7	7.4	4.9

The summary of the numbers and percentages of patients within the BDI scoring categories is demonstrated in Table 2.

Table 2. BDI scoring categories

BDI scores	Total group		Male patients		Female patients	
	Number	%	Number	%	Number	%
Baseline <=9	9	64	6	86	3	43
6 months <=9	8	57	6	86	2	29
Baseline + 6months <=9	8	57	6	86	2	29
Baseline >9	5	36	1	14	4	57
6 months >9	2	14	0	0	2	29
Baseline + 6 months >9	2	14	0	0	2	29
Baseline =>13	0	0	0	0	0	0
6 months =>13	2	14	0	0	2	29
Baseline <=9 +6 months >9	1	7	0	0	1	15
Baseline >9 +6 months =>13	2	14	0	0	2	29

BDI scores <=9 - within `normal` limits BDI scores >9 - outwith `normal` limits

BDI scores =>13 - suggestive of `caseness`

The data demonstrated that 57% of the total group of patients (86% males,29% females) had BDI scores which remained within `normal` limits over the 6 months, 14% of patients (0% males,29% females) had BDI scores which were consistently above `normal` over the 6 months and 7% of patients (0% males,15% females) increased their scores from a `normal` status at baseline to above `normal` at 6 months. However, the results also demonstrated that none of the patients who had scores at 6 months suggesting `caseness` ie. =>13, had baseline scores which were within `normal` limits.

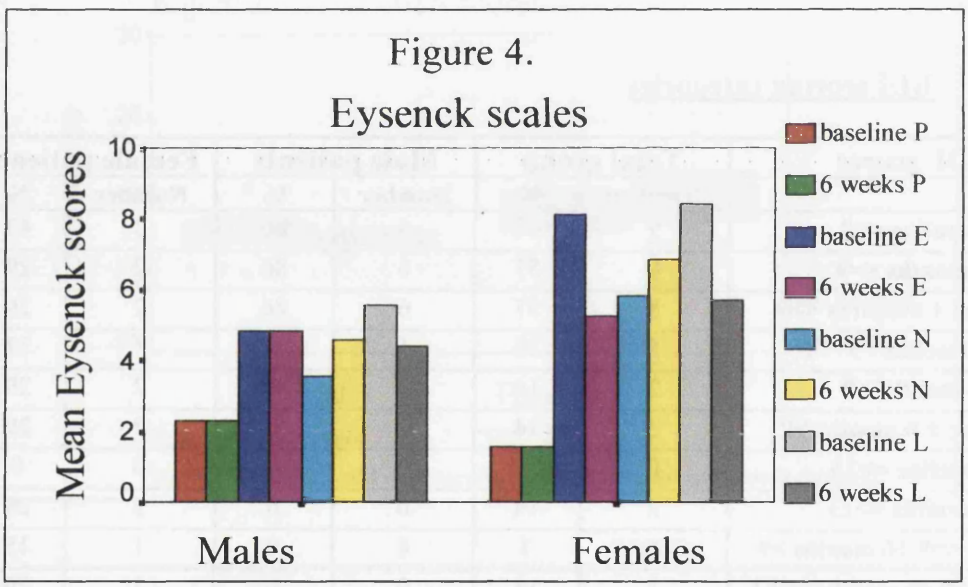


Figure 4.
Eysenck scales
Mean Eysenck scores
10
8
6
4
2
0
Males
Females
baseline P
6 weeks P
baseline E
6 weeks E
baseline N
6 weeks N
baseline L
6 weeks L

Correlation analysis of the data demonstrated no significant association between the baseline and 6 months BDI scores for the group as a whole or for male and female patients when considered separately. Paired t-test analysis of the data demonstrated no significant differences between the baseline and 6 months scores for the total group of patients or for males or females when considered separately. Inter-gender unpaired t-tests demonstrated that BDI scores were significantly higher in female patients at the 6 months assessment when compared with male patients (p=0.03, t=-2.6, df=12, md =-5.7, 95% CI -11.1, -0.3).

The results of simple regression analysis demonstrated that the baseline BDI score did not significantly contribute to the variance in the BDI score at 6 months, for the total group of patients or for male and female patients when considered as separate groups Although the results of the analysis are not highly significant, inspection of the data suggests that there are differences in the pattern of scores for male and female patients and that these differences relate to individual and to persistent BDI scoring levels.

Results - (b) Personality

The mean scores for the personality characteristics of psychoticism, extroversion, neuroticism and lying are shown in Table 1(b) and Figure 4.

Table 1(b). Baseline and six months Eysenck scores

Eysenck scales	Baseline					6 Months			
	Male patients		Female patients			Male patients		Female patients	
	mean	std dev	mean	std dev		mean	std dev	mean	std dev
Psychoticism	2.3	2.6	1.6	1.3		2.3	1.8	1.6	1.5
Extroversion	4.9	1.7	8.1	3.5		4.9	1.6	5.3	3.7
Neuroticism	3.6	2.6	5.9	2.3		4.6	2.0	6.9	2.9
Lie	5.6	2.9	8.4	2.4		4.4	2.9	5.7	3.5

Paired t-tests analysis of the data demonstrated no significant differences between the baseline and six months scores for any of the personality characteristics for the group as a whole or for male or female patients when considered separately. Although inspection of the data demonstrated decreases in mean extroversion and lie scale scores for female patients between the baseline and 6 months assessments (Table 1(b) and Figure 4), the results were not significant.

Correlation analysis demonstrated no significant association between the assessments for any of the personality characteristics, nor between any of the BDI scores and any of the Eysenck scale scores. Stepwise linear regression analysis using the baseline PENL scores as predictor variables and the 6 month BDI score as the predicted variable demonstrated that baseline extroversion and neuroticism scores contributed 60% of the variance in the BDI score at 6 months ($R = 0.78$, $R^2 = 0.6$, $F = 8.5$, $df = 2/11$, $p = 0.006$; regression equation BDI2 = 0.837 x Eye E1 + 0.858 x Eye N1 - 2.06). Regression analysis of male and female patients as separate groups were unproductive due to the small numbers involved.

6.2.6 Discussion

The most important result from this pilot study was the demonstration that the patients were able to complete the questionnaires within a short time from the onset of the stroke. The results also demonstrated that the majority of patients, particularly male patients, had persistently `normal` BDI scores over the 6 months of the study and that the 2 patients who had scores suggesting `caseness` at the 6 months assessment had baseline scores which were above the `normal` BDI limit.

Although there were no significant differences in BDI scores between the assessments for the group as a whole, a significant difference in depression scores was demonstrated between the male and female patients at the 6 months assessment due to higher depression scores for female patients. As there was no significant difference between male and female patients at the baseline assessment, this observation suggests that females may be more susceptible than males to changes in affective status after stroke. This is in keeping with previous studies by Wade et al.(1987) and Sharpe et al.(1994), where associations between depression after stroke and gender have been noted.

The results of the personality data demonstrated that there were no significant changes in any of the personality scores between the baseline and six months measurement nor were there significant associations between any of the personality characteristics and the BDI scores. Although this is surprising, given that neuroticism has been shown previously to be related to depression (Chodoff,1972, Andrews et al.,1990), the results of linear regression analysis did demonstrate that the baseline extroversion and neuroticism scores significantly contributed to the variance in the BDI score at 6 months for the group as a whole. This is an interesting outcome, in view of the fact that the results of the simple regression analysis demonstrated that the baseline BDI score did not significantly contribute to the BDI score at 6 months.

6.3.1(a) Changes in the methodology of the main study in comparison with the pilot study

1. The number of patients to be included in the study would be considerably larger than in the pilot study: this would increase the ability of the study to identify true associations and potentially help to eliminate type II errors.

2. Three assessments would be performed instead of two; i.e. within 48 hours, at 6 weeks and at 6 months post the onset of the stroke. This would eliminate the possibility of overlooking the onset of depression that may occur when patients begin to realise the physical and social limitations imposed by the stroke. It may also provide a stronger predictor of the long term psychological effects of stroke.

(3) A more comprehensive range of depression and personality questionnaires would be administered. This would allow a wider range of personality characteristics to be evaluated, and would include clinical as well as social personality characteristics. The inclusion of the MMPI would also provide a secondary assessment of depression, which would potentally strengthen the assessment of affective status in the absence of a clinical interview.

(4) The cognitive status of the patients would be assessed using the CAMCOG instead of th MMSE. Although it is considered that the MMSE is adequate to assess mental status, from practical perspective the CAMCOG would also establish the patients physical, visual and mental abilities to participate successfully in the study.

(5) The inclusion of clinical, social, disability, risk factors and location of stroke lesions, hav previously been demonstrated as potential factors in the the onset or level of affective disorder after stroke. Their exclusion could have been considered as a potential weakness in relating the effects of personality to affective status after stroke.

(6) Baseline haematology, biochemistry and endocrine factors have been known to affect psychological status eg. Hyperparathyroidism, hypothyroidism. Therefore baseline blood measurements would be included to eliminate potentally influencing factors.

(7) The co-habitees of stroke patients would be assessed at the same time intervals as the patients. Previous studies have demonstrated that the co-habitees of stroke patients exhibit higher levels of depression than is present in the general population. Assessment of the co-habitees of the patients could establish if their affective status was influencing the psychological status of patients after stroke.

Although the outcomes of this pilot study were not highly significant, they did suggest that there may be a relationship between gender and certain personality characteristics at the onset of stroke, and affective status at 6 months after stroke. The results were of secondary interest at this point however, as the patient numbers were small, limiting the statistical power of the tests used. The important outcome from the pilot study, and one of the main reasons for carrying out the study, was the demonstration that the selected patients were able to successfully complete the questionnaires in the acute post-stroke period.

6.3 Main Study

6.3.1 Introduction

In light of the success of the pilot study in demonstrating that patients were able to complete questionnaires in the acute phase of stroke, it was decided that a larger and more intensive study of affective status after stroke, with particular reference to personality, would be possible and worthwhile. The larger study would differ from the pilot in a number of ways and these are detailed opposite:-

6.3.2 Patient admission procedures

Patients included in this study were selected from a consecutive series of patients admitted to the Acute Stroke Unit in the Western Infirmary in Glasgow during the period April 1993 until January 1995. Although the majority of the patients were admitted from home, through the Accident and Emergency Department in the Western Infirmary, a number of patients had also been transferred to the Acute Stroke Unit (ASU) from other outlying hospitals where they had initially been diagnosed as having suffered from a stroke.

On admission to the Acute Stroke Unit, the procedure was that the patients were intensively monitored and observed over a period of 24 hours from the onset of the stroke to check that there was no deterioration in their vital signs. During this time, patients had neuroradiological investigations of CT, SPECT or MR scans (95% of patients admitted to the Acute Stroke Unit had CT performed within 24 hours of onset of the stroke) and patients were also invited to participate in therapeutic drug trials. When their condition was stabilized and they had completed their drug regime, patients were either transferred to another ward within the Western Infirmary, or to another hospital for rehabilitation, or were sent home.

6.3.3 Patient recruitment to the study

Patients were informally interviewed by the researcher as soon after admission as practically possible (usually within 12 hours of admission), and again on the day following admission, to ascertain their cognitive and communication status. If the patient appeared to be suitable for inclusion in the study, the purpose of the study was explained, and if the patient agreed to participate, the consent form (The West Ethical Committee of the Greater Glasgow Health Board) was left with the patient to complete. Although there were occasional difficulties in approaching the patients in the acute stage of their illness, it was possible to recruit and commence >95% of patients within 48 hours of onset of the stroke. The remaining <5% of patients were recruited and commenced within 72 hours of onset.

The criterion for admission to the study was that the patients had been diagnosed as suffering from a stroke by either neurological assessment alone or neurological assessment confirmed by neuroimaging. Patients were excluded from the study if their level of consciousness was poor i.e.GCS<15, if they were severely aphasic, if they had a documented diagnosis of dementia, were receiving treatment for clinical depression or had a severe alcohol problem.

It is acknowledged that the implementation of the exclusion criteria created a bias in the selection of patients included in the study. Although this must be considered as a potential methodological weakness, it is acknowledged that in studies of this nature, it is not possible, particularly in the acute stage of stroke, to accurately assess patients who are unconscious or who have fluctuating conscious levels, are severely aphasic, suffer from dementia or are in a stage of alcohol withdrawal. Although it is acknowledged that it would have been possible to assess patients who were being treated for depression, it was considered that a true assessment of the effects of stroke on their depression would have been difficult to evaluate. However, in light of current thinking that there may be a causal link between depression and the onset of stroke, it may have been prudent to have included this group of patients. It may also have allowed post-stroke comparisons of psychological status to be made between depressed and non-depressed patients.

6.3.4 Procedure

As in the pilot study, it was considered necessary to test the cognitive status of the patients to determine if they were suitable for inclusion in the study. As previously stated, the cognitive function of the patients was tested in the pilot study using the Mini Mental State Examination, which is normally considered as adequate to establish cognitive status in a

CAMCOG assessment criteria

The use of the CAMCOG in this study was to establish the patients` mental, physical and visual abilities to independently complete a number of different questionnaires..The main reasons for using the CAMCOG in this study were as follows;

(1) To test the patients general language comprehension.in an effort to determine their abilities to follow instructions.

(2) To establish if the patient`s vision was sufficient to read the questionnaire. To determine if there was evidence of hemianopia, which would make the reading of complete sentences difficult. To determine general reading difficulties due perhaps to a degree of illiteracy.

(3) To find out if patients would be able to complete the questionnaires on their own, without supervision.

(4) To establish the patients ability to read and understand the actual meaning of the questions in the questionnaires.

(5) To establish if the patients had the ability, to physically complete the questionnaires, i.e. tick the appropriate boxes, turn the pages and hold the booklets.

It should be noted however that no actual score would be obtained from the CAMCOG assessment. The reasons for this are that certain sections of the CAMCOG assessment are based on a timed response. While this may be reasonable in a quiet setting without distractions, it was not reasonable or indeed possible to complete these sections with any accuracy in a busy acute stroke ward. It was therefore decided that an actual score on the CAMCOG would be irrelevant, and that the patients abilities to complete the individual sections of the CAMCOG would determine the abilitties of patients to participate in the study

normal population. However when this study was reviewed by the Chief Scientist's Office in Edinburgh for funding, a criticism of the proposed methodology was that the MMSE was not adequate to test for cognitive function. Consequently, the MMSE was replaced with the CAMCOG (Lindeboom et al.,1993), which is the cognitive section of the CAMDEX (Cambridge Mental Disorders of the Elderly Examination, Roth et al.,1986), and is considered to provide a more satisfactory assessment of testing the cognitive status of elderly patients. In the current study the specific reasons for using the CAMCOG are detailed opposite. When the patient had successfully completed the CAMCOG, and the consent form had been signed, each patient was given a booklet containing the following questionnaires:-

1. The Beck Depression Inventory (BDI)
2. The Eysenck Personality Scales (EPS), which included
   (a). The Eysenck Personality Questionnaire-Revised (EPQ-R)
   (including Criminality and Addiction)
   (b). The Impulsiveness Questionnaire (IVE)
   (including Impulsiveness,Venturesomeness and Empathy)
3. The Faschingbauer Abbreviated Minnesota Multiphasic Personality Inventory (FAM)

The patients were asked to complete the questionnaires within as short a time as possible and the booklets were collected within 24 hours and checked for any omissions. At six weeks and six months post-stroke, the same questionnaires were sent to the patients, together with an appointment for the researcher to see the patient at the hospital or in their own homes.
If the patient was living with someone, an approach was also made to the carer, with the patient's permission, to ask for their participation in the study. The procedure involved in assessing the carers was essentially the same as that for the patient, except that the carer was not cognitively assessed.

6.3.5 Subjects

During the period of this study, 1083 patients were admitted to the Acute Stroke Unit. Of the patients admitted to the unit 137 (13%) patients were recruited to the study. The reasons for patients not being recruited were as follows;

101 (9%) deceased	160(15%) not a stroke	119(11%) unconscious
130(12%) poor eyesight	119(11%) aphasic /dysarthric	111(10%) dementia
33(3%)history of depression	17(2%)refused	156(14%) discharged

(a) **Patients** A total of 89 males and 48 females were recruited to the study. Although it was initially assumed that all of the patients who were recruited to the study had suffered from stroke, subsequent examination of the patients case records at the end of the study, revealed that six of the recruited patients were diagnosed as suffering from `stroke-like` symptoms which were `non-organic`. The resulting data are therefore based on an initial cohort of 131 patients.

Details of the patients who completed individual and combined assessments are given in Table 3(a) and show that 85 males and 46 females completed the baseline assessment ie. within 48 hours of stroke onset. Of the original cohort 116 patients (89%) completed the 6 week assessment, 115 patients (88%) completed the assessment at 6 months and 112 patients (85%) completed all three of the assessments.

Table 3(a). **Completion data for patients**

Completed Assessments	Patients	% Patients	Male patients	% Male patients	Female Patients	% Female patients
BDI 1	131	100	85	100	46	100
BDI 2	116	89	72	85	44	96
BDI 3	115	88	74	87	41	89
BDI 1+2	116	89	72	85	44	96
BDI 1+3	115	88	74	87	41	89
BDI 1+2+3	112	85	71	84	41	89

Reasons for those patients who did not complete all three of the assessments is as follows:- 2 patients died, 1 patient developed multiple sclerosis, 1 patient developed lung cancer, 1 patient absconded from prison, 1 patient had further multiple strokes, 2 patients had moved away from home and were unable to be contacted, 1 patient developed dementia, 2 patients refused, 2 patient questionnaires were lost when the patients were transferred to other wards and 6 patients appeared not to return the questionnaires (although 2 of these patients insisted that they had returned them, these were never received by the researcher).

(b) **Carers** Details of the carers who participated in the study and who completed individual and combined assessments are given in Table 3(b) and show that 45 carers (17 males and 28 females) completed the baseline assessment. Of these 34 (13 males and 21 females) completed all three of the assessments, 35 completed the baseline and 6 weeks assessments only, and 40 completed the baseline and 6 month assessments only.

Table 3(b) **Completion data for carers**

Completed Assessments	Total No Carers	%Carers	Male Carers	% Male Carers	Female Carers	% Female Carers
BDI 1	45	100	17	100	28	100
BDI 2	36	80	13	76	23	82
BDI 3	41	91	16	94	25	89
BDI 1+2	35	78	13	76	22	79
BDI 1+3	40	89	16	94	24	86
BDI 1+2+3	34	76	13	62	21	75

Reasons for carers failing to complete all three of the questionnaires were as follows:- 2 of the carers stated that they had returned questionnaires which were not received by the researcher, 4 carers were associated with patients who did not complete the study and the researcher failed to send follow-on questionnaires to 5 of the carers for completion.

6.3.6. Demographic details of patients and carers

The mean ages of the patients and carers who completed all three of the assessments were; patients 61years (sd 14) and carers 54 years (sd 15). Demographic details of the patients and carers who participated in the study demonstrated that 11(10%) of the patients were single, 67 (60%) were married, 29 (26%) were widowed and 5(4%) were divorced. The data also demonstrated that 38 carers did not participate in the study. Reasons for this disparity are as follows:- 2 patients did not want their carers approached because of the poor health of the carers, 2 carers suffered from dementia, 2 carers suffered from alcoholism, 1 carer was in prison and 2 of the patients were in prison, 2 patients (1 female and 1 male) stated that they did not like their spouses and did not want them involved, and 3 patients stated that they did not want their carers approached. Apart from these omissions, the researcher was unable to contact 24 relatives personally during hospital visiting times to request their participation in the study.

6.4 Case record survey

The case records of all of the stroke patients who were recruited to the study were retrospectively examined to determine the details of the exact nature of the type and location of the stroke. Details of relevant comorbid illnesses such as hypertension, cardiac illness and diabetes, which are common in stroke patients, were also documented, as were the blood measurements which were done on the patients on admission. The admission and discharge details of the patients were also obtained from the patient case records.

6.4.1 Admission and discharge data of the stroke patients

Details of the time between the onset of the stroke and the patients` admission to hospital, as well as the duration of their stay in the Acute Stroke Unit, and their overall hospital stay were determined from the patient case records. The data demonstrated that the median time between onset of the stroke and admission to the Acute Stroke Unit was 7 hours (interquartile range 4-12 hours), the median stay in the unit was 5 days (interquartile range 3-6 days) and the median hospital duration was 6 days (interquartile range 4-21 days).

6.4.2 Clinical description of patients on admission

For the group of patients as a whole 40% had right sided weakness, 54% had left sided weakness, 2% had right and left sided weakness, 2% had facial weakness and 2% had no physical effects of the stroke. With regard to speech impairment, 62% of patients had no speech impairment, 16% were dysphasic and 22% were dysarthric. Although patients with aphasia and dysarthria are usually excluded from participating in studies of depression after stroke, the patients included in this study who had speech impairment demonstrated that they had sufficient cognitive abilities and communication skills to allow them to participate.

6.4.3 Clinical classification

The clinical classification of stroke was obtained from patient case records. The classification usually refers to the location of the infarct ie.whether the infarct is located in the cerebral hemispheres or is separate from the hemispheres and is located in the brain-stem or cerebellum.. The clinical classification usually considers whether the stroke is transient, is associated with generalized atrophy or that the presenting symptoms have no organic basis (NINDS 1990). In this study the clinical classification for males and females was similar, in that 81% of the total group of patients had cortical strokes (47% right hemisphere and 34% left hemisphere.) The clinical assessment also determined that approximately 11% of the total group of patients had non-hemispheric strokes and that 4.3% of the total group had stroke-like symptoms of a `non-organic` nature.

It is acknowledged that patients with TACI or haemorrhagic strokes were excluded from this study. In keeping with other studies, patients with TACI`s are impossible to assess in the acute stage of stroke, and patients with haemorrhagic strokes were transferred on diagnosis to the Institute for Neurological Sciences at the Southern General Hospital for treatment.

6.4.4 Neuroimaging assessment

The clinical purpose of performing neuroimaging on stroke patients is primarily to determine whether the patient has suffered from a haemhorragic stroke or from an infarct. The results of the neuroimaging however, can also demonstrate the specific location and type of the infarct from which the patients has suffered. Of the total group of patients in this study 91% had CT scans done within 24 hours of admission, and of this group 30% had additional SPECT scans, 13% had additional MR scans performed and 4% patients had MR scans only.

Although the results of neuroimaging can demonstrate the type and the exact location of brain infarcts involved, for the purposes of this study, the locations detailed in the neuroimaging reports have been summarized into the categories of right and left cerebral hemispheres, and a miscellaneous group comprised of brain-stem, cerebellum and bilateral hemispheres. The neuroimaging results showed that for the group as a whole 39% were in the right hemisphere, 29% were in the left hemisphere, 14% were in the miscellaneous group and 16% showed no demonstrable lesion at the time of imaging. References in radiological reports to evidence of previous strokes was included in the data as a risk factor only. Detail of location of previous strokes was not included.

6.4.5 Comparison of clinical and neuroimaging results

When the results from the clinical classification of the patients were compared with the results of neuroimaging studies, it was noted that there are a number of differences. For instance the results of the clinical diagnosis suggested that 65 strokes were due to lesions in the right hemisphere compared with 51 detected by neuroimaging. For the left hemisphere, the results of clinical diagnosis suggested the presence of 47 whereas neuroimaging demonstrated 38. It was also noted that there was a disparity in diagnosing non-organic strokes, in that while the clinical classification of the patients suggested that 6 of the patients had stroke like symptoms which may have been due to non-organic causes, the neuroimaging results demonstrated that there was no evidence of an organic lesion for 21 patients. This disparity is not entirely unexpected, since the majority of the patients in this study were imaged within 24 hours of onset of the stroke using CT, and it is known that, while CT is unlikely to mis-diagnose an acute stroke which has been caused by a cerebral haemorrhage, it may not detect a stroke caused by a cerebral infarct, where the morphological differences may not be obvious in the acute stage.

6.4.6 Risk factors

As discussed in Chapter 2. There are a number of known risk factors which in a general population are associated with stroke. The analysis of the risk factors associated with the patients in the current study demonstrated the following:-

12% patients suffered from a previous stroke (8% males and 18% females)
16% patients had a family history of stroke (18% males and 13% females)
33% patients had a history of cardiac illness (36% males and 26% females)
43% patients had high blood pressure (47% males and 36% females)
9% patients had diabetes (9% males and 9% females)
52% patients smoked (53% males and 52% females).

It was also noted that some patients had more than one comorbid illness.

6.4.7 Disability

The effects of the physical disability of the patients, as a result of the neurological impairment of the stroke, were assessed using the Barthel Index. This is an index of independence and is used in evaluating the ability of patients to care for themselves (Mahoney and Barthel,1965). The index includes ten items on which the patient is assessed and includes all the activities required for daily living, from feeding and dressing to bladder control. Each item is assessed independently and the total possible score which could be obtained by someone who is independent, although they may not necessarily be able to live on their own, is 100. The results of the data demonstrated that at the onset of stroke 63% of patients had no level of impaired independence, 37% of patients had Barthel scores of <100 and 16% had scores of <50 which suggests a considerable loss of independence and a significant level of physical disability. The Barthel Index measurements were completed at the time of the onset of the stroke and were not repeated at the 6 weeks and 6 months intervals, therefore, any improvement or deterioration in the patients` physical status is not included in the results.

6.4.8 Biochemistry, haematology and endocrinology data

When patients are admitted to the Acute Stroke Unit, a comprehensive blood analysis is done as soon as possible after admission. For the patients in this study, details of the base-line blood analyses were obtained from the patient case records. The summary of the mean values and standard deviations, together with the expected normal ranges for the results of the characteristics of the blood analysis, are detailed in Chapter 7.

It is emphasized however that it is outwith the remit of this thesis to evaluate the clinical relevance of the individual blood measurements in themselves, but simply to determine if there is any relationship between the affective status of the patients and their blood measurements.

6.5 Screening for ability to complete the questionnaires

After the first 50 patients and their carers had been recruited and had completed the initial assessment, a decision was made to discontinue using the CAMCOG as a method of assessing the cognitive status of the patients for inclusion in the study.

The reason for this change in protocol was that the initial interview that the researcher had with the patients, in effect, determined the suitability of the patients to participate in the study. This interview usually lasted about 20 minutes and included asking the patients a few pertinent questions about the onset of their stroke, their previous medical history, general family matters and current affairs. The researcher then asked the patient some details and their opinions about a selected article in their daily newspaper. On the basis of a satisfactory response from the patients at this stage, the researcher explained the protocol of the study to the patients and asked them if they would like to participate. The patients were then formally assessed using the CAMCOG. The initial reasons for using the CAMCOG to assess patient suitability for inclusion in the study have been detailed (6.3.4a).

When the first 50 patients had completed the baseline and 6 weeks assessments of the study it became apparent that formal assessment using the CAMCOG in the initial stages was not necessary. The reason for this was that the initial informal assessment of the patient`s suitability for inclusion in the study, which was done by the researcher, was not different from the outcome of the formal assessment using the CAMCOG.

It is acknowledged however that this change of practice may have had an effect on patient selection and that it makes replication of the study more difficult.

Chapter 7. Results

The results of this study are extensive and wide-ranging. To present them as clearly and concisely as possible, they have been divided into 4 sub-chapters. Each sub-chapter includes the analysis of the data, together with a summary, discussion and conclusions of the results. The 4 sub-chapters are titled (1) Depression - BDI, (2) Personality - EPS, (3) Personality and depression - FAM and (4) Baseline blood measurements. The chapter concludes with a summary of the results in relation to the stated hypotheses.

7.1 Introduction

Depression is reported to be the most important psychological sequelae of stroke. The hypotheses being tested in this study is that this depression may be related to the intrinsic affective and personality status of the patient, and to other factors, including the baseline blood measurements of the patients. As previously stated, it is not possible to test these hypotheses absolutely without conducting a large community longitudinal study. It is therefore proposed that by measuring the depression and personality status of the patient and their carers in the acute stage (ie. within 48 hours), at 6 weeks and at 6 months from the onset of the stroke, that this might give an indication of the relative stability or instability of the psychological status of the patients during this period of time. The results might also demonstrate the significance of any changes in affective status which take place. Whether or not it is possible to postulate that the stability of the psychological status of the patients after stroke could be considered to be a reflection of, or indeed related to, their premorbid psychological status remains to be determined.

7.1.1 Analysis

The results will take the form of a detailed analysis of the patient and carer data as individual total groups, and where appropriate, the data will be analysed according to gender. The analysis will be divided into specific sections as follows:-

1. Analysis of the BDI data will determine the affective status of the patients and carers at each of the assessments. The stability of the data over the 6 months period with respect to `normality` and `caseness` will be assessed. The significance of change in affective status during the 6 months will also be determined. External factors that may be related to affective status will also be included in the analyses.

2. Analysis of the Eysenck personality scales will demonstrate the stability and/or changes in personality characteristics of the patients and carers during the 6 months. Factors which may

be related to changes in personality characteristics will be analysed and discussed, as will the relationship between the Eysenck scores and the BDI scores

3. Analysis of the FAM questionnaires will evaluate the personality profiles of patients and carers and will also focus on the relationship between personality and depression characteristics, since depression is included as a characteristic in this questionnaire. External factors that may be related to changes in personality will also be analysed and discussed, as will the relationship between the FAM and BDI scores.

4. The analysis of the baseline blood data, ie. haematological, endocrinological and biochemical measurements, will be used to determine if there is a relationship between the baseline blood data and the BDI, EPS or FAM scales.

The results will also include analysis of the depression and personality questionnaires for each patient group with respect to a number of factors, including, gender, age, demographic factors, comorbid risk factors, degree of physical impairment and resultant disability, speech impairment and laterality and location of the stroke lesion.

Although the carers are not being used as a control group in this study, they are the nearest group to the patients in terms of age and social status, but who have not experienced the neurological trauma of the stroke. The results of their personality and depression questionnaires will be analysed and compared with those of the patients, to determine if there is an association between the affective status of the carers and the patients.

The initial detailed analysis of the BDI data will determine the affective status of the patients and their carers at each of the three assessment times. This will allow for comparison with the results of previous studies with regard to the level of depression after stroke. It is emphasized however, that the analysis of the data in this study is primarily to determine if the incidence of affective disorder which others have measured after stroke, (usually some time from onset), could be related to the level of affective disorder present at the onset of the stroke. The inclusion of a detailed analysis of the many variables which have been considered, is in fact an exploratory exercise to eliminate potentially confounding factors which may influence the significance of the outcome of the results. In view of the number of tests and variables involved in the analysis, a significance factor of $p<0.01$ has been used as the accepted level of significance in this study.

7.1.2 Methods of analysis

The statistical analysis of the data was performed using SPSS Version 6.0, and graphical output included the use of Quattro Pro Spreadsheet Version 5.0. The results were analysed on each occasion for the patients and the carers separately as whole groups, and also for male and female patients and male and female carers, as individual groups. The data and analysis includes the following profiles each measured on three occasions :-

The Beck Depression Inventory (BDI)
Eysenck Personality Scales (EPS)
Faschingbauer Abbreviated MMPI - (FAM)

From these inventories, 20 basic variables have been measured on three separate occasions, and analyses of the variables have been performed on different subject groups. It is accepted that in these circumstances, the application of the Bonferroni correction factor should be applied to data of this nature, to reduce the occurrence of Type I errors. However it is also considered that with this number of variables that the application of the Bonferroni correction factor would potentially create more Type II errors. Consequently two-tailed tests of significance with a 1% confidence limit, rather than the normally acceptable 5%, have been applied to this experimental data to reduce chance findings of significance.

The normality of the data for each category of subjects and for each variable and for each assessment was tested using the Kolmogorov Smirnov (KS) test, and the appropriate statistical test has been used in accordance with the result of the KS analysis. Where the distribution of the data was found to be non-normal for any of the variables the data were converted using square root transformations. The data is generally described in terms of means and standard deviations and medians and interquartile ranges for ease in demonstrating ranges.

Prior to performing multiple stepwise regression analysis on the data, simple linear regression analysis was performed on each variable, for each assessment and for each category of subject. All variables were checked for linearity of data using a normal probability plot of the residuals. The homoscedasticity of the data (homogeneity of variance) was determined by plotting the relationship between the residual and predicted values of each independent variable against the dependent variable at 6 months. `Outliers` were rarely removed since their removal created a `cascade` of other outliers and complicated the analysis.

7.2 Depression - BDI

7.2.1 Introduction

In this study affective disorder has been assessed using two different questionnaires on three separate occasions after stroke. The main questionnaire which has been used to measure affective status is the Beck Depression Inventory (BDI). While the Depression (Dp) scale of the Faschingbauer Abbreviated Minnesota Multiphasic Personality Inventory (FAM) has also been included, to consider the input of depression as part of an overall personality profile. Each of the questionnaires was completed at the three time-points.

Apart from the basic data obtained from the above questionnaires, a number of variables have also been considered which may or may not be implicated in the final results of the depression and personality scores being measured. These variables include gender, age, domestic, social and marital status, neurological and physical impairment, the type and location of the cerebral infarct, the presence of risk factors, blood measurements done on admission to hospital, the time from onset of the stroke to admission to hospital, and the duration of the the patients` stay in hospital. The outcome of the analysis of each of these variables will be detailed and the independent variables will be entered into a regression analysis to determine the significance of their input to the level of affective disorder which may exist after stroke.

7.2.2 The Beck Depression Inventory (BDI)

The BDI is a self assessment questionnaire which measures a number of symptoms of depression. Although there is no universally agreed cut-off score on the BDI total to identify `cases` of depression, either in the general population or in medical patients, it has previously been accepted that a cut-off score of 13 can be applied to denote `caseness` in a normal population (House et al.,1987;1989; 1990). Consequently in this study, the results have been assessed according to the BDI cut-off points of >9 to denote borderline affective states and =>13 to detect `caseness`. Although the BDI is not considered to be influenced by gender, other research has shown that depression can be gender dependent (Kendler et al.,1993). In this study the analysis of all of the BDI results will include gender as a factor.

Figure 5. BDI scores - total group of patients

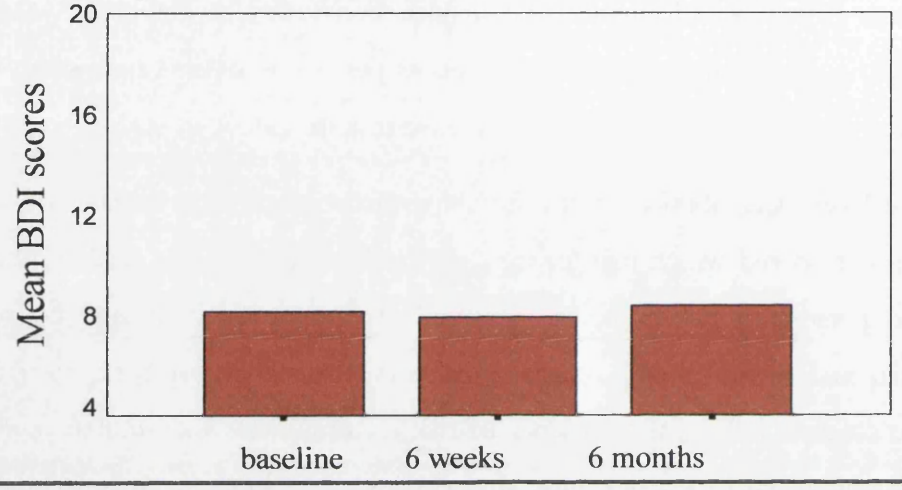
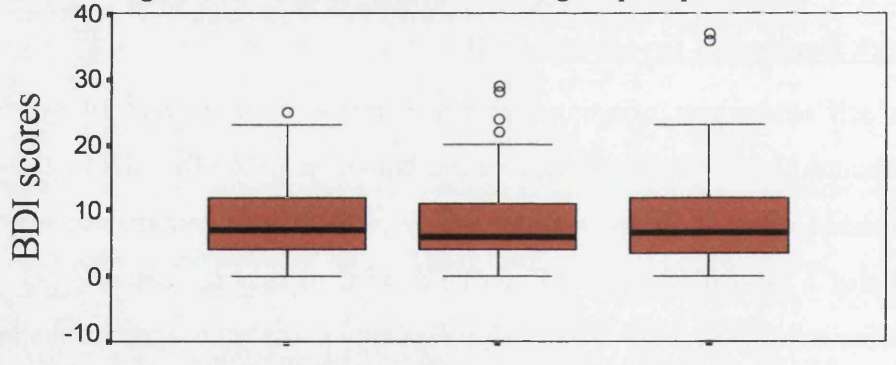


Figure 6. BDI scores - total group of patients



Box and whisker plot

Box = 50% values, solid line = median, whiskers = ranges

7.2.2.1 BDI scores - Patients

The numbers and percentages of patients who completed the assessments are detailed in Table 4. Of the original cohort of patients 112 (85%,) completed all three of the assessments.

Table 4. Completed BDI assessments - patients

Completed BDI Assessments	Patients	% Patients	Male patients	% Male patients	Female Patients	% Female patients
Baseline (1)	131	100	85	100	46	100
6 Weeks (2)	116	89	72	85	44	96
6 Months (3)	115	88	74	87	41	89
BDI 1+2+3	112	85	71	84	41	89
BDI 1+2	116	89	72	85	44	96
BDI 1+3	115	88	74	87	41	89

Analysis of the data to determine normality (KS) demonstrated that when the group of patients was considered as a whole, the baseline distribution of the BDI scores was normal, while the 6 weeks and 6 months distribution of scores was non-normal. When the data were divided into males and females the distributions for all of the assessments were normal. Details of the BDI means and standard deviations, medians and interquartile ranges for the patients who completed all of the assessments are given in Table 5. Mean and median scores for the total group of patients and for male and female patients are shown in Figures 5-8.

Table 5. Analysis of BDI data for the total group of patients

Total Group	No	Mean	SD	Median	Q1	Q3	Min	Max
BDI1	112	8.2	6.6	7.0	4.0	12.0	0	36
BDI2	112	8.0	7.1	6.0	4	11.0	0	43
BDI3	112	8.4	6.8	6.5	3.3	12.0	0	37
Male Patients								
BDI 1	71	7.8	6.2	6.0	3	12	0	25
BDI2	71	6.7	5.4	5.0	3	8	0	29
BDI3	71	7.1	5.5	6.0	3	11	0	23
Female Patients								
BDI1	41	8.8	7.2	7	4	13	0	36
BDI2	41	10.1	9.1	9.1	4	13.5	0	43
BDI3	41	10.7	8.3	9.0	4	15.5	1	37

Figure 7. BDI scores - patients

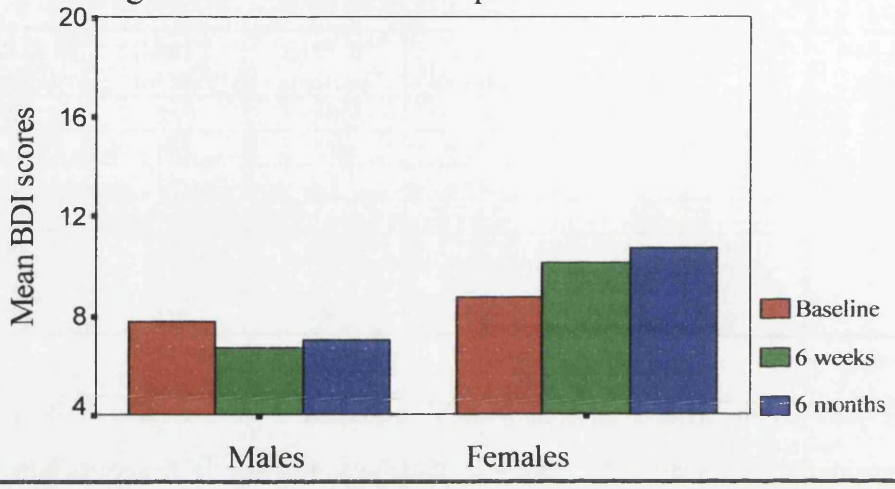
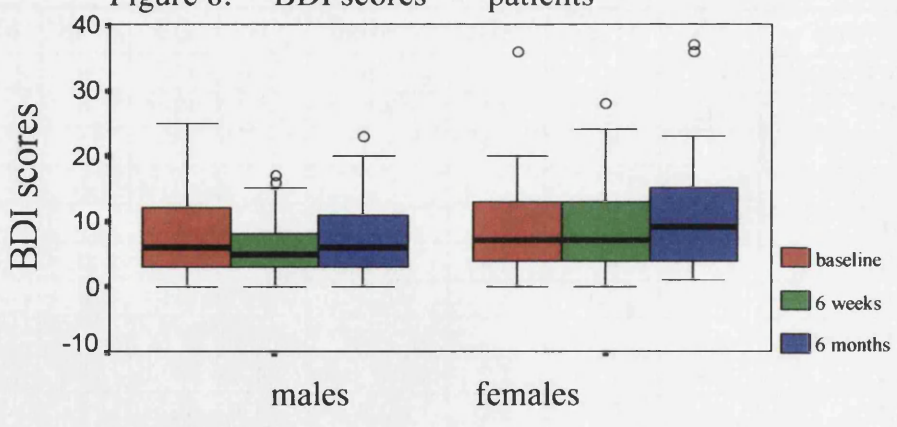


Figure 8. BDI scores - patients



Box and whisker plot

Box= 50% values, solid line=median, whiskers=range (excluding outliers)

(a) Percentage of subjects in different scoring categories

In keeping with the previously described BDI cut-off scores, the data were categorized into BDI scores of <=9, >9 and =>13, and the results are shown in Table 6.

Table 6. Summary of patients above and below BDI threshold scores

Assessment	BDI	Patients		Males		Females	
Number	Threshhold	Number	%	Number	%	Number	%
1	<=9	78	60	54	64	24	52
2	<=9	81	69	56	78	25	57
3	<=9	71	62	49	66	22	54
1+2+3	<=9	60	54	44	62	16	39
1	>=9	53	40	31	36	22	48
2	>=9	35	31	16	22	19	43
3	>=9	44	38	25	34	19	46
1+2+3	>=9	23	21	13	18	10	24
1	>=13	39	30	24	28	15	33
2	>=13	25	22	13	18	12	27
3	>=13	27	23	14	19	13	32
1+2+3	>=13	11	10	6	8	5	12

Assessment number 1= baseline; Assessment number 2 = 6 weeks; Assessment number 3 = 6 months

Assessment number 1+2+3 Patients who completed all three assessments

BDI Threshhold <=9 within 'normal' limits; =>9 outwith'normal' limits; =>13 suggests 'caseness'

Initial inspection of the results of the data suggests that a high percentage of patients had BDI scores outwith the 'normal' BDI scoring range at each of the individual assessments. For instance more than 30% of patients had BDI scores which were above the 'normal' BDI range (ie.>9) at each of the assessments while >20% of patients had BDI scores =>13 which suggested 'caseness' at any individual assessment. It is noted however, that the interpretation of the results has to be considered in relation to the time between the onset of the stroke and the assessment time. This effect is highlighted by the following observations:-

1. If an assessment was only made at 6 months from the onset of stroke 23% of patients would have been identified as having levels of affective disorder suggesting 'caseness'.
2. If an assessment was only carried out at 6 weeks after stroke 22% of patients would have been identified as 'caseness'.
3. For patients who had assessments done at 6 weeks and 6 months after stroke, 16% would have been identified as 'cases'.
4. For patients who had assessments done on all three occasions the results demonstrated that 10% patients had a level of affective disorder suggesting 'caseness' which was present from the onset of the stroke and was present for the 6 months after the stroke.

