CHAPTER 2

LITERATURE REVIEW

Introduction:

The residual deficits associated with stroke often predispose stroke survivors to disability. This disability may emanate from various sources. The increased energy expenditure associated with activities of daily living (ADL) tasks are thought to be a significant factor leading to poor engagement in ADL and the resultant disability. This chapter will illustrate theories relating to the relationship between increased energy expenditure and stroke and how this results in disability. There is a special focus on dressing due to the nature of the study being conducted. Factors affecting energy expenditure in dressing will be discussed as well as how accelerometers can be used as tools to measure energy expenditure in dressing. Finally, stroke as a public health issue in South Africa is discussed with the concern that disability is a result of poor engagement in ADL and consequent poor activities health and activities satisfaction.

2.1 Energy Expenditure and Stroke

The progression of treatment of patients afflicted by stroke is guided by the clinical status, prognosis, and tolerance of activities in the context of neurological dysfunction (Matthews, 2001). The rate at which treatment can progress is also guided by the patients' previous functional history and their cardiac condition. Matthews (2001) states that this is further determined by the energy costs of activities and the factors that influences them.

Traditional stroke rehabilitation programmes emphasize functional training as a means to improve independence. Training in the performance of mobility and ADL tasks remain the central focus of rehabilitation (Gordon et al, 2004). It is not clear however, whether exercise training programmes with a focus on endurance are also emphasized as the physical skill involved in performing ADL, places demands on the endurance level, energy expenditure and cardiovascular fitness of the patient.

Energy expenditure can be expressed in calories but is usually stipulated in terms of METs (basal metabolic equivalents) (Matthews, 2001). It is measured by the amount of oxygen that is consumed. One MET is equal to the energy consumed when a person is at rest in a semi-Fowler position (semi-reclined with extremities supported), which is equal to 3.5mlO_2 per minute per kilogram of body weight. When the person sits, walks or performs activities, the metabolic demands and oxygen consumption increases (Matthews, 2001).

Despite long term activity limitations and participation restrictions being prevalent among stroke patients, there has been criticism of the lack of scientific consideration for factors such as the effects of physical activity and aerobic capacity that could contribute to their disability. There are no longitudinal studies on the general physical activity level of stroke patients, and their perceived exertion or their energy expenditure during activities of daily life (Farsnas, 2005). Gordon et al (2004) assert that stroke survivors are often de-conditioned and predisposed to a sedentary lifestyle that limits the performance of activities of daily living and may raise their risk for recurrent stroke and cardiovascular disease. This study by Gordon et al (2004) supports the use of physical activity and exercise training to improve endurance, hence reducing the energy expenditure on simple ADL tasks. Foti (2001) asserts that the demands of time and energy that an ADL task warrants can influence the extent to which a patient with a stroke can initiate and complete that task. If the physical demands of the task exceed the patient's capacity, patients are often rendered unable to engage in the task, thus further exaggerating their disability.

Gordon et al (2004) state that ambulatory persons with a history of stroke only perform at 50% of peak oxygen consumption and 70% of the peak power output compared to age and gender matched individuals without a history of stroke. Such intolerance is likely due to several factors including: bed rest induced deconditioning, concomitant left ventricular failure and neurological deficits including flaccidity, spasticity, impaired trunk balance, weakness and cognitive dysfunctions. Energy expenditure in turn, varies with the degrees of weakness; spasticity and training. Hence stroke survivors are likely to need increased energy expenditure to accomplish tasks that are far less demanding than matched able –bodied persons (Gordon et al, 2004).

The debilitating motor effects of stroke can markedly decrease the mechanical efficiency and increase the energy costs of tasks. Gordon et al (2004) argue that even common household tasks can be associated with considerably greater energy requirements. These variables create a vicious circle of further decreased activity and greater activity intolerance leading to increased muscle weakness; decreased cardiorespiratory endurance and ultimately activity restrictions and disability.

A randomized control trial of 42 hemiparetic stroke survivors training three times a week for ten weeks evoked significant improvement in peak oxygen consumption, aerobic capacity as well as an improvement in sensorimotor function (study cited in Gordon et al, 2004). Despite all subjects having completed a therapeutic programme prior to random assignment into the control and experimental group, the experimental group demonstrated that improvement in sensorimotor function was related to an increase in aerobic capacity through endurance training. These findings were further reinforced by Macko et al (2001) where a six month treadmill training programme to investigate the effects on energy expenditure and aerobic exercise indicated that aerobic exercise training and cardiovascular fitness might enable activities of daily living to be performed at a lower energy cost. A critical analysis of this study indicated that this was an assumption and not actually proved.

