EFFECT OF GROUP EXERCISE ON ANTHROPOMETRY, NUTRITIONAL STATUS AND HEALTH RELATED QUALITY OF LIFE OF OLDER PERSONS LIVING IN AGED CARE HOMES WITHIN THE ETHEKWINI MUNICIPALITY

Submitted in the fulfilment of the requirements of the degree of Masters in Sport Science
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DECLARATION

STATEMENT 1

This dissertation is being submitted in fulfilment of the requirement for the degree of M. Sport Science.

Signed: _____

Date: _____

STATEMENT 2

This dissertation is the result of my own work, except where otherwise stated. Other sources are acknowledged by giving explicit references. I hereby declare that I did not commit plagiarism.

Signed: _____

Date: _____

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DEDICATION

I dedicate this dissertation to my family; especially in memory of my beloved father who played a pivotal role in my childhood and more importantly had inculcated values of love, honesty, respect and truth so that I can contribute positively to society and the world at large. My gratitude goes out to my late father for the valuable lessons taught and the wisdom he bestowed upon me. My every success is his success. Thank you to my family for teaching me that work is worship and providing full effort in any task will surely yield success.

LIST OF ABBREVIATIONS

BMI	Body Mass Index
CDC	Centre for disease control
CHD	Coronary Heart Disease
Cm	Centimeters
CBD	Central Business District
DoH	Department of Health
HRQoL	Health Related Quality of Life
Kg	Kilogram
mm	Millimeter
MNA-SF	Mini Nutritional Assessment Short Form
m	Meter
Kg/m^2	Kilogram per meter squared
n	Number
NGO	Non-Governmental Organization
NCD	Non-Communicable Disease
SA	South Africa
SF-36	Short Form Health Survey
WC	Waist Circumference
WHO	World Health Organization
WHR	Waist/Hip Ratio

DEFINITION OF TERMS

- ❖Anthropometry: The study of human body measurements such as height, weight, body mass, girth and skinfold measurement (Marfell-Jones, 2001)
- ❖Activities of daily living: Performing everyday tasks efficiently and effectively (Cadore, Rodríguez-Mañ s, Sinclair, & Izquierdo, 2013).
- ❖Aerobic capacity: Ability to perform work or physical activity for a prolonged period of time without undue fatigue (Prentice, 2004).
- ❖Body composition: Measurement of the percent lean muscle, fat mass and body tissue (Marfell-Jones, 2001).
- ❖Body Mass Index: A person's height in relation to weight. Expressed as kg/m^2 (Wellman & Kamp, 2008).
- ❖Chronic disease: Disease that is reoccurring and occurs for a prolonged period of one's life. These diseases are heart disease, high blood pressure and diabetes to name a few (Chodosh et al., 2005).
- ❖Cool down: A routine performed to aid in recovery after activity (Prentice, 2004).
- ❖Flexibility: The ability of joints to move through a pain free range of motion (Prentice, 2004).
- ❖Group exercise: People engaging together in a structure plan were components of fitness are stressed according to principles of frequency and optimal intensities for a prolonged period of time ensuring health goals are reached (Morley, Haren, Rolland, & Kim, 2006; Topinková, 2008).
- ❖Health related quality of life: Self efficacy and a perceived perception of optimal health (Lima et al., 2009).
- ❖Malnutrition: Is the lack of optimal macro and micro nutrients, in relation to dietary need (Meijers, Schols, Soeters, & Halfens, 2010)
- ❖Muscular endurance: The ability of muscles to perform work for a prolonged period of time without undue fatigue (Prentice, 2004).
- ❖Nutrition: Intake of food in relation to dietary need (WHO, 2000)
- ❖Non communicable disease: Not as a result of infection but due to lifestyle or genetic factors, namely type 2 diabetes, hypertension (Mayosi et al., 2009).

❖Overweight: A Body Mass Index of ≥ 25kg/m^2 (Cole, Bellizzi, Flegal, & Dietz, 2000).

❖Obese: A Body Mass Index of ≥ 30kg/m^2 (Leroy et al., 2005).

❖Proprioception: The awareness of joint space of movement. (Prentice, 2004; Zazulak, Hewett, Reeves, Goldberg, & Cholewicki, 2007).

❖Wellbeing: Stability and perception of one's life, emotionally, physically, socially and socio-economically (Topinková, 2008).

❖Warm-up: Prepares one for the activities ahead. Incorporate rhythmical activities and stretches (Church, Wiggins, Moode, & Crist, 2001).

ABSTRACT

Introduction: Globally, the prevalence of chronic disease is on the increase with cardiovascular disease being the leading cause of death. Worldwide the proportion of older persons aged 60 years and older is also increasing. The elderly within institutionalised setting are often neglected, with the probability of poor nutrition being highly prevalent. Increasing in age and visceral fat coupled with a lack of structured exercise results in inflammatory and pro-inflammatory processes, contributing to the deterioration of physical and physiological functioning. In the context of the elderly living in aged care homes, health related quality of life is defined as their functional status and independence in engaging in activities of daily living. Little is known about the effect of group based exercise and its relation to anthropometry, nutritional status and health related quality of life among the elderly living in aged care homes within the eThekwini central business district (CBD).

Aim: The aim of the study was to establish the effect of group exercises in relation to anthropometry, nutritional status and health related quality of life of older persons living in age care homes in the eThekwini central business district.

Methodology: A quasi-experimental design was used to compare the effect of a 12 week group exercise programme on two groups of participants using pre-test and post-test procedures. A total of 100 participants selected from five aged care homes. Twenty participants from each of the five facilities were randomly selected through convenient sampling. From the 20 participants, ten participants were randomly assigned to Group A –experimental group and 10 in Group B-observed group. Group A exercise three times a week and group B exercise two times a week for 12 weeks. Group based 12 weeks exercise intervention was implemented for both groups. Anthropometrical indices investigated included sum of skinfold, waist circumference, waist to hip ratio and BMI. MNA-SF, SF-36 questionnaires were used before and after the exercise intervention to determine nutritional status and health related quality of life respectively. Data was analysed using the Statistical Package for Social Science Version 18.0 (SPSS) for Windows software. A p-value of <0.05 was considered statistically significant. A paired t-test and independent t-test was used to analyse parametric data. Wilcoxon signed rank test and Mann Whitney U test was used to analyse normally distributed and non-parametric data.

Results/Discussion: An inverse relation between 12 weeks of group exercise and sum of skinfold was noted comparing before (M: 141.05 mm, SD: ±37.43mm) and following (M: 153.66 mm, SD: ±46.59mm) group exercise ($p<0.01$). However this cannot be attributed to group exercise independently, but as a result of the inherent inverse relationship that exists between fat free mass and age. Group exercise when compared to baseline (M: 12.96, SD: ±1.48) and follow up (M: 13.02, SD: ±1.11) was effective in improving nutritional status ($p<0.01$). Group exercise improved components of HRQoL. Participation in vigorous activities had improved following the group exercise intervention ($p<0.01$). Exercise was effective in reducing a feeling of worn out ($p=0.01$), improving social functioning ($p<0.01$), improved feeling of peace ($p<0.01$), happiness ($p<0.01$), change in reported health ($p<0.01$), mental health ($p=0.03$) and vitality ($p=0.01$). There was a significant difference in social functioning ($p<0.01$), vitality ($p<0.01$) and mental health ($p=0.03$) comparing before and following training thrice a week. Group exercise twice a week may improve social functioning ($p=0.02$). There was a significant difference in mental component summary following 12 weeks of group exercise ($p<0.01$). There was a significant difference in physical component summary scale ($p=0.03$) and mental component summary ($p=0.04$) comparing before and following training twice a week. A significant difference was evident in the mental component summary scale comparing before and following training thrice a week ($p<0.01$).

Conclusion:

Group exercise significantly improved nutritional status and health related quality of life of the elderly living in aged care homes. Group exercise performed three times a week may improve social functioning, vitality and mental health whilst exercising two times per week may improve social functioning. This may assist the elderly in accomplishing activities of daily living safely, improving their functional ability and quality of life.