The results of the study also demonstrated that 54% of the patients had BDI scores which were consistently within 'normal' limits over the 6 months, that 89% of the patients who had 'normal' baseline scores also had scores within 'normal' limits at 6 weeks and 82% were within 'normal' limits at 6 months. This suggests that patients who have 'normal' scores in the acute phase of stroke, have a relatively stable affective status in the 6 months after stroke. The results however, also demonstrated that there were changes in BDI scores for a small number of patients. For instance 7% of patients who had a 'normal' baseline BDI score had subsequent scores which were above 'normal' at the 6 weeks and 6 months assessments and 5% of patients who had a 'normal' BDI score at the onset of the stroke became 'cases' at the 6 weeks and 6 months assessments. A further 2 patients who had 'normal' baseline and 6 weeks BDI scores became 'cases' at the 6 months assessment.

It was also noted that 7 patients who had BDI scores between 9 and 13 at baseline reverted to scores <9 for the remainder of the 6 months of the study and that a further 2 patients who had baseline scores of >13 reverted to BDI scores <=9 at the 6 weeks and 6 months assessments. It may be that for this group of 9 patients, their baseline scores were a natural response to the initial impact of the stroke, after which they reverted to a more stable affective state, once the initial effect of the stroke had resolved. This preliminary analysis of the results demonstrates the difficulty in determining the true level of affective disorder which could be attributed to the neurological impact of stroke.

(b) <u>Significant differences and correlations between the three assessments</u>

Analysis of the data showed that that there were no significant differences in depression scores between the assessments for the group of patients as a whole. Although the mean and median data shown in Table 5 suggested an upward trend in the scores of the female patients over the 3 assessments, repeated measures ANOVA demonstrated no significant differences in scores for either male or female patients. When the data were split according to whether or not the baseline BDI scores were <=9 or >9, repeated ANOVA demonstrated significant changes in scores over the three assessments for female patients who had baseline BDI scores which were within 'normal' limits, ie.<=9 ($p=0.003$, ss 797.5, df 46, ms 17.3, $F = 6.5$) and significant changes in scores for male patients who had baseline BDI scores of >9 ($p = 0.002$, ss 637.8, ms15.2, df 42, $F = 7.6$).

Figure 8a. Age distribution - male and female patients

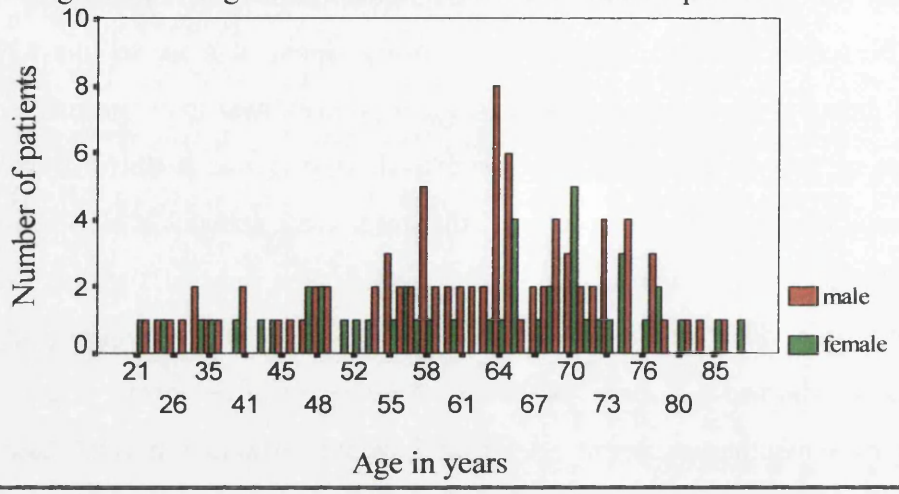


Figure 8b. Age distribution - male patients

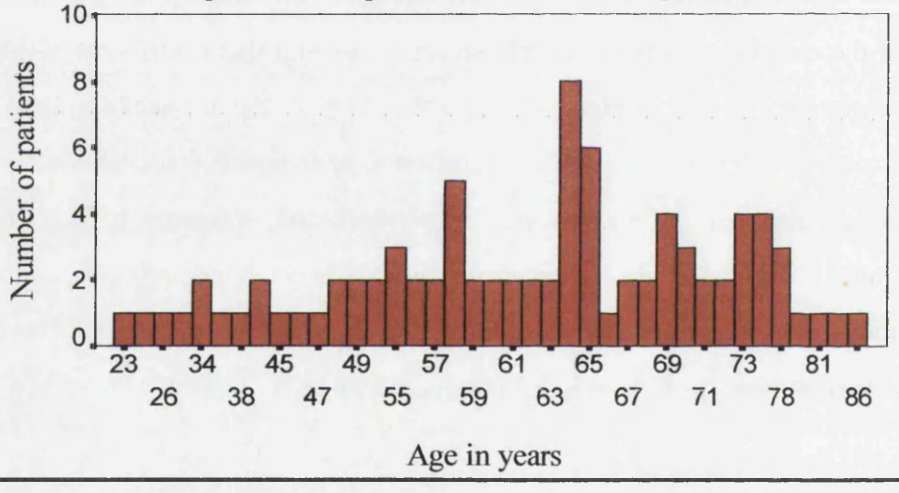
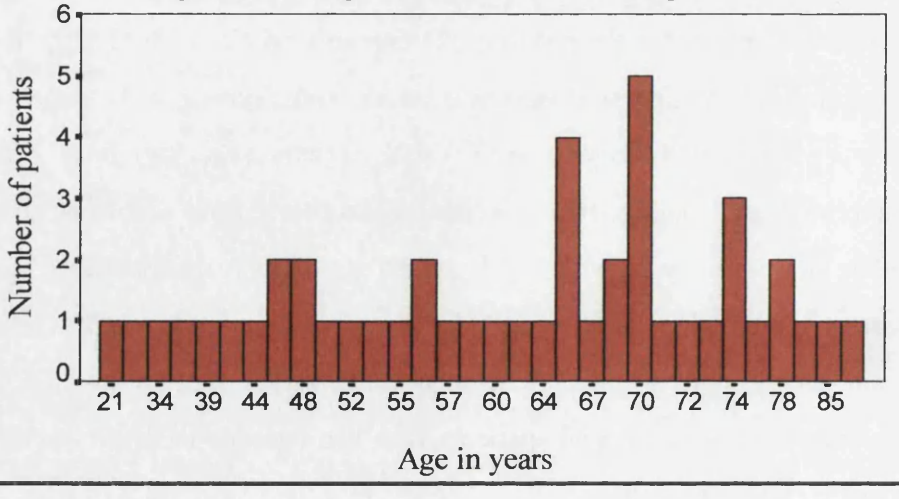


Figure 8c. Age distribution - female patients



Inspection of the BDI means and standard deviations for each of the assessments, demonstrated that the significant ANOVA changes that were demonstrated, related to increases in scores for female patients and decreases in scores for male patients over the three assessments. Correlation analysis demonstrated significant associations between individual assessments as demonstrated in Table 7.

Table 7. **BDI Correlation co-efficients between assessments**

	Total patient group			Male patients			Female patients		
	n	*r*	*p*	*n*	*r*	*p*	*n*	*r*	*p*
Baseline/6 weeks	116	0.59	<0.001	71	0.64	<0.001	44	0.63	<0.001
Baseline / 6 months	115	0.61	<0.001	74	0.66	<0.001	41	0.66	<0.001
6 weeks / 6 months	112	0.78	<0.001	72	0.78	<0.001	41	0.81	<0.001

The outcome of these results demonstrates highly significant correlations and no significant differences between the BDI scores at each of the assessments. It is noted however, that for the sub-set of female patients who had baseline scores which were within 'normal' limits there were significant increases in BDI scores over the 6 months.

7.2.2.2 Gender related differences in BDI scores

Differences between the BDI scores of male and female patients for each of the assessments were determined using paired t-tests for independent samples. The results demonstrated minimal significant differences at 6 weeks ($p = 0.03$, $t = -2.2$, md = -3.4, df 1/113, 95% CI -6.6,-0.3) and significant differences at the 6 months assessments ($p = 0.01$, $t = -2.5$, md = -3.7, df=1/110, 95% C I -6.5, -0.8) due to higher scores for female patients (Table 5). Chi^2 analysis demonstrated no significant associations between BDI scoring categories (ie.<=9, >9, =>13), and the gender of the patient at any of the assessments.

7.2.2.3 Age as a factor in BDI scores

Correlation analysis demonstrated a significant relationship between age and BDI scores for male patients at the baseline assessment only ($p=0.01, r=0.9, n=85$). When the data were split into age groups <50 and =>50 years, the results of Chi^2 analysis demonstrated that there was no association between age and any of the BDI scoring categories for the patient group as a whole, or for male or female patients when considered as separate groups.

7.2.2.4 Domestic status and BDI scores

The demographic details of the patients with respect to domestic status demonstrated that 30% of male patients and 41% of female patients lived alone and 65% of male patients and 43% of female patients lived with a partner, 5% of male patients lived with family or in residential care and 15% of female patients lived with family. Analysis of the data with respect to domestic status was restricted to patients who lived alone, or lived with a partner.

Mann Whitney-U test demonstrated no significant differences between the patients who lived alone compared with those who lived with a partner either for the group as a whole or for male and female patients considered separately. However, repeated measures ANOVA demonstrated a significant change (increase) in BDI scores within the 3 assessments for female patients who were living with a partner ($p= 0.005$, ss = 885.2, df 34, ms = 26.0, $F=6.2$).

7.2.2.5 Marital status and BDI scores

Marital status was considered in terms of whether or not the patients were single, married, divorced/separated or widowed. In this study 17 patients were single (12 males, 5 females), 77 patients were married (57 males, 20 females), 32 were widowed (13 males, 19 females) and 6 patients were separated or divorced (4 males, 2 females). Analysis of the data (one-way ANOVA) for each of the assessments demonstrated no significant differences in BDI scores between the single, married or widowed groups for BDI scores either when the group was considered as a whole or when analysed for male and female patients separately. Repeated measures ANOVA demonstrated a significant change (increase) in BDI scores within the 3 assessments for female patients who were married ($p= 0.01$, ss = 928, df 34, ms = 27, $F=4.9$). These results suggest that female patients who are living with someone may be more at risk of developing affective disorder after stroke than those living alone.

7.2.2.6 Social status and BDI scores

The social status of the patients in this study was evaluated on the basis of whether they were employed, unemployed or retired. The data demonstrated that 33% of patients (36% males, 28% females) were employed, 11% of patients (13% males, 9% females) were unemployed and 55% of patients were retired (51% males and 63% females).

Table 8. **Hospitalization and admission details**

Patient groups	Mean	Std dev	Median	Q1	Q3	Min	Max
Total patients							
Acute Stroke Unit stay (days)	4.6	1.8	5.0	3.0	6.0	2.0	10
General Hospital inpatient (days)	21.5	40.6	6.0	4.0	21.0	2.0	180
Time from onset to admission (Hrs)	9.5	7.9	7.0	4.0	12.0	1.0	34
Male patients							
Acute Stroke Unit stay (days)	4.6	1.9	5.0	3.0	6.0	2.0	10
General Hospital inpatient (days)	21.2	37.6	6.0	4.0	21.0	2.0	180
Time from onset to admission (Hrs)	10.1	8.5	7.0	4.0	14.0	1.0	34
Female patients							
Acute Stroke Unit stay (days)	4.7	1.6	5.0	3.0	6.0	2.0	8.0
General Hospital inpatient (days)	22.1	45.9	5.5	3.0	14.0	2.0	180
Time from onset to admission (Hrs)	8.4	6.5	6.0	3.2	11.8	2.0	30

Q1- 25% Interquartile range Min - minimum

Q3 - 75% Interquartile range Max - maximum

7.2.2.7 BDI scores and hospitalization after stroke

As previously described in chapter 6, patients were admitted to the Acute Stroke Unit for a maximum time of 5 days and were then transferred to other wards for rehabilitation or were discharged home. Details of the duration of the patients' stay in the Acute Stroke Unit, their overall stay in hospital together with the time delay from onset of the stroke to admission to hospital are detailed in Table 8.

Spearman-rank correlation analysis demonstrated no association between BDI scores and the duration of hospitalization after stroke, nor between BDI scores and the time difference from the onset of the stroke to hospital admission. These outcomes applied to the patient group as a whole and also to male and female patients when considered as separate groups.

7.2.2.8 Risk factors and BDI scores

The demographic data on the patients in this study showed that the patients were subject to certain risk factors for stroke. These risk factors are detailed in Table 9 and demonstrate that 12% had suffered from a previous stroke, 33% had a history of cardiac illness, 16% had a family history of stroke, 45% had high blood pressure, 10% had diabetes and 53% smoked.

It was also noted that a considerable number of patients had more than one risk factor. For instance, while 6% had no risk factors at all, 28% had a combination of high blood pressure and smoking, while 8% of patients who had high blood pressure also had a history of stroke.

Table 9. Percentage of patients with co-morbid risk factors

Risk Factor	Total group		Males		Females	
	No.	%	No.	%	No.	%
Previous stroke	17	13	9	10	8	17
Cardiac problems	45	34	33	38	12	26
Family history	21	16	15	17	6	13
High blood pressure	61	47	43	49	18	39
Diabetes	13	10	9	11	4	9
Smoking	76	58	50	58	26	57

Analysis of the data demonstrated no significant differences between the groups with or without the presence of any of the risk factors, at any of the assessments. This outcome applied to patient groups as a whole and to male and female patients when considered as separate groups. Chi^2 analysis demonstrated no associations between BDI scoring categories (ie <=9, >9, =>13), and any of the risk factor groups and there were no differences between assessments for any of the risk factor groups.

7.2.2.9 Impairment, Disability and BDI scores

(a) Laterality of physical impairment

In this study 51 (39%) of the patients had right sided impairment (ie right arm or leg or both) and 69 (53%) had left sided impairment (ie left arm or leg or both). Unpaired t-tests analysis of the BDI data demonstrated no significant differences between patients with right or left sided impairment, for the patient group as a whole or for male and female patients when considered as separate groups. Chi^2 analysis demonstrated a significant association between side of impairment and `caseness` for female patients at the 6 months assessment ($p=0.006$, $r=0.34$, df 1)

(b) BDI scores speech impairment

Speech impairment was classified in terms of whether the patients had normal speech, were dysphasic or dysarthric as a result of the stroke. The results demonstrated that 62% of patients had no speech impairment, 16% were dysphasic and 22% were dysarthric. One-way ANOVA demonstrated no significant differences between the scores of speech groups, either as a total group or when considered separately as male and female patients. Repeated measures ANOVA demonstrated no significant differences between the assessments for any of the groups

(c) Disability and BDI scores

Analysis of the Barthel data demonstrated that 36% of patients in this study had Barthel Index scores of <100 and 16% had scores of <50. Correlation analysis demonstrated no significant relationship between the Barthel scores and any of the depression scores for the patient group as a whole, nor when the group was divided into males and females. Mann Whitney-U tests demonstrated no significant differences between the BDI scores of patients with Barthel scores of >50 and those with scores < 50 (which suggests a considerable degree of dependence), for any of the assessments, for the group as a whole or when considered as male and female patients separately. Chi^2 analysis demonstrated no association with `caseness` for patients with Barthel Index scores of 100 or scores >50 compared with those of <=50. for any of the assessments.

The analysis of the data with respect to Barthel scores and laterality of impairment demonstrated that for patients with right sided impairment 73% had Barthel scores of 100, 15% had scores 51-99 and 12% had scores <=50. For patients with left sided impairment 53% had Barthel scores of 100, 27% had scores 51-99 and 20% had scores <=50.

Table 10. BDI scores and clinical classification of the cerebral infarct

Assess No	Total No.	Mean	SD	Median	Min	Max	Q1	Q3
Right PACI (Partial anterior circulation infarction)								
Baseline	27	9.4	8.2	7.0	1	36	3	11
6 Weeks	26	10.9	10.2	7.0	0	43	3	15
6 Months	26	9.2	8.2	8.0	0	37	3	12
Left PACI (Partial anterior circulation infarction)								
Baseline	20	6.4	5.3	4.0	0	17	1	9
6 Weeks	19	5.3	3.3	5.0	0	13	4	7
6 Months	18	5.0	3.8	4.0	0	12	2	9
Right POCI (Posterior circulation infarction)								
Baseline	15	10.3	6.3	8.0	6	19	8	11
6 Weeks	12	6.8	3.5	7.0	2	11	5	10
6 Months	12	8.9	5.5	9.0	0	16	4	15
Left POCI (Posterior circulation infarction)								
Baseline	8	13.4	5.1	14.0	5	19	9	17
6 Weeks	8	9.0	7.1	8.0	0	20	2	17
6 Months	8	9.6	4.9	10	1	15	6	14
Right LACI (Lacunar infarction)								
Baseline	16	8.7	6.1	7.0	2	23	4	13
6 Weeks	15	8.3	8.6	6.5	0	29	2	13
6 Months	14	8.2	6.7	7.0	2	23	4	13
Left LACI (Lacunar infarction)								
Baseline	12	9.9	9.0	7.0	1	35	4	14
6 Weeks	12	8.1	4.8	7.0	0	17	4	13
6 Months	12	7.5	5.4	6.5	1	19	3	12

Table 11. BDI scores and laterality of infarct - Total group of patients

Assessment	Total No.	Mean	SD	Median	Min	Max	Q1	Q3
Right CVA								
Baseline	62	9.2	6.8	8.0	1	36	4	12
6 Weeks	57	9.5	8.6	7.0	0	43	4	13
6 Months	55	10.2	8.0	9.0	0	37	4	14
Left CVA								
Baseline	48	8.5	7.1	7.0	0	35	3	14
6 Weeks	43	6.7	4.9	6.0	0	20	4	8
6 Months	43	6.9	5.5	6.0	0	19	2	11
Miscellaneous								
Baseline	19	9.0	6.6	9.0	0	25	5	13
6 Weeks	16	6.9	4.6	7.0	0	14	3	11
6 Months	15	7.0	4.2	6.0	0	16	4	10

Table 12. BDI scores and laterality - Male and female patients

Assessment	Male patients						Female patients					
	R CVA		L CVA		Misc		R CVA		L CVA		Misc	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Baseline	8.2	5.8	8.9	7.7	8.9	6.8	10.8	8.1	7.6	5.9	10.0	7.1
6 Weeks	7.1	5.9	6.2	5.0	7.0	4.6	12.8	10.6	7.5	4.9	6.8	5.1
6 Months	7.6	5.5	6.8	6.1	7.6	4.7	13.9	9.5	7.1	4.0	5.2	2.2
	Med	Q1 Q3	Med	Q1 Q3	Med	Q1 Q3	Med	Q1 Q3	Med	Q1 Q3	Med	Q1 Q3
Baseline	7	4 12	8	3 14	8	5 14	10	4 17	5	3 14	11	4 16
6 Weeks	5	3 9	6	2 8	6	4 11	11	4 22	6	5 11	7	2 12
6 Months	6	3 11	5	2 12	7	4 12	14	5 18	8	3 10	5	3 8

M - Mean SD - Standard deviation Med - Median Q1-Q3 - 25% - 75% interquartile range

Although this suggests an association between left sided weakness and disability, Chi^2 analysis demonstrated no significant association between the side of impairment and the level of disability for the group as a whole or for male or female patients when assessed separately. From these results it would appear that dependence as a result of the physical impairment of stroke is not significantly related to affective disorder in this study.

7.2.2.10 BDI scores related to clinical classification and location of infarct

The classification of stroke according to clinical assessment and neuro-imaging describes the stroke in terms of laterality of infarct and also whether the infarct is anterior, posterior or lacunar. Details of the scores using the OCSP (Bamford, 1992) classifications are detailed in Table 10. Patients with TACI's and intracerebral haemorrhagic were excluded from the study due to the severity of the impact of their strokes in the acute stage of their illness.

Unpaired t-tests demonstrated no significant differences in mean BDI scores between any of the pairs of classifications for any of the assessments (ie right and left PACI, right and left POCI, right and left LACI) for the group as a whole. Gender analysis demonstrated significantly higher BDI scores for the 6 months assessment for male patients with right PACI's compared with male patients with left PACI's ($p = 0.003$, $t = 3.3$, $md = 5.5$, $df\ 24$, 95% CI 2.0, 8.9). Unpaired t-tests also demonstrated significant differences between male and female patients at 6 weeks ($p= 0.006$, $t = -3.5$, $md = -9.0$, $df\ 9$, 95% CI -14.8, -3.2) and 6 months for left PACI patients ($p = 0.01$, $t = -3.1$, $md = -6.2$, $df\ 8$, 95% CI -11.6, -1.7). These differences were due to female patients having higher BDI scores compared with males. One-way ANOVA demonstrated that there were no significant differences in the three BDI scores, between the clinical classifications for any of the groups. Repeated measures ANOVA demonstrated that there were no significant differences across the BDI scores for any of the assessments for any of the groups.

(a) Laterality of infarct and BDI scores

As previously described, the location of the cerebral infarct was determined from the results of neuroimaging data and clinical classification. To simplify the complexities involved in analysing numerous locations, the data were analysed initially in terms of whether the stroke was caused by an infarct on the right side, the left side or was due to a miscellaneous cause (ie. cerebellar or bilateral infarcts). The summary of the BDI scores for each of the categories, for the total group of patients and male and female patients separately, are detailed in Tables 11 and 12 and demonstrated in Figures 9-11.

Figure 9.
Mean BDI scores- R CVA v L CVA (M+F)

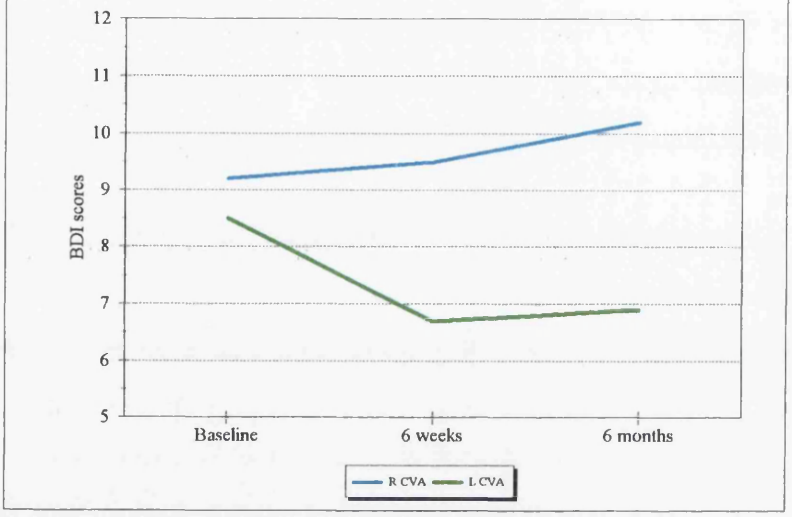


Figure 10.
Mean BDI scores-R CVA v L CVA (M)

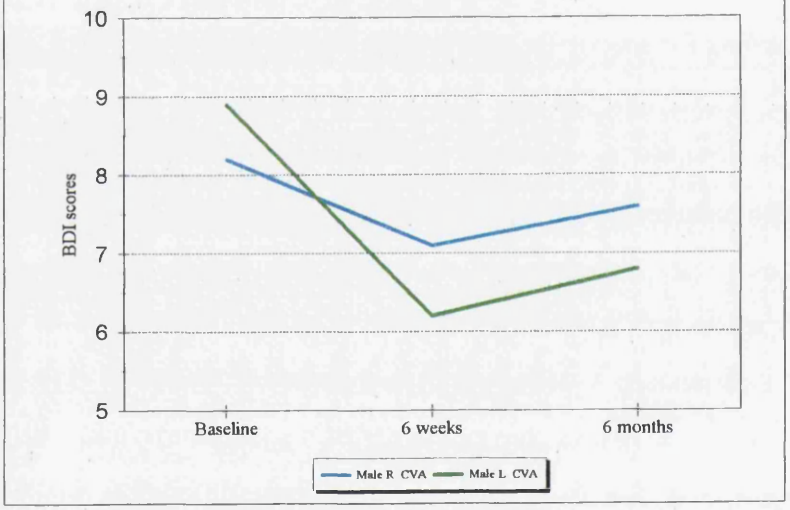
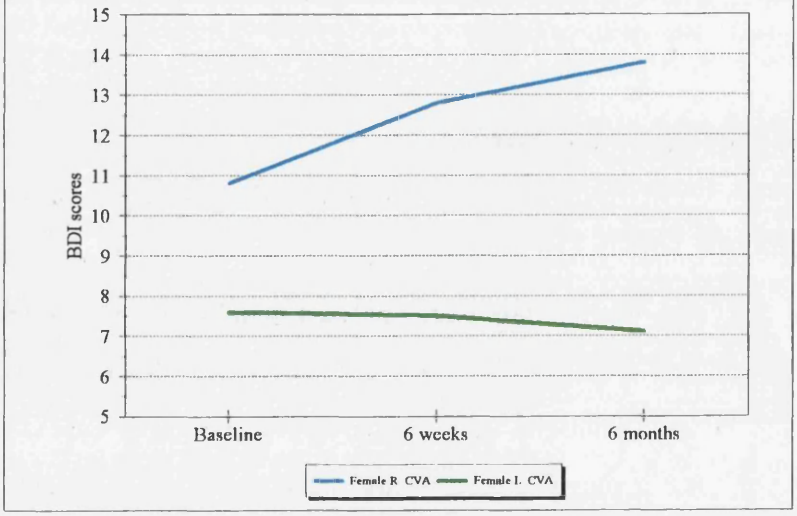


Figure 11.
Mean BDI scores- R CVA v L CVA (F)



Analysis of the data demonstrated no significant differences between the total group of patients with right and left CVA`s. Unpaired t-tests of the data for male and female patients as separate groups demonstrated that female patients with right CVA`s had minimally significant higher scores at 6 weeks (p= 0.04, t = 2.1, md = 5.5, df 33, 95% CI 0.1, 10.9), but significantly higher BDI scores by the 6 months assessment (p= 0.006, t = 2.95, md = 6.7, df 32, 95% CI 2.1,11.3) when compared with female patients with left CVA`s. Unpaired t-tests demonstrated significant differences between BDI scores of male and female patients with right CVA`s at the 6 months assessment (p=0.008, t=-3.08, md =-6.3, df =53, 95% CI -10.2, -1.8). There were no differences in BDI scores between patients with right or left CVA`s and the miscellaneous group. The percentages of patients in each of the BDI scoring categories for patients with right and left CVA`s are detailed in Table 13.

Table 13. Percentages of patients in BDI scoring categories for right and left CVA`s

BDI scores	Assessment	Male patients		Female		Total patients	
		R CVA	L CVA	R CVA	L CVA	R CVA	L CVA
		%	%	%	%	%	%
BDI <=9	Baseline (1)	69	68	52	71	62	69
	6 Weeks (2)	81	78	43	79	65	79
	6 Months (3)	63	75	35	71	51	71
BDI >9	Baseline (1)	31	32	48	35	38	33
	6 Weeks (2)	19	21	57	21	35	21
	6 Months (3)	38	29	65	35	49	29
BDI=>13	Baseline (1)	19	29	30	21	24	26
	6 Weeks (2)	19	18	39	12	27	17
	6 Months (3)	16	18	52	7	31	14
BDI (1+2+3)<=9	Combined ass.	59	64	22	64	43	64
BDI (1+2+3) >9	Combined ass.	16	21	35	14	24	19
BDI (1+2+3) >13	Combined ass.	7	11	17	7	11	10

BDI scores <=9 - within `normal limits, BDI scores >9 - above `normal` limits, BDI scores =>13 - suggests `caseness

The data demonstrate that the percentages of BDI scores above the `normal` BDI value, or which suggested `caseness` was higher for female patients with right CVA`s at each of the assessments. Chi$^2$ analysis of the data confirmed a significant association between `caseness` and the laterality of the CVA for female patients (p=0.006, r=0.5, df =1) at 6 months, and also demonstrated a significant association between `caseness` and gender of the patients at 6 months (p=0.01, r=0.4) for patients with right CVA`s. Unpaired t-tests also demonstrated significantly higher scores for female patients with right CVA`s at 6 months (p = 0.008, t = -2.8, md = -6.3, df 32, 95% CI -10.8, -1.8) compared with male patients.

Post-hoc analysis of these results suggests an apparent association between the laterality of the CVA and the groups of patients, particularly female patients, who had persistently `normal`, above `normal` and `caseness` scores. For patients with persistently `normal` BDI scores there were minimal differences between the percentages of the 37 male patients who had right or left CVA`s (51% RCVA, 49% LCVA). However the 14 female patients who had persistently `normal` BDI scores, were more likely to have had a left CVA (36% RCVA, 64% LCVA). For the 11 male patients with persistently above `normal` BDI scores the differences were minimal (46% RCVA, 64% LCVA) whereas for the 10 female patients in this category, the difference was marked (80% RCVA, 20% LCVA). In addition to this finding, it was noted that, of the 7 patients whose BDI scores changed from `normal` at baseline assessment to above `normal` at the 6 weeks and 6 months assessments, 5 were female patients with right CVA`s, 1 was a male patient with a right CVA and 1 was a male patient with a left CVA.

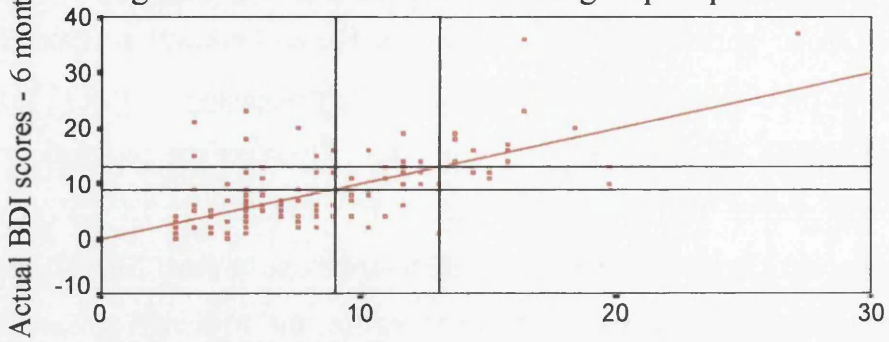
These results have also shown that for the small number of patients who developed affective disorder after stroke, that there may also be an association between the onset of affective disorder and the combination of the laterality of the stroke and the gender of the patient. This association is highlighted by the observation that female patients with right CVA`s appear more likely to develop affective disorder after the onset of stroke than any other group.

7.2.3 Linear regression analysis

Analyses of the data have demonstrated significant correlations between the BDI scores at the 6 weeks and 6 months assessments (i.e. 0.78 for male patients and 0.8 for female patients). Although correlations of =>0.8 suggest that colinearity should be considered as a factor in regression analysis, the above correlations are just on the border of acceptability and therefore the application of colinearity is not being considered in these analyses. However it is acknowledged that the regression equation may not be robustly applied with confidence to values of the BDI that vary markedly from the regression line.

Simple regression analysis using the baseline BDI score as the independent variable, and the 6 months BDI score as the dependent variable, demonstrated that for the total group of patients the baseline BDI scale score accounted for 42% of the variance in the 6 months BDI scores ($R = 0.65$, $R^2 = 0.42$, $F = 82.7$, df 1/113, $p < 0.001$, Regression equation BDI3 = 0.67 x BDI

Figure 12. BDI scores - Total group of patients

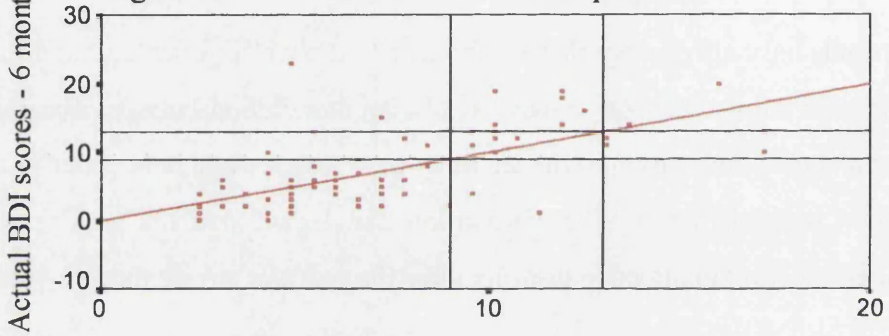


Predicted 6 months BDI scores = 0.673 x BDI + 2.919

Horizontal and vertical lines represent BDI 'cut-off' scores of 9 and 13

Diagonal line represents the linear regression line

Figure13. BDI scores - Male patients

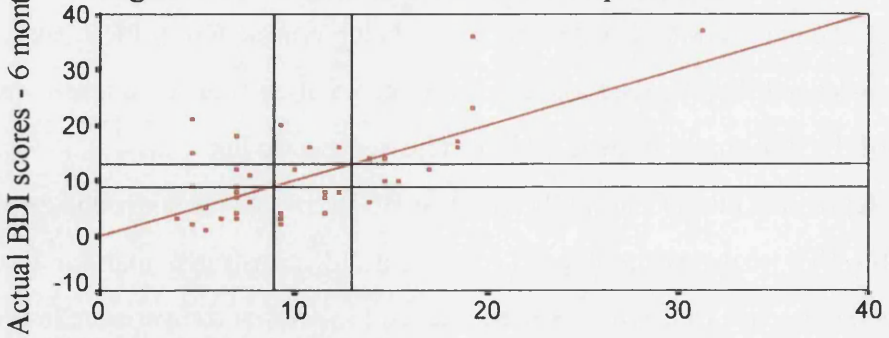


Predicted 6 months BDI scores = 0.587 x BDI + 2.556

Horizontal and vertical lines represent BDI 'cut-off' values of 9 and 13

Diagonal line represents linear regression line

Figure 14. BDI scores - Female patients



Predicted 6 months BDI scores = 0.759 x BDI + 4.046

Horizontal and vertical lines represent BDI 'cut-off' values of 9 and 13

Diagonal represents regression line

+ 2.9). For male and female patients, the baseline BDI score accounted for 44% of the variance in the 6 months BDI score: male patients - ($R = 0.66$, $R^2 = 0.44$, $F = 56.5$, $p<0.001$, df 1/72: Regression equation BDI3 = 0.0.59 x BDI + 2.6) and female patients- ($R = 0.66$, $R^2 = 0.44$, $F = 30$, $p<0.001$, df 1/39: Regression equation BDI3 = 0.76 x BDI + 4.05) (Figures 12-14).

When the 6 weeks BDI score was considered as the independent variable, regression analysis demonstrated that for the group as a whole the 6 weeks BDI scores accounted for 66% of the variance in the 6 months BDI score ($R = 0.81$, $R^2 = 0.66$, $F = 208$, $p<0.001$, df 1/110: Regression equation BDI3 = 0.7x BDI2 + 2.2). For male patients the 6 weeks BDI score accounted for 60% in the variance ($R = 0.78$, $R^2 = 0.6$, $F = 104$, df 1/69, $p<0.001$: Regression equation BDI3 = 0.79BDI2 + 1.73) and for female patients the 6 weeks BDI score accounted for 66% of the variance in the 6 months BDI scores ($R = 0.81$, $R^2 = 0.66$, $F = 76.5$, $p<0.001$, df 1/39: Regression equation BDI3 = 0.74 x BDI2 + 3.2).

When the baseline BDI and 6 weeks BDI scores were combined the results demonstrated, that for the group as a whole, this combination of BDI scores accounted for 68% of the variance in the 6 months BDI scores ($R = 0.83$, $R^2 = 0.68$, $F = 117$, $P <0.001$, df 2/109: Regression equation BDI3 = 0.65 x BDI2 + 0.22 x BDI + 1.4). For male patients the combination accounted for 64% in the variance ($R = 0.8$, $R^2 = 0.64$, $F = 59$, $p<0.001$, df 2/68: Regression equation BDI3 = 0.2 x BDI + 0.63 x BDI2 + 1.15) while for female patients only the 6 weeks BDI score was included in the final regression equation and contributed 66% to the variance in the 6 months BDI scores ($R = 0.8$, $R^2 = 0.66$, $F = 76$, $p<0.001$, df 1/39: Regression equation BDI3 = 0.74 x BDI2 + 3.2) (Figures 15-17).

To determine the independent effect of the miscellaneous predictor variables on the 6 months BDI scores, the miscellaneous predictor variables were divided into three sub-sets and preliminary multiple regression analyses were performed on each of the following sub-sets.

Demographic variables

Gender, age, domestic status, marital status, social status

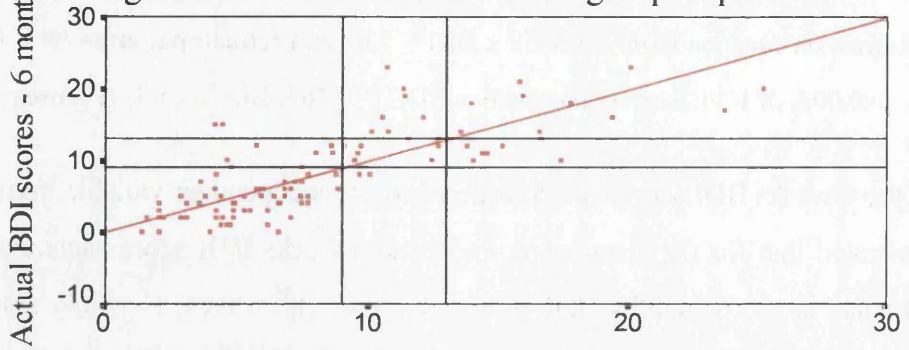
Risk factors

Previous stroke, cardiac illness, family history of stroke, high blood pressure, diabetes, smoking, time from onset of stroke to admission to hospital, and hospital duration

Neurological factors

Barthel Index, speech, laterality of CVA, and location of infarct.

Figure 15. BDI scores - Total group of patients

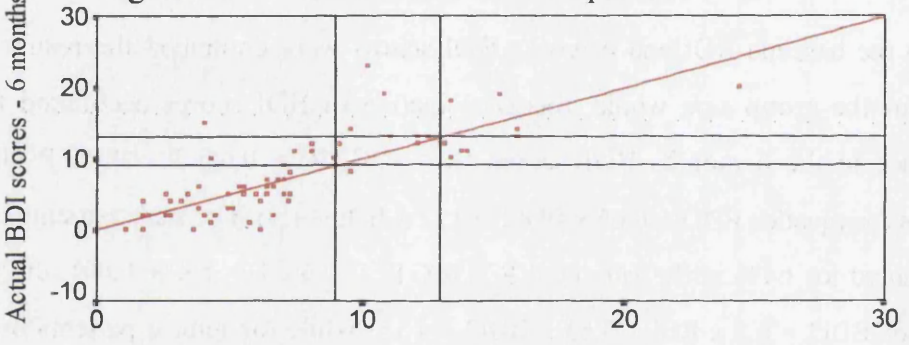


Predicted 6 months BDI scores = 0.223 x BDI + 0.646 x BDI2 + 1.423

Horizontal and vertical lines represent BDI 'cut-off' values of 9 and 13

Diagonal line represents the linear regression line

Figure16. BDI scores - Male patients

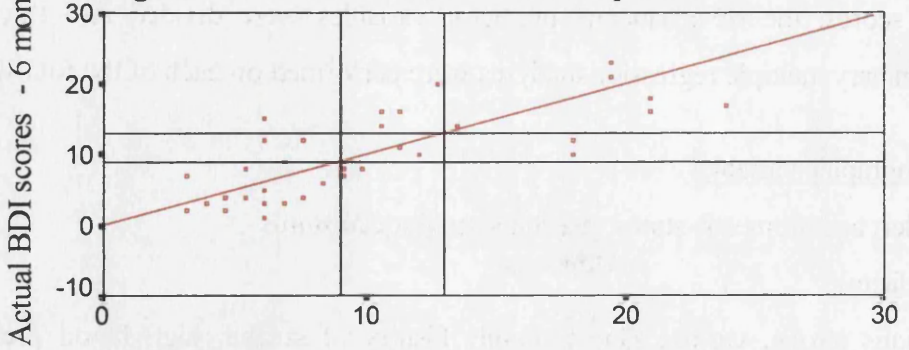


Predicted 6 months BDI scores = 0.211 x BDI + 0.635 x BDI2 +1.15

Horizontal and vertical lines represent BDI 'cut-off' values of 9 and 13

Diagonal represents linear regression line

Figure 17. BDI scores - Female patients



Predicted 6 months BDI scores = 0.739 x BDI2 + 3.207

Horizontal and vertical lines represent BDI 'cut-off' values of 9 and 13

Diagonal represents linear regression line

The results of the regression analyses using the three sub-sets of variables as independent variables and the 6 months BDI score as the dependent variable, identified gender as being a significant variable from the demographic subset of variables, laterality of infarct was identified from the neurological sub-set and no specific variable was identified as significant from the risk factor sub-set of variables.

The results of regression analysis demonstrated that the combination of gender and laterality of infarct accounted for 12% of the variance in the 6 months BDI score (Multiple R = 0.34, R^2 = 11.8, F = 6.4, df 2/95, p = 0.002: Regression equation BDI3 = 3.8 x Gender - 2.9 x Laterality + 8.6). However when the baseline and 6 weeks BDI scores were included in the regression analysis, gender and laterality of infarct were no longer significant predictor variables.

Plots of the predicted 6 months BDI from the baseline BDI score, against the actual 6 months BDI scores are shown in Figures 12-14 for the total group of patients and also for male and female patients separately. The graphs demonstrate that the ability to predict the classification of the 6 months BDI score may be more relevant rather than determining the actual BDI score at 6 months (ie. whether the 6 months scores came within the BDI categories <=9, >9 or =>13). For instance for the total group of patients who had 6 months BDI scores which came within the `normal` BDI classification, the predicted score from the baseline BDI score accounted for 86% of these patients (93% males, 59% females). For patients who had 6 months BDI scores which were outwith the BDI `normal` score ie. >9, the predicted score from the baseline BDI score accounted for 70% of the total patient group (76% males, 74% females) while patients who had 6 months BDI scores suggesting `caseness` the percentages of accurate predicted scores from the baseline scores accounted for 44% of the total patient group (21% males, 54% females).