Meek et al (2003) carried out a systematic literature review of randomized and quasi-randomized controlled trials in order to determine the effect of cardiovascular exercise training on impairments, disability and quality of life. Contrary to Potempa et al (1995) and Macko et al (2001), insufficient evidence was identified to establish whether cardiovascular exercise had a positive effect on disability, impairment, extended ADL and case fatality post stroke (Meek et al, 2003).

This has brought to the fore the question of whether endurance training can improve functional independence by reducing the energy expenditure in ADL tasks and concomitantly increasing sensorimotor function. No randomized control trials were found to establish a link between ADL and energy expenditure.

2.2 Energy Expenditure and ADL activities

There has been limited investigation into the relationship between the physical ability of patients afflicted by a stroke and their consequent ability to engage in ADL tasks. In the physiology literature, physical activity is often described in terms of energy expenditure (Verbunt et al, 2001). It is postulated in this study that the neurological sequelae of stroke such as spasticity, hypotonicity, weakness, involuntary movements, hemianopia, reduced hand function and diminished /absent sensation can increase the physical demands of the activity thus requiring increased energy expenditure. These demands can exceed the patient’s capacity resulting in limited participation in ADL tasks thus increasing their disability.

In some cases, Gordon et al (2004) showed that due to the debilitating motor effects reducing the mechanical efficiency of tasks, the energy expenditure was twice that of the matched controls. Gordon et al (2004) also found that other common ADL tasks such as household tasks, bed making and vacuuming were also associated with considerably greater energy requirements among post-stroke women when compared to their healthy counterparts. The level of physical activity of the ADL task will determine the ability to expend sufficient energy to complete the tasks.

Several classifications have been proposed for rating the difficulty of sustained physical activity in terms of strenuousness. McArdle et al (1981) recommends a five level classification of intensity of work related to METs. This is illustrated in Table 2.1.

In Table 2.1, the levels are scaled from light to unduly heavy with METs increasing accordingly. Measurements for males and females are considered separately as data reveals that the resting metabolic rate is 5-10% lower in females than in males (McArdle et al, 1981)

Table 2.1: The classification of intensity of work and related METs.

Level	**METs: Males**	**METs : Females**
Light	1.6-3.9	1.2-2.7
Moderate	4.0-5.9	2.8-4.3
Heavy	6.0-7.9	4.4-5.9
Very Heavy	8.0-9.9	6.0-7.5
Unduly Heavy	10.0-	7.6-
Adapted From: McArdle et al (1981, p 112)		

The different levels of work related to the METs required in different activities, can largely explain why some stroke survivors can re-engage in ADL activities such as food preparation in standing and walking which requires two and a half METs but may not be able to sweep the exterior of their home which requires four METs. Food preparation would classify as light work but sweeping as moderate work. Leisure activities such as gardening should generate a minimum of five METs with aerobic exercises requiring at least seven METs (Ainsworth et al, 2000). It is likely that primary deficits evident in stroke prevent high levels of energy expenditure and limit tasks on the latter end of the classification scale.

Therapists may use Table 2.1 to guide treatment and prognosis of a patient with stroke in order to understand what ADL the patient will be able to engage in if they are able to ascertain the capacity of the patient and the energy requirements of the activity. There appears to be a lack of energy expenditure measurements related to dressing and self care.

2.3 Dressing and Energy Expenditure

There is lack of clarity regarding the exact energy costs expended in dressing. Furthermore, it is of concern that there are no well researched randomized control trials establishing norms for energy expenditure for different aspects of dressing but rather estimations which are not specific to the type of dressing. For example, dressing and undressing will have different energy costs due to the muscles activity and different postural adjustments made. Similarly, dressing the upper body will be different to dressing the lower body as the lower body requires an increased displacement to reach the lower limbs and feet. The complexity of the clothes to be dressed and the fastening are also likely to change the motor demands and hence the energy costs of the task.