SYMBOLS

%	Percent
=	Equal To
<	Less Than
>	Greater Than
≥	Greater Than and Equals To
≤	Less Than and Equal To
*	Statistically Significant
X	Times
/	Per
±	Plus or Minus

CHAPTER 1. INTRODUCTION

1.1 Introduction

Globally, the prevalence of chronic disease is on the increase, specifically in developing countries, with cardiovascular disease being the leading cause of death (Blair, 2009). Worldwide, the proportion of older persons aged 60 years and older is also increasing (World Health Organization, 2002). In 2025 there will be approximately 1.2 billion people over the age of 60 years, and in 2050, the number will increase to 2 billion, with 80% percent living in developing countries (World Health Organization, 2002). By the year 2025, more than 1 person in 10 will be 60 years and older in South Africa (Joubert & Bradshaw, 2006). Increasing in age results in inflammatory and pro-inflammatory processes, contributing to the deterioration of physical and physiological functioning (Baylis, Bartlett, Patel, & Roberts, 2013). This predisposes the elderly to chronic disease, disability and frailty (Daniel Baylis et al., 2013; Hubbard & Woodhouse, 2010; Topinková, 2008).

There is compelling scientific evidence worldwide which suggests that a structured exercise program can improve the physiological functioning, health related quality of life and functional ability of older persons living in aged care homes (Haskell et al., 2007; Manini & Pahor, 2009; Nelson et al., 2007; Peri et al., 2008; Proctor, Singh, Salem, & Skinner, 2009). Despite the benefits of a structured exercise program, many older persons lead sedentary lifestyles (Joubert & Bradshawb, 2006). An international study reported that physical activity decreased substantially from 23% in the 65-69 year group to 13% in the ≥ 85 year group (McGuire, Ahluwalia, & Strine, 2006). Increase in age reduces the ability to maintain the guidelines of 150 minutes of moderate or vigorous physical activity per week (Sun, Norman, & While, 2013). Inactivity in South Africa is common in persons over the age of 55 years, with the associated lowest reported moderate to vigorous physical activity levels (Joubert et al., 2007). Inactivity is associated with increased risk of heart disease, type 2 diabetes, hypertension and osteoporosis (Gothelf, 2008; Kaur et al., 2014; Sallis, 2009).

Malnutrition is rife at age 65 years and older, and is reportedly due to an imbalanced diet, and results in poor absorption of key nutrients and vitamins and a loss of appetite among the elderly (Govender, 2011). The prevalence of malnutrition is relatively low in older community dwellers (2-10%) but increases substantially in older persons living in long term care facilities (30-60%) in developed countries (Guigoz, 2006). The aged within institutionalised settings are often neglected (Govender, 2011), with the probability and risk of malnutrition and poor nutrition being increased (Arvanitakis et al., 2008)

Quality of life is defined as an individual's perception and concerns of life in relation to their goals, expectation and values that they imbibe (Skevington, Lotfy, & O'Connell, 2004). Quality of life is affected by physical health, psychological state, social interaction, personal belief and level of independence (Skevington et al., 2004). Health related quality of life is synonymous to health-related subjective wellbeing, functional status and self-perceived health (Bond & Corner, 2004). In the context of the elderly living in aged care homes, health related quality of life is defined as their functional status and independence in engaging in activities of daily living (Cleary & Howell, 2006). Health related quality of life is associated with improvements in activities of daily living, preserved physical, physiological functioning and promoting active aging among the elderly (Bowling, 2005).

Aging is associated with decrease skeletal muscle and increase in fat mass (Riechman, Schoen, Weissfeld, Thaete, & Kriska, 2002). Increase in visceral truncal fat predisposes the elderly to chronic cardiovascular disease (Ahmed & Haboubi, 2010; Hughes et al., 2004). However little is known about the effect of fat redistribution with advancing age (Hughes et al., 2004). Body composition determines amount of fat and fat free mass that is present (Wells & Fewtrell, 2006). Anthropometry quantifies body size and proportion and is a developing scientific specialization that looks at various measurements in an attempt to assess and evaluate composition, size, growth, and gross function of the human population (Marfell-Jones, 2001).These measurements include Body Mass Index, waist to hip ratio, waist circumferences and skinfold thickness (Wang, Thornton, Kolesnik, & Pierson, 2000). Anthropometric indices are the most frequently used as they are low-cost and safe (Ayvaz & Çimen, 2011).

Little is known about the effect of group based exercise and its relation to anthropometry, nutritional status and health related quality of life among the elderly living in aged care homes within the eThekwini central business district (CBD).

1.2 Background

The World Health Organisation initiated the 'Active Aging' policy to reduce inactivity and improve health related quality of life (World Health Organization, 2002). The elderly within aged care homes should aim towards maintenance of autonomy and independence to ensure a reduction in disabilities associated with chronic disease and the promotion of an active role in all spheres of life (World Health Organization, 2002).

The 'Well for Life' initiative was implemented by the State Government of Vitoria, Australia, Health Department in 2003. The Well for Life Policy advocates the use of physical health principles to improve physical health, nutrition and emotional wellbeing of aged care residence and community dwellers. The Older Persons Act of 2006 is legislation that protects and empowers older persons, promotes wellbeing and provides safety and security against challenges faced by older persons. The South African Older Persons Forum is a discussion group forum aligned with the human rights commission. The forum addresses issues affecting the elderly and ensures support for older persons so that they remain in mainstream society. According to the Kwazulu-Natal Department of Social Development, approximately 1913 persons live in government subsidised old aged homes in the eThekwini Municipality. This study was undertaken at 5 such old aged homes.

Although sporting initiatives have been implemented by the South African Older Persons Forum to promote active ageing, little emphasis was placed on general wellbeing. The purpose of the active aging policy in the South African context is to promote activities to enhance quality of life in all spheres namely physical, emotional, social and mental. The aim is further to reduce chronic illnesses and facilitating functional fitness, in preserving activities of daily living and reducing the challenges of ageing.

Despite the policy interventions, physical inactivity was listed among the major health risk factors, contributing to non-communicable diseases, global mortality and morbidity

(World Health Organization, 2002). Tobacco use and poor diet are also major risk factors for chronic diseases (Naidoo, Coopoo, Lambert, & Draper, 2009). The burden of chronic diseases is higher in developing than in developed countries, with the lack of cardiovascular fitness being the main cause of mortality (Blair, 2009) .

Residential care facilities in Western Cape accommodates 2000 residents, with challenges in intellectual behaviour and mental health (McKenzie, McConkey, & Adnams, 2013). There is an over representation of females compared to males (McKenzie et al., 2013). In general there is a lack of health care serves in these facilities, which relies on referring residents for physiotherapy and speech therapy (McKenzie et al., 2013).

Nutritional problems evident in aged care homes in Brussels, indicate that weight loss and protein under nutrition are prevalent (Arvanitakis et al., 2008). Weight loss and poor protein intake can be attributed to a lack of access to appropriate food, socio-economic factors and poor knowledge about food and choices (Alibhai, Greenwood, & Payette, 2005). Tooth loss, inadequate swallowing, cognitive and physical disability prevents the elderly from buying food and preparing it, resulting in poor access to a wide variety of food groups (Leydon & Dahl, 2008). The elderly within aged care homes are therefore more susceptible to disease, death and frailty, as well as loss of functional dependence (Jukkola & MacLennan, 2005). Lifestyle behaviours such as not smoking, coping skills and physical activity can modify the heredity risk of functional decline and onset of disease. However social isolation and loneliness is linked to decrease in physical and mental wellbeing (Lima et al., 2009) .

Aged care homes in South Africa incorporate the ‘Golden Game’ annually, the purpose being to compete with different provinces, under a banner of designated events ranging from novelty items to speed and endurance races. Social interaction, physical and mental components are stressed during the event. However, the emphasis of the game is primary competitive in nature and does not cater for all older persons residing in aged care homes.