For the total group of patients who had 6 months BDI scores which came within the `normal` BDI classification, the predicted score from the 6 weeks BDI score accounted for 96% of patients, (98% of males, 82% of females). For patients who had 6 months BDI scores which were outwith the BDI `normal` score ie. >9, the predicted score accounted for 74% of the total patient group (65% male patients, 84% female patients). However for patients who had 6 months BDI scores suggesting `caseness` the percentages of accurate predicted scores accounted for 60% of the total patient group (34% males, 62% females).

Plots of the predicted 6 months BDI from the baseline and 6 weeks BDI scores, against the actual 6 months BDI scores are shown in Figures 15-17. The figures demonstrate the

predictability of the combined input from the baseline and 6 weeks BDI scores applied to the total group, and to the male patient group only, since the baseline BDI score was not included in the final regression analysis for female patients.

The results of the regression equations identified 97% of the total group of patients and 98% of male patients who had obtained BDI scores within the 'normal' BDI scoring range at 6 months. For patients whose BDI scores were outwith the 'normal' range at 6 months, the results of the regression analysis identified 83% of the total group and 71% of male patients. For patients who had BDI scores suggesting 'caseness' at 6 months, the regression analysis using the combined baseline and 6 weeks BDI scores, accurately identified 56% of the total patient group (42% male patients).

These results suggest that the baseline and/or 6 weeks BDI scores can predict the classification of the affective status of patients at 6 months after stroke to a greater extent than predicting the precise BDI score at that time.

7.2.4 BDI scores - Carers

The carers of the patients in this study have been included for two reasons:-

1. As a comparison group, since they are in effect the closest social group to the patients in this study. They have also suffered a similar emotional trauma as the patients but without the neurological trauma of the stroke or the resulting disability.
2. Previous studies have demonstrated high levels of affective disorder in the carers of stroke patients, but the association between the psychological status of stroke patients and their carers has not previously been evaluated.

A summary of the carers who completed the assessments is given in Table 14. Of the original cohort of carers, 76% completed all three of the assessments.

Table 14. Completed BDI assessments for carers

Completed Assessments	Total No Carers	%Carers	Male Carers	% Male Carers	Female Carers	% Female Carers
BDI 1	45	100	17	100	28	100
BDI 2	36	80	13	76	23	82
BDI 3	41	91	16	94	25	89
BDI 1+2+3	34	76	13	76	21	75

The results of means, standard deviations, medians and interquartile ranges for all of the carers for each of the assessments are detailed in Table15.

Table 15. BDI scores - Carers

Total Group	No	Mean	SD	Median	Q1	Q3	Min	Max
BDI1	45	7.2	6.3	6.0	3	11	0	29
BDI2	36	7.8	6.5	6.0	3	11	0	24
BDI3	41	7.6	7.4	5.0	2	14	0	33
Male carers								
BDI 1	17	5.5	7.2	3.0	1	8	0	29
BDI2	13	7.6	6.5	6.0	3	11	0	23
BDI3	16	6.4	6.4	4.5	1	13	0	20
Female carers								
BDI1	28	8.3	5.5	7.0	4	12	0	23
BDI2	23	7.9	6.7	6.0	3	11	0	24
BDI3	25	8.4	8.9	5.0	3	14	0	35

Pearson correlation analysis for the total group of carers demonstrated significant correlations between assessments and these are detailed in Table16.

Table 16. BDI Correlation co-efficients between assessments

	Total carer group			Male carers			Female carers		
	n	*r*	*p*	*n*	*r*	*p*	*n*	*r*	*p*
Baseline/6 weeks	35	0.5	<0.001	13	0.6	0.03	22	0.6	0.001
Baseline / 6 months	40	0.7	<0.001	16	0.6	0.008	24	0.8	<0.001
6 weeks / 6 months	35	0.8	<0.001	13	0.6	0.001	22	0.9	<0.001

Unpaired t-tests demonstrated no significant differences between the scores of male and female carers for any of the assessments. Repeated measures ANOVA demonstrated no significant differences in the BDI scores for the three assessments, either for the carer group as a whole or for male and female carers separately. Chi^2 analysis of BDI scores in the categories of <=9, >9 or =>13, also demonstrated no association between BDI scores denoting `caseness` for either male or female carers.

7.2.4.1 Comparison of BDI scores of carers and patients

Unpaired t-tests demonstrated no significant differences between the BDI scores of the patients and carers when considered either as a whole group or when male patients and carers were compared or when female patients and carers were compared (Figures 18-20).

Figure 18.
Mean BDI scores-Tot Patients v carers

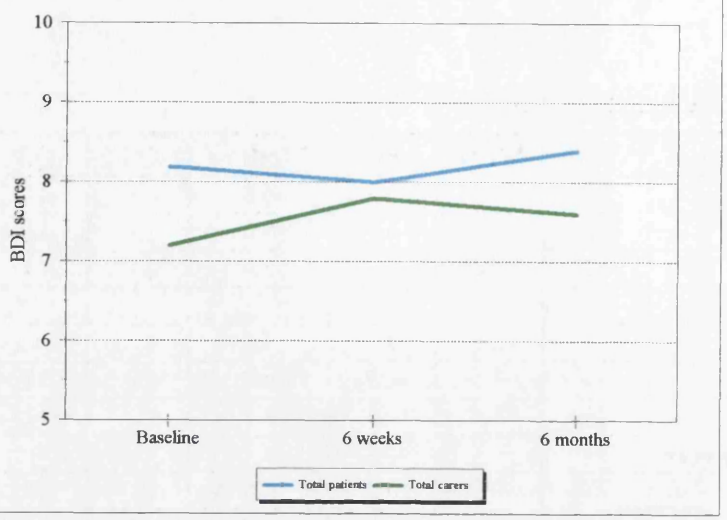


Figure 19.
Mean BDI scores- patients v carers (M)

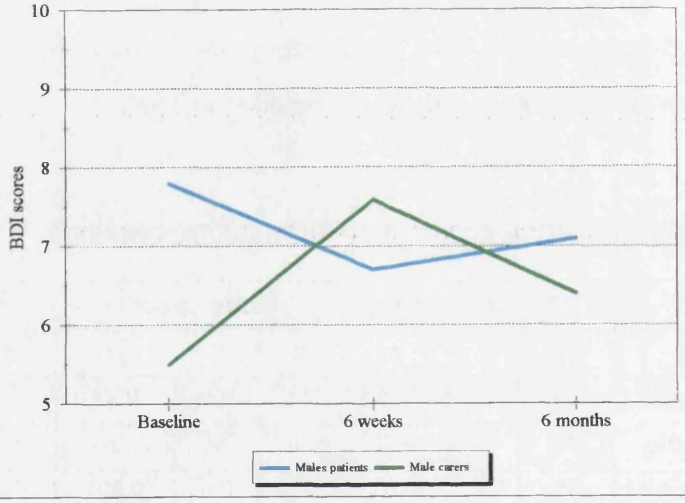
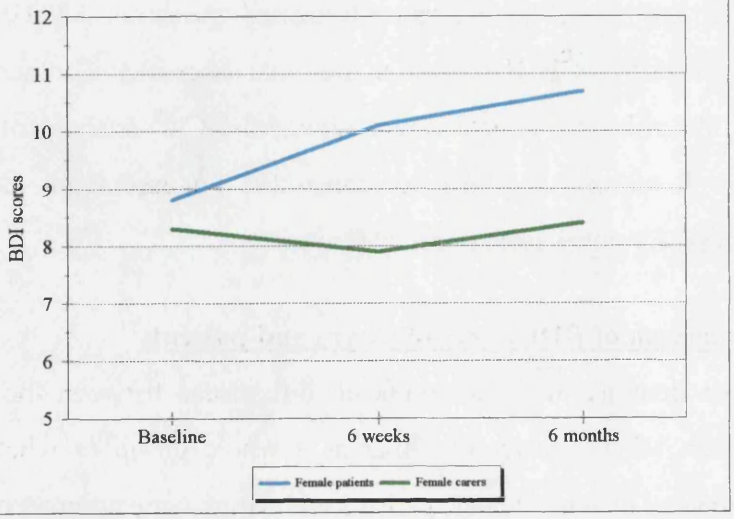


Figure 20.
Mean BDI scores- patients v carers (F)



There were also no significant differences between married patients (ie.the group living with the carers) and the carers. It was however noted that female patients who had a 'normal' baseline BDI score had significantly higher BDI scores at 6 months ($p = 0.005$, $t = 2.5$, md = 4.4, df 35, 95%CI 1.4, 7.3) compared with female carers who had a 'normal' baseline BDI scores.

Correlation analysis between the BDI scores of married patients and their carers demonstrated a significant association at each of the assessments. Further analysis showed that the association between patients and carers was due to the association between male patients and female carers, there was no association between the BDI scores of female patients and male carers. Details of the correlations are given in Table 17.

Table 17. BDI Correlation co-efficients patient and carer groups

	Total patients / carers			Male patients / female carers			Female patients / male carers		
	p	*r*	*n*	*p*	*r*	*n*	*p*	*r*	*n*
Baseline	0.012	0.4	39	0.004	0.56	25	0.43	0.23	14
6 Weeks	0.007	0.5	34	0.001	0.68	23	0.78	-0.09	11
6 Months	0.024	0.37	38	0.001	0.74	24	0.8	-0.07	14

The results demonstrate an association between the BDI scores of male patients and female carers where none exists between female patients and male carers. Linear regression analysis also demonstrated that the baseline BDI score of female carers contributed 38% to the variance in the 6 months BDI score of male patients ($R=0.61$, $R^2 = 0.38$, $F = 13$, df 1/21, $p=0.0019$; Regression equation BDI3 (male patients) = 0.7 x BDI (female carers) + 2.36) but there was no significant association between male carers and female patients, nor between patients and carers as total groups.

As previously stated a number of patients had BDI scores at each of the assessments which were persistently 'normal' or 'above normal' for the 6 months of the study. Table 18 details the percentages of carers and patients who had scores within the categories <=9, >9 and =>13. Chi^2 analysis of the data demonstrated no significant associations between patients and carers in the different scoring categories

Inspection of the data however, demonstrates a considerable similarity between the percentages of patients and carers in the different BDI scoring categories, at each assessment. The results also demonstrate that the affective status of the majority of the carers

was stable over the 6 months of the study and compared well with the patients. For instance 83% of the carers who had baseline BDI scores which were within the 'normal' limits also had BDI scores at 6 months within the 'normal' limits. Of the 15% of carers who had baseline BDI scores above the 'normal' range, 43% were also above the 'normal' range at the 6 months assessment. Two carers changed their BDI scores from a 'normal' baseline score to one of 'caseness' at 6 months, this represented 6% of the group while one carer changed from a 'normal' baseline BDI score to one of 'caseness' at 6 weeks and 6 months, representing 3% of the group.

7.2.4.2 Linear regression analysis of carer data

The variables included in the regression analysis of the carer data were the baseline and 6 weeks BDI scores only, since the variables gender and age of the carers, were independently shown to contribute <2% to the variance in the final BDI score.

Simple regression analyses using the 6 months BDI score as the dependent variable and the baseline BDI score as the predictor variable demonstrated that for the total group of carers, the input from the baseline BDI score contributed 49% to the variance in the 6 months BDI score ($R = 0.7$, $R^2 = 0.49$, $F = 37$, df 1/38. $p < 0.001$; Regression equation BDI3 = 0.81 x BDI + 1.78). For male carers the baseline BDI score contributed 40% to the variance in the final BDI score ($R=0.63$, $R^2=0.4$, $F = 9$, df 1/14, $p <0.008$; Regression equation BDI3 = 0.55BDI + 3.3) while for female carers the baseline BDI score contributed 59% to the variance in the final BDI score ($R = 0.77$, $R^2 = 0.59$, $F =32$, df 1/32, $p<0.001$; Regression equation BDI3 = 1.12BDI - 0.86).

Regression analysis using the baseline and 6 weeks BDI scores as independent variables accounted for 72% of the variance in the 6 months BDI score for the total group of carers ($R = 0.85$, $R^2 =0.72$, $F = 41$, $p = 0.0000$, df 2/31: Regression equation; BDI3 = 0.34 x BDI + 0.75 x BDI2 - 0.55). Male carers demonstrated that the 6 weeks BDI score was the only significant variable in the final equation and accounted for 63% of the variance in the 6 months BDI score ($R = 0.8$, $R^2 = 0.63$, $F = 19$, $p = 0.001$, df 1/11; Regression equation BDI3 = 0.78 x BDI2 + 3.7). For female carers the combined baseline and 6 weeks BDI scores contributed 79% to the variance in the 6 months BDI score ($R=0.89$, $R^2 = 0.79$, $F = 33$. $p <0.001$, df 2/18; Regression equation BDI3 = 0.54 x BDI +0.75 x BDI2-1.9).

As with the patient data, the ability to predict the BDI classification of carers at the 6 months assessment from the baseline BDI score varied. For instance for the total group of carers who had 6 months BDI scores which came within the `normal` BDI classification, the predicted score from the regression equation, accounted for 93% of these carers (100% of males, 75% of females). For carers who had 6 months BDI scores which were outwith the BDI `normal` score ie. >9, the regression equation score accounted for 82% of the total carer group (75% male carers, 75% female carers).

Using the regression equation which included the combination of the baseline and 6 weeks BDI scores predicted 91% of the total group of carers to have 6 months BDI scores within the `normal` BDI scoring range, 98% to have scores at 6 months outwith the `normal` range and 54% to have had 6 months BDI scores suggesting `caseness`. As with the patient data these results demonstrate high levels of predictability of the BDI classification of carers at 6 months from baseline and /or the 6 weeks BDI scores.

7.2.5 Summary of BDI results

In this study the results reflect the affective status of the patients and their carers in the 6 months period after the onset of stroke. The analysis of the data has highlighted a number of anomalies in the levels of affective disorder that appear to be present after stroke. For instance, if assessments had only been done at 6 weeks after stroke, the data would have demonstrated that 65% of patients had BDI scores which were within `normal` limits, 35% had scores outwith the `normal range and 20% would have scores consistent with `caseness`. If the assessments had only been done at 6 months after stroke the data would have demonstrated that 62% of the patients had `normal `BDI scores, 38% had scores outwith the `normal` range and 23% had scores significant of `caseness`.

The outcomes changed however, when baseline scores were included and were coupled with the 6 weeks and 6 months assessment scores. The subsequent results demonstrated that 54% of the total group of patients had scores which were consistently within the `normal ` BDI scoring category in the 6 months period after stroke, 20% had scores which were persistently outwith the `normal` BDI scoring range and 10% had BDI scores =>13 which would be significant of `caseness` for the whole of the 6 months period of the study.

Further analysis demonstrated that, of the patients who had `normal` baseline BDI scores, 82% also had `normal` BDI scores at 6 months, while 59% of the patients who had baseline scores which were above the BDI `normal` range, also had above `normal` BDI scores at

6 months and 44% of the patients who had BDI scores significant of `caseness` at the onset of the stroke would also be considered to be `cases` at the 6 months assessment.

The results demonstrated that 7% of patients who had `normal` BDI scores at the onset of the stroke had above `normal` scores at the 6 weeks and 6 months assessments, while 5% of patients with `normal` baseline scores had scores suggesting `caseness` at the 6 weeks and 6 months assessments. The results also showed however, that 8% of patients who had above `normal` BDI scores at the onset, and who may have been affected by the stroke psychologically, reverted to a `normal` status by 6 weeks and remained so for the duration of the study.

The analysis of the BDI data demonstrated significant correlations and no significant differences, between the BDI scores at each of the three assessments. These outcomes were significant for the patients as a whole group and for male and female patients when considered as separate groups. Although the results showed that a number of patients appeared to have a degree of affective disorder at different time intervals after stroke, it was noted that for a significant percentage of these patients, this affective state may have been present from the onset of the stroke, or may perhaps have pre-dated the stroke.

Gender analysis highlighted significant differences in BDI scores between male and female patients at different time intervals after the onset of the stroke and also demonstrated significant increases in the scores of the group of female patients who had baseline BDI scores which was within `normal` limits.

There were minimal associations between the BDI scores of patients and the miscellaneous factors of age, domestic, social or marital status, disability, speech impairment or the presence of risk factors. However there was a relationship between the location of the cerebral infarct and affective disorder after stroke, in that female patients with right CVA`s had significantly higher BDI scores at the 6 weeks and 6 months assessments compared with female patients with left CVA`s. There was also a significant association between female patients with right CVA`s and `caseness` at 6 months. It was further noted that 5 of the 6 female patients whose BDI scores changed from `normal` at the baseline assessment to `above normal` at 6 weeks and 6 months, had right CVA`s. The results also suggested that there may be a potential association between the laterality of the CVA and persistent affective states.

The outcome of these results suggests that analysing the data of stroke patients as a total group may not give the complete picture of affective status, whereas including the gender of the patients as a factor may give a clearer picture of outcome.

The results of regression analysis also demonstrated that the gender of the patients and the laterality of the infarct contributed 12% to the variance of the 6 months BDI score. However the most significant variables overall were the baseline and 6 weeks BDI scores which contributed almost 70% to the variance in the 6 months BDI scores for the group as a whole, with the 6 weeks assessment score being the more significant of the two variables. It was also noted that perhaps the true value of the baseline and 6 weeks BDI scores as predictor variables was the ability to identify the patients who would remain `normal` for the subsequent 6 months, and consequently the potential to identify the patients who might be at risk of developing affective disorder after stroke.

The results of the BDI scores for the carers who were used as a comparative but not as a control group in this study, demonstrated significant correlations and no significant differences between any of the scores, nor any association with `caseness` at any of the assessments. The percentages of carers with scores within the BDI scoring categories of <=9, >9 and =>13 were similar to those of the patients for individual and cummulative assessments. In contrast to the patients, there were no significant difference in BDI scores between male and female carers for any of the assessments. The results of the linear regression analyis for carers demonstrated that the baseline and 6 weeks BDI scores were significant variables and contributed 72% to the variance in the final BDI score.

Comparing the BDI scores of patients and carers demonstrated no significant differences between patients and carers as a whole group. The only significant difference noted was that female patients who had baseline BDI scores <=9 had significantly higher scores at the 6 months assessment compared with female carers with baseline scores <=9. Although correlation analysis demonstrated significant associations at each of the assessments, between the total group of carers and the patients they cared for, further analysis demonstrated that the association was significant for male patients and female carers, but not for female patients and male carers. The results also demonstrated that the baseline BDI score of female carers contributed 38% to the variance in the 6 months score of the male patients whom they cared for.

7.2.6 Discussion

The main questionnaire which has been used to determine the affective status of the patients and carers in this study is the BDI. The BDI was selected because it has been used in previous studies of stroke patients and it gives a quantitative assessment of the affective status of the patient at the time of completion, and also for a period of approximately three weeks prior to the completion date. It is acknowledged that the use of the BDI as the main tool to evaluate affective disorder has been criticized by House (1989), on the basis that it can give a false positive rate of 25-30%, and that the inclusion of somatic symptoms due to stroke, which may resolve over time, can give a false impression of high scores in the early stages of stroke, which decrease with the resolution of the physical disability. Nevertheless it is also acknowledged by House (1990), that the BDI was chosen as an instrument for assessing affective status in the OCSP because it had been used widely in research into the psychiatric sequelae of physical illness. The results of this study will be discussed with reference to the results of other studies where the BDI and other assessment methods have been used to measure affective disorder.

In the current study the presence of affective disorder was based on BDI cut-off values of >9 to demonstrate levels of mild depression and =>13 to demonstrate `caseness`. Although these values are not definitive of the presence of an affective disorder, they have been used previously in stroke research (House et al.,1991; Kotila et al.,1998; Kellermann et al.,1999). Based on these cut-off values the results of this study demonstrated that 30% of patients had BDI scores suggesting `caseness` at the baseline assessment.

Comparison of this result with other studies is difficult since very few studies have evaluated stroke patients in the acute period after stroke, however, a study by Astrom et al.(1993) assessed patients 4-5 days post stroke and demonstrated that 25% had symptoms of major depression. Kellermann et al.(1999) also evaluated patients between 5 and 9 days post stroke and demonstrated that 19.5% of patients had BDI scores =>10 and that 5% of patients demonstrated severe depressive symptoms (ie. BDI=>15). The JHG considered their acute phase to be 0-21 days and demonstrated similar levels of `caseness` (25%) at that time using the DSM III-R diagnostic criteria, while Wade et al.(1987) demonstrated that 22% of patients were `definitely depressed` at three weeks post-stroke using the Wakefield Self Assessment Scale. The results of this study also demonstrated that 22% of patients had scores suggesting `caseness` at 6 weeks post-stroke and this compares directly with the percentage of `cases` in the OCPS at 1 month post stroke. In the current study 23% of

patients demonstrated `caseness` at the 6 months assessment and this was similar to the 25% demonstrated by the JHG at their 3 and 6 months assessments, although slightly higher than the 20% demonstrated in the BCSS (Wade et al.,1987) and by MacHale et al.(1998), and higher than the 15% demonstrated at 6 months in the OCSP study (Bamford et al.,1988).

Comparing percentages of patients with stable affective states was also variable. The outcomes of the current study demonstrated that 54% of patients were consistently `not depressed` over the 6 months period from the onset of the stroke which is similar to the (52%) demonstrated by Wade et al.(1987). In contrast, 10% of patients in the current study were assessed as persistent `cases` during the 6 months of the study, which is somewhat lower than the results of the results of the BCSP (Wade et al. 1987), which demonstrated that 17% of patients were consistently `depressed `over the 12 months of the study, and somewhat higher than the OCSP in which 3% of patients were demonstrated as `cases` at each of the assessments over 12 months. Although the OCSP figure increased to 8% for assessments done at 1 month and 6 months, this was lower than the 15% of patients in the current study who had scores suggesting `caseness` at both the baseline and 6 months assessments. In their studies, the JHG demonstrated that 25% of patients diagnosed with depression at the onset of the stroke remained unchanged throughout the 6 months follow-up period, however the significance of their results has to be qualified by the fact that the follow-up cohorts may not have included the same patients as those in the original group. In the current study, a small percentage of patients who had `normal` baseline scores became `cases` over the 6 months and this outcome compares directly with results of Wade et al.(1987), who also showed that 5% of patients who were not depressed at the 3 weeks assessment became so at 6 months.

The results have demonstrated that the subjects in the current study are a representative cohort of stroke patients who can be assessed in the acute stage of stroke. The outcomes of the assessments of their affective status, at different time scales over 6 months using the BDI, are comparable with the outcomes of other studies. Differences in the outcomes of studies could be due in part to differences in the compositions of the patients included in the cohorts.

Although there was no selected control group in this study the results of the co-habiting relatives as carers have been included as a reference to the nearest group of people to the patients in age and social status, who have been living with the patient, but who have not suffered the neurological trauma of a stroke. The data of the carers were analysed to determine if there was a level of affective disorder in the carers of stroke patients which

could have had an influence on the affective status of the patients. This is quite relevant in view of the fact that previous studies have shown that high levels of depression are present in the carers of stroke patients (Kotila et al.,1984, Carnworth and Johnstone,1987).

The results of the current study demonstrated similar patterns of affective disorder in patients and carers, at individual assessments and also in the levels of persistent affective disorder which were present. This was demonstrated by the fact that 18% of carers and 21% of patients had BDI scores which were persistently above the `normal` BDI level and that 12% of the carers and 10% of patients demonstrated persistent `caseness` from the onset of the stroke. These results are similar to the results of the study by Kotila et al.(1984), who demonstrated that almost the same percentage of carers as patients were depressed at 3 months and 12 months after stroke. Although a survey by Carnwath and Johnson (1987), demonstrated that 39% of carers of stroke patients were depressed compared with 12% of the carers of patients with diseases other than stroke, the results of the OCSP demonstrated that there were similar mean scores between patients and controls. Thomson et al.(1990) also suggested that the psychological difficulties between the carer and patients may have been present prior to the onset of the stroke. In the current study, the results also highlighted a significant association between the scores of male patients and female carers at each assessment from the onset of the stroke, and also a predictive association between female carers and male patients.

The relevant associations which were noted in this study between miscellaneous factors and depression, are in accord with some other studies but not others. These included, being female generally, being female and living with someone and being female with a right CVA. Comparison with other studies demonstrated that the dual association of being female and living with a partner has previously been demonstrated by Wade et al.(1987), while the OCSP demonstrated an association between depression and being female but no association with domestic status. The association between location of the cerebral lesion and affective disorder was demonstrated by the observation that the presence of a right-sided lesion was associated with `caseness` at 6 weeks and 6 months after the onset of stroke, the association was only significant for female patients. The increase in affective status over the 6 months was also associated with female patients who had right CVA`s.

These results are in contrast to the different associations which have been noted between laterality and levels of depression in a number of studies, but are in keeping with the study by MacHale et al.(1998), who demonstrated a significant association between depression and

the presence of a right-sided lesion at 6 months. These authors also commented that the period of time which has elapsed after stroke is an influential factor in the association between location of lesion and depression. In contrast, Astrom et al.(1993) demonstrated an association with left-sided lesions at 3 and 6 months post-stroke, which was in agreement with studies by the JHG, whereas other studies have found no associations between depression and the laterality (House et al.,1990; Grasso et al.,1994; Sharpe et al.,1994; Kotila et al.,1998).

The specific association between lesion location and depression after stroke has been questioned in a review and meta-analysis of previous studies by Carson et al.(2000). From the outcome of their analysis, these authors concluded that the risk of depression after stroke is unaffected by the location of the brain lesion. The relevance of the outcome of the meta-analysis to the results of the current study is difficult to evaluate, however, since the specific association between the presence of, and increase in, levels of affective disorder with female patients who have right CVA`s, which has been demonstrated in this study, has not previously been reported.

In the current study there was no significant association between disability as measured by the Barthel Index scores and the depression scores, and these results are in agreement with those of Feibel and Springer (1982) and with Robinson and Price (1982). In contrast, the OCSP demonstrated a significant association between impaired physical functioning and depression as did others (Astrom et al.,1992,1993; MacHale et al.,1998; Singh et al.,2000).

Although it has not been possible to state conclusively that the post-stroke affective status of patients in this study reflected their pre-stroke affective status, it is worth considering that the Established Populations for Epidemiologic Studies of the Elderly, prospectively studied more than 10,000 people for 6 years and determined that rates of stroke were almost 3 times higher in persons designated with `high` versus `low` levels of depressive disorder (Simonsick et al.,1995). The more recent study by Ohira et al.(2001) also demonstrated that people who suffer from depressive symptoms are twice as likely to have a stroke, compared with those who do not suffer from depression.

The analogous situation to the onset of depression after stroke is the evidence of the depression which is reported to develop after cardiac surgery. In a review of the literature, Musselman et al.(1998) note that depression is frequently underdiagnosed and untreated in

patients with cardiovascular disease, despite the fact that studies have shown relatively consistent prevalence rates of depression of approximately 19% in CVD patients. They also comment that recent studies have shown an increased level of cardiovascular morbidity and mortality in patients with depressive symptoms, and that this implicates depression as an independent risk factor for CVD, rather than as a secondary emotional response to the illness.

In keeping with this, a study of pre-and post-CABG patients by McKhann et al.(1997) demonstrated that the post-operative psychological status of the patients after CABG surgery was significantly related to their pre-operative psychological state. This finding confirmed the results of Burker et al.(1995) who also demonstrated that the factors associated with depression after CABG surgery were the pre-surgical baseline status of the patients and being female. These authors consider that although depression is commonly reported after most cardiac surgery procedures, most of the reports of studies do not take into account the pre-operative mood of the patients.

In this regard, it is also relevant to consider the significance of the stability of the affective status which was demonstrated in patients and carers in this study. This was highlighted by the fact that 54% of patients were consistently `normal` throughout the 6 months of the study, that 20% of patients had BDI scores which were consistently outwith the `normal` BDI limits and that 10% of patients demonstrated persistent `caseness`. These stable levels of affective status were replicated in the carers of the patients. So, it could be argued that, unless these patients had become `normal` as a result of the stroke, and remained in that state for the 6 months, it is not unreasonable to consider that they may have been `normal` prior to the stroke. In keeping with this hypothesis, albeit to a limited extent, the results of the linear regression analysis demonstrated that for patients and carers, the baseline and/or 6 weeks BDI scores contributed to, and were predictors of, the classification of the BDI score at the 6 months assessment.

The results in this study have shown that the timing of the assessment of the affective status on patients after stroke is an important factor and can lead to quite different levels of `caseness` being reported. For the patients who had persistent levels of `caseness` throughout the 6 months the question must be asked `was this affective state due to the initial impact of the stroke which persisted over 6 months, or were these patients `cases` prior to the stroke and for whom the stroke had minimal psychological impact? To the same extent it could also be asked of the patients who had `normal` scores at each of the

assessments, whether in fact the impact of the stroke had created an improvement on their affective status at the onset of the stroke which persisted throughout the 6 months of the study? For patients who had `normal` baseline and 6 weeks assessments and became `cases` at 6 months was this an opportunistic measure or were these patients now developing delayed depression as a result of the stroke? Finally, is the group of 5 patients who had `normal` baseline scores and who became `cases` at 6 weeks and 6 months the only group to have been affected by stroke?` These results highlight the difficulties in making judgements about the level of affective disorder which can be attributed solely to the effects of stroke.

7.2.7 Conclusions

The analysis of the BDI data demonstrated that similar levels of affective disorder were present in patients and carers at individual assessments and also persistently over the 6 months of the study. The data demonstrated that the onset of affective disorder after stroke affected only a small percentage of patients, particularly female patients with right CVA`s and a smaller percentage of carers. Linear regression analysis demonstrated that the baseline and 6 weeks BDI measurements contributed significantly to the affective status at 6 months, and could also predict the classification of the affective status of the patients and carers at 6 months after stroke. The results also showed that the baseline BDI scores of female carers contributed significantly to the affective status of the male patients being cared for. Post-hoc analysis suggested that there may also be an association between the stability of the affective status of the patients and the laterality of the CVA.

The conclusions from the BDI data in this study are that, although a number of patients demonstrated levels of affective disorder at different times after the onset of stroke, these levels were similar in patients and carers. The results showed however that a small number of patients appeared to develop affective disorder in the 6 months period after stroke and that the onset of this affective disorder was associated with being female and having right CVA`s. The study also identified a group of patients who demonstrated levels of affective disorder which were present from the onset of the stroke, and which persisted throughout the 6 months. It is considered that the persistent level of affective disorder which was demonstrated in this group, may be a reflection of the affective status of the patients prior to the stroke. This is based on the fact that a similar percentage of carers who were not neurologically affected also demonstrated similar persistent levels of affective disorder, and that the majority of patients and carers remained `normal` for the 6 months of the study.

Table 21. **Eysenck scores - Female patients**

Eysenck	Baseline		6 Weeks		6 Months	
Scales	mean	std dev	mean	std dev	mean	std dev
Psychoticism	5.6	3.8	5.3	4.8	4.8	2.5
Extroversion	13.6	4.6	12.4	5.0	11.5	5.1
Neuroticism	13.1	5.6	13.1	6.4	13.0	5.8
Lie	10.9	4.1	11.3	4.6	11.4	4.4
Addiction	11.0	4.8	11.3	5.2	11.0	4.6
Criminality	12.2	5.4	12.4	5.8	11.6	5.2
Impulsiveness	8.9	3.8	7.3	4.2	7.7	4.6
Venturesomene	3.3	3.2	3.1	3.4	2.5	2.6
Empathy	13.8	3.1	14.3	3.2	14.5	2.8

Table 22. **Eysenck scores - Male patients**

Eysenck	Baseline			6 Weeks			6 Months		
Scales	Median	Q1	Q3	Median	Q1	Q3	Median	Q1	Q3
Psychoticism	5.0	3.0	6.6	4.0	3.0	6.0	3.2	2.0	6.0
Extroversion	13.8	8.0	17.0	12.0	7.0	16.0	11.0	8.0	16.0
Neuroticism	11.0	5.0	15.0	9.5	5.0	15.0	8.0	5.0	14.0
Lie	11.0	7.0	14.0	11.0	8.0	16.0	11.5	8.0	16.0
Addiction	9.0	5.0	13.0	7.5	5.0	12.0	7.5	5.0	13.0
Criminality	9.0	5.8	13.5	8.0	5.0	13.0	8.0	4.0	13.6
Impulsiveness	6.8	4.0	10.0	5.0	3.0	8.0	4.0	3.0	7.5
Venturesome	5.0	2.0	8.0	4.0	2.0	7.0	3.5	1.5	6.0
Empathy	12.0	10.0	14.0	12.0	9.5	15.0	12.0	10.0	14.0

Table 23. **Eysenck scores - Female patients**

Eysenck	Baseline			6 Weeks			6 Months		
Scales	Median	Q1	Q3	Median	Q1	Q3	Median	Q1	Q3
Psychoticism	5.8	3.0	7.0	4.0	2.0	7.0	5.0	2.3	6.0
Extroversion	13.5	10.0	17.0	12.0	9.0	17.0	11.0	8.0	16.0
Neuroticism	13.3	9.0	17.5	14.5	7.3	18.0	13.0	10.0	18.0
Lie	10.0	8.0	14.0	11.0	7.0	16.0	11.5	8.0	14.0
Addiction	10.0	7.0	14.0	10.0	7.6	15.0	11.0	7.0	15.0
Criminality	11.5	9.0	15.0	12.5	8.0	17.0	11.0	8.0	15.0
Impulsiveness	8.0	6.0	12.0	7.0	4.0	9.8	6.5	4.0	11.0
Venturesome	2.0	1.0	5.0	2.0	1.0	5.0	2.0	0.0	3.5
Empathy	15.0	12.0	16.0	15.0	13.0	17.0	15.0	12.0	17.0

7.3 Personality

7.3.1 Introduction

In this study personality has been evaluated using the Eysenck Personality Scales (EPS) and the Faschingbauer Abbreviated Minnesota Multiphasic Personality Inventory (FAM).

7.3.2 EPS scores - patients

The number of patients who completed each of the assessments in this study is shown in Table 19. Of the original cohort of patients 84% completed all three of the assessments.

Table 19. Eysenck Personality Scales - completion data

Completed Assessments	Patients	%	Male patients	%	Female Patients	%
Baseline (1)	128	98	82	96	46	100
6 weeks (2)	116	89	72	85	44	96
6 months (3)	114	87	74	87	40	87
Assessments 1+2+3	110	84	70	82	40	87

The control ranges for the EPS are different for males and females, therefore the results of the means and standard deviations are detailed separately in Tables 20 and 21, for male and female patients. The medians and interquartile ranges for male and female patients are detailed in Tables 22 and 23. Line diagrams of the mean values for each of the characteristics for each of the assessments for male and female patients are shown in Figures 21 and 22.

Table 20. EPS scores - Male patients

Eysenck	Baseline assessment		6 Weeks		6 Months	
scale	mean	std dev	mean	std dev	mean	std dev
Psychoticism	5.2	3.1	4.3	2.5	4.3	2.9
Extroversion	12.8	5.1	12.2	5.4	12.0	5.6
Neuroticism	10.4	6.0	9.9	6.0	9.8	6.3
Lie	10.8	4.5	11.5	5.0	11.4	4.9
Addiction	9.3	4.5	8.6	4.6	8.4	5.3
Criminality	9.6	5.3	8.9	5.3	9.1	5.6
Impulsiveness	7.1	3.6	5.9	3.9	5.4	3.7
Venturesomeness	5.3	3.5	4.8	3.5	4.4	3.5
Empathy	12.1	2.7	12.2	3.3	11.8	3.3

Figure 21.
EPS mean scores - Male patients

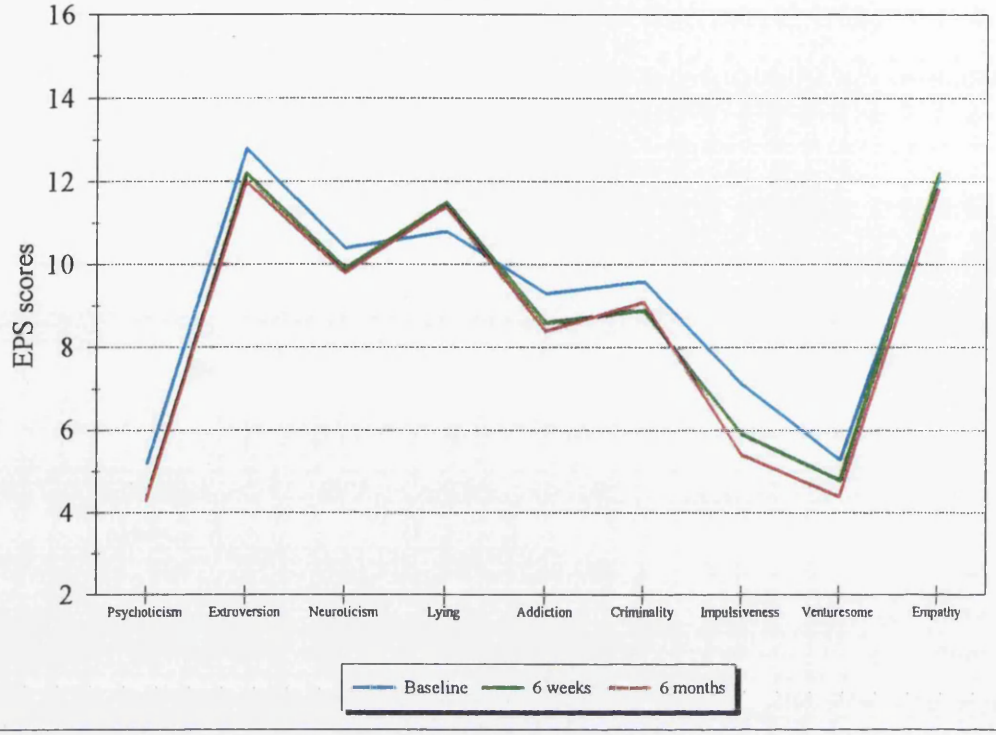
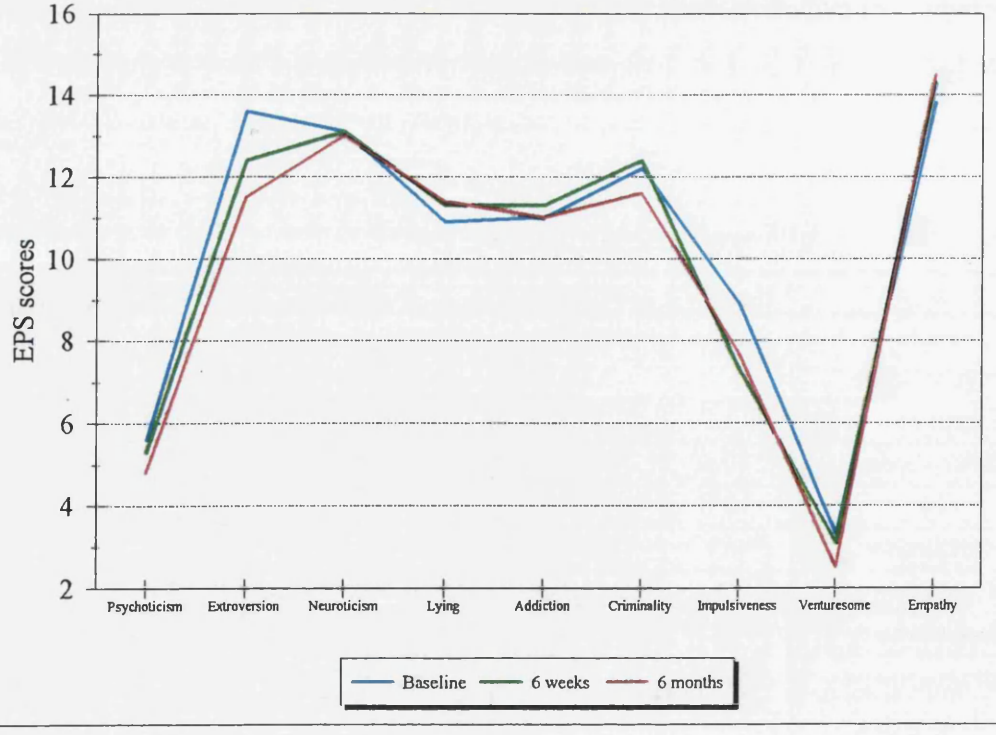


Figure 22.
EPS mean scores - Female patients



(a) Correlation-coefficients of the EPS

The results demonstrated a consistency in scoring for male and female patients across each of the three assessments with significant correlation coefficients ($p<0.001$) being noted between the individual assessments for all of the personality characteristics (Table 24).

Table 24. EPS Correlation co-efficients between assessments

Eysenck scales	Male patients					Female patients			
	No. of patients	Assessment correlations				No of patients	Assessment correlations		
	71	1/2	1/3	2/3		41	1/2	1/3	2/3
Psychoticism	71	0.71	0.54	0.64		41	ns	0.72	ns
Extroversion	71	0.75	0.74	0.88		41	0.83	0.76	0.89
Neuroticism	71	0.87	0.76	0.84		41	0.74	0.65	0.89
Lie	71	0.89	0.93	0.88		41	0.66	0.62	0.82
Addiction	71	0.74	0.70	0.80		41	0.5	0.59	0.78
Criminality	71	0.83	0.74	0.84		41	0.6	0.67	0.76
Impulsiveness	71	0.67	0.70	0.79		41	0.64	0.78	0.67
Venturesomeness	71	0.75	0.71	0.76		41	0.66	0.55	0.68
Empathy	71	0.63	0.64	0.76		41	0.8	0.61	0.70

Assessment correlations

1. denotes baseline assessment **2.** denotes 6 weeks assessment **3.** denotes 6 months assessment

1/2 - Denotes correlation between baseline and 6 weeks assessments

1/3 - Denotes correlation between baseline and 6 months assessments

2/3 - Denotes correlation between 6 weeks and 6 months assessments

ns - Denotes p value <0.01

Analysis of the data also demonstrated significant correlations ($p<0.001$) between the following pairs of characteristics, for male and female patients for each assessment.