Without stipulating the type of dressing, Matthews (2001) state that dressing requires two METS and hence can be classified as light work to an able-bodied person. Ainsworth et al (1993) classified dressing to be two and a half METs and then reclassified it to two METs in 2000 (Ainsworth, 2000). Despite the trend of two METs, the type of clothing, aspects of dressing evaluated and method of dressing have not been specified. These are important aspects as many factors can influence the measurement of energy expenditure. Matthews et al (1996) stated that the use of upper versus lower extremities, the use of isometric muscular efforts (dictated by types of clothing), pace and muscles used in the activity can influence this value especially when evaluating tasks that fall in the low to moderate levels of work. Another measurement of energy expenditure in dressing was done by Harris and Martin (2003) who measured dressing in kilo calories per minute and documented that individuals expend 3 Kcal/min in this task. They warn however that energy costs are relative and can differ depending on the maximal oxygen uptake that the subject has available to them. Since patients afflicted with stroke are only able to perform at 50% of their total oxygen consumption, (Gordon et al 2004) they are likely to require twice the amount of energy expenditure in the same dressing tasks when compared to their able-bodied counterparts.

Inability to generate enough energy output to initiate or sustain the dressing task is likely to cause activity restrictions and disability. Walker and Walker (2001) state that independence in dressing is not an essential part of life but the loss of this ability can be devastating following a stroke. They argue that patients who are unable to dress remain dependant on their spouse or caregiver thereby increasing the burden of care.

A review of the literature by Walker and Walker (2001) to understand the limitations in dressing in patients with stroke indicated that most studies were poorly conducted and of limited value. Of the 40 articles reviewed only four used a standardized measure and most failed to report on the reliability of scores. A lack of randomized control studies indicated poor evidence to understand factors leading to limitations in dressing.

An unpublished survey (cited in Walker and Walker, 2001) to evaluate the current practice of occupational therapist regarding the rehabilitation of patients with dressing difficulties indicated that the methodology of cause and intervention techniques were not evidence based. The survey also suggests that therapists often have little understanding of cases with similar pathology, that is, why some patients can dress and others experience further complications

Studies measuring the influence of motor deficits on the ability to relearn to dress are sparse, however results indicating the impact of limited physical abilities have shown a reduction in independence in dressing (Walker and Walker, 2001). But physical disabilities alone cannot explain why some stroke survivors can learn to dress independently in the presence of motor deficits. Hence it is proposed that one reason possibly contributing to declining independence in dressing is the amount of energy expenditure required to execute these tasks superimposed on various physical, cognitive and perceptual deficits.

2.4 Factors Affecting Energy Expenditure in Dressing

2.4.1 Level of Physical Activity

McArdle et al (1981) state that the level of physical activity of an individual has by far the most profound effect on human energy expenditure. Levels of physical activity influence the muscle fibre composition in the body (McArdle et al, 1981). Sedentary males and females are found to have 45-55% slow twitch muscles. Hence the ability to execute tasks requiring rapid contraction in relatively short periods of time, such as dressing, may be impaired. In a stroke survivor, this is further exacerbated by neurological consequences leading to poor physical activity. Hence, poor physical activity is likely to increase the energy cost in tasks such as dressing.

2.4.2 Age, Gender and Weight

Physiological performance measures generally improve during childhood and reach a maximum between the late teens and thirty years of age. Functional capacity begins to decline after this age. This is associated with a gradual decline in muscle strength, nerve conduction velocity, resting cardiac index and breathing capacity. It is likely that these factors will impact on energy expenditure (McArdle et al, 1981). It is important to note that the level of physical ability can improve in latter years and that physical activity can retard the processing of aging (McArdle et al, 1981).

A significantly more dynamic interaction occurs between energy expenditure and weight. Body weight and related obesity are important factors that affect the energy expended in tasks such as dressing. McArdle et al (1981) argue that the energy costs of an activity are generally greater for heavier people especially in weight bearing activities (such as standing to dress lower body) because the person has to transport their body weight during the activity. McArdle et al (1981) states that the total number of calories expended by a heavier person is considerably larger than that expended by their lighter counterparts simply because of the body weight that must be transported during the task which requires proportionately more energy.

Men have been shown to expend more energy than women in daily activities (McArdle et al, 1981). Table 2.1 also indicates that the intensity of work is different between men and women. Morio et al (1997) however found contrary results where no gender related differences were found in the energy expenditure in physical activity. The impact of the study findings however is limited by the small subject numbers.