In 2008 the South African government implemented the active ageing policy using the guidelines of the Older Persons Act of 2006 and the international Madrid plan of action on aging (2002) as a framework for implementation (Sidorenko & Walker, 2004). At the

second world ageing assembly held in Madrid April 2002 a declaration on action on aging was adopted (Sidorenko & Walker, 2004) and compelled government to address the challenges of population ageing . The plan highlighted 117 recommendations, however the three core categories were older persons development, health and wellbeing and supportive structures for older persons

Although the "Active Aging" policy in South Africa and Golden Game initiative is implemented in South Africa, little is known about the effects of group exercise in relation to quality of life of the elderly living in old aged homes. Further there is a paucity of literature in this area and a contextualised policy in South Africa is required for those living in aged care homes (Crampton, 2011). Despite international efforts such as 'Active Aging' and local initiatives such as 'Golden Game', disability, frailty and chronic disease prevalence is escalating within the elderly (Joubert & Bradshawb, 2006). The purpose of the study was therefore to determine the effect of group exercise in relation to anthropometry, nutritional status and health related quality of life of the elderly living in aged care homes within the eThekwini municipality of South Africa.

1.2.1 Exercise and the Elderly

Globally the lack of a structured exercise program, reduced physical activity and poor nutrition are prevalent among the elderly persons living in aged care homes, predisposing them to disease, disability and even death. Moreover aging, physical inactivity and disability are related to an increase in visceral fat mass, which is a contributing factor to developing cardiovascular and metabolic disease (Deschenes, 2004). In the elderly, being overweight and underweight can cause disability and disease (Ferraro, Su, Gretebeck, Black, & Badylak, 2002). Overweight is due to an imbalance of energy intake and expenditure, sometimes resulting in obesity (Larrieu et al., 2004). An increase in intra-abdominal visceral fat and obesity are common problems faced by the elderly living in aged care homes (Charlton et al., 2008).

Independence and autonomy are core values attributed to residents residing in aged care homes (Govender, 2011), Physical activity enhances aerobic fitness, muscular endurance and flexibility ensuring that the elderly will be able to perform their activities of daily living such as shopping and house hold chores without limitations (Czerniewicz &

Nicholson, 2004). This will promote independence, self-confidence and quality of life (Czerniewicz & Nicholson, 2004), which could reduce the secondary effect of aging, thus limiting the risk of disability (Topinková, 2008).

1.2.2 Motivation for Group Exercise Intervention

Group exercise and social interaction is important for an elevated emotive experience within the elderly living in aged care homes (Morley, Haren, Rolland, & Kim, 2006; Topinková, 2008). Many studies have focussed on aerobic and strength training protocols in relation to health and wellbeing of the elderly living in aged care homes (Manini & Pahor, 2009; Pienaar, De Swart, De Vries, Roos, & Joubert, 2004; Rabaglietti, Liubicich, & Ciairano, 2010) . To achieve benefits in health indicators and quality of life a multicomponent exercise program is preferred, which should consist of aerobic , muscular endurance, stability/balance and flexibility exercises (Baker et al., 2007). Most studies implemented a frequency of two and three times a week, with a duration ranging from 3 to 12 months (Baker et al., 2007). The current study was designed as a 3 month intervention. Exercise frequency is normally prescribed as 3X per week. In the current study the rationale for introduction of 2X per week was to introduce a control arm into the quasi-experimental design and to assess the effect between the two groups. The aim of an exercise intervention in the elderly living in aged care homes is to increase and preserve the ability to perform activities of daily living, ensuring that they can conserve a level of independence as long as possible. The exercise intervention is targeted to reduce the onset of chronic disease and add life to years instead of years to life (Armstrong, 2006).

1.3 Problem Statement

The elderly living in aged care homes are often neglected and socially excluded from other population groups (Govender, 2011). The current study consisted of non-frail participants, however poor nutritional habits and lack of physical activity predisposes the elderly to chronic disease and an increases risk of disability and progression to frailty (Ahmed, Mandel, & Fain, 2007). Frailty increases dependence and reduces one's ability to perform activities of daily living, which will inevitably affect quality of life (Hazzard, 2005)

There is a direct relationship between increased disability with age which can predispose the elderly to frailty (Ferrucci et al., 2004). The inability to perform activities of daily

living is a major problem associated with the elderly living in aged care homes (Covinsky et al., 2003),with the more active who spend less time sitting have a better quality of life and mental health then those who are less active (Fox, Stathi, McKenna, & Davis, 2007). Poor nutrition, a lack of independence and inactivity predisposes the elderly to chronic disease, particularly for those living in aged care homes. The above finding are well documented internationally, but to date, no studies have been done in South Africa to establish the effect of group exercises on anthropometry, nutritional status and health related quality of life of older persons living in aged care homes in the eThekwini municipality.

1.4 Aim

To investigate the effect of group exercises in relation to anthropometry, nutritional status and health related quality of life of older persons living in age care homes in the eThekwini municipality

1.5 Objectives

1. To determine the demographic profile of older persons residing in aged care homes
2. To determine the effect of group exercise on anthropometry
3. Compare the effect of participation on a group exercise program 3 ×/week vs. 2 ×/ week (for 12 weeks) on anthropometry
4. To determine the effect of group exercise (12 weeks) on nutritional status
5. Compare the effect of participation on a group exercise program 3 ×/ week vs. 2 ×/ week (for 12 weeks) on nutritional status
6. To determine the effect of group exercise on health related quality of life
7. Compare the effect of participation on a group exercise program 3 ×/ week vs. 2 ×/ week (for 12 weeks) on health related quality of life

1.6 Significance of the Study

The study will inform policy for development of physical activity within residential care facilities in the South African context. Group based exercise in South Africa will aid in social interaction among the elderly and an increase in self confidence and self-esteem, resulting in an increase in health related quality of life and high participation rates. This may improve functional and health status of the elderly encouraging cohesion in society and promoting efficiency in activities of daily living. Adherence to a structured group

based exercise program for a prolonged period of time will ensure physical, mental, emotional and social benefits are obtained by the elderly living in aged care homes (Czerniewicz & Nicholson, 2004). To determine adherence attendance –registers were kept at each research site. If participants missed more than 5 sessions, there data was not included in the analysis. The current study will also provide evidence of the nutritional status of the elderly and the effect exercise has on nutritional status. This may provide intervention strategies in promoting adequate nutrient intake in the elderly living in aged care home. The long term goal of the study is to encourage the elderly within long term aged care homes to be active. This could increase their health related quality of life and self-efficacy, which could reduce the burden of chronic diseases in institutionalized facilities and hospitals.

1.7 Thesis Structure

This thesis is presented in 6 chapters, with the structure of each being as follows:

Chapter 2 will review the literature regarding pathophysiology of aging, preventing the progression of frailty, impact of aging on anthropometrical profile, impact of aging on nutritional status, impact of aging on health related quality of life, evaluation of anthropometrical profile, nutritional status and health related quality of life and effectiveness of exercise as an intervention.

Chapter 3 presents the study methodology, and outlines what study population, sampling methods, tools and process were used to meet the objectives.

Chapter 4 presents the results of the data analysis for each of the 6 objectives in tables and graphs.

Chapter 5 discusses the study results with respect to local and international literature.

Chapter 6 answers the research question, presents the study limitations, outlines the significance of the findings, and makes recommendations for further research.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

Impairments in physical functioning, cognitive ability and dependence in activities of daily living are common among people living in aged care homes (Littbrand, 2011). This chapter therefore reviews the literature with respect to the pathophysiology of aging, preventing the progression of frailty, impact of aging on anthropometrical profile, impact of aging on nutritional status, impact of aging on health related quality of life, evaluation of anthropometrical profile, nutritional status, health related quality and effectiveness of exercise as an intervention in the elderly living in aged care facilities.