Addiction / Criminality		Impulsiveness / Criminality
Addiction / Neuroticism		Impulsiveness / Psychoticism
Criminality / Neuroticism		Impulsiveness / Neuroticism

(b) Significant changes in EPS scores

The data were analysed using repeated measures ANOVA to determine if there were significant differences between the scores of any of the personality characteristics over the

three assessments. The results demonstrated significant changes for male patients in the impulsiveness scale ($p<0.001$, ss 535.9, df 138, ms 3.88, F = 11.8) and in the venturesomeness scale ($p=0.008$, ss 395.4, df 138, ms 2.87, F = 4.96). For female patients there were significant changes in the extroversion ($p=0.005$, ss 320.0, df 78, ms 4.1, F = 6.) and impulsiveness scales ($p=0.01$, ss 414.8, df 78, ms 5.3, F = 4.65). Inspection of the data demonstrated that the mean values for each of the scales, for male and female patients, decreased over the 6 months.

(c) Gender Differences in EPS scores

Significant differences noted between the Eysenck scores of male and female patients are detailed below:-

Baseline assessment

Neuroticism	p = 0.01, t = -2.6, md = -2.8, df 126, 95% CI -4.9, -0.7	(females >males)
Empathy	p = 0.001, t = -3.4, md = -1.8, df 126, 95% CI -2.8, -0.7	(females >males)
Venturesomeness	p = 0.002, t = 3.0, md = 1.9,df 111, 95% CI 0.7, 3.2	(males >females)

6 Weeks assessment

Neuroticism	p = 0.007, t = -2.7, md = -3.2, df 126, 95% CI -5.5, -0.9	(females >males)
Empathy	p = 0.001, t = -3.3, md = -2.0, df 114, 95% CI -3.3, -0.8	(females >males)
Venturesomeness	p = 0.015, t = 2.5, md = 1.6, df 114, 95% CI 0.3, 2.9	(males >females)

6 Months assessment

Neuroticism	p = 0.01, t = -2.6, md = -3.1, df 112, 95% CI -5.5, -0.8	(females >males)
Empathy	p = 0.000, t = -4.4, md = -2.7, df 111, 95% CI -3.9, -1.5	(females >males)
Venturesomeness	p = 0.001, t = 3.3, md = 2.1, df 126, 95% CI 0.8, 3.3	(males >females)

The results of gender differences demonstrate significantly higher scores for female patients for neuroticism and empathy at each of the 3 assessments, and significantly higher scores for male patients for the characteristic of venturesomeness.

7.3.3 Miscellaneous factors and EPS scores

As with the BDI scores, analysis of the Eysenck data was performed to determine if there were factors which created a significant difference in any of the profile scale scores for the patients. These factors included marital, domestic and social status, degree of impairment and disability, risk factors, and laterality and location of the cerebral infarct.

(a) Marital status and EPS scores

As previously stated marital status is being considered in terms of whether or not the patients were single, married, divorced/separated or widowed. In this study 17 patients were single (12 males, 5 females), 77 patients were married (57 males, 20 females), 32 were widowed (13 males,19 females) and 6 patients were divorced (4 males, 2 females).

One-way ANOVA demonstrated that there were no significant differences in the scores of the three marital groups (single, married, widowed) for male or female patients for any of the Eysenck scales at any of the assessments.

(b) Domestic status and EPS scores

The category of domestic status is defined as patients who lived alone or with a partner. The group of patients who lived alone included single, widowed and divorced patients, whereas those living with a partner comprised mainly married patients. In this study 45 patients lived alone (26 males, 19 females), 76 patients lived with a partner (56 males, 20 females) a further 7 patients lived with family and 2 patients were in residential accommodation.

Unpaired t-tests between patients living alone or with a partner demonstrated no significant differences between the groups.

(c) Social status and EPS scores

Social status was categorized according to whether the patient was employed, unemployed or retired. The number of patients included in each of the categories was 44 employed (31 males,13 females), 15 patients were unemployed (11 males, 4 females) and 72 patients were retired (43 males, 29 females).

Within subjects ANOVA demonstrated the following significant differences within the three social groups for male patients due to higher scores for the unemployed category:-

Baseline Psychoticism	$p < 0.001$, ss 166.5, ms 83.2, df 2/79, $F = 10.8$
6 weeks Psychoticism	$p = 0.009$, ss 59.1, ms 29.6, df 2/69, $F = 5.1$
Baseline Lie	$p < 0.001$, ss 350.3, ms 175.2, df 2/79, $F = 11.0$
6 weeks Lie	$p = 0.002$, ss193.3, ms 96.6, df 2/69, $F = 4.2$
6 months Lie	$p = 0.002$, ss 298.6, ms 149.3, df 2/71, $F = 7.0$

For female patients, analysis of data was performed between the employed and retired categories only, since only 4 females came into the unemployed category.

The results demonstrated significant differences in the baseline psychoticism scale (p=0.004, t=-.2.4, md=-3.6, df 40, 95% CI -4.2, -0.3) and the 6 months lying scale (p=0.01, t=-2.6, md =-3.6, df 37, 95% CI -6.4, -0.8) due to higher scale scores for retired female patients.

7.3.4 Risk factors and EPS scores

As previously stated the risk factors being considered in this study are history of stroke, history of cardiac illness, family history of stroke, high blood pressure, diabetes and smoking.

(a) Risk factor 1. - History of stroke

The number of patients with a history of stroke was 17 (9 males, 8 females) this represented 14% of the total group of patients being studied and compared with 104 patients who had not had a previous stroke (69 males, 35 females). For male patients unpaired t-tests demonstrated significant differences between the groups for the characteristic of venturesomeness at 6 weeks and 6 months as follows:-

6 weeks p=0.01, t= 2.7, md3.6, df 69, 95% CI 0.9, 6.2

6 months p=0.01, t= 2.6, md 3.5, df 69, 95% CI 0.8, 6.2

These differences were due to male patients with a history of previous stroke having higher venturesomeness scores compared with male patients without a history of stroke.

(b) Risk factor 2 - History of cardiac illness

The number of patients with a history of cardiac illness was 45 (33 males,12 females). This represented 36% of the data and compared with 76 patients who did not have a documented history of cardiac illness (45 males, 31 females). Unpaired t-test demonstrated no significant differences between patients with or without a history of cardiac illness for any of the Eysenck mean scales for any of the assessments, for male or female patients.

(c) Risk factor 3 - Family history of stroke.

The number of patients with a risk factor of a family history of stroke was 21 (15 males, 6 females) and represented 17% of the patients in the study. The remaining 100 patients with no documented family history of stroke included 63 males and 37 females. Unpaired t-tests demonstrated that there were no significant differences between the risk factor groups for any of the Eysenck scales for male or female patients.

(d) Risk factor 4 - High blood pressure

The number of patients with a history of high blood pressure was 61 (43 males, 18 females) and 60 patients (35 males, 25 females) did not have documented high blood pressure. Unpaired t-tests demonstrated no significant differences in any of the Eysenck scales for male or female patients with or without high blood pressure.

(e) Risk factor 5 - Diabetes.

The number of patients with diabetes was 13 (9 males, 4 females) and this represented 10% of the total patients. The remaining 108 patients comprised 69 males and 39 females. Unpaired t-tests demonstrated significant differences in extroversion between patients with and without diabetes due to lower scores for the patients with diabetes.

Baseline Extroversion	p= 0.004 t= -2.9, md=-4.2, df 116, 95% CI -6.8, -1.3
6 weeks Extroversion	p = 0.004 t= -2.9, md=-4.4, df 111, 95% CI -7.4, -1.4
6 months Extroversion	p = 0.018 t= -2.4, md=-3.9, df 109, 95% CI -7.1, -0.7

(f) Risk factor 6 - smoking

In this study 76 patients (50 males, 26 females) smoked and 45 patients (28 males, 17 females) did not smoke. Unpaired t-tests demonstrated significantly higher extroversion scores for male patients who smoked compared with male patients who did not smoke.

Baseline Extroversion	p= 0.013 t=2.6, md=2.9, df 69, 95% CI 0.6, 5.3
6 Weeks Extroversion	p= 0.001 t=3.5, md=4.3, df 69, 95% CI 1.9, 6.9
6 Months Extroversion	p= 0.001 t=3.4, md=4.3, df 70, 95% CI1.8, 6.9

7.3.5 Disability, Impairment and EPS scores

(a) Laterality of physical impairment

The laterality of physical impairment was described in simple terms of whether the impairment affected the right side or left side of the body. In this study 51 patients had right sided impairment (35 males, 16 females) and 69 patients had left sided impairment (42 males, 27 females). Analysis of the data demonstrated no significant differences or changes across the three assessments, in any of the scales, for male or female patients with right or left sided impairment.

Table 25. **Eysenck Personality scores - Patients**

Eysenck	Assessment	Male patients					Female patients			
Scales		R CVA		L CVA			R CVA		L CVA	
		mean	std dev	mean	std dev		mean	std dev	mean	std dev
Psychoticism	Baseline	4.6	2.5	5.4	3.6	•	5.4	4.4	6.0	3.0
	6 Weeks	4.1	2.6	4.4	2.6	•	4.8	3.9	6.5	6.6
	6 Months	4.1	2.5	4.0	3.3	•	5.0	2.9	4.9	1.8
						•				
Extroversion	Baseline	12.8	4.9	12.3	4.9	•	14.7	3.9	13.0	4.5
	6 Weeks	12.4	5.2	11.0	5.2	•	13.0	4.7	12.7	4.5
	6 Months	12.4	4.8	10.9	4.8	•	12.7	5.3	11.4	4.5
						•				
Neuroticism	Baseline	9.3	6.6	11.8	6.6	•	13.8	5.3	11.3	5.5
	6 Weeks	9.0	5.9	10.8	5.9	•	13.9	5.8	11.3	5.8
	6 Months	9.7	6.1	9.8	6.1	•	13.8	5.9	11.7	4.9
						•				
Lie	Baseline	12.0	4.1	9.6	4.5	•	11.0	4.6	10.8	3.7
	6 Weeks	13.1	4.2	10.3	5.2	•	10.8	4.7	13.1	4.2
	6 Months	12.7	4.1	10.5	5.4	•	11.8	5.1	10.9	3.3
						•				
Addiction	Baseline	8.4	3.8	10.1	5.6	•	10.8	5.1	10.4	4.3
	6 Weeks	7.9	4.2	8.9	4.7	•	11.8	5.0	9.8	5.2
	6 Months	8.0	4.9	8.8	5.5	•	11.3	5.2	9.9	3.9
						•				
Criminality	Baseline	8.5	5.1	10.9	5.8	•	12.5	5.5	11.3	5.1
	6 Weeks	8.4	5.1	9.3	5.3	•	12.9	5.3	11.3	6.2
	6 Months	9.0	5.0	8.6	5.9	•	12.8	5.9	10.0	3.6
						•				
Impulsive	Baseline	6.5	3.5	7.5	3.7	•	8.4	4.3	9.9	2.6
	6 Weeks	5.4	3.7	6.3	4.2	•	7.9	4.8	6.8	3.1
	6 Months	5.3	3.5	5.3	4.3	•	8.1	5.2	7.9	3.9
						•				
Venturesome	Baseline	5.4	3.6	4.8	3.3	•	3.3	3.1	3.3	3.7
	6 Weeks	5.5	3.6	3.4	2.5	•	3.3	3.4	3.3	3.6
	6 Months	4.6	3.7	3.5	2.6	•	2.1	2.5	3.4	3.0
						•				
Empathy	Baseline	12.1	3.0	12.4	2.4	•	14.3	2.9	12.8	3.5
	6 Weeks	12.1	3.6	12.5	2.8	•	15.1	2.3	12.5	4.0
	6 Months	11.9	3.5	12.2	2.9	•	15.3	2.2	12.9	3.0
						•				

(b) Disability and EPS scores

The measure of the effects of the physical impairment of the patients was assessed using the Barthel Index. Analysis of the data demonstrated no significant correlations between the Barthel Index scores and any of the Eysenck scores for patients with right or left-sided impairment, nor were there significant differences in the Barthel Index scores between patients with right or left-sided impairment.

(c) Speech impairment and EPS scores

The analysis of the data on speech impairment was based on whether the patients were diagnosed as being dysphasic, dysarthric or had no speech impairment as a result of the stroke. From the documented results 20 patients were classified as dysphasic (12 males, 8 females), 28 patients were classified as dysarthric (20 males, 8 females) and 78 patients had no speech impairment as a result of the stroke. Repeated measures ANOVA demonstrated no significant differences between the normal, dysarthric or dysphasic speech groups for any of the Eysenck scales at any of the assessments for male or female patients.

7.3.6 Location of infarct and EPS scores

This classification was derived from the combination of neuroimaging data and clinical assessment and delineated the patients into right and left hemispheric strokes (right CVA and left CVA). Within this classification 61 patients had right CVA`s (36 males, 25 females) and 46 patients had left CVA`s (30 males, 16 females),.

Means and standard deviations for male and female patients are detailed in Table 25.

Male patients

Unpaired t-tests demonstrated a significant difference between male patients with right and left CVA`s, in the venturesomeness scale at the 6 weeks assessment (p=0.009t=2.6, md =2.1, df 59, 95% CI 0.5,3.7). The difference was due to higher scores for male patients with right CVA`s. Repeated measures ANOVA demonstrated a significant change in impulsiveness across the three assessments (p=0.007, ss 187.6, df 52, ms 3.6, F = 5.6) for male patients with left CVA`s.

Female patients

Unpaired t-tests demonstrated a significant difference in empathy scores at 6 months between female patients with right and left CVA`s ($p=0.01$, $t=2.7$, md=2.4, df 34, 95% CI 0.6, 4.2) due to higher scores for patients with right CVA`s. Repeated measures ANOVA demonstrated significant changes in extroversion ($p=0.009$, ss 176.1, df 42, ms 4.2, $F= 5.2$) for female patients with right CVA`s, while female patients with left CVA`s demonstrated significant changes in impulsiveness across the three assessments ($p=0.001$, ss = 100, df 26, ms = 4, $F = 9$).

Summary of the laterality effects of stroke on the EPS scores

Differences in Eysenck characteristics between patients with right and left CVA`s were minimal for male and female patients. However male and female patients with left CVA`s demonstrated a significant change in impulsiveness, while female patients with right CVA`s also demonstrated a significant change in extroversion. The changes appeared to be due to decreases in the impulsiveness and extroversion scores across the three assessments.

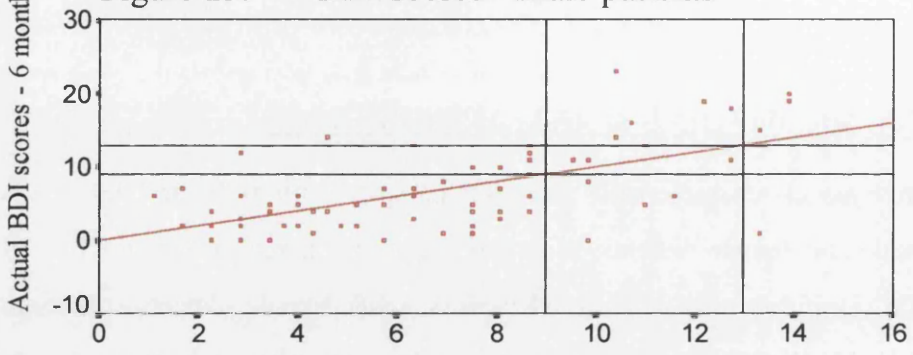
7.3.7 EPI scores related to BDI scores

BDI scores of male and female patients at each assessment significantly correlated with the characteristics of neuroticism, addiction, criminality and impulsiveness (it has previously been demonstrated that these characteristics are significantly inter-correlated). Male BDI scores further correlated with empathy at each assessment and female BDI scores significantly correlated with baseline and 6 months psychoticism scores. All of the correlations were significant at $p<0.001$, r~0.6-0.7. Analysis of the EPS data in relation to BDI scoring categories demonstrated a number of outcomes.

Male patients with a `normal` BDI baseline score, repeated measures ANOVA demonstrated significant changes (decreases) in the impulsiveness scale scores ($p<0.001$, $F = 9.6$, ms = 3.2, df 96, ss = 303.6) and significant changes (increases)in the lie scale scores ($p = 0.001$, $F = 7.3$, ms = 2.6, df 96, ss = 253.8), while female patients there were significant changes (decreases) in the extroversion scale scores ($p = 0.001$, $F = 8.1$, df 46, ms = 3.6, ss = 163.9).

For patients who had BDI scores that were consistently within the `normal` range, there were significant changes (increases) in the lie scale ($p = 0.001$, $F = 7.3$, df 96, ss = 253.8, ms = 2.6) and significant changes (decreases) in the impulsiveness scale ($p<0.001$, $F = 9.7$, ms = 3.3, df 96, ss =285.9) for male patients only.

Figure 23. BDI scores - Male patients

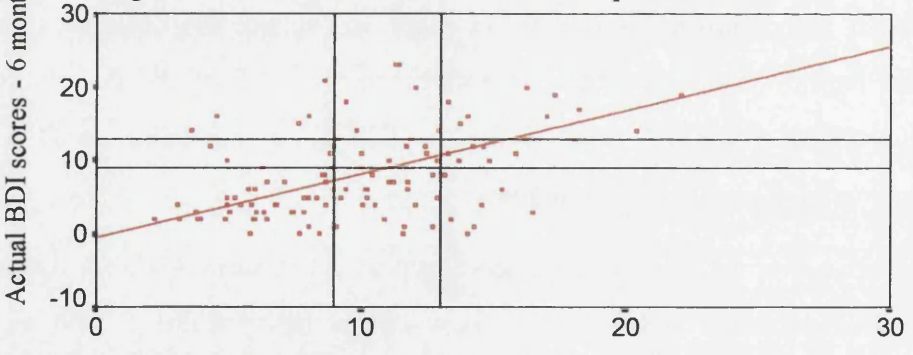


Predicted 6 months BDI scores = 0.58 x EynN + 1.122

Horizontal and vertical lines represent BDI 'cut-off' values of 9 and 13

Diagonal represents linear regression line

Figure 24. - BDI scores - Female patients



Predicted 6 months BDI scores = 0.467 x EynN + 1.032 x EynP - 0.167

Horizontal and vertical lines represent BDI 'cut-off' scores of 9 and 13

Diagonal represents linear regression line

For the total group of patients who had `normal` baseline BDI scores and who had subsequent BDI scores outwith the `normal limits` there were significant changes in the following scales:-

Extroversion	($p<0.001$, $F = 11.5$, ms= 2.6, ss = 37.0, df 14)
Psychoticism	($p=0.01$, $F = 6.3$, ms = 0.8, ss = 11.4, df 14)
Neuroticism	($p<0.001$, $F = 19.2$, ms = 3.8, ss = 53.4, df14)
Criminality	($p<0.001$, $F = 19.9$, ms = 4.3, ss = 60.0, df 14)
Addiction	($p<0.001$, $F = 33.9$, ms = 2.8, ss = 39.6, df 14).

Comparing patients who had consistently `normal` BDI scores with patients who had BDI scores which were consistently above the `normal` BDI range, the results demonstrated significantly higher Eysenck scale scores for each of the assessments for the characteristics of neuroticism, impulsiveness, addiction, criminality and empathy, for the patients who had BDI scores which were consistently above the `normal` BDI scoring range.

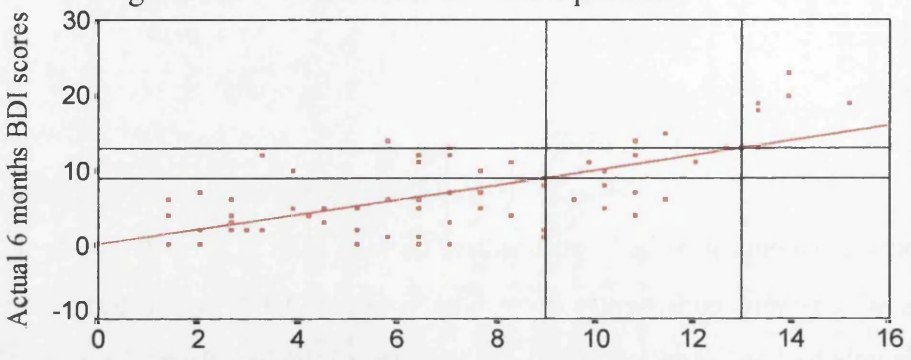
Comparing patients who had consistently `normal` BDI scores with patients who changed their baseline BDI scores from `normal` to score >9 at the 6 weeks and 6 months demonstrated a significantly higher neuroticism score at the baseline assessment ($p= 0.01$, $t=2.47$, md =4.2, df 66, 95%CI 0.8-7.5) as well as the significant differences in the characteristics of neuroticism, impulsiveness, addiction, criminality and empathy at 6 weeks and 6 months as previously demonstrated.

7.3.8 Linear regression analysis

The results of the multiple stepwise regression analysis using only the baseline psychoticism, extroversion, neuroticism and lying (P E N L) scores as predictor variables demonstrated that for male patients the baseline neuroticism score contributed 37% to the variance in the 6 months BDI score ($R = 0.61$, $R^2 = 0.37$, $F = 41$, $p < 0.001$, df= 1/70: Regression equation BDI3 = 0.58 x EynN + 1.12) (Figure 23). For female patients the combination of baseline psychoticism and neuroticism contributed 39% to the variance in the 6 months BDI score ($R = 0.63$, $R^2 = 0.39$, $F = 12$, $p<0.001$, df= 2/38: Regression equation BDI3 = 0.41 x EynN + 1.03 x EynP - 0.167) (Figure 24).

Multiple stepwise regression analysis using the 6 weeks P E N L scores as predictor variables demonstrated that neuroticism contributed 47% to the variance in the 6 months BDI score

Figure 25. BDI scores - Male patients

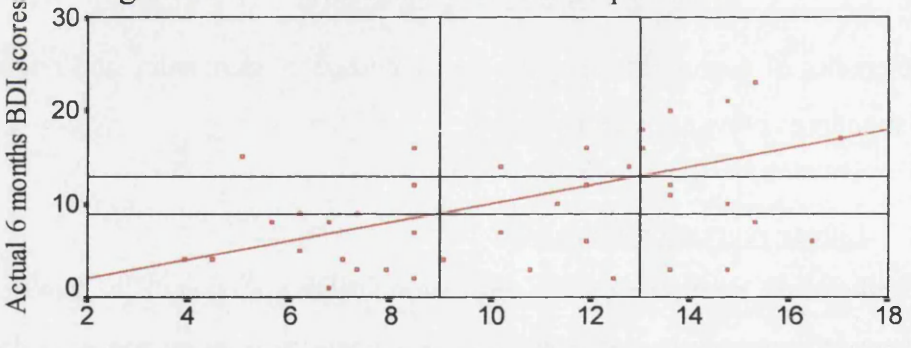


Predicted 6 months BDI scores = 0.626 x Eyn N2 + 0.81

Horizontal and vertical lines represent BDI `cut-off` values

Diagonal represents linear regression line

Figure 26. BDI scores - Female patients



Predicted 6 months BDI scores = 0.57 x Eyn N2 + 3.38

Horizontal and vertical lines represent BDI `cut-off` values of 9 and 13

Diagonal represents linear regression line

for male patients ($R = 0.69$, $R^2 = 0.47$, $F = 61$, $p<0.001$, df= 1/69: Regression equation BDI3 = 0.63 x EynN2 + 0.8) (Figure 25), and contributed 19% to the variance in the 6 months BDI score for female patients ($R = 0.44$, $R^2 = 0.19$, $F = 9.2$, $p = 0.004$, df= 1/39: Regression equation BDI3 = 0.57 x EynN2 + 3.37) (Figure 26).

The inclusion of the laterality of the CVA with the baseline P E N L characteristics had no effect on the prediction equation for male patients, however for female patients the combination of baseline psychoticism and laterality of the CVA contributed 53% to the variance in the final BDI score ($R = 0.73$, $R^2 = 0.53$, $F = 19$, $p<0.001$, df = 2/34: Regression equation BDI3 = 1.33 x EynP - 7.24 x Location of infarct + 6.69).

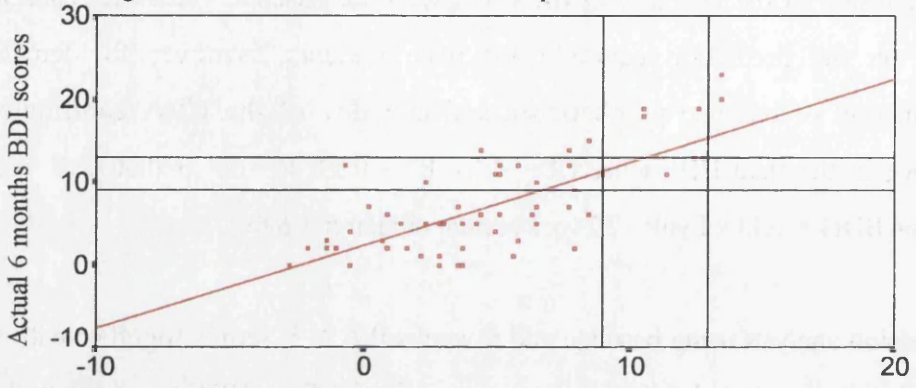
Regression analysis using baseline and 6 weeks P E N L scores together with the laterality of the infarct, contributed 54% to the variance in the final BDI score for male patients ($R = 0.73$, $R^2 = 0.54$, $F = 32$, df=2/56, $p=0.001$; Regression equation BDI3 = 0.7 x EynN2 - 2.28 x location of infarct - 1.18) (Figure 27), while the combination of baseline psychoticism and 6 weeks neuroticism, together with the location of the infarct, contributed 60% to the variance in the final BDI score for female patients ($R=0.77$, $R^2= 0.6$, $F=16$, df=3/33, $p<0.001$; Regression equation BDI3 = 0.39 x EynN2 -1.18 x EynP -6.2 x location of infarct + 2.17) (Figure 28).

When the baseline BDI score was included with the baseline P E N L scores as predictor variables, the baseline BDI score remained the significant variable for male patients, while for female patients the combination of baseline BDI and psychoticism scores contributed 50% to the variance in the final BDI score ($R=0.7$, $R2=0.5$, $p<0.001$, $F=19$, df=2/38; Regression equation BDI3 = 0.63 x EynP + 0.57 x BDI + 2.23).

The results of the linear regression analysis also demonstrated that baseline Eysenck scores, could predict the outcome of 85% of males and 59% of females who had BDI scores at 6 months that were in the 'normal' BDI category. For patients who had 6 months BDI scores outwith the 'normal' BDI score ie. >9, the baseline Eysenck scores accurately predicted the classification of 52% male patients and 68% female patients. However, for patients who had 6 months BDI scores suggesting 'caseness' the percentages of accurately predicted scores from the Eysenck baseline scores were considerably smaller and accounted for 25% males and 46% females.

The results of regression analysis using the 6 weeks Eysenck scores as predictor variables, accurately predicted the outcome of 85% of male patients and 55% of female patients who

Figure 27. BDI scores - Male patients

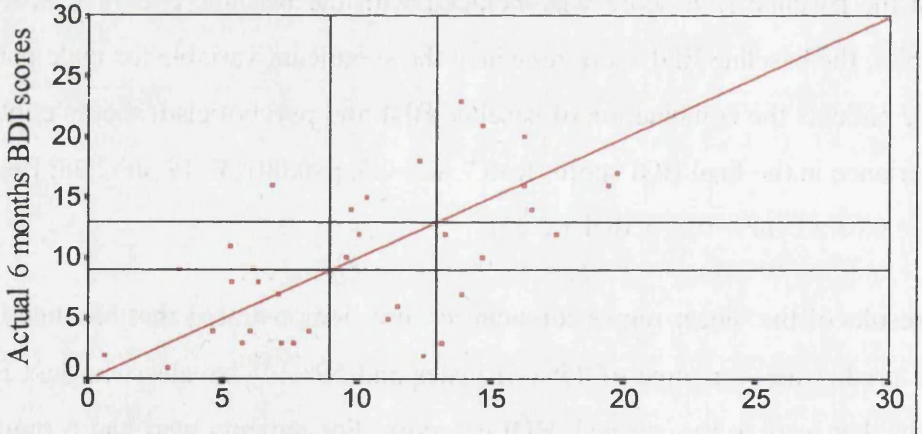


Predicted 6 months BDI scores = 0.7 x Eyn N2 - 2.28 x laterality -1.18

Horizontal and vertical lines represent BDI 'cut-off' values

Diagonal represents regression line

Figure 28. BDI scores - Female patients



Predicted BDI3 = 0.39 x Eyn N2 + 1.18 x Eyn P2 - 6.2 x laterality + 2.17

had 6 months BDI scores which came within the `normal` BDI classification. For patients who had 6 months BDI scores outwith the BDI `normal` score, the outcomes were less accurate and predicted the 6 months BDI scores for 48% male patients and 79% female patients. For patients who had 6 months BDI scores suggesting `caseness`, the results of the 6 weeks EPS scores accurately predicted the outcome for 50% of male patients and 62% of female patients in this category.

These results demonstrate that the baseline and/or the 6 weeks Eysenck scores alone are relevant factors in the affective status of patients at 6 months post-stroke. The results have shown however, that their predictive value appears to be more useful in identifying patients who remain `normal` during the 6 months period after stroke. It is also noted that for female patients the inclusion of the Eysenck scores with the baseline BDI score improved the predictive value obtained by the BDI score when used alone.

7.3.9 Summary of BDI and EPS scores

These results have demonstrated significant correlations between certain personality characteristics and the affective status of patients after stroke. The results also demonstrated a number of changes in certain personality characteristics in relation to BDI scoring categories.

An interesting outcome from these data is the fact that the groups of patients who had consistently `normal` or consistently `abnormal` BDI scores over the 6 months, did not demonstrate any significant changes in any of the Eysenck personality characteristics. This suggests that the `abnormal` affective status could reflect a stable affective state, rather than a response to the onset of the stroke. This proposal is supported by the fact that the small group of patients who significantly increased their BDI scores over the 6 months, demonstrated significant changes in neuroticism and extroversion.

The data also demonstrated significant differences in neuroticism scores at the baseline assessment between the group of patients who had stable `normal` BDI scores over the three assessments, and the group of patients who had `normal` BDI scores at the baseline assessment but who significantly increased their scores over the 3 assessments. This suggests that although the affective states of the two groups of patients were within `normal` BDI limits at the onset of the stroke, that the neuroticism level of the group who changed was significantly higher at this time.

Table 28. Eysenck scores - Female carers

Eysenck Scales	Baseline		6 Weeks		6 Months	
	mean	std dev	mean	std dev	mean	std dev
Psychoticism	4.1	2.4	3.2	2.0	3.3	1.8
Extroversion	13.4	5.7	12.0	5.5	13.0	6.3
Neuroticism	13.1	6.0	13.3	5.6	13.3	6.5
Lie	11.5	4.2	11.0	4.8	10.1	5.2
Addiction	10.1	4.5	10.2	4.9	11.0	4.8
Criminality	11.3	5.1	11.3	5.1	11.6	5.6
Impulsiveness	8.2	4.3	8.4	4.3	8.3	4.6
Venturesomeness	3.0	3.8	2.7	2.7	3.2	3.5
Empathy	14.6	2.9	15.8	2.2	14.4	2.9

Table 29. Eysenck scores - Male carers

Eysenck scales	Baseline			6 Weeks			6 Months		
	Median	Q1	Q3	Median	Q1	Q3	Median	Q1	Q3
Psychoticism	5.0	1.3	6.5	6.0	1.0	7.5	5.0	1.0	7.5
Extroversion	13.0	8.0	17.0	13.0	8.0	17.0	10.0	6.0	16.0
Neuroticism	11.0	5.0	18.0	9.0	3.0	20.5	10.0	3.0	19.0
Lie	9.0	7.5	14.0	11.0	7.0	14.5	9.0	5.0	13.0
Addiction	7.0	5.5	15.0	7.0	4.0	16.5	10.0	6.0	18.0
Criminality	10.0	4.5	16.5	8.0	2.0	18.5	8.0	3.5	17.0
Impulsiveness	5.0	3.0	9.5	4.0	2.0	12.5	5.0	2.0	12.0
Venturesomeness	3.5	3.0	6.5	3.0	2.0	8.5	4.0	2.0	7.0
Empathy	14.0	12.5	16.5	14.0	13.0	16.5	14.0	12.0	16.0

Table 30. Eysenck scores - Female carers

Eysenck scales	Baseline			6 Weeks			6 Months		
	Median	Q1	Q3	Median	Q1	Q3	Median	Q1	Q3
Psychoticism	4.0	2.0	6.0	3.0	2.0	5.0	3.0	2.0	4.5
Extroversion	14.0	10.0	18.0	13.0	7.0	16.0	14.0	6.5	19.0
Neuroticism	12.0	9.0	19.0	12.0	8.0	18.0	15.5	8.3	19.0
Lie	11.5	8.0	15.0	10.0	7.0	14.0	10.0	5.0	14.5
Addiction	11.0	6.5	13.0	11.0	6.0	14.5	12.0	7.0	15.0
Criminality	10.0	8.0	16.0	11.0	6.0	15.0	12.5	6.5	16.0
Impulsiveness	7.5	4.3	12.0	8.0	4.0	13.0	8.0	4.5	13.5
Venturesomeness	2.0	1.0	3.0	1.0	1.0	5.0	2.0	1.0	5.0
Empathy	15.0	17.0	17.0	16.0	14.0	18.0	15.0	14.0	16.0

The results of the linear regression analysis demonstrated that certain baseline and 6 weeks Eysenck scores were significant predictors in the variance of the BDI scores at 6 months. Although it is not surprising that baseline neuroticism was a significant predictor for male and female patients, it is interesting that baseline psychoticism was a stronger predictor for female patients. It was also noted that the laterality of the infarct was relevant as a predictor variable for female patients only, although it appeared to strengthen the regression equation for male patients. These results suggest that the status of certain personality characteristics of patients at the onset of stroke may have an influence on affective status at 6 months after stroke.

7.3.10 EPS scores for Carers

The numbers and percentages of carers who completed the Eysenck data are detailed in Table 26. Of the total cohort of carers 76% completed all 3 of the assessments.

Table 26. Summary of carers completing the Eysenck Personality Scales

Completed Assessments	Carers	%	Male Carers	%	Female Carers	%
Baseline (1)	45	100	17	100	28	100
6 weeks (2)	36	80	13	76	23	82
6 months (3)	40	89	15	88	25	89
Assessments 1+2+3	34	76	13	76	21	75

The means and standard deviations for male and female carers are detailed in Tables 27 and 28 and the medians and interquartile ranges for male and female carers are detailed in Tables 29 and 30. Line diagrams of the mean EPS scores are shown in Figures 29 and 30.

Table 27. EPS scores - Male carers

Eysenck	Baseline		6 Weeks		6 Months	
scale	mean	std dev	mean	std dev	mean	std dev
Psychoticism	4.5	2.9	4.9	3.6	4.3	2.8
Extroversion	12.5	5.7	12.7	5.2	10.7	5.9
Neuroticism	11.4	6.9	10.2	8.0	11.2	7.4
Lie	10.2	4.1	10.2	4.4	8.8	4.5
Addiction	9.8	5.9	9.3	6.7	11.2	6.3
Criminality	10.3	6.3	9.7	7.8	10.1	7.2
Impulsiveness	6.6	5.2	6.5	5.6	6.9	6.1
Venturesomeness	4.5	2.9	4.9	3.8	4.3	2.8
Empathy	14.1	2.7	14.4	2.8	14.3	2.4

Figure 29.
EPS mean scores - Male carers

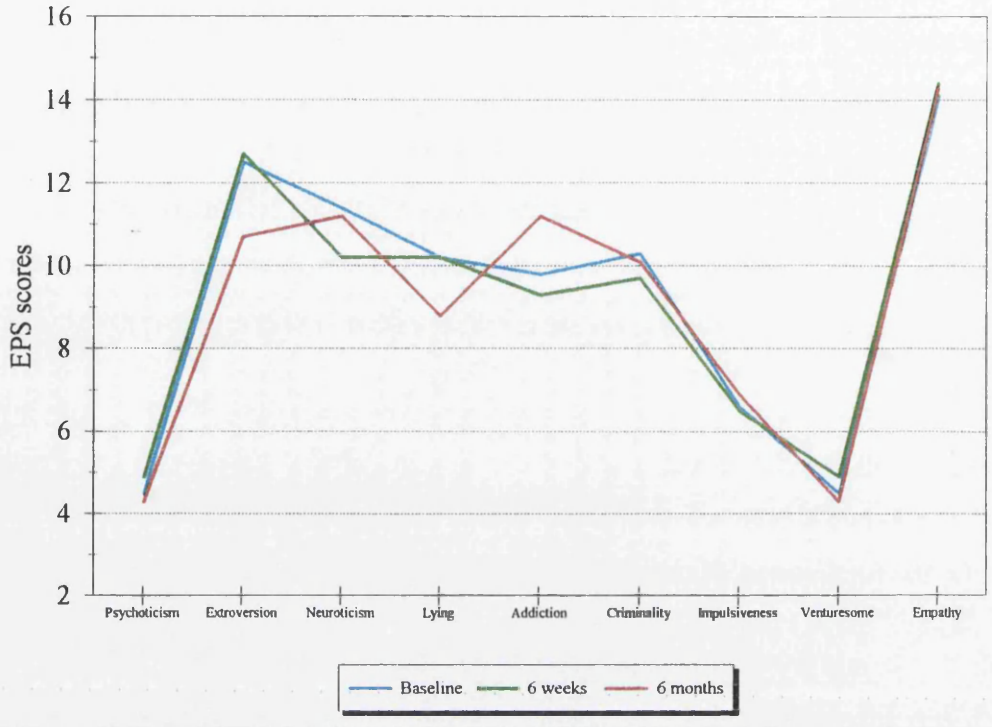
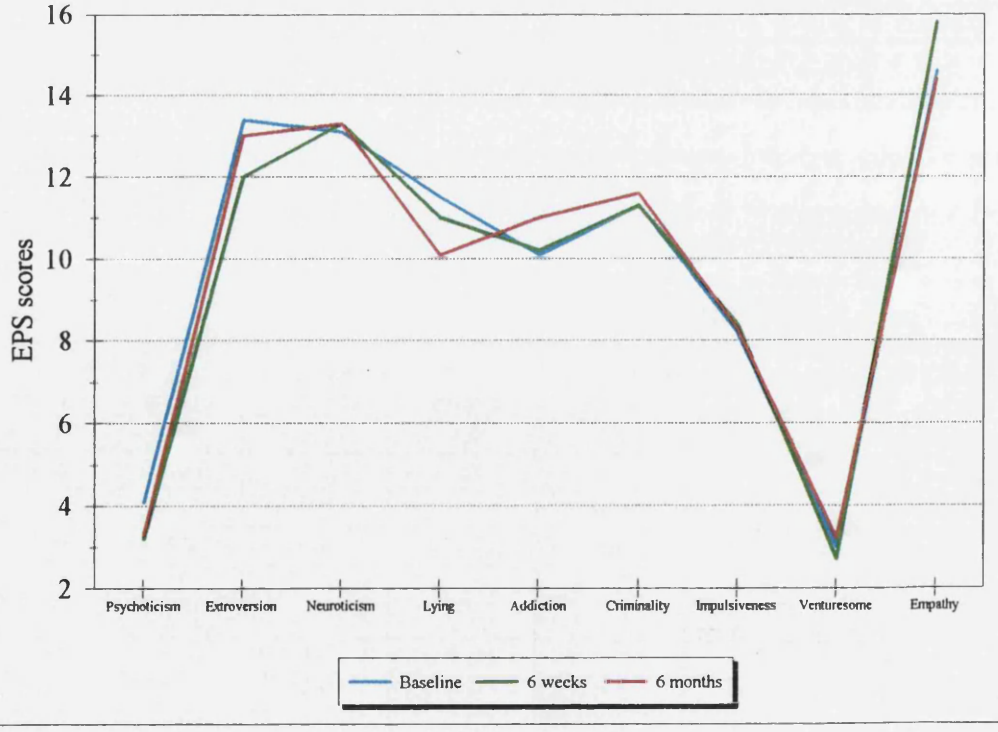


Figure 30.
EPS mean scores - Female carers



(a) Correlation-coefficients of the EPS scores

The results show that there is a consistency in scoring for male and female carers across the three assessments, with significant correlations ($p<0.001$) being noted between the individual assessments for all of the personality characteristics. The *r* values of all of the correlations are detailed in Table 31(* denotes correlations <0.01).

Table 31. Correlation coefficients of EPS scores between assessments

Eysenck	Male carers				Female carers			
scales	No.	Assessment correlations			No.	Assessment correlations		
	13	1/2	1/3	2/3	22	1/2	1/3	2/3
Psychoticism	13	0.91	0.80	0.90	22	0.6	0.61	0.61
Extroversion	13	0.97	0.88	0.89	22	0.85	0.86	0.80
Neuroticism	13	0.98	0.92	0.94	22	0.66	0.77	0.93
Lie	13	0.83	0.70	0.74	22	0.87	0.89	0.89
Addiction	13	0.95	0.81	0.89	22	0.76	0.76	0.89
Criminality	13	0.98	0.90	0.94	22	0.80	0.81	0.94
Impulsiveness	13	0.92	0.94	0.96	22	0.85	0.78	0.72
Venturesomeness	13	0.95	0.65	0.78	22	0.63	0.59	0.69
Empathy	13	0.34*	0.62*	0.51*	22	0.65	0.66	0.80

1. denotes baseline assessment **2.** denotes 6 weeks assessment **3.** denotes 6 months assessment

1/2 - Denotes correlation between baseline and 6 weeks assessments

1/3 - Denotes correlation between baseline and 6 months assessments

2/3 - Denotes correlation between 6 weeks and 6 months assessments

In keeping with the patient data, correlation analysis demonstrated significant correlations ($P<0.001$) between the following pairs of characteristics, for male and female carers for each assessment.

Addiction / Criminality	•	Impulsiveness / Criminality
Addiction / Neuroticism	•	Impulsiveness / Psychoticism
Criminality / Neuroticism	•	Impulsiveness / Neuroticism

(b) Gender Differences in carers EPS scores

In contrast to the patient data, unpaired t-tests demonstrated no significant differences between male and female carers for any of the EPS scores for any of the assessments.

(c) Significant changes in EPS scores of carers

The results of one-way ANOVA demonstrated no significant differences in the scores of male or female carers over the three assessments.

(d) Differences in EPS scores between patients and carers

Unpaired t-tests demonstrated significant differences between the baseline and 6 months scores of male patients and carers for the characteristic of empathy due to higher scores for male carers and significantly higher psychoticism scores for female patients compared with female carers.

Baseline Empathy	$p = 0.007$, $t=-2.8$, md = -2.0, df 97, 95% CI -3.4, -0.6
6 Months Empathy	$p = 0.008$, $t=-2.7$, md = -2.4, df 86, 95% CI -4.2, -0.6
6 Months Psychoticism	$p = 0.009$, $t = 2.7$, md = 1.5, df 63, 95% CI 0.4,2.7)

7.3.11 Relationship between EPS and BDI scores of carers

Significant correlations between BDI scores and Eysenck scale scores were noted for male and female carers for each of the assessments for the characteristics of neuroticism and addiction. All correlations were significant ($p<0.001$, $r \sim 0.6$-0.7).