2.4.3 Muscle Strength

Carr and Shepherd (2000) argue that there are multiple but finite ways in which muscle activation and segmental rotations can be coordinated to achieve a single desired outcome such as a task in dressing. The individual however, acquires the skill of optimal movement patterns for effective performance to execute the dressing tasks in the most biomechanically advantageous manner. In the presence of neurological deficits, a similar task poses a challenge such that the patients will use whatever muscles are required to generate sufficient force to move the necessary body segments in order to achieve the dressing task. There is often a lack of isolated movement and muscle synergies are often recruited increasing the energy demands of the limbs and postural musculature. As a result the energy expenditure of a dressing task for an unaffected individual and a stroke survivor is likely to be significantly different.

2.4.5 Endurance

Not only are the concentric and eccentric contractions of muscles necessary to perform the physical action of dressing important, but the ability to sustain the action and complete the task is essential. Trew and Everett (1997) state that considering energy expenditure for the frail and disabled, individual's functioning is at the limit of their ability; they should be encouraged to undertake activities in the most energy efficient way possible. This is likely to further compromise their endurance due to constant compensation and resultant deconditioning due to decreased physical activity. Physical activity, which is a prerequisite for building endurance, is discouraged as patients are taught methods of energy conservation.

Despite low endurance being common among stroke survivors, traditional emphasis in stroke rehabilitation has largely been associated with improving movement patterns, muscle strength and co-ordination (Potempa et al, 1995). This endurance may decline further after discharge. Potempa et al (1995) argue that low endurance may compound the increased energy costs of movement associated with residual hemiparesis which in turn, may contribute to poor rehabilitation outcomes. Meek et al (2003) state that there is a link between reduced mobility and the increased energy expenditure required by patients to carry out daily functions such as dressing. Furthermore, the exercise capacity of stroke patients has been found to be approximately 40% below the age and gender-adjusted norms for sedentary individuals.

2.4.6 Movement Ability

The focus on treating movement patterns have largely been thought to be useful to gain participation in ADL. Signe Brunnstrom proposed an assessment and treatment protocol for evaluating motor performance in hemiplegia (Sawner and LaVigne, 1992). Although the treatment has been largely flawed by the lack of evidence to support her theories and the replacement of the Reflex Theory of Motor control, her assessment scale remains a useful tool to evaluate the level of movement available to a hemiplegic patient in the arm, hand and leg (Sawner and LaVigne, 1992). Occupational therapists utilize this scale to guide movement patterns to drive physical ability in order to return to premorbid ADL.

The assessment scale remains widely used due to the sequencing of movement observed. It is based on clinical observations made by Brunnstrom (Sawner and LaVigne, 1992). Flaccidity (stage one) in muscles was observed to follow an acute neurological episode replaced by spasticity (stage two). During the early spastic period, limb synergies were seen to make their appearance either reflexively or voluntarily (stage 3). These consisted of either gross flexor movement i.e. a flexor synergy or a gross extensor movement or extensor synergy. Variations do occur depending on the relative strength of the muscles. These muscles are seen to be activated in a synergic pattern and a patient is unable to recruit these same muscles for different combinations of movements. A patient in stage four utilizes basic aspects of the synergies but can only use combinations of synergic patterns to use more controlled movement. Stage five sees the evolution of moment independent from synergy but generally movement is slow and poor muscle strength prevents efficiency of movement. Stage six movements are controlled co-ordinated movements where there is complete independence of synergies and movement is near normal. Patients can begin dressing the upper body using the affected limb in typical patterns from stage 4 onwards in the arm and hand. Dressing in the lower limb using the affected limb for flexion to dress leg can begin at stage 4 of the lower limb. Compensatory techniques such as one handed dressing methods are used prior to these stages.

Despite the theories related to the effect of physical inactivity on energy expenditure and the related consequences to dressing, these factors have proved difficult to quantify. Accelerometry has become a popular method of measuring physical activity, specifically the energy expenditure required to physically execute an ADL task (Mathie et al, 2004 ;Verbunt et al, 2001)

2.5 Monitoring Human Movement in ADL tasks using an accelerometer

Functional ability in ADL has a significant impact on levels of disability. Many tools have been developed to assess the functional ability of an individual (Mathie et al, 2004). These include photogrammetry, kinematic and kinetic analyses, video recording, electromyography, forceplate analysis, simple time measures, questionnaire tools, validated functional tests and observation (Mathie et al, 2004). The difficulties with measuring the physical activity required to execute ADL tasks and the influence that neurological deficits have on energy expenditure is that the measurement techniques stated are time consuming and expensive, requiring specialized equipment and a dedicated laboratory set up (Mathie et al, 2004). Accelerometry has become a cost effective means (Verbunt et al, 2001) of executing an objective measurement of functional ability such that it can measure the energy expenditure of control individuals and compare it with those individuals afflicted with stroke to determine the discrepancy that may lead to their limited participation in ADL tasks.