2.2 Pathophysiology of Aging

Aging is a complex and inevitable process, which leads to a decline in the body's physiological system and physical capacity (Manini & Pahor, 2009). The musculoskeletal and cardiovascular systems are affected by their everyday activities. They may also experience cognitive decline, increased prevalence of chronic diseases, and conditions such as hypertension, cardiovascular disease, diabetes, cancer and osteoporosis (McKevith, 2005). Aging is commonly characterized by a progressive and general impairment of function, resulting in vulnerability to environmental challenges, and a growing risk of disease and disability (Kirkwood, 2005).

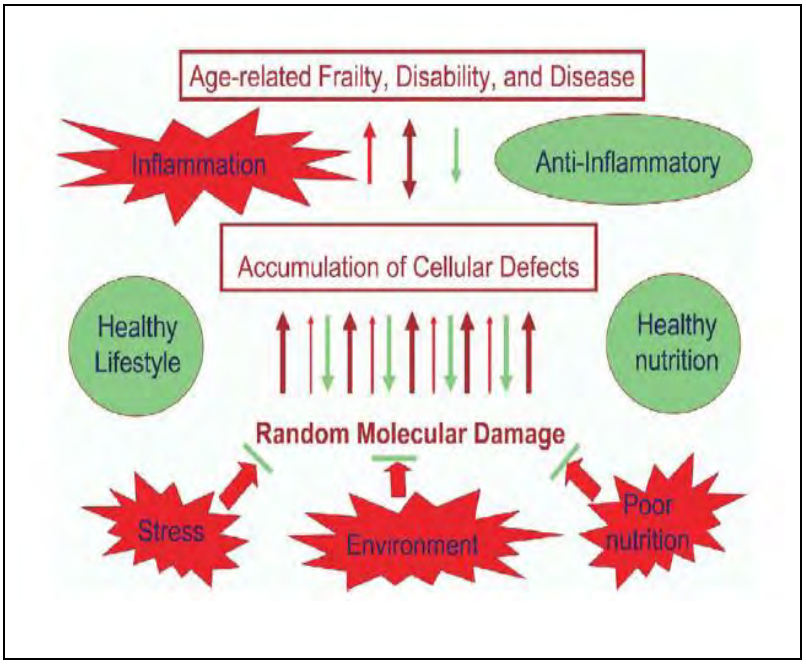


Figure 2.1: The aging process (Kirkwood, 2005)

The aging process (figure 2.1) is due to changes at the cell level, specifically in the mitochondrial DNA, which have been postulated to trigger abnormal functioning of mitochondrial proteins, resulting in greater levels of free radical molecules (Rahman, Marwick, & Kirkham, 2004). Chronically high levels free-radical molecules may lead to altered gene expression, and damage the lipids and proteins (Rahman et al., 2004), which appears to be associated with mitochondrial abnormalities. These cellular defects often cause inflammatory reactions (red colour arrow) that can increase existing damage. In addition, the intrinsic (Biological mediators e.g. cytokines and stress) and extrinsic (e.g. external environment and poor nutrition) stressors, impact on the inability to maintain homeostasis of physiological processes and inadequate resilience to overcome disease and disability predisposes the elderly to frailty (Kirkwood, 2005). Healthy lifestyle including exercise and nutrition may reduce inflammation and heighten anti-inflammatory response which may reduce cellular defects, age related frailty, disability and disease (Pinto et al., 2012; Sears & Ricordi, 2011)

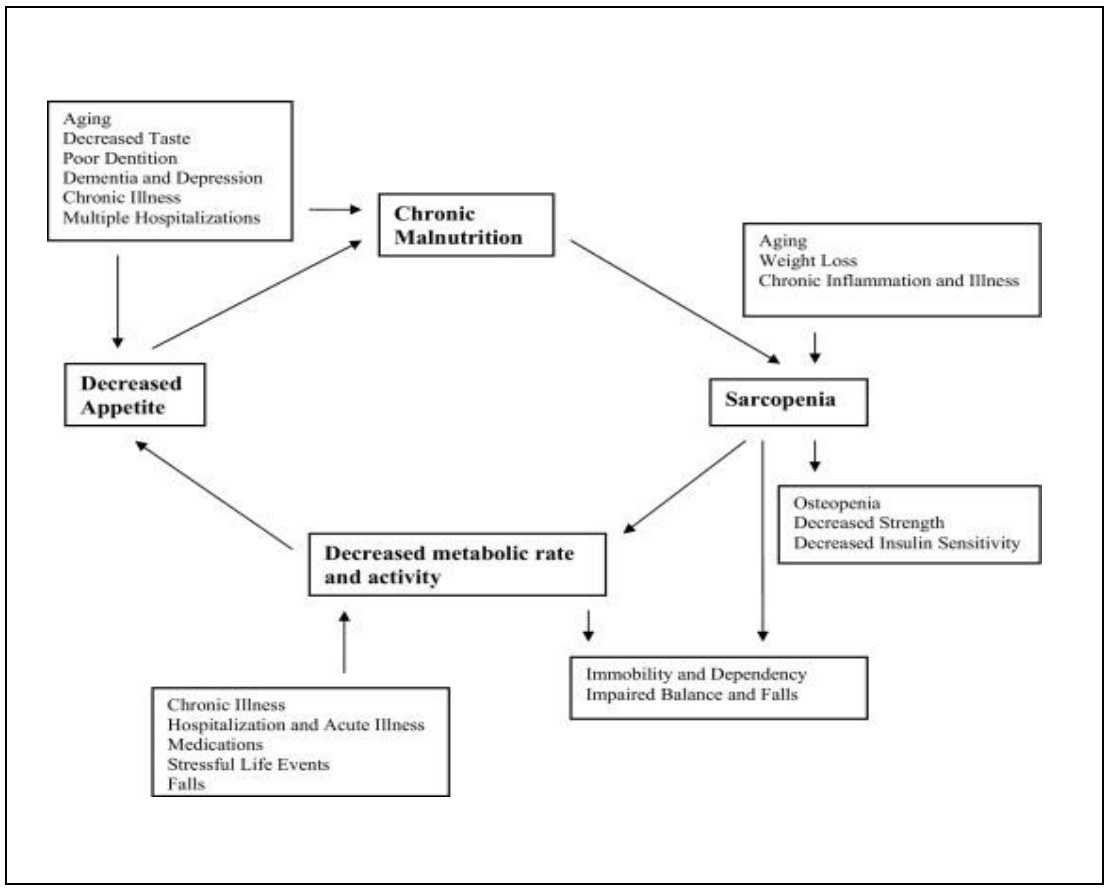


Figure 2.2: The frailty cycle (Ahmed el al., 2007)

Frailty is defined as a physiological decline in multiple body systems, resulting in a loss of functional ability and an increase occurrence in acute illness, falls, disability and eventually death (Fried, Ferrucci, Darer, Williamson, & Anderson, 2004). Sarcopenia is a central factor in the pathophysiology of frailty (Morley et al., 2006), and is defined as a loss of lean muscle mass and cross sectional area of muscle, which occurs from approximately 40 years of age (Kim & Choi, 2013). This loss in lean muscle mass has been estimated at approximately 8% per decade until the age of 70 years, after which it increases substantially to 15% per decade (Kim & Choi, 2013). Decrease in muscle mass is directly related to physical inactivity, reduced mobility and muscular endurance, which are common features among the elderly (Cesari et al., 2006).The process of frailty is not yet fully understood, however, it has been suspected to involve multiple systems. Clinically frailty is associated with unintentional weight loss, self-reported exhaustion, reduced grip strength and slowness in walking (Fried et al., 2004; Hazzard, 2005)- Figure 2.2. A multicomponent exercise intervention consisting of resistance training, cardiorespiratory endurance, proprioception and balance exercises may improve walking and stair climbing ability and muscle strength (Cadore, Rodríguez-Mañ s, Sinclair, & Izquierdo, 2013). Exercise may reduce fall risk which may prevent the progression of frailty (Cadore et al., 2013). The pathophysiology of frailty includes sarcopenia and neuroendocrine deregulation.