For the group of carers who had BDI baseline scores which were within `normal` limits and had subsequent BDI scores above `normal limits, there were no significant changes in any of the Eysenck characteristics over the 6 months of the study for male or female carers. For the group of carers who had persistently `normal` BDI scores or who had persistently above `normal` scores there were no significant changes in any of the Eysenck scale scores.

Male carers who had persistently elevated BDI scores demonstrated significantly higher neuroticism, impulsiveness, addiction and criminality scores compared with male carers who had persistently `normal` BDI scores. Female carers who had persistently elevated BDI scores demonstrated significantly higher neuroticism, addiction and criminality scores scores compared with female carers who had persistently `normal` BDI scores.

7.3.12 Linear regression analysis for carers

The results of multiple stepwise linear regression analysis using baseline P E N L scores as predictor variables, demonstrated that the baseline psychoticism score contributed 41% to the variance in the 6 months BDI score for male carers ($R = 0.64$, $R^2 = 0.41$, $F = 10$, $p < 0.007$, df 1/14: Regression equation BDI3 = 1.045 x EyP - 0.05), while for female carers baseline

neuroticism contributed 20% to the variance in the 6 months BDI score ($R = 0.45$, $R^2 = 0.2$, $F = 6$, $p<0.003$, df 1/22: Regression equation BDI3 = 0.57 x EynN +0.96).

Regression analysis using the 6 weeks P E N L scores as predictor variables demonstrated that neuroticism contributed 60% to the variance in the 6 months BDI score for male carers ($R = 0.85$, $R^2 = 0.6$, $F = 17$, $p<0.002$, df 1/11; Regression equation BDI3 = 0.62 x EynN2 -0.1), and 6 weeks neuroticism scores contributed 40% to the variance in the 6 months BDI score for female carers ($R = 0.63$, $R^2 = 0.4$, $F = 13$, $p = 0.002$, df 1/20: Regression equation BDI3 = 0.94 x EynN2 - 3.8).

Regression analysis using the combination of baseline and 6 weeks P E N L scores as predictor variables demonstrated that the 6 weeks neuroticism score contributed 61% to the variance in the 6 months BDI score for male carers ($R = 0.77$, $R^2 = 0.61$, $F = 17$, $p<0.002$, df 1/11; Regression equation BDI3 = 0.62 x EynN2 -0.1) and neuroticism contributed 46% to the variance of the 6 months BDI score for female carers ($R = 0.68$, $R^2 = 0.46$, $F = 13$, $p = 0.001$, df 1/19: Regression equation BDI3 = 0.99 x EynN2 -4.1).

However the combination of baseline BDI and baseline psychoticism scores presented the most significant result for male carers and contributed 70% to the variance in the 6 months BDI score (R=0.84, R2=0.7, F=15.6, df 2/13, p=0.0007; Regression equation BDI3 =1.26 x EynP + 0.47 x BDI - 1.87). For female carers the inclusion of the BDI score eliminated the contribution of the Eysenck scales from the final regression equation.

7.3.13 Summary of EPS scores - Patients and Carers

(a) Male patients and carers

There were significant correlations between each of the assessments for all of the EPS scales for male patients and male carers. The only significant difference between the scores of male patients and carers related to higher empathy scores at the baseline and 6 months assessments for male carers.

The results of male patients and carers demonstrated highly significant correlations between the BDI scores and the characteristics of neuroticism, criminality and addiction at each of the assessments. However for male patients with persistently `normal' BDI scores there were significant changes in the lying and impulsiveness scale scores over the 3 assessments, where no significant changes were noted for male carers. Comparing male and female patients demonstrated significantly lower neuroticism, addiction, criminality, and impulsiveness and

higher venturesomeness scores for male patients compared with female patients for each of the three assessments. There were no significant differences between male and female carers.

The results of multiple stepwise regression analyses demonstrated that for male patients and carers, neuroticism was a significant contributor to the variance in the final BDI score. It was interesting however that for male carers the combination of baseline BDI and Eysenck psychoticism scale score, was a more significant influence on the variance in the BDI score at 6 months post-stroke.

(b) Female patients and carers

Analysis of the data for female patients and carers demonstrated that there were significant correlations between each of the assessments for each of the scales, for female patients and carers, with the exception of the correlation between the baseline and 6 weeks psychoticism scales for female patients. The only significant difference between female patients and carers related to a significantly higher psychoticism score for female patients at 6 months. Female patients as a whole group demonstrated significant decreases in extroversion and impulsiveness over the six months whereas female carers demonstrated no significant changes in any characteristics over the 6 months. When the Eysenck scale scores were related to the BDI scores, the only significant change noted was a decrease in extroversion for the group of female patients with `normal` baseline BDI scores.

In keeping with the male patient/carer comparison, female patients demonstrated significantly higher neuroticism, addiction, criminality, impulsiveness scores and significantly lower venturesomeness scores compared with male patients for each of the three assessments, where there were no significant differences between male and female carers.

The results of the multiple stepwise regression analyses for female patients, demonstrated that the combination of the characteristics of psychoticism and neuroticism contributed significantly to the variance in the final BDI score. However, when the baseline BDI score was included in the analysis, only the baseline psychoticism and BDI scores remained as significant variables. For female carers the baseline and 6 weeks neuroticism scores contributed significantly to the variance in the BDI score at 6 months, although the influence of these characteristics was diminished by the inclusion of the baseline BDI scores.

These results suggest that the main changes in personality which occur in female patients in the 6 months period after stroke, relate to significant decreases in the characteristics of extroversion and impulsiveness. It is interesting that the change in extroversion appears to be associated with female patients who have right CVA`s and who have a `normal` BDI score at the baseline assessment, since this is the same group of female patients who demonstrated significant increases in BDI scores over the 6 months of the study. The demonstration that baseline psychoticism was a significant predictor variable in the BDI scores at 6 months for female patients and male carers is interesting. Although psychoticism has not previously been shown to be significantly associated with depression, and has not been shown to related to cerebral blood flow, it has been associated with lower levels of serotonin in the brain which have been associated with depression (Pritchard, 1991).

7.3.14 Discussion

There has been very little research into the relationship between the concepts of personality and the affective status of patients after stroke using the EPS. Previous research into the relationship between personality and non-stroke depression, which has been based mainly on patients recovering from depression, or patients undergoing treatment, has demonstrated that neuroticism and depression are highly correlated in both medical and general populations (Costa and Mc Crae,1980; Martin 1985). However there appears to be a consensus among researchers that the level of neuroticism is related to exogenous rather than to endogenous depression (Chodoff, 1972; Charney et al.,1981).

The association between neuroticism and affective status is also explained by Eysenck who described the neurotic individual as `overly emotional, reacting strongly to all sorts of stimuli, and finds it difficult to get back on an even keel after each emotionally arousing experience.` Matussek et al.(1983) also considered that non-endogenous patients have different personality attributes and different repertoires of coping behaviour patterns which result in a negative attitude towards life. As a result of this they experience situations more traumatically because of their neurotic tendencies and as a consequence become depressed.

Andrews et al.(1990) demonstrated that neuroticism was a predictor of poor outcome in depression and also demonstrated that neuroticism is strongly genetically determined, especially among females, although the authors admit that the exact mode of the inheritance is not yet known. Kendler et al.(1993), also noted that neuroticism was related to the

prevalence of major depression in women while Weisman (1978) demonstrated that patients who were the most depressed initially did not have the worst outcomes, instead it was patients with the most neurotic personalities who recovered least. Paykel et al.(1976) and Hirshfield et al.(1989) considered that there was increasing evidence of the importance of personality in neurosis and concluded that an underlying personality vulnerability to neurosis could reduce the response to treatment.

Chodoff (1972) noted that increased premorbid neuroticism existed in reactive depressions rather than in endogenous depressions and he considered that certain personality patterns influence clinical depressions, by altering symptoms and possibly predisposing certain individuals to episodes of depressive illness. Since high levels of neuroticism have been shown in prospective studies to predict depression following major stressful life events (Hirshfield et al.1989; Boyce et al.1991), it is not unreasonable to consider that people who have neurotic personalities may be limited in their capacity to respond appropriately to the trauma of a stroke, and as a result may become despondent and consequently depressed.

The only study relating Eysenck personality characteristics and the prevalence of depression after stroke was a retrospective study of stroke patients by Morris and Robinson (1995) using the shortened form of the EPI and the MADRS to assess the personality and depressive status of the patients. In their study the authors demonstrated that `neuroticism was correlated positively with depressive symptomatology... suggesting that neuroticism is a risk factor for the severity of depression rather than for a particular diagnosis ... and that neuroticism may be an independent risk factor for depression after stroke`. These findings have been confirmed by the results of the current study, which have shown that the neuroticism scores significantly correlated with the BDI scores for each of the assessments, for male and female patients. The results of linear regression analysis also demonstrated that certain personality characteristics, particularly neuroticism, contributed significantly to the affective status of patients and carers at 6 months. The results also demonstrated significantly higher neuroticism scores at the baseline assessment for the group of patients who had `normal` baseline BDI scores and who significantly increased their scores over the 6 months of the study. It was also noted that female patients had significantly higher levels of neuroticism compared with male patients, this was not replicated in the carers.

The other personality characteristic which has been noted in previous studies of depression is extroversion. Although Morris and Robinson (1995) noted in their study that the patients

with a diagnosis of major depression had lower extroversion scores compared with patients with minor depression, they stated that extroversion was not associated with depression. However other researchers have not found this to be the case. For instance Kendell and DiScipio (1968) demonstrated that neurotic depressives were less extroverted than normals, even when they were well, and that women had lower extroversion levels than males. Hirshfield and Klerman (1979) also demonstrated that neuroticism and introversion were directly related to depression and Duggan et al.(1990) showed that an increase in neuroticism and a decrease in extroversion scores related to increases in depression. Hirshfield (1983) also demonstrated that unipolar patients were more introverted, and that the personality characteristic of social introversion was the most powerful characteristic associated with primary non-bipolar depression.

The association between extroversion and depression may be explained in relation to regional cerebral blood flow, since blood flow and cerebral function have been shown to be closely coupled in the normal brain. This linking of cerebral blood flow and the personality characteristic of extroversion is in keeping with Eysenck`s theories, that extroversion is directly related to the RAS (Reticular Activating System), with collaterals from the ascending sensory pathways exciting cells within the RAS which then transmits that excitation to various sites in the cerebral cortex. In this context the extrovert is predicted to be in a cortically inhibited state and the introvert to be in a cortically excited state. Eysenck also proposed that behavioural differences between extroverts and introverts result from an innate drive to compensate for overactive and underactive reticulo-thalamo-cortical pathways respectively. Although these theories are hypothetical constructs, there have been studies which have demonstrated a relationship between regional cerebral blood flow and the personality characteristic of extroversion.

In a study by Mathew et al.(1984), the authors demonstrated an inverse correlation between total cerebral blood flow and extroversion in female patients, and Stenberg(1990) showed that introverts have higher blood flow in the bilateral temporal lobes compared with extroverts. These authors commented that higher temporal lobe activity in introverts may be interpreted as increased functional connections between the cortex and the limbic system. However Ebmeier et al.(1994) demonstrated increased uptake in the anterior and posterior cingulate areas bilaterally which was associated with extroversion, while Mayberg et al.(1994) demonstrated areas of decreased blood flow bilaterally in the frontal and anterior

temporal cortex and anterior cingulate gyrus in depressed patients. These authors hypothesized that the disruption of circuits linking frontal, temporal and cingulate areas in the brain may independently underlie various depressive phenomena. Johnson et al.(1999) also demonstrated that extroversion was associated with uptake in the anterior cingulate gyrus, the temporal lobes and the posterior thalamus, whereas introversion was associated with increased blood flow in the frontal lobes and in the anterior thalamus. These authors also suggest that differences in introversion and extroversion are related to differences in the fronto-striato-thalamic circuit. Although depression has been non-specifically linked in many studies to hypoperfusion in various regions of the brain, neuroticism has never been associated with any specific pattern of cerebral blood flow. Neuroticism is generally considered to be associated with the limbic system.

The main outcomes of the results of this current study are, that there were significant differences in certain personality characteristics between male and female patients, but there were no differences between male and female carers. There were also significant changes in certain characteristics of patients over the 6 months of the study where there were no changes in the characteristics of carers. The differences between male and female patients related to significantly higher venturesomeness scale scores for male patients and significantly higher neuroticism, and impulsiveness scale scores for female. The results also demonstrated significant changes in certain personality characteristics from the onset of the stroke for patients but not carers. For male patients there were decreases in venturesomeness and impulsiveness and for female patients there were decreases in impulsiveness and extroversion.

It could be argued that the decrease in venturesomeness in male patients might be due to the fact that as time progresses, the psychological and /or physical impact of the stroke becomes more significant. This effect might be highlighted for male patients particularly, being unable to respond to certain `macho` questions in the EPS in a positive light because of the physical impairment of the stroke, or the fear of another stroke.

Examples of the type of questions in the EPS which might create this dichotomy for male stroke patients to a greater extent than female patients are:-

`Would you like parachute jumping?`

`Would you like to go pot-holing?`

The significant changes noted in the impulsiveness scale for both male and female patients may also be due to the psychological effects of a life threatening experience such as a stroke and may make patients less confident and more reticent about making decisions. The practical side of this being, that as the time from the onset of the stroke progresses, and the patients are within their own environment, the physical disability imposed as a result of the stroke may make it more difficult to do things on impulse. This could affect responses to such questions as:-

`Do you often do things on the spur of the moment?`

`Do you often buy things on impulse?`

The significant changes in extroversion which were noted in female patients were applicable to the female group as a whole but also to sub-groups of female patients, viz. females with right CVA`s and females who had `normal` baseline BDI scores. The results also demonstrated a significant decrease in extroversion in the small group of patients who increased their BDI scores from a baseline `normal` value to one of `caseness` at 6 weeks and 6 months from the onset of the stroke.

As discussed previously, changes in extroversion have been associated with depression, and extroversion and depression have also been shown to be related to cerebral blood flow. However the results of this study demonstrated that there was no significant association between the BDI and extroversion scores for male or female patients. In view of the fact that extroversion is an intrinsic personality characteristic in males and females, it is therefore difficult to explain why it was only female patients, particularly those with right CVA`s and `normal` baseline BDI scores who demonstrated a significant decrease in extroversion over the 6 months from the onset of the stroke.

In view of the known association between neuroticism and depression it was not surprising that significant associations were noted between neuroticism and BDI scores for male and female patients, and male and female carers, for each of the assessments in this study. The stability of the characteristic was also demonstrated by the fact that the only significant increase in neuroticism occurred in the patient group who significantly increased their BDI scores over 6 months. The significant predictive value of baseline neuroticism as a factor in the affective status of patients and carers at the 6 months assessment was therefore not unexpected.

However the results also demonstrated a significant association between psychoticism and BDI scores for female patients at each assessment, and that for female patients and male carers, the characteristic of psychoticism created a stronger predictor factor of affective status at 6 months than neuroticism. The impact of this specific characteristic with depression has not previously been documented. This result, together with the significant association which was demonstrated between psychoticism and BDI scores for female patients and male carers, and the significant difference in psychoticism between female patients and carers at 6 months, suggests the additional involvement of the characteristic of psychoticism in the prediction of affective status of females after stroke.

7.3.15 Conclusions

The results of the carers in this study have demonstrated that the personality characteristics which were measured using the Eysenck Personality Scales were stable over a period of 6 months. The results also demonstrated that for male and female patients the majority of the Eysenck characteristics measured were also stable over 6 months and that there were minimal differences between the scores of patients and carers over the 6 months. If it can be considered that the personality scores of the carers are representative of stable personality characteristics that were unaffected by the patients' stroke, then it is possible to consider that the stable personality scores of the patients over the 6 months may also be a reasonable representation of their personality status before and after stroke.

The analysis of the data demonstrated significant correlations between the personality characteristics of neuroticism and affective status as measured by the BDI, for male and female patients and carers which was not unexpected. The results also demonstrated significantly higher neuroticism scores for female patients when compared with male patients at each of the assessments, whereas there were no differences between male and female carers. Linear regression analysis confirmed that neuroticism contributed significantly to the variance in the BDI scores at 6 months for patients and carers, although it was also demonstrated that baseline psychoticism was seen to be a significant predictor of affective status in female patients and male carers.

The significant changes in the characteristics of impulsiveness and venturesomeness which were noted may have been explained to a degree by the structure of the questionnaires. However, the significant decrease in extroversion which was demonstrated in female

patients, particularly those with right CVA`s and `normal` baseline BDI scores is more likely to be associated with changes in cerebral blood flow, since previous research has shown that extroversion and depression may be associated with decreased levels of cerebral blood flow. Decreases in extroversion have also been demonstrated in patients with depression particularly reactive depression.

The conclusions from this study are that certain patients are vulnerable to changes in the personality characteristics of extroversion, impulsiveness and venturesomeness after the onset of stroke. These changes are more evident in females than males, and appear to be associated in females with the presence of right CVA`s and a `normal` affective status at the onset of the stroke. The results of the data confirmed the known association between the characteristic of neuroticism and affective status but also demonstrated that psychoticism is significantly associated with affective status in female patients and their male carers after stroke. For those patients who developed affective disorder, the results showed that the change in affective status was accompanied by significant increases in neuroticism and psychoticism, and significant decreases in extroversion. It was also noted that there was a significantly higher level of neuroticism but not depression at the baseline assessment for this group of patients, when compared with patients who did not develop affective disorder over the 6 months.

It is concluded therefore that changes in personality take place after the onset of stroke to a greater extent in female patients than in males, and that these changes are associated with the onset of affective disorder and with the presence of a right CVA. It is also concluded that baseline personality characteristics are implicated in the onset of affective disorder after stroke. It is suggested that this finding confirms the anecdotal evidence of the personality change in stroke patients reported by the carers. However it may be that the changes in personality which have previously been noted by carers may be associated with unrecognized changes in the affective status of the patients.

Table 33. Mean FAM `T` scores - total group of patients

FAM scale	Baseline		6 weeks		6 months	
	mean	std dev	mean	std dev	mean	std dev
L	52.5	7.6	52.4	7.9	53.3	8.9
F	60.1	10.5	58.0	8.8	58.0	9.8
K	54.1	8.4	54.4	8.9	55.3	8.9
Depression	67.0	13.3	70.3	14.3	72.0	12.7
Hypochondriasis	65.1	13.7	66.3	15.3	68.0	14.6
Hysteria	59.5	10.6	60.7	11.3	62.3	11.1
Hypomania	57.6	12.4	55.5	11.6	56.5	10.7
Gender	55.3	11.7	55.1	12.5	55.3	12.3
Paranoia	53.3	10.1	53.3	9.3	52.3	9.9
Psychopathic dev	56.8	11.7	55.0	10.8	56.8	11.1
Psychasthenia	56.9	14.6	56.8	13.6	57.9	13.9
Schizophrenia	61.4	14.8	61.4	14.2	62.5	13.9
Social introversion	62.2	10.9	61.3	10.5	61.1	11.1

Table 34. FAM scores - total group of patients

FAM scale	Baseline scores			6 Weeks scores			6 Months scores		
	Median	Q1	Q3	Median	Q1	Q3	Median	Q1	Q3
L	53	46	56	53	46	56	53	46	58
F	60	53	66	58	53	62	58	50	64
K	53	48	61	55	46	61	55	49	62
Depression	68	60	77	71	59	82	72	60	82
Hypochondriasis	65	54	76	67	54	78	67	56	80
Hysteria	60	53	68	62	53	68	62	54	72
Hypomania	58	48	67	55	48	63	55	50	63
Gender	55	47	65	55	47	61	55	47	65
Paranoia	53	47	62	53	47	59	53	44	59
Psychopathic dev	60	50	66	57	48	64	57	48	64
Psychasthenia	56	48	66	55	46	66	56	48	66
Schizophrenia	61	52	71	58	52	69	61	52	71
Social introvert	64	52	70	62	53	70	62	52	70

Table 35. FAM `T` scores =>70 - total group of patients

FAM scale	Baseline	6 weeks	6 months
Depression	36%	49%	57%
Hypochondriasis	40%	40%	47%
Social introversion	26%	28%	28%
Schizophrenia	26%	23%	28%

7.4 Faschingbauer Abbreviated MMPI - (FAM)

7.4.1 Introduction

The MMPI scales were designed to provide an objective assessment of some of the major personality characteristics that can affect personal and social adjustment. The MMPI scale being used in this study is the Faschingbauer Abbreviated MMPI (FAM).

7.4.2 FAM scores - patients

The numbers and percentages of patients who completed the FAM assessments are detailed in Table 32 and show that of the original cohort of 131 patients, 108 patients (82%) completed all three of the assessments.

Table 32. **FAM assessments - patient completion data**

Completed Assessments	Patients	%	Male patients	%	Female Patients	%
Baseline FAM (1)	124	95	80	94	44	98
6 Weeks FAM (2)	115	88	71	84	44	98
6 Months FAM (3)	113	86	73	86	40	89
FAM 1+2+3	108	82	69	81	39	87

The summary of means and standard deviations and means and interquartile ranges of the FAM `T` scores for each of the three assessments for the total group of patients are detailed in Tables 33 and 34 and the profiles of the mean `T` scores are shown in Figure 31.

For the patient group as a whole, the results demonstrated that the only MMPI scales to reach significant `T` scores =>70 were the 6 weeks and 6 months depression scale scores. Correlation analysis demonstrated significant associations between the assessments for each of the scales ($p<0.001$, $r \sim 0.6$-0.7), for the group as a whole and also for male and female patients separately. Paired t-tests demonstrated a significant difference between the baseline and 6 months depression scores ($p<0.001$, $t = -3.9$, md = -5.0, df 107, 95% CI -7.5, -2.5) due to higher `T` scores at 6 months. The results also demonstrated that >20% of patients had `T` scale scores >70 for the depression, hypochondriasis, social introversion and schizophrenia scales at each of the assessments (Table 35).

Overall the results suggest that at different times after the stroke a considerable number of patients had FAM scores suggestive of pathological characteristics of depression, a concern

Figure 31.
FAM mean score- patients (M+F)

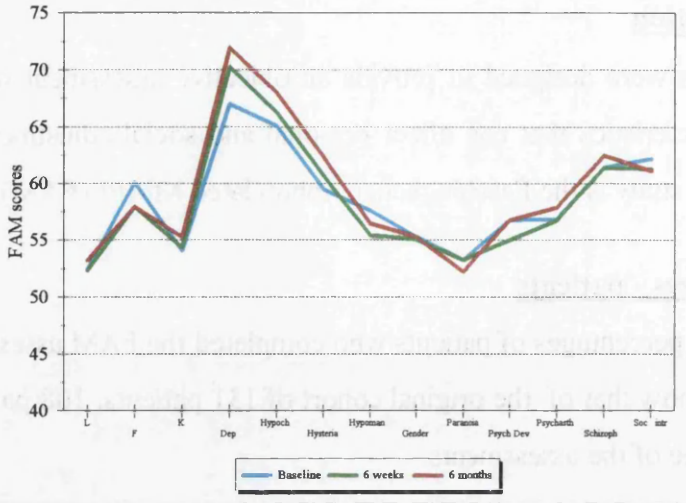


Figure 32.
FAM mean scores - Male patients

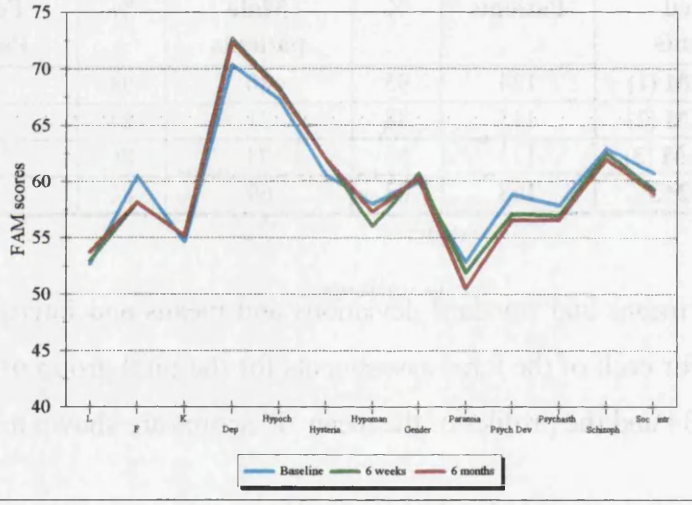
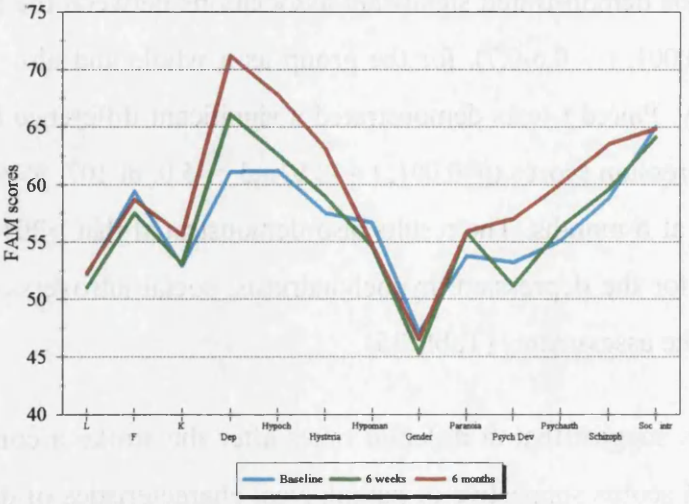


Figure 33.
FAM mean scores - Female patients



for health, confused thinking, emotional lability and introversion, and that for 27% of patients the symptoms of depression and hypochondriasis were persistent for 6 months.

7.4.3 FAM scores related to the gender of the patient

(a) Male patients

The means and standard deviations and medians and interquartile ranges of male patients in this study are detailed in Tables 36 and 37, and profiles of the mean FAM `T` scores for male patients are shown in Figure 32.

Table 36. Mean FAM `T` scores - male patients

FAM scales	Baseline		6 Weeks		6 Months	
	mean	std dev	mean	std dev	mean	std dev
L	52.7	8.3	53.0	8.9	53.8	9.4
F	60.5	11.1	58.2	8.5	58.2	9.2
K	54.7	8.5	55.2	8.7	55.2	8.5
Depression	70.4	12.9	72.7	14.3	72.4	13.2
Hypochondriasis	67.3	14.1	68.4	16.6	68.1	15.8
Hysteria	60.5	10.1	61.9	11.0	61.9	10.7
Hypomania	58.1	12.8	56.1	12.7	57.4	11.2
Gender	59.9	10.9	60.7	10.7	60.3	11.0
Paranoia	52.9	10.9	51.9	9.4	50.5	9.7
Psychopathic dev	58.9	11.7	57.2	9.9	56.6	10.5
Psychasthenia	57.9	14.9	57.0	13.6	56.7	13.5
Schizophrenia	62.9	15.9	62.5	14.6	61.9	14.1
Social introvert	60.7	11.7	59.2	10.5	58.9	10.9

Table 37. FAM `T` scores - male patients

FAM Scales	Baseline			6 Weeks			6 Months		
	Median	Q1	Q3	Median	Q1	Q3	Median	Q1	Q3
L	53	46	56	53	46	63	53	46	60
F	58	53	66	58	53	62	58	53	64
K	55	49	61	55	46	61	55	47	61
Depression	68	60	82	72	60	82	72	60	82
Hypochondriasis	67	58	81	67	54	82	70	54	82
Hysteria	60	55	69	62	55	67	62	53	73
Hypomania	56	48	68	55	48	63	58	50	65
Male/female	62	54	69	61	55	69	61	51	69
Paranoia	53	44	62	53	44	56	47	44	56
Psychopathic dev	60	51	67	57	50	64	57	48	63
Psychasthenia	56	49	64	54	46	66	54	47	64
Schizophrenia	63	53	73	61	53	71	61	51	71
Social introvert	64	51	68	60	50	66	56	51	69

The MMPI profiles for male patients demonstrated a two-scale high point of depression and hypochondriasis at each assessment and the depression scale was the only scale with

Table 39. Mean FAM 'T' scores - Female patients

FAM scales	Baseline		6 weeks		6 months	
	mean	std dev	mean	std dev	mean	std dev
L	52.2	6.3	51.1	5.8	52.4	7.4
F	59.4	9.4	57.5	9.4	58.7	10.9
K	52.9	8.1	53.1	9.4	55.6	9.9
Depression	61.1	11.7	66.1	13.4	71.2	11.6
Hypochondriasis	61.2	12.1	62.6	12.0	67.8	12.4
hysteria	57.5	11.5	58.9	11.6	63.1	11.7
Hypomania	56.7	11.8	54.6	9.4	54.8	9.5
Gender	47.1	8.2	45.3	8.9	46.5	9.1
Paranoia	53.8	8.3	55.9	8.6	55.9	9.3
Psychopathic dev	53.2	11.1	51.2	11.2	57.0	12.3
Psychasthenia	55.1	13.8	56.3	13.8	60.1	14.3
Schizophrenia	58.8	12.6	59.6	13.2	63.5	13.7
Social introversion	65.0	8.9	64.1	9.5	64.8	10.6

Table 40. FAM scores - Female patients

FAM Scales	Baseline			6 Weeks			6 Months		
	Median	Q1	Q3	Median	Q1	Q3	Median	Q1	Q3
L	53	46	56	53	46	56	53	46	59
F	60	51	64	58	50	64	58	50	64
K	51	48	59	54	47	61	55	49	62
Depression	63	52	71	65	59	76	72	60	82
Hypochondriasis	60	53	72	62	53	70	66	58	74
Hysteria	57	52	68	61	49	68	63	54	70
Hypomania	60	48	65	57	48	63	55	50	60
Gender	49	41	55	47	39	51	49	40	51
Paranoia	53	50	62	53	50	61	56	50	64
Psychopathic dev	54	48	64	53	46	62	57	49	64
Psychasthenia	53	46	68	55	47	66	58	50	66
Schizophrenia	59	50	70	57	52	66	60	53	74
Social introvert	67	56	72	66	56	70	65	61	72

Table 41. Percentages of FAM T' scores =>70 - Female patients

FAM scales	Baseline	6 Weeks	6 Months
Depression	36%	41%	64%
Hypochondriasis	31%	26%	41%
Social introversion	31%	31%	36%
Schizophrenia	21%	18%	33%

significant 'T' scores at each of the assessments. The percentages of male patients who had mean scale 'T' scores =>70 are detailed in Table 38.

Table 38. **Percentages of 'T' scores =>70 for male patients**

FAM scales	Baseline	6 weeks	6 months
Depression	45%	53%	53%
Hypochondraisis	45%	48%	51%
Schizophrenia	28%	26%	23%

These results suggest that a large number of male patients demonstrated clinical levels of depression, hypochondriasis and symptoms of schizophrenia at each of the assessments, and that more than 30% of male patients had persistently elevated 'T' scale scores for depression and hypochondriasis. Repeated measures ANOVA demonstrated no significant changes in any of the scales over the three assessments.

(b) Female patients

The means, standard deviations, medians and interquartile ranges of female patients are detailed in Tables 39 and 40 and profiles for mean FAM 'T' scores are shown in Figure 33.

The results demonstrated that the MMPI two-point scale profile for female patients at the baseline assessment was social introversion followed by depression, whereas at the 6 weeks and 6 months assessments the profiles were depression followed by social introversion. Although the only scale to reach a 'T' scale score =>70 was the 6 months score of the depression scale there were significant increases in scores between the assessments for the following scales:-

Depression - Baseline and 6 months - $p<0.001$, df 38, md = -10.2, t= -4.8, 95% CI -14.4, -5.9
Depression - 6 weeks and 6 months - $p=0.006$, df 38, md = -5.2, t= -2.9, 95% CI -8.7, -1.5
Hypochondriasis - Baseline and 6 months - $p<0.001$, df 38, md = -6.6, t= -4.3, 95% CI -9.8,-3.4
Hysteria - Baseline and 6 months - $p<0.001$, df 38, md = -5.5, t= -4.1, 95% CI -8.2, -2.8

The results demonstrated that a considerable percentage of female patients had individual 'T' scale scores =>70 for depression, hypochondriasis and social introversion (Table 41), and that more than 20% of female patients had persistently significant scale scores for depression and social introversion.

In contrast to male patients, female patients had significant increases in the depression, hypochondriasis, hysteria, schizophrenia and psychasthenia scale scores in the 6 months after stroke. These results suggest that female patients have been psychologically affected by the stroke to a greater extent than male patients.

(a) Comparisons of FAM scores - Male and female patients

Unpaired t-tests demonstrated significant differences between male and female patients for the following characteristics at each of the assessments:-

Depression assess. 1	- p <0.001, df106, md = 9.3, t=3.7, 95% CI 4.3,14.3*
Psychopathic dev assess.1	- p = 0.01, df 106, md = 5.7, t= 2.5, 95% CI 1.2, 10.3*
Psychopathic dev assess.2	- p = 0.005, df106, md = 6.1, t= 2.9, 95% CI 1.9, 10.2*
Social introvert assess. 2	- p = 0.005, df106, md = -5.9, t= -2.9, 95% CI -9.9, -1.9 **
Social introvert assess. 3	- p = 0.008, df106, md = -5.9, t= -2.7, 95% CI -10.2, -1.6 **
Paranoia assess. 3	- p = 0.006, df106, md = -6.2, t= -2.8, 95% CI -9.3, -1.6 **

*** denotes male scores> female scores * * denotes female scores> male scores**

Assess.1 - Baseline Assess 2. - 6 weeks Assess 3. - 6 months

Chi^2 analysis to determine if there was an association between the percentages of patients scoring <60 or =>70 and gender, for any of the MMPI scales and for any of the assessments, demonstrated that there were no significant associations between the gender of the patients and MMPI scale scoring categories.

7.4.4 Miscellaneous factors and FAM scores

The data were analysed to determine if there were factors which created a significant difference between the profile scale scores for the patients. These factors included the marital, domestic and social status of the patients, the presence of certain risk factors and the laterality and location of the stroke infarct.

(a) Domestic status and FAM scores

The category of domestic status is defined as patients who lived alone or with a partner. In this study 45 patients lived alone (26 males, 19 females), 76 patients lived with a partner (52 males, 20 females) a further 5 patients lived with family and 2 patients were in residential accommodation. Unpaired t-tests demonstrated that there were no significant differences between the domestic groups, in any of the scales, for the group as a whole or for male or female patient groups separately.

(b) Marital status and FAM scores

Marital status is being considered in terms of whether or not the patients were single, married, divorced/separated or widowed. In this study 17 patients were single (12 males, 5 females), 77 patients were married (57 males, 20 females), 32 were widowed (13 males, 19 females) and 6 patients were separated or divorced (4 males, 2 females). The results of one-way ANOVA demonstrated significant differences between the three marital groups for schizophrenia ($p=0.01$, ms=1082, ss = 2165, $F=4.6$, df 2/79) and psychopathic deviate ($p=0.001$, ms = 762, ss = 2178, $F = 7.1$, df 2/78) at the 6 months assessment only. The difference was due to higher scores for single patients as a group when compared with married or widowed patients..

(c) Social status and FAM scores

The social categorization of the patients in this study was defined as employed, unemployed or retired. The number of patients included in each of the categories was 44 employed (31 males, 13 females), 15 patients were unemployed (11 males, 4 females) and 72 patients were retired (43 males, 29 females). Analysis of the data for the patient group as a whole demonstrated significant differences within the three categories for the majority of the MMPI scales at the baseline assessment only. Inspection of the data demonstrated that the baseline differences in the scales were due to significantly higher baseline scores for the unemployed category when compared with the employed and retired categories.

These results suggest that as a group the unemployed patients may be psychologically affected to a greater extent at the onset of the stroke but that this effect diminished with the passage of time. However it was also noted that the unemployed group had mean `T` scale values =>70 at each of the assessments for depression, hypochondriasis and schizophrenia which suggests either that the onset of stroke had a marked effect on the personality characteristics of unemployed patients which persisted throughout the 6 months or that elevations in these characteristics are representative of this group of patients generally.

7.4.5 Risk factors and FAM scores

Risk factors being considered in this study are a history of stroke, a history of cardiac illness, family history of stroke, high blood pressure, diabetes and smoking.

(a) History of stroke

The number of patients with a known history of stroke was 17 (9 males, 8 females) this represented 14% of the total group of patients being studied and compared with 104 patients who had not had a previous stroke (69 males, 35 females).

There were no significant differences between the risk factor groups for any of the scales When the data were analysed according to gender, female patients with a history of stroke demonstrated significantly higher depression scores at the 6 months compared with female patients without a history of stroke assessment ($p = 0.01$, $t = 2.7$, md= 11.5, df 37, 95% CI 2.8, 20.2). Female patients without a history of stroke significantly increased their depression scores between baseline and 6 months ($p<0.001$, $t = -4.0$, md = 9.5, df 29, 95% CI -14.4, -4.6).

(b) History of cardiac illness

The number of patients in the study with a history of cardiac illness was 45 (33 males, 12 females). This represented 36% of the data and compared with 76 patients who did not have a history of cardiac illness (45 males, 31 females). Unpaired t-tests demonstrated no significant differences between patients with or without a history of cardiac illness.

(c) Family history of stroke.

The number of patients in this study with a family history of stroke was 21 (15 males, 6 females) and represented 17% of the patients in the study. The remaining 100 patients with no family history of stroke, included 63 males and 37 females. There were no significant differences in any of the scales between patients with or without a family history of stroke.

(d) High blood pressure

The number of patients with high blood pressure in this study was 61 (43 males, 18 females) and represented 50% of the patients in the study. Sixty patients (35 males, 25 females) did not have high blood pressure. Analysis of the group as a whole or by gender, demonstrated that there were no significant differences between any of the assessments for any of the scales, for patients with or without the risk factor.

(e) Diabetes.

The number of patients with diabetes in this study was 13 (9 males, 4 females) and this represented 10% of the total group of patients. The remaining 108 patients comprised 69 males and 39 females.

Unpaired t-tests demonstrated significantly higher `T` scale scores at each assessment for social introversion for patients with diabetes, compared with those without diabetes.

Social introversion (Baseline)	$p < 0.001$, md=11.2, $t = 3.7$, df 114, 95% CI. 5.2,17.2
Social introversion (6 Weeks)	$p = 0.001$, md=9.9, $t = 3.3$, df 113, 95% CI 4.0,15.8
Social introversion (6 months)	$p = 0.002$, md= 6.9, $t = 2.4$, df 108, 95% CI 13.5, -0.4

Repeated measures ANOVA demonstrated no significant differences between assessments for any of the scales for patients with or without diabetes.

(f) Smoking

In this study 76 patients smoked (50 males, 26 females) representing 63% of the total group of patients. Of the 45 patients who did not smoke, 28 were male and 17 were female.

When taken as a whole group, the analysis of the data demonstrated minimal significant differences between patients who smoked and those who did not smoke. When analysed according to gender unpaired t-tests demonstrated significantly higher social introversion scores at each assessment for male patients who did not smoke.

Social introversion (Baseline)	$p = 0.003$, $t = -3.1$, md = -8.2, df 73, 95% CI -13.5, -2.9
Social introversion (6 weeks)	$p = 0.007$, $t = -2.8$, md = -7.2, df 68, 95% CI -12.3, -2.9
Social introversion (6 months)	$p = 0.001$, $t = -3.6$, md = -8.9, df 69, 95% CI -13.9, -4.1

repeated ANOVA demonstrated no significant differences between the assessments for any of the scales or for male or female patients. Repeated measures ANOVA demonstrated no significant differences between the assessments, for any of the scales, for patients who smoked or did not smoke.

7.4.6 Disability, Impairment and FAM scores

(a) Laterality of physical impairment

The measure of the effects of the physical impairment of the patients was assessed using the Barthel Index and the patients` disability was described in terms of right or left-sided impairment. In this study 51 patients had right-sided impairment (35 males, 16 females) and 69 patients had left-sided impairment (42 males, 27 females). Analysis of data demonstrated no significant differences, nor changes in FAM scores between patients with right or left-sided impairment.

Table 42. Fachingbauer Abbreviated MMPI Scores

FAM	Assess.	Male patients					Female patients			
Scales		R CVA		L CVA			R CVA		L CVA	
		mean	std dev	mean	std dev	•	mean	std dev	mean	std dev
Depression	Baseline	71.9	13.3	71.9	12.8	•	64.0	12.6	61.1	13.2
	6 Weeks	73.8	16.1	71.8	10.7	•	65.7	14.6	64.2	12.7
	6 Months	75.6	13.1	70.8	13.8	•	71.7	13.1	67.6	10.1
Hypochondiasis	Baseline	69.2	16.7	66.7	11.1	•	63.0	13.4	52.3	11.4
	6 Weeks	71.8	17.7	63.9	14.1	•	62.1	12.5	52.2	13.1
	6 Months	70.7	15.3	65.2	15.3	•	62.4	11.0	56.0	11.9
Hysteria	Baseline	63.1	9.9	58.5	9.4	•	61.9	11.9	58.4	12.9
	6 Weeks	63.6	11.7	58.2	8.4	•	61.6	12.8	58.7	11.2
	6 Months	64.5	10.4	57.6	9.4	•	66.4	11.9	59.6	9.4
Psychopathic	Baseline	60.2	11.4	60.1	14.0	•	55.4	11.8	54.3	13.4
Deviate	6 Weeks	58.1	10.6	55.2	9.6	•	54.8	13.5	49.4	11.5
	6 Months	58.4	9.4	52.8	9.8	•	59.0	13.6	55.4	8.6
Gender	Baseline	60.8	11.2	61.3	9.9	•	47.2	9.4	49.6	7.9
	6 Weeks	61.4	11.8	62.3	8.3	•	45.4	8.4	47.9	9.4
	6 Months	61.4	11.5	61.7	10.2	•	46.4	9.3	46.4	8.0
Paranoia	Baseline	60.2	11.4	52.1	11.7	•	55.0	8.3	55.9	7.7
	6 Weeks	58.1	10.6	50.4	9.5	•	56.5	9.5	55.4	7.3
	6 Months	58.4	9.4	49.2	9.7	•	57.2	9.5	56.2	11.3
Psychasthenia	Baseline	59.6	13.9	58.7	18.5	•	59.3	15.7	55.1	13.8
	6 Weeks	58.1	14.5	55.4	12.4	•	59.4	16.2	53.3	10.8
	6 Months	58.7	14.7	54.8	12.0	•	62.6	17.6	55.2	9.2
Schizophrenia	Baseline	64.9	14.9	61.3	16.3	•	62.5	15.0	59.8	13.5
	6 Weeks	64.6	14.7	58.0	13.8	•	62.8	16.5	57.8	10.8
	6 Months	63.1	13.9	58.6	14.5	•	65.8	15.4	60.3	11.1
Hypomania	Baseline	58.3	9.8	55.5	13.5	•	59.6	11.6	58.9	12.8
	6 Weeks	57.6	13.2	54.2	12.3	•	55.6	12.4	56.0	9.2
	6 Months	58.1	8.6	55.0	11.8	•	55.5	9.8	56.7	8.5
Social	Baseline	59.6	12.1	63.0	10.5	•	64.2	8.9	63.5	8.6
Introversion	6 Weeks	58.0	12.5	62.5	9.3	•	64.9	9.4	62.4	8.5
	6 Months	57.5	11.7	62.4	10.1	•	64.2	10.3	63.3	9.9

(b) Disability and FAM scores

Analysis of data demonstrated no significant association between the Barthel Index scores and any of the FAM scores for patients with right-sided or left-sided impairment.