An accelerometer is a small electronic device that measures kinetic energy (motion) and converts the energy into electrical energy which can be read by computer software to establish the acceleration measurement in the respective motion planes. The accelerometer use in the study was the RT3 triaxial accelerometer manufactured by Stayhealthy, USA. The activity monitor is based on movement registration and is used to measure minute by minute acceleration in three dimensions: the anteroposterior axis, the medio-lateral axis and the vertical axis (Chen et al, 1997). Measuring human movement in three directions instead of one improves the prediction of energy expenditure. Activity counts in the three motion planes can be converted into activity calories using the formula programmed in to the equipment using data on age, gender, weight, and height of the subject (Hill, 2005). The RT3 is the size of a small pager and is worn around the waist on a purpose made belt.

In a study measuring the physical activity requirements of daily activities in patients with chronic back pain, a triaxial accelerometer was shown to be a valid instrument for measuring energy expenditure (Mathie et al, 2004, Chen et al, 1997, Verbunt et al, 2001). Accelerometers have however been shown to be valid only if placed correctly on the body. This is compounded by the fact that the acceleration generated during human movement varies across the body depending on the activity being performed.

Accelerometers have been criticized for accuracy of measuring activity concentrated in the upper body if waist bound. Mathie et al (2004) have shown that accelerometers have the ability to underestimate the energy expenditure of activities concentrated in the upper body in waist bound accelerometers. Despite these limitations, findings in this same research showed that the triaxial accelerometers provide valid and stable measurements of physical activity levels in comparison to most measurement technologies and have proved to be a valid and reliable method of measurement. Furthermore, the triaxial accelerometers are also appropriate in this research as they are relatively low cost, not cumbersome and provide a practical means of evaluation.

Takeshima et al (2001), using a well designed study without randomization, argues that accelerometers could be a highly effective tool to investigate the engagement of tasks in individuals who are sedentary and physically unfit as is found in stroke patients. Accelerometry can also be used to determine the effect of interventions on patients and evaluate the effect of increased physical activity on occupational performance. This is supported by Welk et al (2000) who used a well controlled laboratory environment but non randomized subjects to support the validity of accelerometers which detect motion in three planes. It must be noted that a limitation of this study was that the results could not be extrapolated to free living subjects and ADL as measurement was limited to choreographed routines of exercise related tasks.

Accelerometers have many desirable features in measuring human movement. Accelerometers can measure the frequency and intensity of movement, the extent of body movement and have been shown to demonstrate a high degree of reliability in measurement with little variation over time (Mathie et al, 2004). Furthermore, enhancements in microelectromechanical systems technology have made it possible to manufacture miniature low cost accelerometers that are light weight, portable systems that can be worn by free living subjects without impeding movement (Chen et al, 1997). This has made it possible to recreate ADL activities within a controlled environment to measure the physical energy expenditure of ADL tasks in subjects afflicted by stroke and compare this with matched controls. It provides a practical means to investigate the neurological effects that stroke has on individuals participating in ADL activities and to correlate this with levels of activity limitation and disability.

A criticism has been that the energy cost of an activity is largely related to muscular loading due to isometric contractions in upper body movement, which are required in dressing that the accelerometer will not be able to detect (Hendelman et al, 2000). Hendelman et al (2000) suggest that the limitation imposed by the accelerometer as a measuring instrument can be alleviated by combining accelerometry with a questionnaire based assessment to reflect subjective perceptions of exertion.

2.6 Perceptions of Difficulty in Dressing Tasks

Perceptions of increased difficulty of a task can lead to decreased participation of tasks. McArdle et al (1981) states that motivational factors leading to task execution are difficult to categorize or quantify yet play a key role in the amount of work and energy expended. The increased energy requirements observed in survivors of stroke were noted to contribute to a vicious cycle of further decreased activity, greater exercise intolerance, leading to secondary complications such as reduced cardio- respiratory fitness, muscle atrophy, osteoporosis and impaired circulation. These impairments together with the perceived difficulty of the task were in turn seen to foster greater dependence for activities of daily living and reduce normal societal interactions thereby exacerbating levels of disability and participation (Gordon et al 2004).