2.2.1 Sarcopenia

There are many causes of sarcopenia in the elderly, including an imbalance of energy expenditures and decreased appetite (aggravated by anorexia), which renders the elderly person vulnerable to both macro- and micro-nutrient deficiency (Donini et al., 2013). Progressive weight loss can lead to inadequate protein intake for muscle maintenance (Morley, 2001a; Wilson & Morley, 2003), and lean body mass, bone, muscle, and connective tissues decline with advancing age (Stenholm et al., 2008). In those with frailty, up to 50% of lean body mass is lost (principally skeletal muscle) and replaced with adipose tissue (Morley, Perry, & Miller, 2002).

Sarcopenia limits functional capacity in the elderly and leads to decreased exercise (and energy expenditure), weakness and fatigue, resulting in a diminished ability to perform activities of daily living (Morley et al., 2002). Furthermore sarcopenia predisposes the

elderly to poor balance, slow gait, and increased risk of falls (Hazzard, 2005) . Therefore sarcopenia and nutritional changes are often contributing factors of chronic and acute illness. The lack of resilience of the elderly to overcome acute and chronic illnesses predisposes them to co-morbid conditions, initiating the process of frailty (Hubbard & Woodhouse, 2010), eventually leading to institutionalization or death.

2.2.2 Neuroendocrine Control

Neuroendocrine control includes changes in the cardiovascular system, with advancing age resulting in diminished ability to respond to normal stimuli and a sluggish negative feedback system incurs. This diminished physiological process and increases vulnerability to stressors, include responses to physical danger, psychological distress and pain (Hickson, 2006). Pain limits a person's ability to exercise, which is an important precipitant of frailty (Morley et al., 2006). Sex hormone secretion is also diminished with advancing age, decreasing lean body mass and increasing adipose tissue (Hickson, 2006)

Growth hormone which is secreted by the pituitary glands stimulates growth in plant and animal cells and Insulin-like growth factor 1 (IGF-1) is a protein that has a similar molecular structure to insulin and provides an anabolic effect in adults. Growth hormone and Insulin-like growth factor 1 are often diminished with aging, and both are clearly reduced with chronic diseases, these hormones being important to maintain lean body mass (Hickson, 2006). Adiposity increases the incidence of dyslipidemia, hypertension and resistance to insulin, predisposing the elderly to the pathogenesis of metabolic syndrome and cardiovascular disease (CVD) (Hazzard, 2005).

In addition, insulin resistance leads to fat infiltration within muscle cells , predisposing the elderly to arteriosclerosis (Frisoli, Chaves, Pinheiro, & Szejnfeld, 2005), which is defined as the thickening and hardening of arteries as a result of plaque build-up. The reduced diameter of the artery increases resistance to blood flow (LeMura & Von Duvillard, 2004), and the total peripheral resistance increases to accommodate the narrowed diameter (Sagiv, 2012). Blood pressure is a product of the heart rate and total peripheral resistance, an increase in total peripheral resistance exasperates the workload of the myocardium (Sagiv, 2012).

Minor strokes within the brain can lead to cognitive impairment, while coronary artery atherosclerosis can cause deterioration of cardiac output and a decline in maximal oxygen consumption (VO_2 max) (Morley et al., 2002). The reduced cardiac output and VO_2 max increases heart rate, which has the ripple effect of increasing rate pressure product (Armstrong, 2006). The myocardium has to work harder to sustain daily activities as a result of a reduced volume of blood being pumped after each stoke (Custodis et al., 2010). Eventually, the efficiency of the cardiovascular system is hampered, and the elderly experiences signs of exhaustion and syncope when performing activities of daily living (Ungar et al., 2009). Atherosclerosis further leads to an accelerated loss of muscle units, while poor blood flow to the legs leads to decreased blood flow to the nerves and muscles, aggravating sarcopenia and decreasing the availability of oxygen to the muscles (Hubbard & Woodhouse, 2010).

The interaction of sarcopenia and neuroendocrine dysfunction is important in the complex pathogenesis of frailty and aging (Hazzard, 2005). While aging may be an end point of life, increased knowledge about the aging process can enable people to cope and delay the continuum of frailty. Knowledge about the pathophysiology of aging, its deleterious effects and interaction with frailty are essential to providing a better quality, more enjoyable and longer final part of their life.

2.2.3 Preventing the Progression of Frailty

Prevention of frailty should start early in life focusing on lifestyle factors (T. E. Strandberg, Pitkälä, & Tilvis, 2011). In the elderly insulin resistance, low and high Body Mass Index, abdominal obesity and lack of protein intake was associated with frailty (Chen, Wu, Chen, & Lue, 2010). Smoking reduces health related quality of life increasing the risk of frailty (A. Y. Strandberg et al., 2008). Therefore lifestyle interventions such as non-smoking, healthy diet, weight control and exercise may reduce the progression of frailty(Bergman et al., 2007). A multicomponent exercise program promotes strength and power improving activities of daily living, which may reduce the risk of frailty (Waters, Baumgartner, Garry, & Vellas, 2010). A Cochrane review suggested that a when a diet rich in protein and supplementation was introduced to malnourished patients, their mortality risk reduced (Milne, Potter, & Cochrane, 2003). Another study reported that the installation of hand rails reduced mortality among the elderly living in aged care homes

(Mitoku & Shimanouchi, 2014). Therefore home modification may prevent the progression of frailty (Mitoku & Shimanouchi, 2014). Because of the multifaceted nature of frailty, more research is required to investigate interventions required to prevent the progression of frailty (T. E. Strandberg et al., 2011).

2.4 Impact of Aging on Anthropometrical Changes

Anthropometric changes that take place in the elderly include a reduction in height by a possible 1 cm from age 40- years and older (Proctor et al., 2009). The thoracic curvature becomes more prominent at age 60 years and older (Grieger, Nowson, & Ackland, 2007) and results in the kyphotic posture, which results in weakened shoulder retractors and tightens pectoralis major and minor muscles (Prentice, 2011). In addition, the force couple relationship between deltoids and rotator cuff muscles, upper trapezium, levator scapulae and lower trapezium is greatly affected, (Prentice, 2011) resulting in the glenohumeral and sternoclavicular joints not functioning in synchronisation. This predisposes the elderly to shoulder pathology, rotators cuff impingement, scapulae dyskinesis and adhesive capsulitis (Prentice, 2011). Owing to the above muscle imbalance, cervical postural syndrome can develops due to the excessive protrusion of the cervical spine (Brukner, 2012). As one ages, facet joints narrow, predisposing the elderly to cervical spinal stenosis, which is exasperated by cervical postural syndrome (Brukner, 2012). The above postural defects can cause chronic pain and paralysis among the elderly, inevitably affecting activities of daily living.

Changes in body composition accounts for the majority of the elderly, living in elderly care facilities. (Bechtold, Palmer, Valtos, Iasiello, & Sowers, 2006). Increase visceral fat mass increases the prevalence of co-morbid pathology with age (Proctor et al., 2009). Increase in intra-abdominal fat results in increase arteriosclerotic plaque, contributing to a reduction of vasodilatation properties of endothelial arteries (Proctor et al., 2009). Moreover aging, physical inactivity and disability are related to an increase in visceral fat mass, which is a contributing factor in the development of cardiovascular and metabolic disease (Deschenes, 2004).

While an increase in the Body Mass Index (BMI) is directly related to an increase in disease and disability (Borrell & Samuel, 2014) , the correct maintenance of Body Mass

Index was found to increase functional ability in performing activities of daily living (Apovian et al., 2002). There is a strong relationship between a high BMI and decreased physical ability related to walking in a sample of older women aged 74 years who had lived in aged care homes for at least 9 years (Bohannon et al., 2005).