(c) Speech impairment and FAM scores

The analysis of the data on speech impairment after stroke is based on whether the patients were diagnosed as being dysphasic, dysarthric or had no speech impairment as a result of the stroke. Patient case records documented 20 patients as dysphasic (12 males, 8 females), 28 as dysarthric (20 males, 8 females) and 78 patients had no speech impairment as a result of the stroke. Repeated measures ANOVA demonstrated no significant differences between the speech groups, for any of the FAM scales for any of the assessments.

7.4.7 Location of infarct and FAM scores

This classification delineated the patients into right and left hemispheric strokes. Within this classification 60 patients had right CVA`s (35 males, 25 females) and 45 patients had left CVA`s (30 males, 15 females).

(a) Comparing patients with right and left CVA`s.

For the group of patients as a whole. Details of the means and standard deviations for male and female patients with right and left CVA`s are shown in Table 42. Percentages of patients with elevated `T` scale scores =>70 for the total group of patients and for male and female patients separately are detailed in Table 43.

Table 43. Percentages of FAM elevated `T` scale scores =>70

FAM scale	Assessment	(%) Right CVA			(%) Left CVA		
		Males	Females	Total	Males	Females	Total
Depression	Baseline (1)	46	40	43	37	20	31
Depression	6 Weeks (2)	53	42	48	61	47	56
Depression	6 Months (3)	61	64	62	45	50	46
Depression	Assess. (1+2+3)	32	23	28	30	15	25
Hypochondriasis	Baseline (1)	34	28	32	40	27	36
Hypochondriasis	6 Weeks (2)	53	25	38	36	27	31
Hypochondriasis	6 Months (3)	55	55	55	44	15	35
Hypochondriasis	Assess. (1+2+3)	32	18	26	26	7	20
Hysteria	Baseline (1)	29	24	27	6	13	10
Hysteria	6 Weeks (2)	22	29	25	7	20	12
Hysteria	6 Months (3)	32	36	34	10	22	14
Hysteria	Assess. (1+2+3)	19	14	17	4	0	3

Although the results suggest that higher levels of depression, hypochondriasis and hysteria were present in patients with right CVA's when compared with patients with left CVA's, the differences were not significant (Chi^2). There were no significant differences between right and left CVA's for any of the scales at any of the assessments.

(b) Patients with right CVA's

For the group as a whole, paired t-tests demonstrated significant differences in depression scores between the baseline and 6 months assessments (p=0.001, t= -3.4, md = -6.3, df 59, 95%CI -1.0, -2.6). Subsequent gender analysis demonstrated significant increases in the depression and hypochondriasis scales between baseline and 6 months for female patients:-

Depression p=0.007, t = -3.0, md = -9.4, df 21, 95%CI -15.9, -2.8

Hypochondriasis p<0.001, t = -3.5, md = -8.5, df 21, 95%CI -12.7, -4.2

Further analysis demonstrated a significant increase in the depression scale 'T' scores between the baseline and 6 months assessment for female patients with right anterior infarcts (p=0.01, t=-2.9, df 11, md =-11.2, 95% CI -19.7, -2.7).

(c) Patients with left CVA's

For the group as a whole, there were no significant differences between any of the assessments, however for female patients, paired t-tests analysis demonstrated a significant increase in the depression scale between the baseline and 6 months assessments (p=0.005, t= -3.5, md = -11.1, df 21, 95% CI -18.0, -4.1).

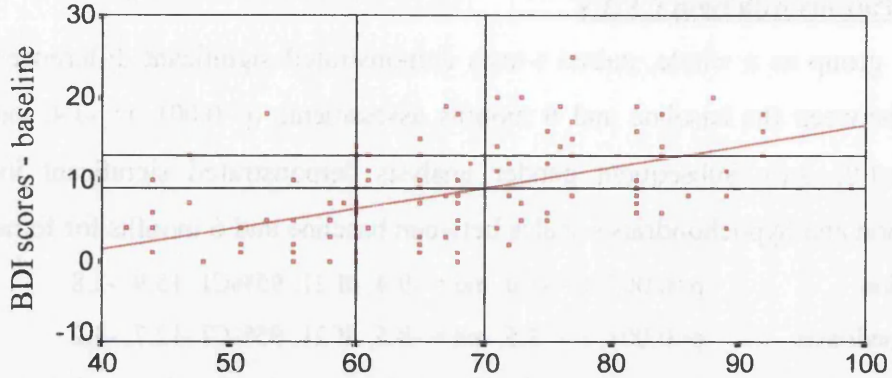
(d) Comparison of the location of infarcts

Overall these results suggest that the location of the cerebral infarct was not an important factor in the outcome. Although it was noted that it was only female patients who experienced significant increases in their depression scores, this increase was applicable to female patients with right and left CVA's. However it was also noted that female patients with right CVA's also experienced a significant increase in hypochondriasis during this time.

7.4.8 Comparison of BDI and FAM scores

For the group as a whole, the BDI scores at each assessment significantly correlated with each of the FAM scale scores with the exception of the hypomania, gender and psychopathic deviate scales. All of the correlations were significant (p<0.001, r~0.6). Correlations for male and female patients were also significant for the same scales as the total group, although the significance levels were lower (p = 0.01, r~0.5).

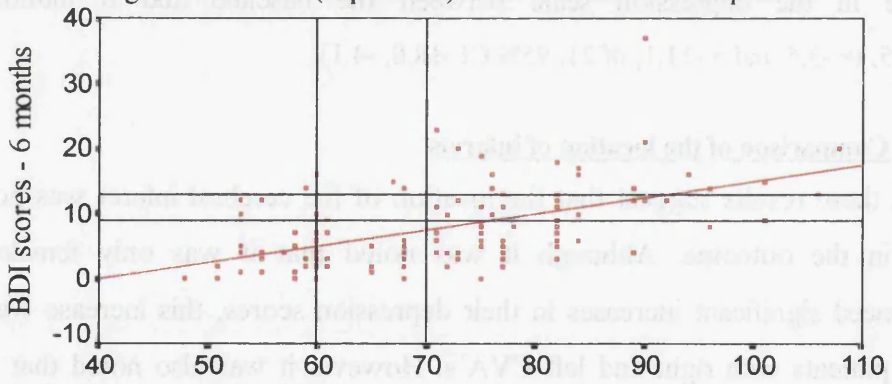
Figure 34. FAM (depression) v`s BDI scores - Total patients



Horizontal and vertical lines represent BDI `cut-off` values of 9 and 13

Diagonal represents linear regression line

Figure 35. FAM (depression) v`s BDI scores - Total patients



Horizontal and vertical lines represent BDI and FAM `cut-off` values

Diagonal represents the linear regression line

Analysis of the data in relation to BDI scoring classifications, demonstrated that for the total group of patients who had BDI baseline scores which were within the `normal` BDI range, there were no significant changes in any of FAM scales. Analysis of the data for male and female patients separately, demonstrated significant increases between the baseline and 6 months assessments for the FAM depression, hypochondriasis and hysteria scales, for female patients only, as follows:-

Depression	$p < 0.001$, $t = -4.6$, df 23, md = -12.1, 95% CI -17.6, -6.6
Hypochondriasis	$p = 0.01$, $t = -2.8$, df 23, md = -6.0, 95% CI -10.5, -1.6
Hysteria	$p = 0.003$, $t = -3.3$, df 23, md = -5.8, 95% CI -9.4, -2.2

Patients who had `normal` baseline BDI scores and who had subsequent BDI scores above the `normal` limits, demonstrated significant increases between the baseline and 6 months assessment for the FAM depression scale ($p = 0.01$, $t = -3.7$, md = -17.4, df 6, 95% CI -28.9, -5.9) and the psychasthenia scale ($p = 0.01$, $t = -3.7$, md= -12.6, df 6, 95% CI -20.8, -4.4).

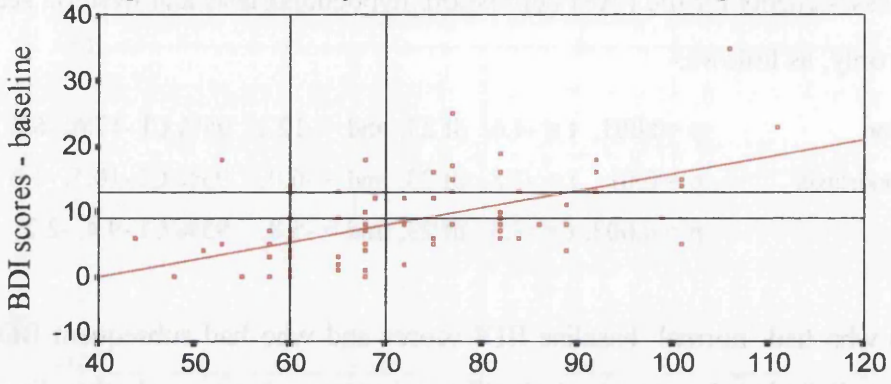
When the outcomes of the FAM depression and BDI scales for patients who had BDI scores suggesting `caseness` were compared, they demonstrated considerable differences. `Caseness` in the FAM scale is represented by `T` scores =>70 and in the BDI scale in this study as =>13. The percentages of FAM depression scores =>70 and BDI scores =>13 (and also >9), which were demonstrated at each individual assessment and also persistently over the 3 assessments are detailed in Table 44. The relationships between the BDI and FAM depression scale scores at the baseline and 6 months assessments for the total group of patients and for male and female patients separately are demonstrated in Figures 34 - 37.

Table 44. Percentages of FAM and BDI patient scores in different scoring categories

Assessment	% FAM scores =>70			% BDI scores >9			% BDI scores =>13		
	Total	Males	Females	Total	Males	Females	Total	Males	Females
Baseline (1)	37	45	30	35	31	41	24	23	27
6 Weeks (2)	50	53	43	29	23	39	21	18	27
6 Months (3)	58	53	63	38	32	46	22	17	32
Assess 1+2+3	27	30	20	21	18	24	10	8	12

Table 44 shows that there is no obvious relationship or pattern between the scores. Further analysis of the data, by raising the FAM depression `T` score threshold to 80 did not improve the relationship. However analysis of the data of patients who had FAM `T` scale scores of

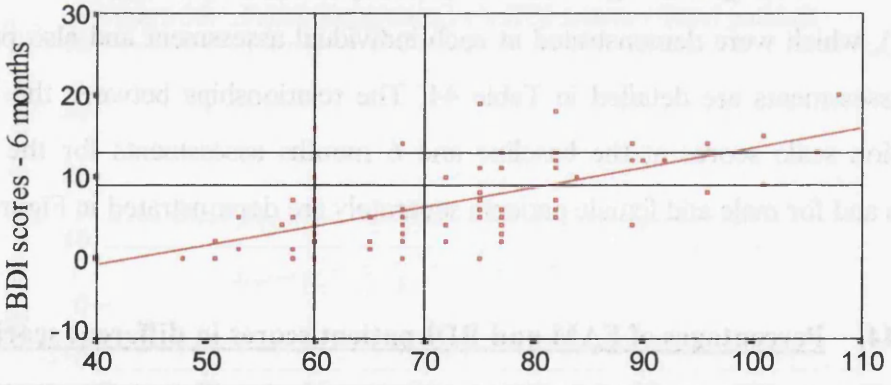
Figure 36. FAM (depression) v`s BDI scores - Male patients



Horizontal and vertical lines represent BDI and FAM `cut-off` values

Diagonal represents regression line

Figure 36a. FAM (depression) v`s BDI scores - Male patients



Horizontal and vertical linesrepresent BDI and FAM `cut-off` values

Diagonal line represents regression line

=>70 for both the characteristics of depression and hypochondriasis, reduced the differences between the outputs of the FAM depression and the BDI scales, such that for female patients the percentages of the combined FAM `T` scores =>70 were almost exactly equal to the percentages of BDI scores =>13, while for male patients they were similar to BDI scores >9.

7.4.9 Summary of FAM and BDI scores

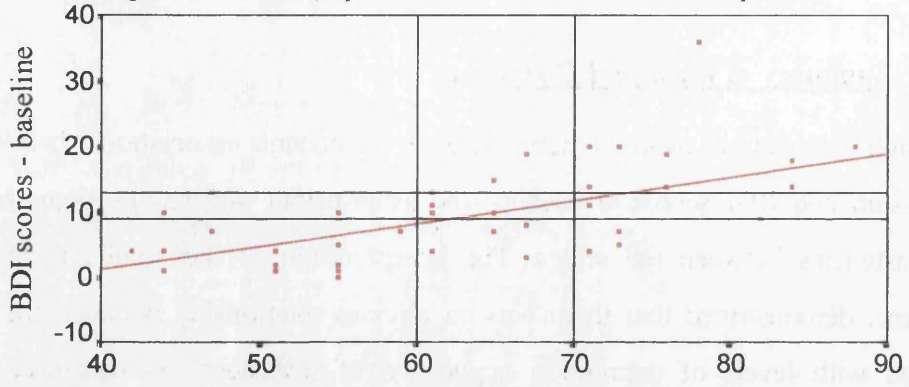
Although correlation analysis demonstrated significant associations between the FAM depression and BDI scores at each of the assessments, the results demonstrated marked inconsistencies between the scales. The interpretation of the results in terms of clinical outcome, demonstrated that there was no obvious relationship between the percentage of patients with levels of depression suggestive of `caseness` as measured by the FAM depression scale with that measured by the BDI scale. Further analysis of the data suggested that incorporating the FAM depression with hypochondriasis scales, where both `T` scores were =>70, reduced the differences between the FAM and BDI scales at each assessment for male and female patients - to a greater extent for females than for males.

7.4.10 Linear regression analysis of FAM scores

Multiple stepwise regression analysis was performed using the 6 months FAM depression score as the dependent variable and then the 6 months BDI score as the dependent variable. The regression analysis was performed using (a) the baseline scores of the FAM scales and (b) the 6 weeks scores of the FAM scales as variables. The final stepwise regression analysis included the baseline and 6 weeks FAM variables together with the location of the infarct.

Regression analysis using the baseline FAM scales as predictor variables, and the 6 months FAM depression score as the dependent variable, demonstrated that for the group of patients as a whole, the baseline FAM depression score contributed 25% to the variance in the final FAM depression score ($R = 0.5$, $R^2 = 0.25$, $F = 0.36$, df 1/108, $p<0.001$; Regression equation FAM Dp3 = 0.48 x Dp + 40.6). For male patients the baseline depression scale contributed 34% to the variance in the final FAM score ($R = 0.58$, $R^2 = 0.34$, $F = 34$, df 1/69, $p<0.001$; Regression equation FAM Dp3 = 0.58 x Dp + 31.7). While for female patients schizophrenia contributed 17% to the variance in the 6 months FAM depression score ($R = 0.38$, $R^2 = 0.17$, $F = 17$, df 1/37, $p<0.001$: Regression equation FAM Dp3 = 0.38 x Sc+48.9).

Figure 37. FAM (depression) v`s BDI scores - Female patients

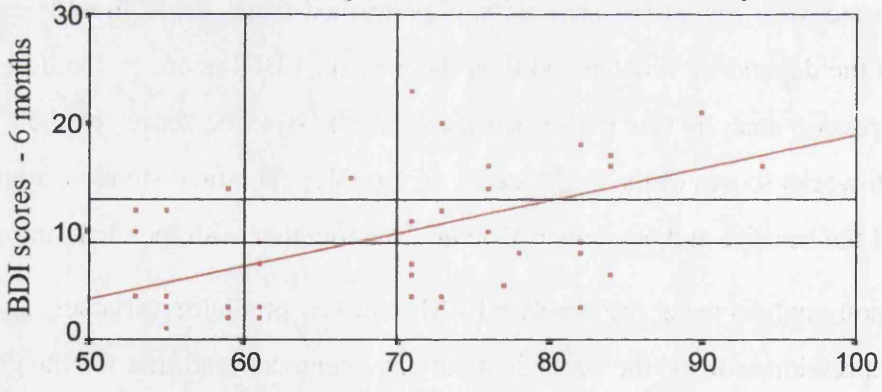


FAM depression `T` scores - baseline

Horizontal and vertical lines represent BDI and FAM `cut-off` values

Diagonal line represents regression line

Figure 37a. FAM (depression) v`s BDI scores - Female patients



FAM depression `T` scores - 6 months

Horizontal and vertical lines represent BDI and FAM `cut-off` values

Diagonal line represents regression line

Using the 6 weeks FAM scales as predictor variables, the results for the whole group of patients, demonstrated that the combination of 6 weeks depression and psychopathic deviate scores contributed 46% to the variance in the final FAM depression score ($R = 0.68$, $R^2 = 0.46$, $F = 46$, df 2/107, $p<0.001$; Regression equation FAM Dp3 = 0.63 x Dp2 - 0.28 x Pd2 + 42.7). For male patients depression and psychopathic deviate, also contributed 48% to the variance in the final FAM depression score ($R = 0.69$, $R^2 = 0.48$, $F = 31$, df 2/67, $p<0.001$; Regression equation FAM Dp3 = 0.67 x Dp2 - 0.31 x Pd2 + 41.7). For female patients depression contributed 39% to the variance in the 6 months FAM depression score ($R = 0.63$, $R^2 = 0.39$, $F = 15$, df=1/38, $p<0.001$; Regression equation FAM Dp3 = 0.55 x Dp2 + 34.6).

In the final regression analysis the combination of the 6 weeks depression and psychopathic deviate scores, together with the laterality of the infarct, contributed 50% to the variance in the 6 months FAM depression score for the total patient group ($R = 0.71$, $R^2 = 0.50$, $F = 30$, df =3/89, $p<0.001$; Regression equation FAM Dp3 = 0.63 x Dp2 - 0.3 x Pd2 - 5.3 x laterality of infarct + 46.1). For male patients, baseline and 6 weeks depression scores and 6 weeks psychopathic deviate scores plus the laterality of the infarct, contributed 56% to the final FAM depression score ($R = 0.75$, $R^2 = 0.56$, $F = 17$, df 4/53, $p<0.001$; regression equation FAM Dp3 = 0.25 x Dp + 0.54 x Dp2 - 0.32 x Pd2 - 6.2 x Laterality of infarct + 36.6). For female patients, the 6 weeks depression score alone contributed 41% to the variance in the 6 months depression score ($R = 0.64$, $R^2 = 0.41$, df 1/35, $F = 23$, $p<0.001$; Regression equation FAM Dp3 = 0.56 x Dp2 + 33.9).

Using the 6 months BDI score as the dependent variable, and the baseline and 6 weeks FAM scores as predictor variables, the combination of the 6 weeks psychasthenia, schizophrenia and social introversion scores contributed 43% to the variance in the 6 months BDI score for the total group of patients ($R = 0.66$, $R^2 = 0.43$, $F = 22$, df 3/90, $p<0.001$ Regression equation BDI3 = 0.16 x Pt2 + 0.15 x Sc2 + 0.15 x Si2 - 18.3). For male patients, the baseline depression and 6 weeks psychasthenia scores contributed 42% to the variance in the final BDI score ($R = 0.65$, $R^2 = 0.42$, $F = 20$, df 2/55, $p<0.001$; Regression equation BDI3 = 0.12 x BDI + 0.18 x Pt2 - 12.4). For female patients, the 6 weeks schizophrenia score contributed 52% to the variance in the 6 months BDI score ($R = 0.72$, $R^2 = 0.52$, $F = 37$, df 1/34, $p<0.001$; Regression equation BDI3 = 0.42 x Sc2 - 14.2).

Table 46. Mean FAM `T` scores - total group of carers

FAM scale	Baseline		6 Weeks		6 Months	
	mean	std dev	mean	std dev	mean	std dev
L	49.9	7.9	49.8	7.5	50.5	9.7
F	56.7	11.6	56.7	10.4	57.6	11.6
K	51.7	9.7	52.9	9.4	53.1	9.4
Depression	61.2	14.6	62.7	11.8	59.4	12.7
Hypochondriasis	59.3	10.2	60.6	10.9	59.1	12.0
Hysteria	56.0	8.7	57.6	9.6	55.7	9.4
Hypomania	54.4	11.3	54.0	9.7	52.4	9.8
Gender	51.4	11.8	48.1	12.5	51.4	12.2
Paranoia	51.9	7.8	54.6	7.7	53.2	8.8
Psychopathic dev	50.0	10.3	51.4	11.8	52.0	12.5
Psychasthenia	55.8	14.3	56.7	15.4	53.0	13.7
Schizophrenia	54.2	12.1	55.1	14.4	54.8	14.5
Social introvert	63.1	12.2	62.6	11.9	62.1	12.4

Table 48. Mean FAM `T` scores - Male carers

FAM scale	Baseline		6 Weeks		6 Months	
	mean	std dev	mean	std dev	mean	std dev
L	51.2	9.2	51.2	8.8	52.2	11.4
F	59.9	10.8	59.6	11.9	61.5	13.6
K	53.9	8.8	53.6	9.4	53.5	8.6
Depression	63.4	16.7	67.5	14.8	64.2	16.7
Hypochondriasis	62.3	11.4	63.6	12.4	59.6	15.4
Hysteria	57.2	7.4	60.0	10.1	56.1	9.6
Hypomania	58.4	9.5	53.2	11.4	54.5	9.9
Gender	60.7	8.9	58.6	7.8	62.4	5.5
Paranoia	50.5	7.8	53.8	9.5	54.9	9.1
Psychopathic dev	54.0	6.6	57.2	10.8	56.2	11.7
Psychasthenia	57.0	16.5	59.8	19.3	56.3	15.9
Schizophrenia	55.9	12.5	60.7	18.4	60.2	17.7
Social introvert	59.0	11.7	61.3	12.5	60.5	14.9

Table 49. Mean FAM `T` scores - Female carers

FAM scale	Baseline		6 Weeks		6 Months	
	mean	std dev	mean	std dev	mean	std dev
L	49.1	7.0	48.9	6.6	49.4	8.6
F	54.7	11.9	54.9	9.2	55.1	9.7
K	50.2	10.2	52.5	9.6	52.9	10.1
Depression	61.1	13.5	59.8	8.7	56.6	8.6
Hypochondriasis	57.4	9.2	58.6	9.8	58.8	9.7
Hysteria	55.3	9.6	56.1	9.1	55.5	9.4
Hypomania	51.9	11.8	54.5	8.8	51.1	9.7
Gender	45.7	9.6	41.7	10.4	44.6	10.1
Paranoia	52.9	7.7	55.1	6.6	52.1	8.8
Psychopathic dev	47.5	11.5	47.8	11.2	49.4	12.5
Psychasthenia	55.0	13.2	54.7	12.7	50.9	12.1
Schizophrenia	53.1	11.9	51.6	10.4	51.5	11.4
Social introvert	65.7	12.1	63.4	11.7	63.1	10.8

7.4.11 FAM scores - Carers

The numbers and percentages of carers who completed the FAM are detailed in Table 45. Of the original cohort of 45 carers, 76% completed all three assessments.

Table 45. Summary of carers completing the FAM scales

Completed Assessments	Total Carers	%	Male Carers	%	Female Carers	%
FAM Baseline (1)	45	100	17	100	28	100
FAM 6Weeks (2)	36	80	13	76	23	82
FAM 6Months (3)	40	89	15	88	25	89
FAM (1+2+3)	34	76	13	76	21	75

The means and standard deviations of the FAM 'T' scores for each of the three assessments for carers as a whole group are detailed in Table 46 and the medians and interquartile ranges are detailed in Table 47 (Appendix).

(a) Correlation and significant differences in FAM scores for carers

Inspection of the data demonstrates that none of the baseline mean scores for any of the FAM scales reached a 'T' score of 70 and the two-point scale profile for each assessment was social introversion and depression. There were no mean scale differences between the assessments for any of the scales involving 5 or more scale points, therefore no analysis of significant differences between the data was performed. Pearson correlation analysis of the data demonstrated significant correlations ($p<0.001$, $r\sim 0.6$-0.8) between the assessments for all of the scales for the group as a whole and also for male and female carers when taken as separate groups.

(b) Mean FAM scale scores for carers related to gender

The summary of the means and standard deviations of the FAM 'T' scores for each of the three assessments for male and female carers are detailed in Tables 48 and 49. The summaries of the medians and interquartile ranges for male and female carers are detailed in Tables 50 and 51 (Appendix). Profiles of mean FAM 'T' scores for male and female carers are shown in Figures 38 and 39.

Inspection of the data demonstrates that there were no mean scale 'T' scores = >70 for any of the scales for any of the assessments for male or female carers. Analysis of the data demonstrated that 15% of male carers and 5% of female carers had persistently elevated

Figure 38.

FAM mean scores - Male carers

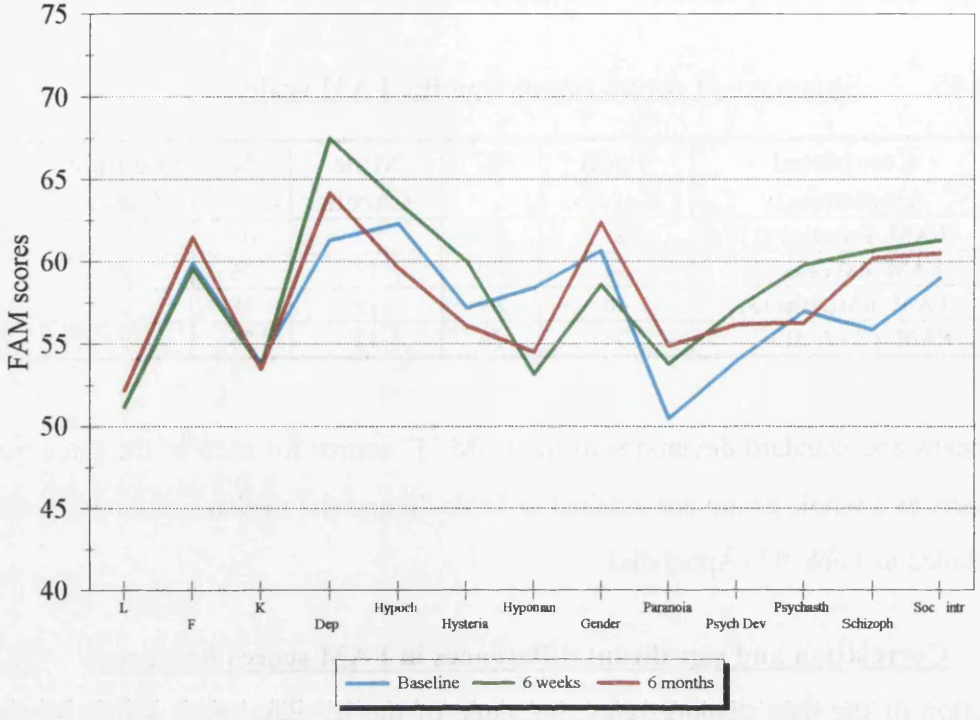
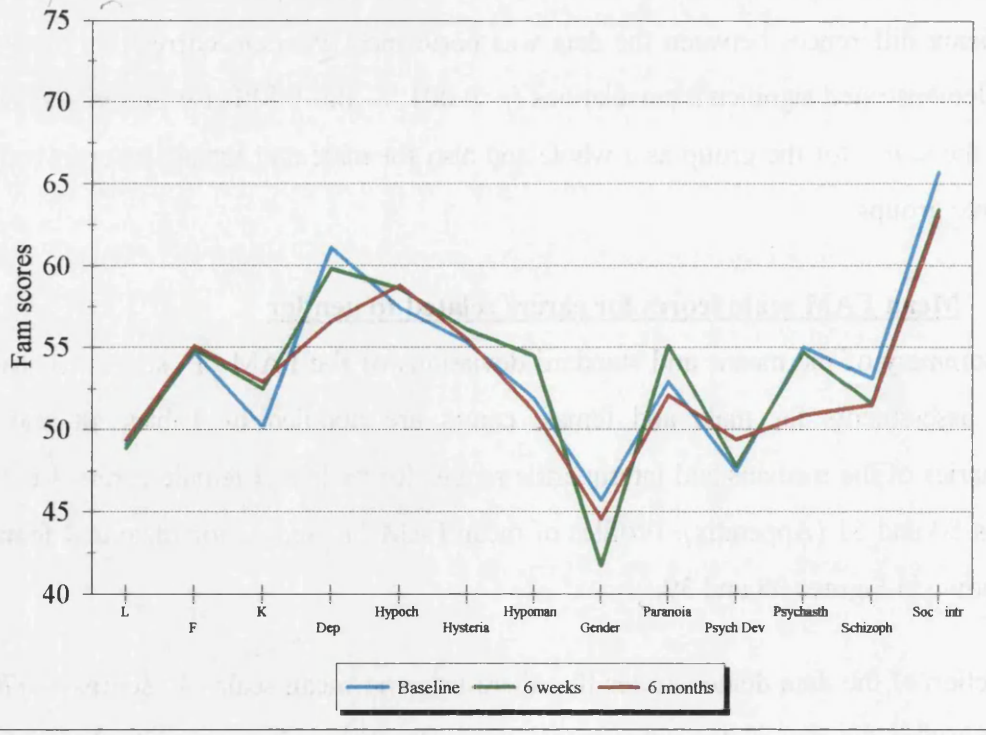


Figure39.

FAM mean scores - Female carers



depression `T` scale scores =>70. Correlation analysis demonstrated significant associations ($p = 0.01$, $r \sim 0.5\text{-}0.7$), and no significant differences between assessments for any of the scales for male and female carers. No significant differences were demonstrated between male and female carers for any of the FAM scores for any of the assessments.

(c) Comparison of FAM and BDI scores of carers

Significant correlations ($p<0.01$, $r \sim 0.4\text{-}0.5$) were demonstrated between the BDI and FAM scores of the total group of carers for each of the assessments for the depression, psychasthenia, schizophrenia and social introversion scales, hypochondriasis and hysteria scales. When the data were analysed for male and female carers separately the number of significant correlations noted was considerably reduced. There were no significant changes in any of the FAM scales for any of the BDI scoring classifications (ie.<=9, >9, =>13). In keeping with the patient data, considerable differences in the percentages of FAM depression `T` scores and BDI scores representing `caseness` were demonstrated for carers at each assessment, and also persistently over the 3 assessments (Table 52).

Table 52. Percentages of FAM and BDI carer scores in different scoring categories

Assessment	% FAM scores =>70			% BDI scores >9			% BDI scores =>13		
	Total	Males	Females	Total	Males	Females	Total	Males	Females
Baseline (1)	24	15	29	25	8	48	18	8	24
6 Weeks (2)	29	46	19	20	23	29	23	23	24
6 Months (3)	18	31	10	25	23	38	29	23	33
Assess (1+2+3)	9	15	5	14	8	24	12	8	14

Table 53. Percentages of FAM Depression `T` scores =>70 - carers and patients

	Carers			Patients		
Assessment	% FAM scores =>70			% FAM scores =>70		
	Total	Males	Females	Total	Males	Females
Baseline (1)	24	15	29	36	45	30
6 Weeks (2)	29	46	19	50	53	43
6 Months (3)	18	31	10	57	53	63
Assess (1+2+3)	9	15	5	26	30	20

Although differences between the percentages of FAM depression `T` scores =>70 and the BDI scores =>13 are not as marked for carers as they are for patients, there is no relationship in the pattern of `caseness` demonstrated by each of the scales for carers.

However, there is no obvious relationship between the percentages of FAM depression `T` scores =>70 between patients and carers, as demonstrated in Table 53.

7.4.12 Comparison of FAM scores between patients and carers

Initial inspection of the data for the patient and carer groups as a whole, demonstrated that the majority of the mean scores of the patients for each of the FAM scales at each of the assessments, was higher than the mean scores of the carers. Unpaired t-tests demonstrated significant differences between patients and carers for the following scales:-

Baseline assessment

Depression	p = 0.005, md = 7.0, t = 2.9, df 149, 95% CI 2.1, 11.8
Hypochondriasis	p = 0.003, md = 7.5, t = 3.0, df 149, 95% CI 1.0, 11.9
Schizophrenia	p = 0.003, md = 7.7, t = 3.0, df 149, 95% CI 1.7, 12.2

6 weeks assessment

Depression	p = 0.003, md = 7.8, t = 2.9, df 151, 95% CI 2.1, 11.8
Hypochondriasis	p = 0.02, md = 6.5, t = 2.3, df 149, 95% CI 1.0, 11.9
Schizophrenia	p = 0.01, md = 7.0, t = 2.5, df 151, 95% CI 1.6, 12.3

6 months assessment

Depression	p = 0.001, md =12.3, t=5,2, df 167, 95% CI 7.6, 16.9
Hypochondriasis	p = 0.001, md = 8.9, t= 3.5, df 167, 95% CI 3.9, 13.9
Schizophrenia	p = 0.009, md = 6.9, t=2.6, df 167, 95% CI 1.7, 12,2

These results demonstrate that there were consistent significant differences between patients and carers for depression, hypochondriasis and schizophrenia over the 6 months from the onset of the stroke. These differences were due to patients having higher FAM scale scores.

Gender analysis of the data demonstrated significant differences between female patients and female carers at the 6 months assessment for the following scales, but no significant differences between male patients and male carers:-.

Depression	p = 0.001, md = 13.9, t = 5.0, df 63, 95% CI 8.4, 19.5
Hypochondriasis	p = 0.002, md = 9.3, t = 3.3, df 63, 95% CI 3.5, 15.0
Schizophrenia	p = 0.003, md = 16.3, t = 3.9, df 63, 95% CI 3.6,16.9

The results show that the significant differences in characteristics between female patients and female carers were not present at the onset of the stroke, and this suggests that the changes in these characteristics developed as a consequence of stroke in female patients.

7.4.13 Linear regression analysis of FAM scores for carers

Stepwise linear regression analysis was performed using the 6 months FAM depression score as the dependent variable and the baseline and 6 weeks FAM scale scores separately as predictor variables. The results demonstrated that for the group of carers as a whole, the baseline FAM depression score contributed 46% to the variance in the 6 months FAM depression score ($R = 0.68$, $R^2 = 0.46$, df 1/37, $F = 31$, $p<0.001$; Regression equation FAM Dp3=

0.6 x Dp + 23.3). For male carers a combination of baseline depression and social introversion scores contributed 74% to the variance in the 6 months FAM depression score ($R = 0.86$, $R^2 = 0.74$, df 2/12, $F = 17$, $p < 0.001$; Regression equation FAM Dp3 = 0.48 x Dp + 0.67 x Si - 4.6) while for female carers the combination of the baseline depression and paranoia scores contributed 47% to the variance in the 6 months FAM depression score ($R = 0.69$, $R^2 = 0.47$, $F = 9.4$, df 2/21, $p = 0.001$; Regression equation FAM Dp3 = 0.44 x Dp + 0.43 x Pa + 7.5).

Linear regression analysis using the 6 weeks FAM scores as independent variables demonstrated that for the total group of carers the depression score contributed 66% to the variance in the 6 months FAM depression score ($R = 0.81$, $R^2 = 0.66$, $F = 64$, df 1/33, $p < 0.001$; Regression equation FAM Dp3 = 0.86 x Dp2 + 5.2). For male carers the 6 weeks FAM depression score contributed 71% to the variance in the final FAM depression score ($R = 0.84$, $R^2 = 0.71$, $F = 27$, df1/11, $p<0.001$; Regression equation FAM Dp3 = 0.96 x Dp2 - 0.5) and for female carers the 6 weeks depression score contributed 49% to the final depression score ($R = 0.7$, $R^2 = 0.49$, df 1/20, $F = 19$, $p<0.001$; Regression equation FAM Dp3 = 0.68 x Dp2 +16.1)

In the final stepwise regression for the total group of carers the results showed that the 6 weeks FAM depression score significantly contributed 66% to the variance in the 6 months FAM depression score ($R = 0.81$, $R^2 = 0.66$, $F = 62$, df 1/32, $p<0.001$; Regression equation FAM Dp3 = 0.87 x Dp2 + 4.9). For male carers the combination of the baseline social introversion and 6 weeks depression scores contributed 90% to the variance in the final FAM depression score ($R = 0.95$, $R^2 = 0.9$, $F = 43$, df 2/10, $p<0.001$; Regression equation FAM Dp3 = 0.7 x Dp2 + 0.7 x Si2 - 24.1) while for female carers the 6 weeks FAM depression score contributed 48% to the variance in the final FAM depression score ($R = 0.69$, $R^2 = 0.48$, $F = 18$, df 1/19, $p<0.001$; Regression equation FAM Dp3 =- 0.7 x Dp2 + 15.8).

7.4.14 Summary of FAM scores

(a) Total group - Patients

The results of the FAM scales for patients demonstrated a number of features;
(a) a significant increase in depression scale scores, (b) a high percentage of patients had elevated `T` scores at each of the three assessments for depression and hypochondriasis and (c) 27% of patients had persistently elevated depression and hypochondriasis scores.

Comparing patients with right and left CVA`s demonstrated that patients with right CVA`s significantly increased their depression scale scores. Furthermore, the percentage of patients

with right CVA's and who had mean depression 'T' scores =>70, increased from 43% - 62% compared with an increase of 38% - 47% for patients with left CVA's. Linear regression analysis demonstrated that the baseline depression score contributed 25% to the variance in the final FAM depression score, while the combination of the 6 weeks depression and psychopathic deviance scores contributed 50% towards the variance in the final FAM depression score.

Although there were significant associations between the FAM and BDI scores at each of the assessments, there were also marked differences between the scales in the classification of affective status which they demonstrated. However when the FAM depression and hypochondriasis scales were combined, it altered the proportions of the observed differeces..

Total group - Carers

The results of carers demonstrated no significant 'T' scale scores at any of the assessments. There were no significant changes in scores over the 6 months for any of the scales. The results of linear regression analysis demonstrated that the baseline and/or 6 weeks depression scales contributed significantly to the variance in the final FAM depression score, to a greater extent than patients. There were no significant differences between male and female carers for any of the scales.

Comparing patients and carers

Comparison of the patients and carers demonstrated that patients had significantly higher scores at each of the assessments for the depression, hypochondriasis, schizophrenia and hysteria scales. The percentages of significant 'T' scores for depression and hypochondriasis at each of the assessments, and also collectively, was higher for patients.

(b) Male patients

For male patients there were no significant changes in 'T' scores for any of the scales, but 30% of male patients had persistently elevated 'T' scale scores for depression and 33% for hypochondriasis. There were minimal differences in any of the scales due to the laterality of the CVA. The results of linear regression analysis demonstrated that baseline depression alone, and the combination of the 6 weeks depression and psychopathic deviance scores significantly contributed to the variance in the final FAM depression scores.

Male carers

There were no significant `T` scores for any of the FAM scales. There were no significant changes in scores over the 6 months for any of the scales. Linear regression analysis demonstrated that the combination of baseline depression and social introversion scores or the 6 weeks depression and social introversion scales significantly contributed to the variance in the final FAM depression score to a greater extent than male patients.

Comparing male patients and carers

There were no significant differences in any of the scales between male patients and male carers. However it was noted that 15% of male carers had persistently elevated depression scale scores compared with 30% of male patients, while 23% of male carers had persistently elevated psychasthenia scale scores compared with 7% of male patients.

(c) Female patients

Significant increases in scores were noted between baseline and 6 months for the depression, hypochondriasis and hysteria scales for female patients and >20% of patients demonstrated persistent `T` scale scores >70 for depression and social introversion. Significant increases in depression and hypochondriais were noted for female patients with right CVA`s and a significant increase in depression for left CVA`s. The results of linear regression analysis demonstrated that the 6 weeks depression score significantly contributed to the variance in the final FAM depression score.

Female carers

Female carers demonstrated no significant differences between any of the assessments for any of the scales and no significant `T` scores for any of the scales, but had significantly lower depression, schizophrenia, psychopathic deviate, hysteria and hypochondriasis at 6 months compared with female patients. The results of linear regression analysis demonstrated that baseline depression and paranoia significantly contributed to the final FAM depression score but that the 6 weeks depression score was a marginally better predictor variable.

Comparing female patients and carers

Significant differences were noted at the 6 months assessment for depression, hypochondriasis and schizophrenia scales. It was noted that >20% of female patients had persistently elevated depression `T` scale scores compared with 5% of female carers. As with male carers, linear regression analysis demonstrated that the predictive value of baseline and 6 weeks characteristics were better for female carers compared with female patients.

7.4.15 Discussion

Virtually all of the empirical studies dealing with the specific relationship between brain damage and personality have used the MMPI. However, while the majority of these investigations have included patients with brain damage of various aetiologies including CVA patients, very few studies have used the MMPI to assess the specific effects of stroke. In a review of these studies, Burns et al.(1994) demonstrated that elevated MMPI profiles were common among brain injured patients, and that one of the most pathological expressions of emotion associated with deficits in neuropsychological performance was depression.

In the case of closed head injury (CHI) research, consistent profile elevations particularly involving the hysteria, hypochondriasis, depression and schizophrenia scales have typically been found when the MMPI has been used as an objective descriptive measure of personality and emotional functioning. In a study by Gass and Ansley (1994), the authors comment that the type of neuropsychological impairment is an important variable in the emotional adaptation to brain injury, irrespective of the diagnosis, and that psychological reactions commonly occur in response to CVA related impairments such as aphasia, hemiparesis and other disabilities which restrict functional independence. The results of the current study demonstrated elevated mean 'T' scores >60 at each of the assessments for the depression, hypochondriasis, hysteria, schizophrenia and introversion scales, which are in keeping with Burns et al.(1994). The study also demonstrated no relationship between aphasic deficit and overall MMPI pathology, which is also in keeping with the studies of CVA and head injury (HI) patients by Gass and Russell (1985) and Cullum and Bigler (1988).