McArdle et al (1981) state that there is a link between the perception of difficulty of the task and the related muscle recruitment used to execute the task. The capacity of muscles to generate force is decreased when neural inhibition prevents them from expressing their true strength capacity. McArdle et al (1981) suggest that psychological inhibition related to perception of difficulty may result in this neural inhibition. This neurological inhibition caused by psychological factors could be the result of past experiences with exercise, fear of injury or even an overly protective home environment that limit the individual from performing the task independently.

Irrespective of the reason, these psychological factors have the capacity to decease the muscles' ability to express their maximum strength. This has important implications for rehabilitation. The perception of difficulty of a task may result in neural inhibition and thus affect the force generated by a muscle. This in turn increases the energy cost to generate sufficient force and may cause a cycle of increased perception of exertion.

Fihlo et al (2001) in a non randomized descriptive study showed that the energy expenditure required to perform routine ambulation is elevated approximately 1.5 to 2.0 fold in hemiparetic stroke patients compared to controls. The level of evidence in this study is however limited by the small subject numbers. Their findings indicate that increased energy costs foster less willingness to move thus favoring a further decline in cardiovascular fitness, disuse atrophy and weakness. Similarly it can be queried as to whether high energy costs in dressing tasks pose similar limitation with high levels of energy being expended thus fostering an unwillingness to execute this task

2.7 Disability and Stroke – A Public Health Issue

Stroke is the fourth most common cause of mortality in South Africa (Connor et al, 2004) with significant numbers of people either needing assistance or who are dependant in activities of daily living. This report also indicated that disability is raised in the context of stroke being the least recognized and worst treated chronic disease of lifestyle in South Africa. It causes between 7-10% of all deaths in the 35-64 age- group, hence impacting significantly on the workforce.

Gordon et al (2004) reported that although 14% of stroke survivors achieve full recovery in physical function; between 25-50% require at least some assistance with activities of daily living. The disability emanating as a result of stroke creates a significant burden of disease within the health system. This is exacerbated by studies suggesting that stroke rehabilitation is flawed as a result of rehabilitation therapists focusing at the impairment level and not at the disability level (Kwakkel et al, 1997). A systematic review conducted by Kwakkel et al (1997) indicated few studies with randomized control trials and experimental designs to support the effectiveness of rehabilitation after stroke. Cost effective approaches to assessment and management are essential to establish appropriate in-patient diagnostic and therapeutic pathways in order to establish prevention and rehabilitation programmes to reduce this burden of disease (Carlo et al, 1999). Decreasing the mortality of these patients is bound to increase the period that stroke survivors live with residual effects of stroke. It is therefore essential to identify factors causing disability in order to address this in a therapeutic programme.

A better understanding of factors leading to disability and decline of function in stroke patients can lead to outcomes based intervention and ultimately a change in health care financing, if risk factors and successful interventions can be established.

2.8 Activities of Daily Living and Disability

The predictability of independence in ADL activities in stroke has been used as a means to quantify disability in stroke (Kwon et al, 2004). Loss of ability to care for personal needs and to manage the environment can result in loss of self-esteem as well as a deep sense of dependence. This dependence has been shown to increase the disability in patients suffering with stroke. Furthermore, several authors (Kwon et al, 2004, Mathie et al, 2004 and Verbunt, 2001) have reported a strong association between poor physical ability and dependency in ADL activities, which in turn has been shown to decrease quality of life. Understanding the causes of limitations in ADL activities can lead to therapeutic interventions and hence a decline in the prevalence of disability in patients afflicted with a neurological dysfunction.

Duncan et al (1997) noted a high rate of depression among stroke survivors, stating it to be between 23-63%. Depression is closely associated with levels of dependency in ADL tasks following a stroke. A diminished quality of life following a stroke is often underestimated as well as its impact on life satisfaction (Duncan et al 1997). This warrants the need to investigate the levels of poor life satisfaction resulting from poor engagement in ADL and its impact on levels of disability.