Contrary to the Bohannon study, a study conducted by Grieger et al. 2007 reported that among 82 year old Italian males and females living in long term care facilities with a BMI of $\leq$21.6 kg/m^2 and $\leq$22 kg/m^2 respectively, had an increased risk of mortality, whereas those in the higher Body Mass Index of >25.4 kg/m^2 had a 40% lower risk of mortality over a period of four years (Grieger et al., 2007). Further studies reported that weight loss among persons aged 70 years and older with a Body Mass Index of lower that 26-27 kg/m^2 was not advisable (Flicker et al., 2010; McLaughlin et al., 2011). Lower Body Mass Index was not found to predict low mortality among the older population, but was associated with lower risk of chronic disease later in life (Flicker et al., 2010). While an increase in fat mass and a decrease in lean muscle mass increases the mortality risk (Hardy & Kuh, 2006), as BMI does not distinguish between fat mass and lean muscle, the above results could be conflicting and inconclusive.

Body Mass Index provides an indication of weight in relation to height and does not distinguish percent body fat (Grieger et al., 2007). Waist circumference and waist to hip ratio is often neglected in many studies (Bohannon et al., 2005; Grieger, Nowson, & Ackland, 2007; Woo, Leung, & Kwok, 2007) , and are important indicators that determine the distribution of fat (Thompson, Gordon, & Pescatello, 2009). Android obesity, which is characterized by larger distribution of abdominal or trunk fat, is associated with an increased risk of hypertension, type 2 diabetes, dislipidemia and coronary heart disease (Kang et al., 2011). However there is a reduced risk of hypertension and coronary heart disease with with gynoid or gynecoid obesity (fat distribution in hip and thigh) (Kang et al., 2011)

2.5 The Impact of Aging on Nutrition

The WHO defines nutrition as the intake of food in relation to bodys dietary needs, with good nutrition being a well balanced diet, their recommendation being that it be combined with regular physical activity (World Health Organization, 2000). Poor nutrition can lead to reduced immunity, increase suseptability to disease and reduced productivity (World Health Organization, 2000). Nutrition is an important factor that contributes directly and indirectly to the quality of life of the elderly, particularly those living in aged care homes (Govender, 2011), and is recognized as an important component of healthy aging (Topinková, 2008).

The nutritional status of many residents remains poor and requires attention in aged care homes (Thomas et al, 2002). In United Kingdom (UK) nursing homes, the elderly face many challenges namely, low Body Mass Index, disease, loss of thirst and appetite, swallowing problems and medication that affects the intake of food and inevitably affects quality of life (Hickson & Frost, 2004). Nursing homes have rigid routines, can be under-staffed, with a lack of choice and variety for the elderly adding to their challenges (Kenkmann, Price, Bolton, & Hooper, 2010). Studies in the UK on elderly people living in aged care homes suggest that 14% were underweight, 16% obese and 85% had some cognitive problem (Kenkmann et al., 2010). A quarter were at risk of depression (Kenkmann et al., 2010), and high levels of anxiety was also noted among the elderly residing in UK aged care homes (Kenkmann et al., 2010). Malnutrition prevalence for community and free dwelling older persons in European countries reported is between 5-20%, the prevalence rate increases in hospitalized elderly (19-65%) and those residing in long term care facilities (29-74%) (Sieber, 2006). Similar prevalence rates were reported for the United states of America (Sieber, 2006)

Nutrient requirements for the elderly living in institutionalized facilities is important due to the effect it has on organ function, body composition and health related wellbeing (Wellman & Kamp, 2008). Illness is one a major causes of under nutrition in developing countries, this being exasperated in aged care homes (Stratton, Green, & Elia, 2003). Under- nutrition has negative health implications and reduces health related quality of life (Stratton et al., 2003), and includes behavioural disturbances such as irritability and

restlessness, which were associated with a change in food intake (Greenwood et al., 2005).

A review of 4 507 participants with an average age of 82 years revealed that 46,2% were at risk for malnutrition (Kaiser et al., 2010), with those residing in nursing homes accounting for 13,8% (Kaiser et al., 2010). The prevalence of malnutrition in aged care homes was 33% in 30 000 elderly subjects screened by the MNA (Guigoz, 2006). Of the 2 114 participants in a Helsinki nursing home study, nearly one-third (29%) of the residents suffered from malnutrition, 60% were at risk of malnutrition, while only 11% had a good nutritional status.

A study conducted on elderly persons in Cape Town, revealed that 5% were classified as malnourished and 50.4% were in the 'at risk' classification of malnutrition (Charlton, Kolbe-Alexander, & Nel, 2005). In the aging population of South Africa, malnutrition is an underline cause, directly related to increase risk of chronic disease, deficiencies and infection (Charlton et al., 2005). Eggs, legumes and vitamin A rich fruit and vegetables were least consumed, mainly by people in tribal and informal urban areas being most affected (Labadarios, Steyn, & Nel, 2011). In KwaZulu-Natal there is a lack of diversity in meals consumed, with the province reporting that 40.8% had a dietary diversity index of less than four out of the nine food groups (Labadarios et al., 2011). Nutritional scientific data is available for South African community dwellers; however little scientific data is available with respect to nutritional status within South African aged care homes. Therefore, there is a strong need to determine the nutritional status of the elderly residing in aged care homes within the eThekwini CBD, to enable strategies to be implemented to improve their nutritional status and quality of life.

Most international and South African studies focused on nutritional status and its relation to malnutrition (Arvanitakis et al., 2008; Charlton et al., 2008; Kaiser et al., 2010; Suominen et al., 2005). The current study will provide a broader insight about nutritional status and the effect that group exercise frequency has on nutritional status of elderly living in aged care homes. Screening the elderly living in aged care homes with the MNA-SF will provide reliable baseline information about the current nutritional status of this group. Targeted intervention can be implemented after clinically establishing their

nutritional status , which will provide insight into reducing the risk of frailty in elderly persons residing in aged care homes (Wilson & Morley, 2003).

2.6 The Impact of Aging on Health Related Quality of Life

Wellbeing is related to your mental and emotional state, and is an indicator of how happy and healthy you are, being strongly related to self-esteem, self-confidence and positive social interaction (Topinková, 2008). Wellbeing is defined as how people feel about their life, and consists of bodily wellbeing, emotional wellbeing, self-concept and global perceptions of health (Paw, van Poppel, Twisk, & van Mechelen, 2004).

Health related quality of life (HRQoL) is a state of wellbeing or happiness experienced by an individual despite the presence of illness or disability (Lima et al., 2009). Health related quality of life is defined as "a multi-dimensional concept that encompasses the physical, emotional, and social components associated with an illness or treatment" (Tajvar, Arab, & Montazeri, 2008). In the elderly, it is best describe in relation to functional status, independence and the ability to perform activities of daily living efficiently (Cleary & Howell, 2006).

Physical health is regarded as a key determinate of wellbeing and quality of life among the elderly living in aged care facilities (Cho, Martin, Margrett, MacDonald, & Poon, 2011). It influences their health and wellbeing, with chronic diseases, namely high blood pressure, being a strong indicator of physical health among the elderly 70-75 years living in elderly care facilities (Cho et al., 2011). Poor physical and mental wellbeing are also affected by social network and interaction among the elderly (Gallicchio, Hoffman, & Helzlsouer, 2007). Good health, good social relationships, having social activities, being financially stable and being independent, increase the quality of life in the elderly (Bowling & Dieppe, 2005).

No significant differences by age were detected in the bodily pain and mental health scales between the elderly (Lima et al., 2009). Population based studies carried out in countries using the SF-36 also found lower scores with an increase in age, especially in the physical component, along with a decline in the mental component (Perkins, Stump, Monahan, & McHorney, 2006).

Lack of physical stimulation results in functional and health disorders affecting Health related quality of life (Rejeski & Mihalko, 2001). Activity and performance levels are enhanced due to self-efficacy, which is the belief in one's own ability (Grönstedt et al., 2011). Low physical functioning and activity levels, as well as dependency and limited activities of daily living were related to poor wellbeing (Grönstedt et al., 2011). There was a high prevalence of chronic disease in the elderly residing in Tehran, indicating that mortality risk was indirectly linked to disease, disability and functional limitation (Tajvar et al., 2008). It was reported that while the elderly live longer, their quality of life decreases with increasing age (Teymoori, Dadkhah, & Shirazikhah, 2006). Therefore it is extremely important to determine health related quality of life within this population, especially in the elderly residing in aged care homes. Measures of health related quality of life are required for promoting active ageing, autonomy and independence in their activities, to enable the elderly to be active agents within their communities (Lima et al., 2009).