The percentages of pathological mean 'T' scores =>70 are also similar to those of Cullum and Bigler (1988, 1991) who studied CVA and head injury (HI) patients with evidence of predominantly lateralized cerebral damage, over a period of 6 months. With reference to the psychological impact of hemiparesis, previous studies have tended to focus on the relationship between the MMPI profiles and the laterality of the neurological trauma, and also on the duration of the time from the onset of the trauma. In their study of CVA and HI patients, Cullum and Bigler (1988) demonstrated that RHD and LHD patients produced similar overall MMPI profiles for both CVA and head injury patients. These authors commented that the results of a number of studies have indicated that cerebral damage, regardless of laterality of injury, tends to result in similar overall patterns of psychological distress as assessed by the MMPI.

However they also postulate that RHD and LHD patients cope differently with acquired deficits because of differences in their manner of processing affect related information.

In the current study the results relating the location of infarct to the MMPI scores demonstrated that the overall profiles of the patients with right and left CVA`s were similar. However, mean scale elevations were noted for each of the assessments for the characteristics of depression, hypochondriasis, hysteria, schizophrenia and social introversion for patients with right CVA`s while for patients with left CVA`s there were mean `T` scale elevations for depression, hypochondriasis and social introversion only. It was also noted that patients with right CVA`s had significant mean `T` scale scores for the depression scale at the 6 weeks and 6 months assessments and demonstrated significant increases in the depression and hypochondriasis scales over the 6 months. In contrast, patients with left CVA`s had no significant `T` scale scores for any of the scales for any of the assessments and demonstrated a significant increase in the depression scale only. When the scores of the groups were directly compared, results showed that patients with right CVA`s demonstrated significantly higher hypochondriasis and hysteria scale scores at the 6 months assessment compared with patients with left CVA`s.

The MMPI plays a major role in neuropsychological research and practice and a considerable literature exists concerning the MMPI and neuropsychological dysfunction. It is noted however, that the samples used in previous studies have been composed primarily if not exclusively of males (veterans). In the few studies that have considered gender as a factor, the results have been varied. For instance in a study of closed head injury (CHI) patients, Alfano et al.(1992) demonstrated different profiles for males and females. In contrast, the study by Cullum and Bigler (1988) of CVA and HI patients demonstrated few overall differences between male and female patients for the majority of the MMPI scales.

In the current study there were a number of significant differences in MMPI scores between male and female patients. There were significantly higher scores for male patients at the baseline and 6 weeks assessments for depression, hypochondriasis and psychopathic deviancy, while female patients demonstrated significantly higher scores at the 6 weeks and 6 months assessments for social introversion and also at the 6 months assessment for paranoia. It was also demonstrated that there were no significant changes in the scores of any of the scales for male patients, while female patients demonstrated significant increases in depression, hypochondriasis and hysteria over the 6 months.

It was also noted that the percentages of male patients with persistently significant depression and hypochondriasis scale scores were 30% and 33% respectively, compared with 21% and 15% for female patients, and that the percentages of `T` scale scores at each of the assessments for male patients for depression (45%,53%,53%), hypochondriasis (45%, 48%, 51%) and schizophrenia (28%, 26%, 23%) were more stable over the 6 months. In contrast, there were marked increases in the percentages of depression (30%,43%, 63%) hypochondriasis (31%, 26%, 41%) and schizophrenia (21%, 18%, 33%) for female patients.

Comparing the FAM scores of patients and carers demonstrated significantly higher depression, hypochondriasis and schizophrenia scale scores for patients. Further analysis of the data with respect to gender demonstrated minimal differences in scores at any of the assessments between male patients and male carers. However female patients demonstrated significantly higher scores compared with female carers at 6 months for the depression, hypochondriasis, schizophrenia, psychasthenia, psychopathic deviancy and hysteria scales. Further analysis of the data for the carers demonstrated no significant changes in any of the scales over the 6 months, whereas for patients, particularly female patients, there were significant increases in the depression scale scores.

The results of this study have shown that patients suffering from stroke demonstrate levels of pathology in a number of personality characteristics, of which depression is the most common. The persistently elevated levels of certain characteristics, suggest as previously, that patients were either pathologically affected by the stroke from the onset and remained in this state thoughout the 6 months of the study, or that these characteristics were inherent and predated the stroke. What is difficult to explain from these results, is the presentation of the different patterns of FAM characteristics which were demonstrated between male and female patients over the 6 months of the study. These include the high percentage of pathological levels of depression and hypochondriasis that were shown to be reasonably stable in male patients, in comparison with female patients who demonstrated lower levels of these characteristics initially, but significantly increased their scores over the 6 months. It may be that the characteristic of hypochondriasis is more relevant in female patients, and consequently becomes more significant after stroke, and as a result could perhaps aggravate the affective status of female patients to a greater extent than males.

The above results cannot be compared directly to the results of other researchers, since longitudinal studies giving detailed profiles of male and female CVA patients, using the

MMPI have not previously been performed. Nevertheless the results do tend to suggest that the stroke had an effect on the personality profiles of patients generally, and that for female patients, the psychological response to the effects of stroke over time was more profound than for male patients. The differences between patients and carers, with respect to persistently elevated personality characteristics, suggests that these pathological characteristics, particularly in male patients, may have been present prior to the stroke.

The differences in the classifications of depression, between the BDI and FAM depression scales, with reference to the level of `caseness` and also to the overall pattern of affective status over the 3 assessments, was an important observation, since the differences affected both patients and carers. The demonstration that the combination of the FAM characteristics of depression and hypochondriasis, produced results which were more compatable with those of the BDI, suggests that the MMPI depression scale on it`s own should not be used as a diagnostic marker for depression and confirms the recommendations by the authors of the scale, Hathaway and McKinley, 1951, that a diagnostic interpretation of the MMPI scales should be based on a two point code representing the two highest clinical scale scores.

Comparisons of the format of the FAM and BDI scales have highlighted differences in their content and construct that might account for some of the observed differences, viz. that 29% of the questions in FAM depression scale have a somatic content in comparison with 19% of the questions in the BDI scale. Furthermore, the questions in the BDI scale are graded, to allow for a degree of response, whereas in the the FAM scale the answers to the questions are simple `true/false` format. In light of the fact that the BDI has previously been evaluated as an effective assessment tool in studies of post-stroke depression (House et al., 1991). In the current study, the observed differences between the results of the BDI and FAM suggest that an evaluation of the FAM scale, in relation to a clinical diagnosis of depression in the presence of physical disability, might identify potential influences of physical disability on the interpretation of the results obtained.

7.4.16 Conclusions

In this study the MMPI was used in the abbreviated form (FAM) to measure the profiles of the personality characteristics of patients who had suffered from the neurological trauma of stroke, and of the carers of the patients who had not. It was expected that if the stroke did not create a psychological impact on the personality of the patients then the characteristics being measured by the MMPI would be stable and would not significantly change over a

period of 6 months. In this regard, the stability of the data was highlighted by the results of the carers, who demonstrated no significant changes over 6 months. In contrast to the carers, the patients in the current study demonstrated higher mean scores for each of the assessments as well as elevations in the characteristics of depression, hypochondriasis and schizophrenia. These characteristics have been demonstrated previously in studies of neurologically impaired patients.

In keeping with other studies the results have also shown that depression is the most significant affective sequelae of stroke in both male and female patients. However, the results have also demonstrated that the manifestation of this characteristic is quite different for male and female patients, both in the acute phase and also over time. In this study a high percentage of male patients had persistently significant depression scores which were present from the onset of the stroke and which did not change significantly with time, whereas female patients had lower levels of persistently significant depression scores, but significantly increased their depression hypochondriasis, hysteria and schizophrenia scale scores over the 6 months. The results also demonstrated that factors associated with significant changes in the affective state of female patients were the presence of a right CVA, and a `normal` baseline affective state as measured by the BDI. This outcome is in keeping with the outcomes of the BDI and Eysenck scores.

The conclusion from the study using the abbreviated MMPI, is that depression accompanied by hypochondriasis are the most significant psychological sequelae of stroke in both males and females and that female patients are affected to a greater extent than males. The FAM results have also shown that changes in the affective status of female patients are accompanied by, or are encompassed in, changes in other personality characteristics. This suggests that anecdotal evidence of personality change in patients after stroke, previously referred to by carers, may be measurable. It is also concluded that levels of affective status, measured at different time periods after the onset of stroke, must be considered in relation to persistent levels of affective disorder which may be present from the onset of stroke. These may be representative of levels of affective disorder prior to the stroke. The analyses of the data in this study have demonstrated that different questionnaires that are commonly used in the assessment of affective disorder can alter the proportions of significant results obtained.

The results have also highlighted the fact that the gender of the patients should be considered as a factor in this type of research.

Table 54. **Baseline blood measurements for total group of patients**

Clinical Measurement	Normal Range	Whole Group of patients				
Biochemistry		**Mean**	**SD**	**Median**	**Q1**	**Q3**
Sodium	135-144	139	5.2	139	137	140
Potassium	3.5-5.1	4.12	4.1	4.1	3.7	4.4
Chlorine	97-108	103	2.0	104	102	105
CO^2	22-32	22.3	2.8	25	23	27
Urea	2.5-7.5	5.8	2.1	5.6	4.5	7.0
Creatinine	60-110	92	7	90	75	103
Calcium	2.2-2.65	2.28	0.11	2.3	2.2	2.4
Phosphate	0.8-1.45	1.02	0.19	1.0	0.9	1.1
Protein	60-77	65	95	66	63	70
Albumin	36-50	44.0	7	42	40	44
Billirubin	3-18	11.5	5.1	11	8	15
Alk. Phos	70-260	201	72	187	154	255
Gamma GT	5-50	37	23	29	21	44
AST	10-35	19	8.3	19	13	23
ALT	10-50	22.5	14.4	20	14	25
Urate	0.1-0.42	0.44	1.01	0.3	0.28	0.36
Glucose	2.8-6.0	7.6	3.6	6.5	5.6	8.4
Haematology						
WCC	4 - 11	8.3	2.6	8.1	6.5	9.6
RBCC	3.9 - 6.5	4.6	0.6	4.6	4.3	4.9
Haematocrit	0.35- 0.54	0.4	0.04	0.41	0.38	0.44
Haemoglobin	12-18	14.2	1.5	14.4	13.4	15.2
Platelets	150-400	250	63	248	2.6	290
Endocrine						
Cholesterol	3-6.5	5.9	1.51	5.8	5.1	6.8
Triglycerides	<2.1	1.6	0.9	1.4	1.1	1.9
PT	15	15.8	4.7	15	14	16
PT control	15	15.6	0.7			
PTT	40	40	7.6	39	37	43
PTT control	40	41	1.6			

7.5 Baseline Biochemistry, haematology and endocrinology measurements

7.5.1 Introduction

When patients are admitted to the Acute Stroke Unit, a comprehensive blood analysis is done as soon as possible after admission. For the patients in this study, details of the baseline blood measurements were documented from the patient case records, to determine if there was an association between baseline blood characteristics and the level of affective disorder in the 6 months period after stroke.

A summary of the means, standard deviations, medians and interquartile ranges of the blood measurements, together with the `normal` ranges for each of the blood measurements, are given in Table 54 for the patient group as a whole and also in tables 55 and 56 for male and female patients separately.

7.5.2 Miscellaneous associations and blood analysis

The results demonstrated minimal associations between the outcome of the blood analysis and the presence of the risk factors detailed previously. For male patients with a history of cardiac illness the results demonstrated significantly higher levels of urea ($p = 0.006$, $t = 2.8$, md = 1.1, df 72, 95% CI 0.3,1.9) compared with male patients without a history of cardiac illness. Patients with diabetes demonstrated significantly lower levels of chlorine ($p = 0.001$, $t = -3.5$, md = -2.8, df 108, 95% CI -3.7, -1.0) and significantly higher levels of potassium ($p = 0.003$, $t = 3.0$, md = 0.4, df 117, 95% CI 0.1,0.6) and glucose ($p=0.001$, $t =4.2$, md =7.2, df 11, 95% CI 3.4, 10.9), when compared with patients without diabetes. Female patients who smoked had significantly lower levels of bilirubin ($p=0.001$, $t = -3.7$, md = -5.8, df 38, 95%CI -9.0, -2.6) compared with those who did not smoke.

In relation to the physical effects of stroke, the results demonstrated no significant association between any of the blood measurements and level of disability as measured by the Barthel Index score. There were also no significant differences in any of the blood measurements between patients with right or left CVA`s nor between patients who were dysarthric or dysphasic. These outcomes were relevant for the group as a whole and also for male and female patients when considered as separate groups.

Table 55. Baseline blood measurements for Male patients

Clinical measurement	Normal range	Male patients				
Biochemistry		**Mean**	**SD**	**Median**	**Q1**	**Q3**
Sodium	135-144	139	3	139	137	140
Potassium	3.5-5.1	4.2	0.45	4.1	3.9	4.4
Chlorine	97-108	103	2.4	103	102	105
CO^2	22-32	25	2.8	25	24	27
Urea	2.5-7.5	5.8	1.76	5.7	4.8	6.9
Creatinine	60-110	96	19.0	94	82	111
Calcium	2.2-2.65	2.28	0.11	2.3	2.2	2.4
Phosphate	0.8-1.45	1.0	0.19	1.02	0.9	1.1
Protein	60-77	65	10	67	63	71
Albumin	36-50	44	6	42	40	45
Billirubin	3-18	12	5	13	9	15
Alk. Phos	70-260	201	67	186	156	262
Gamma GT	5-50	41	23	34	23	56
AST	10-35	19	7.5	19	13	23
ALT	10-50	25	16	22	16	28
Urate	0.1-0.42	0.34	0.07	0.3	0.3	0.3
Glucose	2.8-6.0	7.6	3.8	6.4	5.6	8.1
Haematology						
WCC	4 - 11	8.5	2.7	8.3	6.6	9.5
RBCC	4.5 - 6.5	4.8	0.56	4.8	4.6	5.1
Haematocrit	0.40- 0.54	0.42	0.04	0.42	0.4	0.44
Haemoglobin	13-18	14.8	1.27	14.9	14.2	15.5
Platelets	150-400	238	58	235	201	269
Endocrine						
Cholesterol	3-6.5	6	1.4	5.8	5.4	6.8
Triglycerides	<2.1	1.64	1.03	1.4	1.0	1.9
PT	15	15.4	3.6	15	14	16
PT control	15	15.7	0.72			
PTT	40	39.5	6.74	39	37	43
PTT control	40	41	1.73			

7.5.3 Gender differences

Comparing the blood results of male and female patients demonstrated significant gender differences for the following measurements:-

Platelets	p=0.005, t = -2.9, df 113, md =-34.7, 95% CI -58.7, -10.8	(females>males)
RBC	p<0.001, t = 4.9, df 117, md = 0.51, 95% CI 0.3, 0.7	(males > females)
Haematocrit	p<0.001, t = 4.8, df 114, md = 0.04, 95% CI 0.02,0.05	(males > females)
Haemoglobin	p<0.001, t = 6.3, df 115, md = 1.6, 95% CI 1.1, 2.1	(males > females)
ALT	p=0.001, W 1445, Z = -3.2, U = 742	(males > females)
GGT	p<0.001, W 1702.5, Z = -3.5, U = 882	(males > females)

The significant differences demonstrated between male and female patients for haematocrit, RBC and haemoglobin measurements are not unexpected since the `normal` ranges for these measurements are higher in males compared with females.

When the laterality of the cerebral infarct was considered, significant differences in blood measurements were noted between male and female patients with right CVA`s only. These differences are detailed below:-

GGT	p = 0.007, U = 225, W= 501, Z= -2.1	males > females
ALT	p = 0.009, t = 2.7, md=10.9, df 47, 95% CI 2.8, 18.9	males > females
Platelets	p = 0.001, t = -3.6, md= -51, df 53, 95% CI -79, -22	females > males

7.5.4 Baseline blood measurements and BDI scores

Correlation analysis between BDI scores and blood analysis results demonstrated no significant associations between the baseline blood measurements and any of the BDI scores, either for the group as a whole, or when the data were analysed according to gender. There were also no significant differences in blood measurements between male and female patients within any of the BDI scoring categories.

7.5.5 Personality scales and baseline blood measurements

For the group as a whole, analysis of the data demonstrated no significant associations between baseline blood measurements and any of the Eysenck or FAM scale measurements for any of the assessments. When the data were analysed in relation to gender, the results demonstrated a significant association between triglyceride and the 6 months FAM depression score (p=0.008, r=0.34, n=62) and the 6 months Eysenck neuroticism score (p=0.007, r=-0.3, n=62) for male patients only.

Table 56. **Baseline blood measurements for Female patients**

Clinical measurement	Normal range	Female patients				
Biochemistry		**Mean**	**SD**	**Median**	**Q1**	**Q3**
Sodium	135-144	139	7.2	138	137	140
Potassium	3.5-5.1	4.04	0.46	4.0	3.7	4.3
Chlorine	97-108	104	2	104	102	105
CO^2	22-32	25	3	25	23	27
Urea	2.5-7.5	5.3	2. 6	5.5	4.4	7.0
Creatinine	60-110	83	36	79	70	72
Calcium	2.2-2.65	2.29	0.1	2.3	2.2	2.4
Phosphate	0.8-1.45	1.06	0.18	1.0	1.0	1.2
Protein	60-77	64	8	65	62	70
Albumin	36-50	44	8	42	39	44
Billirubin	3-18	10	5	9	6	13
Alk. Phos	70-260	203	10	206	152	252
Gamma GT	5-50	27	9	24	18	30
AST	10-35	19	10	19	12	22
ALT	10-50	17	0.2	15	10	21
Urate	0.1-0.42	0.33	0.14	0.29	0.25	0.36
Glucose	2.8-6.0	7.51	3..2	6.6	5.7	8.7
Haematology						
WCC	4 - 11	8 2	2.1	7.3	6.3	9.6
RBCC	3.9 - 5.6	4.8	0.5	4.2	4.0	4.6
Haematocrit	0.35- 0.47	0.39	0.05	0.38	0.37	0.41
Haemoglobin	13-16	13	1.4	13.3	12.0	14.0
Platelets	150-400	273	66	287	216	316
Endocrine						
Cholesterol	3-6.5	5.76	1.74	5.7	5.0	6.4
Triglycerides	<2.1	1.56	0.82	1.3	1.1	1.9
PT	15	16	6.3	15	14	16
PT control	15	15	0.55			
PTT	40	41	9	39	36	43
PTT control	40	41.1	1.36			

7.5.6 Linear regression analysis and blood results

No significant predictive association was demonstrated between baseline blood measurements and the 6 months BDI or FAM depression scores, nor between platelets, gender and BDI or FAM depression scores.

7.5.7 Blood analysis - summary

For the total group of patients and for male and female patients as separate groups there were minimal significant associations between the baseline blood measurements and the BDI, EPS or FAM scores at any of the assessments. Correlations with the BDI scores were not significant for any of the blood measurements for the patient group as a whole or for male and female patients when considered as separate groups.

The only notable features of the analysis of the blood measurements were the significant differences between male and female patients. These resulted in significantly higher levels of platelets and lower levels of ALT and GGT for female patients in comparison with male patients at the onset of stroke. Further analysis demonstrated that gender differences of platelets, ALT and GGT were significant for patients with right CVA`s.

7.5.8 Discussion

The significant outcome of the analysis of the baseline blood measurements was the higher number of platelets for female patients compared with male patients, particularly for patients who had right CVA`s. This outcome in this study is interesting since female patients as a group and female patients with right CVA`s have demonstrated significantly higher BDI scores compared with male patients.

Platelet function is known to be relevant in patients suffering from myocardial infarction and stroke since platelets are essential components of the coagulation system. Nearly all of the 5HT (5-Hydroxytriptaline- serotonin) in human blood is contained in the platelets and 5HT is released from platelets when they disintegrate during clotting (Bell et al.,1972).

This relationship between platelets and depression is discussed in a review paper by Nemeroff (1998), where the author comments that the platelets of depressed people are particularly sensitive to activation signals including serotonin. Nemeroff notes that the platelets of depressed people have reduced numbers of serotonin reuptake transporters

compared with those of healthy people, and are less able to soak up serotonin from their environment. Nair et al.(1999) also state that reduced platelet serotonin uptake has been reported in depressed patients, and that heightened platelet activity may be a factor in patients with depression. These authors comment that depressed patients have been shown to exhibit greater platelet activation than healthy controls and that platelet monoamine oxidase (MAO) activity, which depresses the amount of 5HT in the brain, has also been shown to be significantly elevated in depressed patients-especially in women.

The relationship between platelets, depression and coronary vascular disease (CVD) is discussed in a review of the literature by Musselman et al.(1999). These authors consider whether heightened susceptibility to platelet activation might be a mechanism by which depression in physically healthy people acts as a significant risk factor for heart and cerebrovascular disease and/or mortality after MI. They also comment that recent studies have implicated depression as an independent factor in the pathophysiologic progression of CVD, rather than merely as a secondary emotional response to the illness.

In support of this theory the authors consider the results of the `Established Populations for Epidemiologic Studies of the Elderly` which prospectively studied more than 10,000 persons aged 65 years and over for a period of 6 years, and which showed that rates of stroke were almost 3 times higher in persons designated with `high` versus `low` levels of depressive symptoms (Simonsick et al.,1995). From this review of the literature it was also noted that, although women are more vulnerable to depression, and that CVD is the leading cause of death among adult women in the USA, relatively little research has focused on the aetiology of major depression among females with CVD. Nair et al.(1999), also noted that clinical depression has been identified as an independent risk factor for increased mortality in patients after acute MI, and that increased platelet activity has been suggested as the mechanism for this adverse association.

This relationship between platelets and stroke must be considered relevant in light of the fact that hypertension, smoking and CVD are risk factors for stroke. In a review of the literature, Smith et al.(1999) note that platelet reactivity is accentuated in acute ischaemic stroke, particularly following cortical rather than lacunar infarction, and they comment that it is likely that patients with certain risk factor profiles have some degree of platelet activation preceding stroke. However, whether platelet function is a cause or a consequence of stroke is not yet clear. Zeller et al.(1999) also demonstrated that circulating platelets showed

increased activity in patients with acute cerebral ischaemia, but that there were differences in the activation of platelets depending on whether the stroke was atherosclerotic or embolic.

The relationship between platelets and personality has not been well researched. However what is known is that Monoamine oxidase (MAO) is measured in the platelets and plasma of blood and Ballenger et al.(1983) demonstrated that MAO negatively correlated with extroversion and impulsiveness and positively correlated with the characteristic of social introversion as measured by the MMPI. Platelet MAO levels have also been shown to be relatively stable in humans, show strong genetic determination and show characteristics of a mood/state independent biological trait. Platelet MAO has also been shown to be significantly elevated in depressed patients especially in women. This would suggest a relationship between platelets, low levels of extroversion, increased levels of social introversion and depression - particularly in women.

7.5.9 Conclusions

The results of the analysis of the baseline blood measurements have shown that female patients as a group, but specifically those with right CVA's demonstrated significantly higher levels of platelets compared with male patients. In the current study, the results have also shown that female patients, particularly those with right CVA's were implicated in the onset of affective disorder, demonstrated significant decreases in extroversion and impulsiveness and had higher levels of social introversion compared with males. Although the current study found no evidence of a direct link between depression and platelet levels, these findings raise the question of the involvement of platelets in the onset of affective disorder after stroke.

7.6 Summary of results in relation to the hypotheses

The outcomes of the study in relation to the stated hypotheses are detailed below:-

Hypothesis 1. ` The measurement of personality and depression in the acute post-stroke period and at 6 weeks, may be predictors of the affective status of patients at 6 months post-stroke.`

Correlation analysis of the data for patients and carers, demonstrated significant associations between the BDI scores at each of the assessments, the most significant correlation being between the 6 weeks and 6 months assessments. The results of linear regression analysis demonstrated that the BDI scores in the acute phase after stroke were able to predict the classification of the affective status of over 85% of patients at 6 months after stroke.

Correlation analysis demonstrated significant associations between FAM depression scores at each of the assessments, and also significant associations between the BDI and FAM depression scores at each of the assessments. The results of the linear regression analysis demonstrated a significant association between the FAM depression score in the acute phase of stroke and the depression score at 6 months post-stroke, although the predictive ability was less than that obtained with the BDI.

Correlation analysis demonstrated significant associations between BDI scores and neuroticism at each of the assessments for male and female patients. Linear regression analysis of the EPS scales demonstrated that neuroticism for male patients, and a combination of neuroticism and psychoticism for female patients, in the acute post-stroke period, were significant contributors to the variance in the BDI score at 6 months post-stroke. The combination of the BDI and psychoticism scores in the acute phase were also shown to be the most efficient predictors of the classification of affective status at 6 months post-stroke for female patients, while for male patients, the baseline BDI score on its own was the best predictor variable of the BDI scores at 6 months. The results of the FAM personality data demonstrated that the FAM depression score in the acute onset phase was a significant influence on the variance of the FAM depression score at 6 months for male patients, while schizophrenia was a significant factor for female patients.

In keeping with the hypothesis, the results of the data in this study have shown that individual measurements of the affective and personality status of patients at the onset of stroke are associated with, and are predictive of, the affective status at 6 months post-stroke.

Hypothesis 2. **`The gender, age, domestic status, presence of known risk factors, neurological impairment, physical disability and location of the cerebral infarct may be associated with levels of affective disorder after stroke`.**

Correlation and linear regression analysis demonstrated no significant association between affective status after stroke, as measured by the BDI, and age, disability, social status, risk factors, speech impairment or hospital duration. Linear regression analysis however demonstrated that the combination of gender and laterality of the cerebral infarct significantly contributed 12% to the variance in the BDI score of the patients at 6 months after stroke

Analysis of the BDI data with respect to gender, demonstrated that the ratio of affective disorder in males:females was 2:3 and was applicable to both patients and carers. However, gender differences were noted in the BDI scoring patterns of patients but not in carers. These differences were demonstrated by significantly higher BDI scores for female patients at the 6 weeks and 6 months assessments compared with male patients, while female patients who had `normal` BDI scores at the onset of the stroke or were living with someone, significantly increased their scores over the 6 months of the study.

The BDI results also highlighted a specific relationship between gender, the location of the cerebral infarct and affective status. The results showed that female patients who had right CVA`s significantly increased their BDI scores over the 6 months of the study, had significantly higher BDI scores at the 6 months assessment compared with female patients with left CVA`s and and demonstrated a significant association with `caseness` at the 6 weeks and 6 months assessments. Post-hoc analysis also demonstrated a moderate association between females who had persistent levels of affective disorder and the presence of right CVA`s.

The results of the FAM depression scale also demonstrated gender differences in patients in relation to affective disorder. In contrast to the BDI scores, the FAM depression scores in the acute phase of stroke, and also the percentages of persistently significant depression scores throughout the study, were shown to be higher for male patients compared with female patients. In keeping with the results of the BDI data however, male patients demonstrated no significant changes in FAM depression scores over the 6 months of the study, whereas female patients significantly increased their FAM depression scores over the 6 months. This was particularly related to female patients who had right CVA`s and who had

`normal` baseline BDI scores. In keeping with the hypothesis, the results of the data in this study have demonstrated an association between gender, the location of the cerebral infarct and the level and the onset of affective disorder after stroke.

Hypothesis 3. **`The psychological status of the carer may be related to the psychological status of the patient after stroke`.**

Correlation analysis demonstrated significant associations between the BDI scores of patients and carers as total groups at each assessment, but gender analysis demonstrated that the association was significant for male patients and their female carers only. Although this association has not previously been demonstrated in stroke studies, it has been shown previously in studies of depression in patients with chronic back pain. Linear regression analysis also demonstrated a significant association between the baseline BDI scores of carers and the variance of the BDI scores of patients at 6 months, for the male patient and female carer group only. There were no significant associations between patients and carers for any of the personality scales at any of the assessments.

In keeping with the hypothesis, albeit to a limited extent, the results showed a moderate association between patients who did not develp affective disorder and their carers.

Hypothesis 4. **`Baseline, endocrinological, haematological and biochemical measurements, may be associated with the affective status of patients after stroke`.**

The outcome from the analysis of the baseline blood measurements of the patients demonstrated no significant associations between baseline blood measurements and the BDI, EPS or FAM scores at any of the assessment times. The results showed that female patients had significantly higher platelet counts compared with male patients, and that this difference was significant for the group of patients as a whole, and also for patients who had right CVA`s. In this study, female patients as a group and also those with right CVA`s have been shown to have significantly higher depression scores compared with male patients and have also demonstrated changes in affective status after stroke.

Although not in keeping with the stated hypothesis, this outcome suggests a potential relationship between levels of platelets at the onset of stroke and patients who may be at risk of experiencing affective disorder in the post-stroke period.

Chapter 8. Discussion and conclusions

8.1 Introduction

This major longitudinal study was undertaken to evaluate the affective and personality status of stroke patients over a period of six months from the onset of the stroke. The study also assessed the affective and personality status of the carers of the patients, and included a comprehensive blood analysis of patients at the onset of the stroke.

The strengths of the current study were:-

(a) The data were based on a consecutive series of 130 patients who were admitted to hospital soon after the onset of stroke, together with 45 carers of these patients.
(b) There was a high compliance rate of patients (>85%) and carers (>75%) in completing all three assessments during the 6 months period of the study.
(c) The assessments of depression and personality were comprehensive and detailed.

The remit of this study was not to establish the incidence or prevalence of affective disorder after stroke, but to determine if the personality and depression status, in the acute phase of stroke, might be related to, or predictive of, affective status in the 6 months after the stroke. Other factors considered as potentially relevant were gender, domestic and social status, laterality of the cerebral infarct, neurological impairment and physical disability, premorbid risk factors and baseline blood measurements.

Previous research suggests that there is an increased risk of mood disorder following stroke but there remains uncertainty about the true level of the affective disorder and also about its aetiology. Indeed, whether the presence of mood disorder demonstrated in various studies is specific to stroke or is similar to that found in association with other medical conditions has been questioned by House et al.(1991), who demonstrated that a variety of emotional disorders were present after stroke of which depression was only one. The authors acknowledged that the level of these disorders is higher than in the general population but may be similar to other medical populations. They also noted that patients with persistent psychiatric disorders over a period of one year after the onset of stroke were likely to have had psychiatric disorders in the year prior to the stroke.

This doubt about the significance of a specific association between depression and stroke is relevant, particularly in light of the association which is known to exist between depression, myocardial infarction and CABG surgery (Burker et al.,1995; McKhann et al.,1997). The results of these studies have shown that pre-operative mood is the best predictor of post operative depression. These findings are relevant in the investigation of depression after stroke, since cardiovascular disease is a known risk factor for stroke while stroke is a well recognized complication of CABG.

In view of the difficulty of evaluating the pre-stroke affective status of patients, this approach has not been seriously considered, and studies of post-stroke depression have mainly focused on establishing links with disability and the location of the cerebral infarct. In keeping with this, numerous studies of stroke patients by Robinson and co-workers (Robinson and Szetella, 1980, Robinson and Price, 1982, Robinson et al.,1984) have found an association between depression and left frontal lesions, while MacHale et al.(1998) demonstrated an association with right hemispheric lesions. However, the review and meta-analysis of studies carried out by Carson et al.(2000) demonstrated no convincing association between depression and the location of the cerbral infarct.

In contrast to these lateralization theories, associations between depression and disability have also been noted by Ebrahim et al.(1987), House et al.(1987) and Kellermann et al.(1999) while Wade et al.(1987) commented that pre-existing personal or social characteristics may have an important influence on the presence of depression after stroke.

Difficulties in comparing the significance of individual results obtained by different researchers are due to a number factors such as, the construction of cohorts, the types of patients included in studies, different time sequences of assessments, research methods and tools used in acquiring data, and the analytical presentation of the results. Although this present study has attempted to include a wide spectrum of factors which may be implicated in affective disorder after stroke, it is acknowledged that there are limitations in what can and cannot be objectively measured in any one study. It is emphasized however, that the main focus of this study is to determine whether the level of affective disorder after stroke can be related to psychological and/or other factors measured at the onset.

The results in this study are based on a consecutive series of patients who were admitted to hospital acutely after the onset of stroke over a period of 2 years and the patient cohort was almost completely followed up at the different time intervals for 6 months.

The physical status of patients in the study included patients with a broad spectrum of impairment and disability and a fairly wide age span. Although the cohort of patients included a number of patients with aphasia and dysarthria the sample cannot be considered to be representative of the affective status of this group of stroke patients, since their degree of speech impairment was at a level which still allowed them to complete the questionnaires. The cohort also included 13% of patients who had suffered from a previous stroke and therefore does not solely represent patients presenting with a first ever stroke.

The results also incorporated parallel data on the carers of the patients. Although, as previously stated, it was not intended to use the carers as a true control group in this study, the results of the carers have been included as a reference to the nearest group of people to the patients in age and social status, who have been living with the patient, but who have not suffered the neurological trauma of a stroke. The results of the carers have been analysed however, to determine if the affective status of the carers could have an influence on the affective status of the patients. This is quite relevant in view of the fact that previous studies have shown that high levels of depression are present in the carers of stroke patients (Kotila et al.,1984, Carnworth and Johnstone,1987).

The outcomes of this study demonstrated a high compliance rate in completing the questionnaires at each of the assessments. Of the original cohort, 89% of patients completed the questionnaires at 6 weeks, 88% at 6 months and 85% of patients completed the questionnnaires at all three assessments. This compliance rate is comparable with other longitudingal studies including the OCSP, the FINNSTROKE study, the BCSP and the Sunnybrook study. As previously discussed in chapter 7, the results of this study are also, on the whole, in agreement with selective results from a number of other studies on the levels of affective disorder demonstrated at different time intervals after stroke. However the main difference between the structure of this study and those of other similar studies is that it has comprehensively evaluated the personality and affective status of the same cohort of patients and carers on three occasions over 6 months, and it has included data from a very early onset after the stroke ie. within 48 hours of the stroke onset.

In view of the fact that the results for each of the questionnaires have been discussed previously in Chapter 7, in considerable detail, the purpose of this chapter is to summarize and discuss the main outcomes of the depression and personality questionnaires independently and also in relation to each other.

The results will be considered under the sub-headings (a) Depression, (b) Depression and Personality (c) Miscellaneous factors and post-stroke depression and (d) Depression and blood measurements

8.2 Depression

The initial focus of this study was to determine the profile of the affective status of patients in the 6 months after stroke. The main questionnaire used to assess affective status was the BDI, which has been used in previous studies of stroke patients. The overall results of the BDI showed that there was a stability and a similarity in the affective status of the majority of patients and carers over the 6 months of the study. This stability was demonstrated by the results which showed that the majority of patients and carers had BDI scores that were consistently within `normal limits`, that approximately 20% of patients and carers had BDI scores that were persistently above the BDI `normal` level, and that 10% of patients and 12% of carers had scores that were suggestive of persistent `caseness` over the 6 months of the study. These affective states demonstrated in patients and carers in this study were similar to levels of depression estimated to be present in the elderly in the community.

It is difficult to compare directly, the results of the current study with those of others where assessments have been done at different intervals, and have used different assessment tools. Nevertheless the percentages of `cases` identified in the current study at different time intervals were similar overall to those of previous researchers (Robinson et al.1983; Astrom et al.,1993; Kellerman et al.,1999; House et.al.,1989; Wade et.al.,1987; MacHale et al.,1998 and Singh et al.,2000). The percentage of persistent `caseness` demonstrated in the current study was also similar to those demonstrated by Wade et al.(1987) and House et al.(1991), while the 54% of patients who were consistently `not depressed` over the 6 months of the study was similar to the 52% of patients demonstrated by Wade et al.(1987). The levels of affective disorder in the carers were similar to those demonstrated by Kotila et al.(1998).

It is not unreasonable to assume from these outcomes, that the persistent affective states (ie.`normal` or `abnormal`), demonstrated in patients and carers, were unlikely to have been caused solely by the brain damage due to stroke, and could have been present prior to the stroke. This approach is supported by the evidence from cardiac studies which has shown that depression, which is commonly reported after cardiac surgery, and has previously been considered to be newly acquired after surgery, is significantly related to the pre-operative

depression status of the patients and also to female gender (McKhann et al.,1997; Burker et al.,1995). It has also been shown in prospective studies, that rates of stroke are significantly higher in persons designated with `high` versus `low` levels of depressive disorder (Simonsick et al.,1995; Ohira et al.,2001).

In contrast to the stable affective states demonstrated in the study, the results also showed that 5% of patients and 3% of carers who had `normal`BDI scores at the onset of the stroke, developed a level of affective disorder which was significant of `caseness` over the 6 months. Although the percentage of patients was similar to those in the study by Wade et al.(1987), the outcomes of the current study demonstrated significant associations between the onset of affective disorder, gender and the laterality of the CVA. In particular the results demonstrated that female patients generally and female patients with right CVA`s, were more likely to develop affective disorder after stroke. Although the assocation between being female and the onset of affective disorder after stroke has been demonstrated by others (Wade et al.,1987; House et al.,1991) and the association with right lateral infarcts has been demonstrated by MacHale et al.(1998) the combined association of laterality and gender has not previously been identified.

In keeping with the hypothesis, the results of linear regression analysis demonstrated a significant association between BDI scores in the acute phase of stroke and BDI scores at 6 months post-stroke and also showed that it was possible to predict the classification of the affective status of a high percentage of patients and carers at 6 months after stroke (ie. >80% `normal`, >70% `above normal`). This prediction was improved (97% `normal`, 82% `above normal`) when the baseline and the 6 weeks BDI scores were combined.

Affective status was also evaluated in this study using the depression scale of the abbreviated MMPI (FAM) and the results showed that the overall pattern of the outcome of the analysis of the FAM depression scale was similar to that of the BDI. The similarities in the two scales related to the observations that male patients did not demonstrate any changes in affective status over the 6 months, while female patients, particularly those who had right CVA`s demonstrated significant increases in depression scores over the 6 months.

Although correlation analysis showed that there were significant associations between the FAM depression scores and the BDI scores, the outcomes of the scales were quite different. These differences were demonstrated by the fact that the percentages of patients who had

FAM depression `T` scores suggesting `caseness` at each of the individual assessments and also persistent `caseness`, were considerably higher than those demonstrated by the BDI. It was also noted that while the BDI scores were similar for patients and carers, the FAM depression scores were significantly higher in patients compared with carers at each of the assessments. Although it has already been shown that the outcomes of the BDI scale in this study were in keeping with other studies, the outcome of the FAM scale in this study were also similar to studies which had used the MMPI as the assessment tool (Cullum and Bigler, 1988;1991; Alfano et al.1992).

Subsequent comparison of the format of the BDI and FAM scales suggested that there might be intrinsic factors in the compilation of the scales which could be influenced by the presence of disability and impairment. Inspection of the scales revealed that the FAM depression scale contained 29% of questions with a somatic content compared with 19% of the questions in the BDI. This observation was reinforced to an extent by the demonstration that when the outputs of the FAM depression and hypochondriasis scales were combined, the percentages of patients who had scores suggesting `caseness` on both scales at each assessment were more compatable with the percentages of patients who had BDI scores suggesting `caseness`. It is interesting that the combination of the scales affected the outcomes of female patients to a greater extent than males.

It was also noted that there are questions in the FAM depression scale which reflect the influence of the characteristic of `religiosity` which may be a relevant factor in depression in some cultures, but may not be totally applicable to a Glasgow population. Examples of these types of questions include:-

`Everything is turning out just like the prophets of the bible said it would?`

`I believe in the second coming of Christ?`

Despite these differences, the pattern of the outcomes of both the BDI and FAM scales were similar in demonstrating that female patients, particularly those with right CVA`s, were more psychologically affected by stroke than male patients or female patients with left CVA`s. Nevertheless, the observed anomalies in the outcomes of the two scales are important and highlight the difficulties in comparing the outcomes of similar studies using different assessment tools. On balance it is suggested that the analysis of the MMPI depression scale on it`s own should not be used as a diagnostic marker for depression. It is considered

therefore, that the specific results of the FAM in this study, in relation to individual and persistent levels of affective disorder should be viewed with reservations.

Patients, carers and depression

An important consideration in this study was the psychological relationship between the patients and the co-habiting carers who looked after them. Although correlation analysis demonstrated significant associations between the BDI scores of patients and carers as total groups, at each assessment, gender analysis demonstrated that the association was significant between male patients and their female carers only. Linear regression analysis also demonstrated a significant association between the baseline BDI scores of female carers and the variance of the BDI scores of the male patients thwy cared for at 6 months. Although this association has not previously been demonstrated in studies of stroke patients, an association between patients and carers (gender not specified), has been demonstrated in studies of depression in patients with chronic back pain (Romano et al.,1989).

The results of the current study however, appear to suggest that the relationship between the carer and patient is more supportive than detrimental, since it was shown that the significant inter-relationship was between male patients, who did not appear to be affected by the stroke and female carers. There was no apparent relationship between female patients who were detrimentally affected by the stroke, and their male carers. This outcome may be in keeping with the comments of House (1996) that `some unsatisfactory quality of the survivor-carer relationship, stroke induced or not - leads the stroke victim to a sense of unsupportedness that causes depression...`.

Conclusions - depression

The results of the BDI and to a lesser extent the FAM depression scale, have demonstrated that for a high percentage of patients the affective status in the acute phase of stroke is predictive of the affective status at 6 months post-stroke. The results also demonstrated that this predictability is enhanced by measuring the affective status in the acute phase and again at 6 weeks. Although the results demonstrated that a considerable number of patients appeared to have levels of affective disorder at different time intervals from the onset of the stroke, it was noted that only a small percentage of patients, mainly female patients, actually developed affective disorder which persisted for the 6 months after the stroke. Overall, the pattern of the results of patients and carers suggests that the affective status being measured

in the 6 months period after stroke were similar, and therefore may not be totally due to the direct result of the neurological damage of the stroke, but may include a reflection of the pre-stroke affective status of the patients.

8.3 Depression and personality

The relationship between personality and affective status was an important hypothesis in this study. Personality was assessed using the Eysenck Personality Scales (EPS) and the Faschingbauer Abbreviated MMPI (FAM) scales.

The overall results of the EPS showed that there was a stability and a similarity in the majority of the personality characteristics of patients and carers over the 6 months of the study. Analysis of the EPS and BDI scales demonstrated significant associations between affective status and neuroticism at each of the assessments, for patients and carers, which is not surprising, given that the relationship between depression and neuroticism has been well documented in non-stroke populations. Neuroticism has also been associated with the onset and recovery from depression in females (Scott, 1988; Hirshfield et al.,1989; Boyce et al.,1991; Kendler et al.,1993).