2.9 Activities Health and Satisfaction

Activities health delineates a state of well being with regards to participation in activities of daily living (Cynkin and Robinson, 1985). and can be closely associated with levels of dysfunction leading to disability. A measure of activities health has been considered a valid means of measuring an individual's satisfaction with their participation in activities. An Activities Health Profile allows the health professional to investigate the engagement, configuration and variety of activities the patient is involved with through the duration of the day. The configuration is likely to alter and differ from individual to individual according to socio-cultural patterns. The Activities Health Profile allows for an evaluation of how the balance, variety, configuration and satisfaction of activities of daily living have been influenced by ill health and dysfunction.

Cynkin and Robinson (1985) state that health is synonymous with "function" and is manifested by the ability of the individual to participate in a variety of socio-culturally related activities with satisfaction and comfort. They assert that an individual is compelled to be active in order to develop intellectually, emotionally and physically. The involvement in daily activities is socially influenced and that the appropriately patterned involvement and number of activities contributes to “Activities Health”.

Similarly, ill health is often associated with the inability to carry our activities with satisfaction and comfort. The inability to engage in activities also results in the decline of function and greater degrees of disablement. In order to address this, Cynkin and Robinson (1985) propose that therapists must determine the nature of the dysfunction resulting in poor Activities Health. It is hypothesized in this research that important contributors to poor engagement in activities, is the inability to sustain the high levels of endurance and energy requirements related to tasks of daily living. As a result, poor engagement leads to a decreased number and variety of activities as well as poor satisfaction in activities of daily living.

Survivors of stroke have been shown to have significantly lower quality of life than control subjects of similar ages (Oulu Library, 2000). Conversely, quality of life improves with an increased ability to cope with stroke related impairments and these patients also presented with greater life satisfaction (Oulu Library, 2000). Life satisfaction or subjective well being was noted to be an important indicator of quality of life. There have consequently been strong correlations drawn between physical disability, dependency in ADL and declining quality of life and satisfaction.

Residual neurological deficits following stroke often predispose patients to poor functional capacity and a consequent sedentary lifestyle (Filho et al, 2001). This sedentary lifestyle coupled with the primary neurological deficits observed in stroke such as motor weakness, spasticity, poor balance and increased energy expenditure in walking, often lead to a further reduction in the individual's activities of daily living (ADL). Links between poor quality of life, poor engagement in ADL and physical limitations related to neurological deficits, have also been inferred (Fihlo et al, 2001 and Oulu Library, 2000).

It therefore appears that it is necessary to determine factors causing poor engagement in ADL tasks in individuals with stroke. These factors consequently lead to poor engagement in ADL tasks and poor activities health. These have the potential to escalate the level of disability and if severe, can lead to secondary dysfunction due to sedentary states that are the direct sequelae of inactivity.

CONCLUSION

The neurological consequences of stroke including muscle weakness, poor endurance, poor postural and motor control, decreased balance and gait have led to a complex configuration of motor deficits that limit physical activity. This in turn has been argued to create further complications in functional ability. The inability to generate sufficient force to execute ADL tasks is among them. Increased energy expenditure to compensate for these physical deficits to execute tasks can lead patients to a sense of over exertion and resulting fatigue which in turn can result in poor engagement in ADL tasks. This has the potential to spiral into global loss of functioning and decrease quality of life and life satisfaction.

There is concern that factors elevating the energy costs of ADL such as dressing which is considered as light work for able-bodied individuals are exceeding the capacity of stroke survivors. This leads to activity restrictions and disability. Furthermore, the high levels of energy expended to achieve the task of dressing leads to a perceived inability further decreasing engagement in this task.

The energy costs observed in dressing have the potential to permeate into all ADL tasks and affect the activities health of the individual. Poor balance and variety of tasks will ultimately affect the level of satisfaction the person with stroke has regarding their daily engagement in ADL.

The challenge of rehabilitation for occupational therapists worldwide is the re-engagement of patients in ADL activities utilizing their residual capacity. Participation in ADL activities after a stroke depends on the level of disablement that the patient experiences. This combined with factors such as the compensation a patient engages in and the limitations that the environment that the patient participates in, can facilitate or limit the engagement in ADL tasks.

The accelerometer has been shown to be an objective and reliable measuring tool to determine energy expenditure in various tasks, despite its limitations in underestimating measurements in upper body movement. Understanding energy expenditure in ADL tasks for individuals afflicted by stroke can be useful in treatment planning and priority setting for occupational therapists where rehabilitation goals are aimed at decreasing disability and increasing independence in ADL activities.