2.7 Anthropometry, Nutritional and Health Related Quality of Life Measurements

Anthropometry is the measurement of the human body that plays a role in assessing and evaluating, proportion, composition, size, figure, growth, and gross function of the human population (Marfell-Jones, 2001). Over and under-nutrition affects the composition of the body, and the anthropometric measurements are therefore considered key determinants of nutritional status, particularly in the elderly (Perissinotto et al., 2002). Anthropometry measurements include height, weight, waist circumference, waist-to hip ratio and skin fold measurements (Perissinotto et al., 2002) each of which is reviewed with respect to the elderly population.

The Mini Nutritional Assessment (MNA) is a recommended part of the comprehensive geriatric assessment, and is an important research tool in geriatric medicine, with more than 400 scientific papers published about it. Since the MNA was first published in 1994, it has been established as one of the most validated and frequently used nutritional screening tools in older persons (Vellas et al., 2006) including in various aged care homes. It includes anthropometric measurements, dietary questionnaire, global

assessment (questions related to lifestyle, medication and mobility) and subjective assessment (self-perception of health and nutrition) (Guigoz, 2006).

The aim of the MNA is to determine those that are risk of poor nutrition so that interventions can be clinically implemented (Guigoz, 2006). The tool is easy to administer, is not invasive and can take up to 15 minutes to complete. Some disadvantages of the MNA are that demented or psychologically unstable individuals cannot answer the questionnaire, and it cannot be used in patients receiving enteral nutrition (tube feeding) (Sieber, 2006). In a study of the elderly living in aged care homes, only 66% could answer the MNA due to confusion, dementia, post stoke aphasia (damage to brain that controls language) and apraxia (inability to perform purposeful movements) (Guerin et al., 2005). Consequently, the authors developed a mini nutritional short form questionnaire (MNA-SF) (Guigoz, 2006; Rubenstein, Harker, Salvà, Guigoz, & Vellas, 2001), which a number of authors reported to be a useful tool to identify elderly patients with malnutrition or at risk of malnutrition (Langkamp-Henken, 2006; Sieber, 2006; Vellas et al., 2006).

The tool has been used to evaluate nutritional status of the elderly in various residential homes (Saletti, Lindgren, Johansson, & Cederholm, 2000; Suominen et al., 2005). A score of ≤ 11 is obtained, this indicates risk of malnutrition and the full questionnaire should be completed. If a score of ≥ 12 is achieved, this indicates reduced risk of malnutrition and participants are well nourished, no further need to complete other aspects of the questionnaire (Rubenstein et al., 2001).

The SF-36 (Medical Outcomes Study 36-Item Short-Form Health Survey) is a validated instrument that is used to measure health related quality of life in the elderly (Lima et al., 2009). The instrument was developed initially in the United State of America (USA) and is a short form health survey that consists of 36 questions. It provides an indication of the burden of disease and health status of specific and general populations, as well as the effect of wide variety of treatments on health benefits. The SF-36 has been reviewed in more than 200 articles describing different diseases and treatments which entails arthritis back pain, cancer, cardiovascular disease, chronic obstructive pulmonary disease,

depression, diabetes, HIV/Aids, hypertension, musculoskeletal conditions and neuromuscular conditions (Turner-Bowker, Bayliss, Ware Jr, & Kosinski, 2003).

The SF-36 questionnaire comprises of closed ended questions (Stark, Roberts, & Corbett, 2002), the advantage being reduced confusion of respondents due to no technical jargon and ambiguity of language (Babbie, 2013). The questions are concise reducing possible biased responses (Babbie, 2013). The SF-36 allows for generalisation about health related quality of life of a wider and broader group and allows the researcher to predict a possible outcome (Henslin, 2013). The questionnaire also provides opportunities for accessing the truth from subjective perceptions (Macionis, 2011). It provides the respondents with a holistic view of their health and empowering them to take responsibility and improve their perception of their current health status so that they can be active participants in society (Macionis, 2011)

The reliability and validity of the tool has been tested in multiple populations in several studies, including elderly people in some surveys (Cleary & Howell, 2006; Montazeri, Goshtasebi, Vahdaninia, & Gandek, 2005). The SF-36 was judged to be the most widely generic health outcome measure of growth in quality of life published in the British Medical Journal (Garratt, Schmidt, Mackintosh, & Fitzpatrick, 2002). It consists of 10 components, eight subscales namely: physical functioning (PF), role physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role emotional (RE) and mental health (MH). The eight subscales are further summarised into a physical component summary (PCS) and mental component summary (MCS) (Ware & Kosinski, 2001) .

Scores range from 0 to 100 for each subscale with higher scores closer to 100 indicating a better health related quality of life (Eshaghi, Ramezani, Shahsanaee, & Pooya, 2006; Tajvar et al., 2008). In some instances, medical outcomes cannot be explained objectively, for example pain, apprehension, these medical outcomes may increase the risk of chronic disease that affects health of the elderly (Eshaghi, Ramezani, Shahsanaee, & Pooya, 2006). Therefore it is important to evaluate their health subjectively using the SF-36 (Eshaghi, Ramezani, Shahsanaee, & Pooya, 2006).The survey assesses both the impact of

diseases and the benefits of treatment, and is a good indicator of mortality in the elderly population (Tajvar et al., 2008).

2.8 Effectiveness of Exercise as an Intervention

The aging process cannot be escaped , but the process of aging is dependent upon genetic makeup, environmental influences and lifestyle (Gothelf, 2008), with muscle mass preservation being an important factor in maintaining health and independence later in life (Wahab, Sadiku, David, & Akinde, 2012). Muscle tissue is simultaneously broken down and re-synthesized, due to a reduced rate of synthesis of protein and inadequate intake of dietary protein (Rennie, Craven, Leech, & Williams, 2007). Exercise is a key modality for increasing muscle tone and improving bone strength, fitness and joint function (Wahab et al., 2012).

The benefits of regular physical activity entails maintaining body composition at an optimal level, promoting psychological and cognitive wellbeing, managing chronic disease, reducing the effects of physical disability and increasing longevity (Proctor et al., 2009). Physical activity increases average life expectancy by influencing chronic disease development (diabetes, hypertension, heart disease) and preserving activities of daily living such as walking, climbing of stairs, balance and chair standing (Armstrong, 2006; Proctor et al., 2009; Skinner, 2005). Certain types of exercises aids in physical wellbeing of the elderly within residential homes, these include joint stability, balance, strength and resistance (Baker et al., 2007), with habitual exercise promoting functional ability (Galloway & Jokl, 2000).

The interventions that were postulated in a systematic review consisted of multi modal exercise programmes comprising of cardiovascular/endurance, strength/resistance and balance/stability exercises (Baker, Atlantis, & Fiatarone Singh, 2007) which ranged 3 to 12 months (Baker et al., 2007). The above modes provided optimal health benefits as isolated modes of exercise (Baker et al., 2007). Flexibility and stretching were not included, due to many studies using this mode as a placebo (Frankel, Bean, & Frontera, 2006). Resistance training Intensity was progressive in nature, increasing load across training period with no clear intensity range (Latham, Anderson, Bennett, & Stretton, 2003). Cardiovascular exercises entailed exercising large muscle groups for an extended

period of time (Baker et al., 2007). Stability exercises were described as balance exercises that challenged the individual to maintain centre of gravity within limits of stability (Baker et al., 2007). All modes were combined to form a multi component exercise program in the elderly living in aged care homes (Baker et al., 2007).