Although there were no significant changes in neuroticism over the 6 months of the study, the results demonstrated significant decreases in extroversion and impulsiveness in female patients and in venturesomeness and impulsiveness in male patients. A possible explanation for the observed changes in impulsiveness and venturesomeness, is that the responses to the questions may have been influenced by the physical limitations which the disabilities of the stroke may have imposed on the patients. An explanation for the significant decrease in extroversion demonstrated by female patients, particularly those with right CVA`s, is that it may be related to the increase in affective status demonstrated by this group. The relationship between depression and extroversion, although not as well documented as the relationship between neuroticism and depression, has been alluded to in previous studies of non-stroke patients (Kendell and DiScipio, 1968; Peselow et al.,1994). There were however, no significant differences between patients and carers, and no significant changes in carers, in any of the scales at any of the assessments.

In keeping with the hypothesis, the results of linear regression analysis demonstrated that the neuroticism score in the acute phase of stroke, contributed significantly to the variance in the BDI score at 6 months for male patients and female carers. The results also showed that a

combination of baseline neuroticism and psychoticism scores contributed significantly to the variance in the BDI score at 6 months for female patients, whereas the baseline psychoticism score alone was significant for male carers. It was noted however that combination of the BDI and Eysenck scores in the acute phase of stroke gave a better prediction of affective status at 6 months post-stroke, than using the BDI score on its own.

Although the actual mechanisms of the relationship between the personality characteristics of neuroticism, extroversion, psychoticism and depression are not known, studies have shown that depression, and to a lesser extent extroversion, have been non-specifically linked to hypoperfusion in various regions of the brain (Uytdenhoef et al.,1983; Delvenne et al.,1990; Mayberg et al.,1994; Mathew et al.,1984; Stenberg et al.,1990; Ebmeier et al.,1994; Johnson et al.,1999). In contrast however, the characteristics of neuroticism and psychoticism have never been associated with any specific pattern of cerebral blood flow. The emotional characteristics associated with neuroticism are generally considered to be related to the limbic system and neocortical structures (Borod 1992; Stuss et al.,1992) In contrast it is hypothesized that psychoticism may be associated with depression through the presence of low levels of serotonin in the brain (Pritchard,1991).

The outcomes of the FAM scales suggested that a number of patients demonstrated significantly elevated `T` scores for the depression, hypochondriasis, schizophrenia and social introversion scales. This outcome is in keeping with previous studies that have used the MMPI to assess patients suffering from brain injury, and which have shown MMPI scale elevations (Gass and Ansley,1994; Burns et al.1994). The results also demonstrated that levels of significant pathology in a number of scales were present for the whole of the 6 months in male and female patients, suggesting a stability in the characteristics. The levels of significant pathology on the scales, both individually and persistently, were considerably less for carers than for patients.

In contrast to male patients however, significant increases in the depression, hypochondriasis and hysteria scales were noted for female patients in general over the 6 months. The interesting observation was that although there were significant increases in female patients with right and left CVA`s, the significant increase in hypochondriasis, which is the concern for health and physical well-being, was only demonstrated in female patients with right CVA`s. This outcome would suggest that female patients in general and particularly those with right CVA`s, may intrinsically worry more about health and physical well-being.

The level of this characteristic may be aggravated by the onset of stroke and this in-turn may contribute to the changes in affective status that were demonstrated in this group of patients. This outcome could be in keeping with the observations of Silverstein,(1999), who demonstrated that females in the community had higher levels of somatic depression, (ie depression associated with physical symptoms such as sleeplessness, loss of appetite, aches and pains etc). compared with males, but not higher levels of pure depression (ie. no associated physical symptoms).

The relationship between the personality characteristics of the FAM and the affective status of patients after stroke (measured by the FAM depression scale), demonstrated that the baseline characteristics which significantly affected the variance in the 6 months FAM depression score were depression for male patients and schizophrenia for female patients, and depression for male and female carers. The results of the FAM in the current study cannot be compared directly with the results of any other study, since the cohorts of previous studies have either included mixed head injury cases or have been composed almost exclusively of male patients. Nevertheless, a relationship between the characteristics of depression and schizophrenia has been demonstrated in other studies of brain injured patients using the MMPI (Fordyce et al.,1983; Leninger et al.,1991; Alfano et al.,1992).

Conclusions - depression and personality

The results of this study have demonstrated that certain personality characteristics are associated with, and are predictive of the affective status of patients after stroke. The outcome has also shown that changes in affective status and also in a number of personality characteristics take place after stroke and that these changes relate more to female patients, particularly those with right CVA`s, than to male patients. The significance of the inter-relationship between these changes has not yet been established, but may be associated with changes in cerebral blood flow.

8.4 Miscellaneous factors and post-stroke depression

The miscellaneous factors which were included as potentially relevant variables in this study were gender, domestic and social status, impairment and disability, risk factors and laterality of the cerebral infarct. Of these variables only gender and the laterality of the cerebral infarct were shown to be consistent significant factors in the outcomes of all of the results.

The relationship between gender, laterality of the cerebral infarct and affective status using the BDI, was demonstrated by the results of linear regression analysis which showed that the combination of gender and laterality of cerebral infarct significantly contributed 12% to the variance in the BDI score at 6 months post-stroke. This relationship was highlighted in the current study by the results, which showed that female patients who had right CVA`s (a) significantly increased their BDI scores over the 6 months of the study, (b) demonstrated a significant association with `caseness` at the 6 weeks and 6 months assessments and (c) had significantly higher BDI scores at the 6 months assessment compared with female patients with left CVA`s. Post-hoc analysis also suggested that there may be an association between persistent levels of affective disorder and right CVA`s in female patients, and persistent levels of `normal` affective status and left CVA`s in female patients.

In keeping with the results of the BDI data, male patients demonstrated no significant changes in FAM depression scores over the 6 months of the study, while female patients increased their FAM scores over the 6 months. It was also noted that percentages of persistent significant depression were higher for female patients with right CVA`s compared with left CVA`s. Although the association between depression and being female has been demonstrated in previous studies (Wade et al.,1987; House et al.,1991; Sharpe et al.,1994; Herrmann et al.,1998), the association between laterality of infarct and depression after stroke has been the subject of many studies with no definite conclusion being reached. This uncertainty has been highlighted in a meta-analysis of significant studies which demonstrated that there was no convincing evidence to support a lateralization bias in the onset of depression after stroke (Carson et al.,2000). However since gender was not included in this meta analysis it is difficult to compare these results with those of the current study. To-date no study has shown a significant association between gender and laterality of infarct and affective disorder after stroke.

With regard to the impact of gender and laterality of infarct on personality, the results of the EPS data in this study demonstrated significantly higher levels of neuroticism in female patients compared with male patients at each of the assessments. Female patients in general, and also those with right CVA`s demonstrated significant decreases in extroversion and impulsiveness over the 6 months of this study. Since this group of patients also significantly increased their BDI scores over the 6 months of the study, it is considered that the observed changes in affective status and extroversion may have been associated with the changes in

cerebral blood flow as a result of the stroke. This hypothesis is strengthened by the fact that there was no change in the characteristic of neuroticism in this group. Although this is surprising given that neuroticism is the personality characteristic most commonly associated with affective disorder, it is not usually considered to be associated with cerebral blood flow. During this time it was noted that there were no significant changes in any of the characteristics of carers.

The justification for proposing an association between cerebral blood flow, depression and extroversion in this study is based on the results of previous research studies of non-stroke populations. These studies have suggested that there is a negative association between depression and cerebral blood flow in the cingulate gyrus (Mayberg et al.,1994; Goodwin et al.,1996; Hiroshi et al.,1996) and a positive association between extroversion and cerebral blood flow in certain areas of the brain including the cingulate gyrus (Ebmeier et al.,1994; Johnson et al.,1999; Austin et al.,1992). It is therefore reasonable to suggest that the observed changes in affective disorder and extroversion demonstrated in this study, might be related to the changes in cerebral blood flow which take place after stroke.

The association between neuroanatomy and the emotions, has been reviewed by Stuss et al.(1992) who consider that depression produces changes in the limbic system so that the threshold for displaying affective behaviour is lowered. These authors hypothesize that when this is combined with a frontal lesion, this reduces the neocortical control of the limbic behaviours and results in pathological affective disorder. Borod (1992) also considers that emotional processing is attributed to neocortical structures and Heilman (1982) suggests that the right hemisphere may be strongly connected with subcortical systems important in arousal. Since higher concentrations of white to gray matter are present in the right hemisphere, this suggests a greater degree of neuronal interconnectivity among regions, and possibly among functions of the right hemisphere. The association between depression and the presence of deep white matter lesions (DWML) in non-stroke patients has previously been demonstrated by O`Brien et al.(1996), while Baxter et al.(1989) and Matsubayashi et al.(1992) have proposed that DWML might be associated with cerebrovascular risk factors and could predate the onset of depression.

The results of the FAM personality profiles also demonstrated associations between gender and laterality of infarct, in that the personality profiles of female patients changed significantly over the 6 months of the study and these changes were more associated with

female patients who had right CVA's. In contrast there were no significant changes in male patients. Although few studies using the MMPI as an assessment tool, have considered gender differences in personality assessments after stroke, the study by Cullum and Bigler (1988), which included a mixture of male and female patients with either diffuse head injuries or CVA's, demonstrated few overall differences in MMPI profile scores between males and females after stroke. In contrast, the study by Alfano et al.(1992) of patients suffering from closed head injuries demonstrated different profiles for male and female patients. From their results, the authors concluded that female patients demonstrated characteristics of somatically based psychological concerns and depression, whereas male patients demonstrated characteristics of depression and mental confusion. The results of the patients in the current study would be in keeping with the results of Alfano et al.(1992).

The only published study which has used the EPS to consider the impact of personality on the affective status of patients after stroke is the retrospective study by Morris and Robinson (1995). This study demonstrated a relationship between neuroticism and depression after stroke, but no association between extroversion and depression; no reference was made to the influence of gender in this study.

Conclusions - Miscellaneous factors and post-stroke depression

It is concluded that the impact of the laterality of the cerebral infarct on the affective and personality status of the patients as a whole was not particularly significant. However the combination of laterality of the cerebral infarct and female gender were shown to be significant factors in the affective status of patients after stroke. While the changes in the EPS scores appeared to be related to changes in cerebral blood flow as a result of the stroke, the changes in the FAM scores appeared to be more associated with concern over the physical aspects of stroke. The conclusion from the results of this study is that personality, gender and laterality of infarct are factors in the affective status of stroke patients and should be included in future research.

8.5 Depression and blood measurements

The analysis of the baseline blood measurements of the patients in this study was done to determine if there were blood measurements in the acute phase of stroke which could be associated with the affective or personality status of patients, at the onset or in the 6 months after stroke. The results demonstrated that there were no significant associations between

any of the baseline blood measurements and the BDI, EPS or FAM scores at any of the assessments.

It was anticipated that levels of serum calcium might be associated with the affective status of stroke patients, since the release of calcium ions in the brain is a neurological consequence of stroke. Although this has been shown previously to be implicated in affective disorders and to a lesser extent personality (Ballenger et al.,1983), the relationship was not demonstrated in this study. However, the outcome of the blood results, showed that female patients had significantly higher platelet counts compared with male patients. This gender difference was noted for female patients as a whole and also for female patients with right CVA`s. It has previously been demonstrated that female patients generally and those with right CVA`s had significantly higher BDI scores compared with male patients, and also demonstrated changes in affective status after stroke.

The association between platelets and affective disorder has been noted previously by Nemeroff (1998) and Nair et al.(1999) in relation to the observation of reduced platelet serotonin uptake in depressed patients, and also that platelet monoamine oxidase (MAO) activity has been shown to be significantly elevated in depressed female patients. In relation to stroke, Smith et al.(1999) demonstrated that platelet reactivity is accentuated in acute ischaemic stroke.

Although the relationship between platelets and personality is not well known, Ballenger et al.(1983) demonstrated that platelet MAO negatively correlated with the characteristics of extroversion and impulsiveness and positively correlated with social introversion (MMPI). Overall this would suggest a relationship between platelet MAO, low levels of extroversion and impulsiveness and high levels of social introversion and depression - particularly in women. Associations between these characteristics have been demonstrated in this study.

Conclusion - blood measurements

It is acknowledged that there are other factors apart from platelet count that are involved in the association between depression and platelets. These factors, which include platelet `stickiness`, platelet activity and platelet proteins, have not been included in this blood analysis. Nevertheless, the results of the current study have highlighted a significant difference in platelet numbers between male and female patients at the onset of stroke, and that this difference is particularly significant for patients with right CVA`s. It is hypothesized therefore, that platelets may be implicated in affective status after stroke.

8.6 Summary of conclusions

This study potentially makes an important contribution to the subject of the affective status of patients after stroke and highlights a number of factors which may be implicated in the onset of depression and which have not previously been evaluated or considered.

The BDI and the Depression scale of the MMPI were used to determine the affective status of the patients and carers in this study and the outcomes from these questionnaires have been shown to be in accordance with levels of affective disorder previously demonstrated in studies of patients after stroke.

The results of the study using the BDI, which is acknowledged as being an effective instrument for measuring levels of affective disorder, demonstrated that the pattern of the affective status of patients and carers, both males and females, was similar in the 6 months period after stroke. The similarity between patients and carers was highlighted by the observation that the majority of the patients and carers had depression scores which were within `normal` limits for each of the assessments. It was also noted that the percentages of patients who had `abnormal` depression scores at individual assessments were similar to those of the carers at these assessments, and that similar levels of persistent affective disorder were demonstrated for patients and carers during the 6 months of the study.

Linear regression analysis demonstrated that the affective status of patients and carers in the acute phase and also at 6 weeks post-stroke, significantly contributed to the variance in affective status at 6 months after stroke. The results also demonstrated significant associations between male patients and female carers, and that the affective status of female carers at the onset of the stroke was a significant factor in the affective status of male patients at 6 months after the stroke.

Although there were significant correlations between the BDI and FAM scales at each of the assessments for patients and carers, the percentages of `normal`, above `normal` and `cases` demonstrated by the BDI were not replicated by the MMPI depression scale for patients or carers. The relationship between male and female patients and male and female carers was also quite different for each of the questionnaires. While there is no definitive explanation for the difference in these outcomes in this study, inspection of the questions in the BDI and

FAM depression scales suggests that the compilation and format of the questionnaires, particularly in their somatic content, might have contributed to the differences. Despite these differences however, both questionnaires demonstrated that female patients in general and particularly those with right CVA`s were vulnerable to the onset of affective disorder after stroke. These differences in outputs nevertheless highlight the need to interpret the results of validated questionnaires with caution.

The use of the Eysenck and MMPI personality scales in this study were relevant in demonstrating that certain personality characteristics in the acute phase and at 6 weeks post stroke, significantly contributed to affective status at 6 months, confirming the hypothesis. They were also important in demonstrating significant changes in a number of personality characteristics in patients but not in carers, from the onset of the stroke. The demonstration of certain personality changes in patients gives credence to the anecdotal evidence of carers which has been referred to in previous studies.

The significance of the change in extroversion which was demonstrated in female patients in this study is particularly relevant, since previous studies of non-stroke populations have shown positive associations between extroversion and cerebral blood flow and negative associations between depression and cerebral blood flow. In the current study the group of patients who demonstrated significant increases in affective status demonstrated significant decreases in extroversion. This suggests that changes in affective status may possibly be due to the changes in cerebral blood flow caused by the stroke.

The relationship between cerebral blood flow, affective status and certain personality characteristics becomes more interesting when it is considered in relation to levels of MAO in the blood. Previous studies have shown that levels of platelet MAO have been positively associated with depression and social introversion and negatively associated with extroversion and impulsiveness and that these associations are more relevant in women. The proposed mechanism for the associations is that platelet MAO activity depresses the amount of serotonin in the brain and this is directly related to levels of affective disorder. Although it is not possible to state that the female patients in this study, particularly those with right CVA`s, had intrinsically higher platelet MAO levels, the results have demonstrated that these patients had higher platelet levels compared with male patients at the onset of the stroke.

In keeping with previous studies, the results of the current study also showed that the significant changes in personality and affective status were not demonstrated for some time after the onset of stroke. In view of the association between cerebral perfusion and affective and personality status, this raises the question of delayed reduced perfusion after the onset of acute stroke as contributing to these effects. The possibility that different patterns of cerebral perfusion after stroke may be related to the type of ischaemic stroke experienced, raises the question of an association between the onset of affective disorder and embolic rather than thrombotic strokes. This association has not previously been considered, perhaps due to the difficulty of identifying the specific cause of an ischaemic stroke.

The potential for an association between levels of affective disorder and the onset of stroke has been suggested by the results of longitudinal community studies. The results of this study take this hypothesis further by suggesting that there may be an association between persistent levels of affective status and the laterality of the CVA particularly for female patients. This possible association resulted from the demonstration that female patients in this study whose affective status was persistently `normal` during the 6 months were more likely to have left sided infarcts, while those whose affective status was persistently `abnormal` appeared to be associated with right sided infarcts. This observation raises the question of a psychological/ neurophysiological predisposition to right or left CVA`s.

Overall the results of this study have contributed significantly to the subject of depression after stroke. The results have demonstrated an interaction between affective status and intrinsic personality characteristics that has not previously been demonstrated, and have confirmed the outcomes of studies demonstrating an association with right CVA`s. However the association with laterality in this study has been qualified by an association with gender. The question of the influence of platelets and serotonin has been raised, as has the potential impact of the neurophysiology of the stroke infarct. It is accepted that it has not been possible to prove that the baseline assessments of depression and personality replicated the premorbid status of patients in this study. Nevertheless, the similarity and stability of the data over the 6 months in both patients and carers suggests that the impact of the stroke on the psychological status of the patients in the acute phase was minimal.

8.7 Relevance of the results of the current study in clinical practice

The results of this study have demonstrated that levels of affective disorder are present in patients who have had a stroke and that this disorder is present from the onset of the stroke. Whether the affective status of the patients pre-dated the stroke or was as a result of the neurological damage is irrelevant in terms of patient rehabilitation, since previous research has shown that depression can inhibit recovery from illness. It is therefore proposed that the affective status of patients using the BDI, (which takes only a few minutes to complete and to score), should be done as early as possible after the onset of stroke. This would allow treatment to be initiated which might alleviate the potential onset of symptoms of depression, and as a result improve post-stroke rehabilitation.

It is acknowledged however, that assessment in the acute phase might not detect the small percentage of patients who were `normal` at that stage and who subsequently developed affective disorder during the 6 months post-stroke period. A further assessment of all of the patients at 6 weeks should improve the prognostic value. On the basis of the results obtained at 6 weeks, treatment could be continued for those who continue to demonstrate predictive `abnormal` BDI scores, and initiated for those who present with predictive `abnormal` scores at this time. At 6 months post stroke the procedure should be repeated.

The inclusion of the assessment of personality using the EPS would improve the prognostic value of the BDI, and although the completion and scoring of the EPS is more time consuming to complete and to score, it may assist in identifying borderline cases. The implementation and level of treatment would be a clinical decision based on the degree of affective disorder presented.

The study has also demonstrated levels of affective disorder in the carers of stroke patients at intervals during the 6 months. It would seem sensible therefore to consider evaluating the affective status of carers at the same time intervals as the patients, using the same procedures, with a view to implementing preventative treatment for carers at an early stage, if they were agreeable.

8.8 Future research proposals

A number of unexplained observations have been highlighted in this study and it is proposed that these might be considered for future research.

(1) Significant changes in affective status and extroversion were demonstrated in female patients with right CVA`s and were considered to be associated with the changes in cerebral blood flow caused by the stroke. It was noted that the changes demonstrated did not occur for some time after the onset of the stroke. One explanation which is proposed for the delay in manifesting these changes is that they may be associated with the type of ischaemic stroke experienced by the patient, ie. whether the stroke was thrombotic or embolic in origin. It is therefore proposed that a more detailed assessment of the neuroanatomy and neurophysiology of the patient at the onset of the stroke may demonstrate the presence of factors such as `luxury perfusion` in the acute stage, which may be associated with delayed reduction in cerebral perfusion.

(2) The outcome of the blood measurements in conjunction with the outcomes from the BDI, EPS and FAM questionnaires suggested that there might be an association between platelets and affective disorder in female patients. The hypothesis proposed is that the relationship may be as a result of an interaction between elevated levels of platelet MAO and reduced levels of serotonin in the blood. A detailed study of all aspects of platelets in the acute stage and also at intervals over a period of at least 6 months is proposed, to evaluate the contribution of platelets to affective status after stroke.

(3) Post-hoc analysis suggested that female patients with persistent levels of affective disorder, and therefore perhaps pre-stroke affective disorder, were associated with the prevalence of right sided CVA`s, while female patients with persistently `normal` affective status were more likely to have a left sided CVA. An evaluation of the strength of a potential predisposition of the affective status of stroke patients to determine the laterality of the CVA would be interesting.

Post-Viva comments with regard to the study

This was a detailed longitudinal study of the affective-status of patients who had suffered a stroke. The study had many strengths and the results highlighted significant associations and potential influences on the affective status of patients after stroke, that had not been identified in previous studies. Nevertheless, as with studies of this nature, it is acknowledged with hindsight, that there were features of the study that could have been improved upon. These features are considered below:-

The analyses of the data in this study included many variables, and it is accepted that the application of the Bonferroni correction factor could have been included in the analyses to eliminate the possibility of incurring Type I errors. Although consideration was given to applying Bonferroni to the data, on reflection it was considered that the possibility of incurring Type II errors was as great if not greater than the possibilty of incurring Type I errors. In light of the experimental nature of the data, where small differences might be shown to be clinically significant, it was decided not to apply the Bonferroni correction factor to the multivariable analyses, but to apply the criteria of two-tailed levels of significance of 0.01 in preference to the normally accepted significance level of 0.05 to the data.

Regression analysis of the data demonstrated a number of significant correlations between variables. In some cases the correlations were near to the 0.8 value, which is known to affect the robustness of the outcome of multiple regression analysis. However, the adverse effects of colinearity are mainly significant where there are extreme values in the independent variables. It is unlikely in practice that the range of the independent variables used in calculating the dependent variable in future studies will be significantly different from those used in the present study when establishing the predictive equation. Therefore, it was not considered that the predictive power of the multiple regression equation detailed in the present study was undermined.

Patients included in this study were selected from a consecutive series of patients admitted to an Acute Stroke Unit. However, as a result of the application of the entry criteria, the total number of patients who were included in the study represented only 13% of the total admissions to the unit. The majority of the patients were excluded from the study as a result of practical difficulties such as death or discharge within 48 hours of admission, severe

aphasia, dementia, poor conscious levels, the presence of TACI`s or the refusal to participate. It is acknowledged that excluding patients with a previous history of depression could have biased the study. This is particularly relevant for patients with a history of depression in light of the potential relationship between premorbid depression and stroke.

The assessment protocol of the study was changed after the first 50 patients had been recruited, in that the cognitive function of the patients was no longer formally assessed. Although the reasons for the change have been explained in the text, it is accepted that this was not ideal and could have potentially compromised the results.

The level of disability experienced by the patients as a result of the stroke was measured in the acute stage of the stroke using the Barthel Index score. Residual disability was not subsequently measured during the 6 months of the study. It is acknowledged that this omission creates a difficulty in concluding that there was no significant association between disability and depression in this study. It is proposed however, that the Barthel Index Score in the acute phase of stroke is potentially the `worst case scenario` and that with rehabilitation, the degree of disability may improve over time and consequently support the results obtained.

Depression in this study was assessed using the Beck Depression Inventory, which is a validated and accepted assessment of affective status and has been used in previous studies of stroke patients. Nevertheless, the inventory depends on the application of specific `cut-off` values for the diagnosis of levels of depression and `caseness`. To strengthen the results of diagnosing changes in affective status, (where a small change of perhaps one or two points in the BDI scoring may indicate inappropriate reclassifiaction), it would be appropriate to measure affective status in conjunction with a clinical interview. This would also establish the effectiveness of applying `cut-off` values. A clinical interview would also have helped to clarify the disparities that were evident between the BDI and FAM depression scales in this study.

Appendix

Table 47. **Median FAM `T` scores - Total group of Carers**

FAM scales	Baseline			6 Weeks			6 Months		
	Median	Q1	Q3	Median	Q1	Q3	Median	Q1	Q3
L	53	46	55	46	44	53	46	44	55
F	55	50	62	55	50	63	54	50	62
K	53	44	61	55	47	59	55	49	62
Depression	58	52	71	63	53	73	59	52	67
Hypochondriasis	58	52	66	62	53	70	57	51	65
Hysteria	54	51	64	58	52	64	57	49	63
Hypomania	58	45	63	53	46	58	53	46	58
Male/female	51	44	65	47	39	59	55	41	59
Paranoia	53	47	59	53	50	61	53	47	62
Psych deviance	50	43	56	50	43	59	52	44	60
Psychasthenia	54	44	66	52	46	61	51	45	64
Schizophrenia	54	47	63	51	46	60	53	46	63
Social introvert	62	54	69	64	52	72	64	52	70

Q1 - 25% interquartile range

Q3 - 75% interquartile range

Table 50. **FAM `T` scores - Male carers**

FAM Scales	Baseline scores			6 Weeks scores			6 Months scores		
	Median	Q1	Q3	Median	Q1	Q3	Median	Q1	Q3
L	53	64	56	53	44	60	46	46	56
F	58	52	66	58	50	68	58	50	70
K	55	47	61	55	45	62	55	49	61
Depression	60	51	70	68	52	77	65	53	72
Hypochondriasis	57	52	71	62	53	74	54	52	72
Hysteria	53	50	61	60	53	67	55	47	60
Hypomania	60	47	67	53	46	61	55	48	65
Gender	65	59	73	59	53	63	59	59	69
Paranoia	53	44	58	53	46	59	56	47	62
Psych deviance	53	49	59	57	50	64	57	48	71
Psychasthenia	52	42	73	50	46	77	54	44	73
Schizophrenia	53	47	62	57	48	72	57	50	71
Social introvert	60	51	67	56	50	72	60	48	74

Q1 - interquartile range - 25%

Q3 - interquartile range - 75%

Table 51. **FAM `T` scores - Female carers**

FAM Scales	Baseline scores			6 Weeks scores			6 Months scores		
	Median	Q1	Q3	Median	Q1	Q3	Median	Q1	Q3
L	50	45	53	46	44	53	46	44	55
F	53	47	55	55	50	60	50	46	58
K	53	43	60	55	46	59	55	48	62
Depression	56	53	71	59	53	67	53	51	61
Hypochondriasis	59	51	66	60	52	66	58	50	65
Hysteria	54	51	64	57	52	63	57	49	64
Hypomania	55	41	62	55	45	58	53	43	57
Gender	45	39	54	41	34	49	45	34	53
Paranoia	53	47	59	53	50	62	53	47	61
Psych deviance	46	43	55	50	39	53	47	41	59
Psychasthenia	56	45	64	53	45	60	51	46	56
Schizophrenia	54	46	63	49	44	58	52	44	61
Social introvert	62	54	75	64	54	72	64	55	70

Q1 - interquartile range - 25%

Q3 - interquartile range - 75%

Date: _____

ATIENT/CONTROL	NAME	Date of Birth

his questionnaire consists of 20 groups of statements. After reading each roup of statements carefully, please put a cross (X) next to the one tatement in each group which best describes the way you have been feeling uring the past week, including to-day. If several statements within a group eem to apply equally well, then place a cross against each one.
e sure to read all the statements in each group before making your decision.
lease check that you have completed all of the statements.

0 I do not feel sad.
1 I feel sad.
2 I am sad all the time and I can't snap out of it.
3 I am so sad or unhappy that I can't stand it.

0 I am not particularly discouraged about the future.
1 I feel discouraged about the future.
2 I feel I have nothing to look forward to.
3 I feel that the future is hopeless and that things cannot improve.

0 I do not feel like a failure.
1 I feel I have failed more than the average person.
2 As I look back on my life, all I can see is a lot of failures.
3 I feel I am a complete failure as a person.

0 I get as much satisfaction out of things as I used to.
1 I don't enjoy things the way I used to.
2 I don't get real satisfaction out of anything anymore.
3 I am dissatisfied or bored with everything.

0 I don't feel particularly guilty.
1 I feel guilty a good part of the time.
2 I feel quite guilty most of the time.
3 I feel guilty all of the time.

0 I don't feel I am being punished.
1 I feel I may be punished.
2 I expect to be punished.
3 I feel I am being punished.

0 I don't feel disappointed in myself.
1 I am disappointed in myself.
2 I am disgusted with myself.
3 I hate myself.

8 0 I don't feel I am any worse than anybody else.
1 I am critical of myself for my weaknesses or mistakes.
2 I blame myself all the time for my faults.
3 I blame myself for everything bad that happens.

9 0 I don't have any thoughts of killing myself
1 I have thoughts of killing myself, but I would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10 0 I don't cry any more than usual.
1 I cry more now than I used to.
2 I cry all the time now.
3 I used to be able to cry, but now I can't cry even though I want to.

11 0 I am no more irritated now than I ever am.
1 I get annoyed or irritated more easily than I used to.
2 I feel irritated all the time now.
3 I don't get irritated at all by the things that used to irritate me.

12 0 I have not lost interest in other people.
1 I am less interested in other people than I used to be.
2 I have lost most of my interest in other people.
3 I have lost all of my interest in other people.

13 0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to.
2 I have greater difficulty in making decisions than before.
3 I can't make decisions at all anymore.

_____ Subtotal Page 1

CONTINUED ON BACK

14
- 0 I don't feel I look any worse than I used to.
- 1 I am worried that I am looking old or unattractive.
- 2 I feel that there are permanent changes in my appearance that make me look unattractive.
- 3 I believe that I look ugly.

15
- 0 I can work about as well as before.
- 1 It takes an extra effort to get started at doing something.
- 2 I have to push myself very hard to do anything.
- 3 I can't do any work at all.

16
- 0 I can sleep as well as usual.
- 1 I don't sleep as well as I used to.
- 2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
- 3 I wake up several hours earlier than I used to and cannot get back to sleep.

17
- 0 I don't get more tired than usual.
- 1 I get tired more easily than I used to.
- 2 I get tired from doing almost anything.
- 3 I am too tired to do anything.

18
- 0 My appetite is no worse than usual.
- 1 My appetite is not as good as it used to be.
- 2 My appetite is much worse now.
- 3 I have no appetite at all anymore.

19
- 0 I haven't lost much weight, if any, lately.
- 1 I have lost more than 5 pounds.
- 2 I have lost more than 10 pounds.
- 3 I have lost more than 15 pounds.

I am purposely trying to lose weight by eating less. Yes _____ No _____

20
- 0 I am no more worried about my health than usual.
- 1 I am worried about physical problems such as aches and pains; or upset stomach; or constipation.
- 2 I am very worried about physical problems and it's hard to think of much else.
- 3 I am so worried about my physical problems that I cannot think about anything else.

_____ Subtotal Page 2

_____ Subtotal Page 1

_____ Total Score

BARTHEL INDEX

		Please Mark
FEEDING	– independent able to apply any necessary device, feeds in reasonable time	10
	– needs help ie. for cutting	5
	– totally dependent	0
BATHING	– performs without assistance	5
	– cannot perform without assistance	0
PERSONAL-TOILET (GROOMING)	– washes face, combs hair, brushes teeth, shaves (manages plug if electric razor)	5
	– needs assistance	0
DRESSING	– independent – ties shoes, fastens fasteners, applies braces	10
	– needs help but does at least half of task within reasonable time	5
	– totally dependent	0
BOWEL CONTROL	– no accidents – able to use enema or suppository, if needed	10
	– occasional accidents or needs help with enema or suppository	5
	– frequent accidents	0
BLADDER CONTROL	– no accidents – able to use care for collecting device if used	10
	– occasional accidents or needs help with device	5
	– incontinent, needs indwelling catheter	0
TOILET TRANSFERS	– independent with toilet or bedpan, handles clothes, wipes, flushes or cleans pan	10
	– needs help for balance, handling clothes or toilet paper	5
	– no use of toilet, bedridden	0
CHAIR/BED TRANSFERS	– independent including locks of wheelchair and lifting footrests	15
	– minimum assistance or supervision	10
	– able to sit but needs maximum assistance to transfer	5
	– completely bedridden, use of chair not possible	0
AMBULATION	– independent for 50 yards, may use assistive devices, except for rolling walker	15
	– with help for 50 yards	10
	– independent with wheelchair for 50 yards, only if unable to walk	5
	– sits on wheelchair but cannot wheel him/herself	0
STAIR CLIMBING	– independent – may use assistive devices	10
	– needs help or supervision	5
	– cannot climb stairs	0

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Glossary of terms and abbreviations used in the thesis.

Acute stroke - a stage of stroke starting at the onset ofthe symptoms and lasting for a few hours thereafter.

Anosognosia - a cognitive disability characterized by ignorance of or the inability to acknowledge one side of the bofdy or one side of the visual field

Aneurism - a weak thin spot on an artery wall that has stretched or ballooned out from the wall and filled with blood, or damage to an artery leading to pooling of blood between layers of the blood vessel walls.

Anosognosia - unawareness or denial of a neurological deficit such as hemiplegia.

Anoxia - a state of alsmost no oxygen delivery to a cell, resulting in low energy production and possible death of the cell

Anticoagulants - drug therapy used to prevent the formation of blood clots that can become lodged in cerebral arteries and cause strokes.

Antiplatelet agents - a type of anticoagulant drug therapy that prevents the formation of blood clots by preventing the accummulation of platelets that form the basis of blood clots; aspirin is a common antiplatelet

Aphasia - the inability to understand or create speech, writing, or language in general, due to damage to the speech centres of the brain.

ARAS - Ascending reticular activating system

Atherosclerosis - a blood vessel disease characterised by deposits of lipid material on the inside of the walls of large to medium-sized arteries which make the artery walls thick, hard, brittle and prone to breaking.

Atrial fibrillation - irregular beating of the left atrium, or upper chamber of the heart

BCSP - Bristol Community Stroke Project

BDI - Beck Depression Inventory

Blood brain barrier - an network of supportive brain cells called glia, that surrounds blood vessels and protects neurons from the toxic effects of direct exposure to blood.

CABG - Coronary artery bi-pass graft

CAMCOG - Cognitive section of the CAMDEX

CAMDEX - Cambridge Mental Disorders of the Elderly Examination

Carotid artery - an artery located on either side of the neck

Cerebral blood flow (CBF) - the flow of blood through the arteries that lead to the brain,

Cerbrospinal fluid (CSF) - clear fluid that bathes the brain and spinal chord

Cerebrovascular disease - a reduction in the supply of blood to the brain either by narrowing of the arteries through the build-up of plaque on the inside walls of the arteries, called stenosis, or through blockage of an artery due to a blood clot

CHI - closed head injury

CHSA - Chest, Heart and Stroke Association

Cingulate gyrus - The cortical part of the limbic system that lies just above the corpus callosum - has been shown to be involved in emotional behaviour.

CMR - Cerebral metabolic rate

Computed tomography (CT) - a series of cross-sectional x-rays of the brain and head and all other organs of the body.; also called computerized axial tomography or CAT scan

CVD - Coronary vascular disease

Depression - depressed state and feelings of hopelessness, guilt and uselessness

Disability - In the context of stroke disability refers to changes that take place in the interaction between the patient and the environment as a result of the neurological impairment of the stroke.

DWML - Deep white matter lesions

DNA - Deoxyribonucleic acid

Dysarthria - a language disorder characterized by difficulty in speaking / forming words.

Dysphagia - difficulty in swallowing or in eating

DSM - Diagnostic manual of the American Psychiatric Association.

Embolic stroke - a stroke caused by an embolus which is a free roaming clot that usually forms in the heart.

Endogenous depression - no apparent external cause to precipitate the onset of depression

EPI - Eysenck Personality Inventory

EPQ-R - Eysenck Personality Questionnaire - Revised

EPS - Eysenck Personality Scales

Extroversion - outgoing, impulsive, carefree, optimistic

FAM - Faschingbauer Abbreviated MMPI

GHQ - General health Questionnaire

Glutamate - also known as glutamic acid, an amino acid that acts as an excitory neurotransmitter in the brain

HADS - Hospital Anxiety and Depression Questionnaire

Haemorrhagic stroke - a sudden bleeding into or around the brain

Hemiparesis - weakness of one side of the body

Hemiplegia - paralysis of one side of the body

HI - Head injury

HMPAO - Hexamethylpentacetime Oxime

HRDS - Hamilton Rating Scale for Depression

Hypertension - high blood pressure

Hypochondriasis - pre-occupied with health and bodily functions

Hypoxia - a state of decreased oxygen delivery to a cell

Hs - Hypochondriasis - pre-occupied with health and bodily functions

Hypomania - overactive, excitable

Hy - Hysteria -pre-occupied with physical illness, self-centred and socially immature

ICD - International classification of diseases

Impairment - neurological impairment refers to an exteriorized loss or abnormality of physiological or psychological function arising as a result of a stroke eg. hemianopia, sensory loss, muscle weakness (ICIDH,1980)

Incidence - the number of new events in a given period

Infarct - an area of tissue that is dead or dying because of loss of blood supply

Infarction- a sudden loss of blood supply to tissue causing the formation of an infarct

Intracerebral haemorrhage - occurs when a vessel within the brain leaks blood into the brain

Introversion - quiet, introspective, does not like excitement, reliable, pessimistic.

Ischaemia - a loss of blood flow to tissue caused by an obstruction ofthe blood vessel, usually in the form of plaque stenosis or a blood clot, leading to infarction of tissue and cell death

Ischaemic cascade - a series of events lasting for several hours to several days following initial iscaemia that results in extensive cell death and tissue damage beyond the area of tissue originally affected by the initial lack of blood flow.

Ischaemic penumbra - areas of damaged but still living brain cells arranged in a patchwork pattern around areas of dead brain cells

Ischaemic stroke - ischaemia in the brain

LACI's - lacunar circulation infact

Lacunar infarction - occlusion of a small artery in the brain resulting in a small area of dead brain tissue called a lacunar infarct; often caused by stenosis of the small arteries called small vessel disease

Large vessel disease - stenosis in large arteries of the cerebrovascular system

LHD - Left hemispheric deficit

Limbic system - A complex set of evolutionary old structures of the forebrain lying in an arc below the corpus callosum and usually include the hippocampus, anterior thalamus, amygdala, septum, hypothalamus and their interconnecting bundles.

Ma - Hypomania - overactive, excitable

MADRS - Montomery Asperg Depression Rating Scale

Magnetic imaging angiography - an imaging technique involving injection of a contrast dye into a blood vessel and using magnetic resonance imaging techniques to create an image of the flowing blood through the vessel;

Magnetic resonance imaging (MRI) - a type of imaging involving the use of magnetic fields to detect subtle changes in the water content of tissues.

MAO - Monoamine oxidase

Mitochondria - the energy producing organelles of the cell

MF - Masculinity/femininity - rejects traditional sex role behaviour

MI - Myocardial infarction

Mitral valve stenosis - a disease of the mitral heart valve involving the buidup of plaque-like material on and around the valve.

MMPI - Minnesota Multiphasic Personality Inventory

MMSE - Mini Mental Stae Exam

MPI - Maudsley personality Inventory

MRI - Magnetic resonance imaging - a type of imaging involving the use of magnetic fields to detect subtle changes in the water content of tissues.

Necrosis - a form of cell death resulting from anoxia, trauma, or any other form of irreversible damage to the cell; invoves the release of toxic cellular material into the intercellular space, poisoning surrounding the cells.

neurological impairment - refers to an exteriorized loss or abnormality of physiological or psychological function arising as a result of a stroke eg. hemianopia, sensory loss, muscle weakness (ICIDH,1980)

Neuroticism - anxious, worrying, moody, depressed, overly emotional, irrational

NINDS - National Institute of Neurological Diseases and Stroke

OCSP - Oxford Community Stroke Project

PACI`S - Partial anterior circulation infact

Pa - Paranoia - overly sensitive, angry, delusions of persecution and feels mistreated

PCSP - Perth Community Stroke Project

Pd - Psychopathic Deviate - rebellious, egocentric, history of antisocial behaviour

PET - Positron Emission Tomography

Plaque - fatty cholesterol deposits found along the inside of artery walls that lead to atherosclerosis and stenosis of the arteries.

Platelets - structures found in blood that are known primarily for their role in blood coagulation

POCI`s - Posterior circulation infact

Prevelence - the number of cases of a disease in the population at any given point in time

PSE - Present State Examination

Psychopathic Deviate - rebellious, egocentric, history of antisocial behaviour

Psychotic depression - severe depression accompanied by a loss of contact with reality

Psychoticism - solitary, troublesome, cruel, inhumane, aggressive, unsocialized.

Pt - Psychasthenia - anxious, restless, talkative, emotionally labile

Pure depression - depression not associated or accompanied with somatic symptoms

rCBF - Regional cerebral blood flow

Reactive depression - depression resulting from events occurring in one`s life

RHD - Right hemispheric deficit

SADS - Scedule for Affective Disorders and Schizophrenia

Sc - Schizophrenia - confused, disorganized thoughts, feels isolated.

SCID - Structured Clinical Interview for Depression

SCL-90 - Symptom Distress Check list

SDS - Zung Self-rating Depression Scale

Si - Social Introversion - socially introverted, shy, submissive, compliant

SIGN - Scottish Intercollegiate Network

Small vessel disease - a cerebrovascular disease defined by stenosis in small arteries in the brain.

Social Introversion - socially introverted, shy, submissive, compliant

Somatic depression - depression associated with ohysical symptoms such as sleeplessness, loss or gain of appetite, loss of libido or generalizwd aches and pains

SPECT - Single Photon Computerised Tomography

Stenosis - narrowing due to the build up of plaque on the inside wall of an artery

Stroke - a condition of rapidly developing clinical signs of focal or global disturbance of cerebral function with symptoms lasting 24 hours or more or leading to death and with no apparent cause other than of vascular origin (WHO, ICD 1977)

Subarachnoid haemorrhage - bleeding within the meninges, or outer membraones of the brain, into clear fluid that surrounds the brain

TACI`S - Total anterior Circulation Infarct

TBI - Traumatic brain injury

^{99m}Tc - Technecium - radioactive material used in imaging

Thrombosis - The formation of a blood clot in one of the cerebral arteries of the head or neck, that stays attached to the artery wall and can block blood flow.

Thrombotic stroke - a stroke caused by a thrombosis

Transcranial magnetic stimulation (TMS) - a small magnetic current delivered to an area of the brain to promote plasticity and healing

Transient ischaemic attack (TIA) - a short-lived stroke that lasts from a few minutes up to 24 hours; often called a mini-stroke.

Vertebral artery - an artery on either side of the neck

WHO - World health Organisation