The frequency on strength/resistance training was three times per week (Baker et al., 2007), with one study reporting training twice a week (Englund, Littbrand, Sondell, Pettersson, & Bucht, 2005). Intensity was above 65% of 1RM in three studies (Binder et al., 2002; Judge, Lindsey, Underwood, & Winsemius, 1993; Nelson et al., 2004) , furthermore another study reported a score of 7 on a 10 point Borg scale (Borg, 1982) and 17 on a 20 point Rate of Perceived Exertion scale (Pahor et al., 2006). Resistance exercise was primary performed using ankle weights, elastic bands and hand weights (Baker et al., 2007). Upper-body and lower-body strength exercises were performed (Latham et al., 2003). Static and dynamic balance exercises were implemented twice (Rubenstein et al., 2000) and thrice (Baker et al., 2007) per week. Most studies prescribe aerobic exercise three times per week (Baker et al., 2007) with some studies prescribing aerobic exercise twice a week (Latham et al., 2003; Robertson, Devlin, Gardner, & Campbell, 2001). Intensity of aerobic exercises ranged from 13 to 16 on the 20 point Rate of Perceived Exertion scale (Nakamura, Tanaka, Yabushita, Sakai, & Shigematsu, 2007). Duration of exercise ranged from 8 (Rubenstein et al., 2000) to 45 minutes (Jessup, Horne, Vishen, & Wheeler, 2003) per session. Although the current systematic review suggested a multi component exercise programme for the elderly, more randomize control trials are required due to the poor effect size (0.41) of the current review (Baker et al., 2007). In the systematic review it was difficult to draw conclusions on health benefits due to some studies not reporting aerobic fitness results, which could reduce the efficacy of the intervention (Baker et al., 2007). Apart from its methodological errors the review suggested that a multicomponent exercise programme may reduce falls in the elderly (Baker et al., 2007).

An international study reported that physical activity promotes independence by improving functional capacity and physical health which are important domains for developing autonomy (Vagetti et al., 2014). Autonomy increases mental health and state of mind and improves general quality of life (Vagetti et al., 2014). Aerobic and strength

components may improve physical ability of the elderly (Kelley, Kelley, Hootman, & Jones, 2009). However there is insufficient literature regarding training dose that is required to obtain optimal physical functioning (Kelley et al., 2009). Since adherence to physical activity is limited, novel and innovative approaches should be implemented to ensure adherence, so that physical, emotional, health and psychological benefits are obtained (Haskell et al., 2007; Nelson et al., 2007).

Exercise improves health related quality of life in the elderly living in aged care homes (Dechamps et al., 2010). Physical activity improves vitality, mental and psychological health and moderate improvements in emotional , physical, overall health and social relationships (Vagetti et al., 2014). In a meta-analysis of randomized control trials the common mode of training was aerobic and the type of aerobic activities were walking and cycling (George, Kristi, Jennifer, & Dina, 2009). Explanations about the benefits of exercise and the effects it has on their activities of daily living resulted in greater improvement in the adherence to structured programmes (Dechamps et al., 2010).

A meta-analysis of randomized control trials with a small effect size suggested that physical activity has a weak correlation with the 8 sub scales of the SF-36 (general health, vitality, bodily pain, physical functioning, role physical, social functioning, role emotional and mental health) in community dwelling elderly (Kelley et al., 2009). Contrary a systematic review evaluating the association between physical activity and quality of life indicated that physical activity had a positive effect of physical (Morimoto et al., 2006), psychological (Bowling, Banister, Sutton, Evans, & Windsor, 2002) and emotional wellbeing (Lee & Russell, 2003). Other cross sectional studies concluded that moderate or high intensity was associated with the following scales of pain (Aoyagi & Shephard, 2010; Lobo, Santos, Carvalho, & Mota, 2008) , physical (Grimmett, Bridgewater, Steptoe, & Wardle, 2011) , vitality (Acree et al., 2006; Aoyagi & Shephard, 2010; Lobo et al., 2008) , mental health (Aoyagi & Shephard, 2010) and general health((Salguero, Martínez-García, Molinero, & Márquez, 2011). Another study with older Japanese concluded that health related quality of life was associated with daily duration and accumulation of moderate intensity physical activity in men (Yasunaga et al., 2006). Frequency of participation in physical activity at least 5 times a week was associated in

better domains of quality of life namely physical and social domains (Grimmett et al., 2011)

Despite the benefits of physical activity globally, only 21% of people elderly 65 years and older engage in regular physical activity (Armstrong, 2006). There is an indirect relationship between physical activity and advancing age (Americans, 2004), with inactivity being evident in South African. Globally, the lack of physical activity causes 6% of the burden of disease from coronary heart disease, 7%, type 2 diabetes and 10% of colon cancer. The Lancet Physical Activity Series postulates that the elimination physical inactivity would increase the life expectancy of the world's population by 0.68 years (Lee et al., 2012). Persons over the age of 55 years have the lowest reported moderate to vigorous physical activity levels globally, with an increase in age being associated with increased inactivity (Joubert et al., 2007).

In an urban South African study, 49.7% of elderly persons did not meet the minimum guideline of 150 min of physical activity a week (Joubert & Bradshawb, 2006). Another South African study of 11 old age homes suggest that they are well aware about the relationship between physical activity and quality of life, but were less knowledgeable about the influence of exercise on cholesterol, diabetes and hypertension (Pienaar et al., 2004). Most participants (62.8%) felt that they had not received enough information about physical activity from their doctor, while only 3.8% took part in prescribed exercise programmes (Pienaar et al., 2004).

A structured group exercise program promotes additional psycosocial benefits for the elderly (Deforche & De Bourdeaudhuij, 2000; McAuley et al., 2000). International studies indicated that group exercise may improve health related quality of life (Morley et al., 2006; Topinková, 2008). The current study therefore addressed most components of fitness, namely warm-up, aerobic training, resistance training, lumbo pelvic hip complex stability exercises , balance, proprioception and cool down, and focussed on group exercise as an exercise intervention in aged care homes.

2.9 Summary

An increase in the risk of chronic diseases occurs with aging, however chronic disease can be delayed by lifestyle changes implemented at age 55-65 years of age (Andrews, 2001). Decrease in muscle strength is directly linked to disability, which is an important determinant of independence (Wannamethee, Shaper, Lennon, & Whincup, 2007). Interpersonal factors, such as self-efficacy , enjoyment and social support, are important determinants of optimal nutrition and physical activity behaviours (Sharkey, Johnson, & Dean, 2010). Structured and sustainable interventions encouraging physical activity for residence living in aged care homes in South Africa are limited (Cott, Dawson, Sidani, & Wells, 2002). Long-term aged care homes have stringent routines such as meal times, medication, vital checks and activities, which can pose challenges to providing activities due to the lack of flexibility (Dal Bello-Haas, Thorpe, Lix, Scudds, & Hadjistavropoulos, 2012). Therefore there is a need to develop a structured group exercise intervention that would encourage the elderly in aged care homes to be active. By participating in group exercises, the elderly will benefit emotionally, physically and socially. Improving self-efficacy and confidence with a group based exercise intervention could promote a sense of wellbeing, influence adequate nutrition, and enhance activities of daily living and independence among the elderly. International studies that investigated frequency of exercise in relation to body composition and functional fitness suggests to achieve the desired effects on body composition and functional fitness frequency of exercise should be three times a week for a duration of 12 weeks (Nakamura, Tanaka, Yabushita, Sakai, & Shigematsu, 2007). Improvement in functional fitness and body composition my directly improve independence in daily activity which may have a desirable effect on HRQoL. Evidence suggests that there is a direct relationship between group exercises and HRQoL. A Korean study, indicated that less regular exercise was reported to be directly related to poor nutrition in Koreans elderly 50 years and older (Yim, 2007). Therefore exercise frequency apart from volume of exercise, should be considered in achieving optimal well-being in the elderly living in aged care homes.

CHAPTER 3. METHODOLOGY

3.1 Introduction

This chapter describes the research design, data collection methods, ethical considerations and group exercise intervention.

3.2 Study Design

A quasi-experimental design was used to compare the effect of a 12 week group exercise programme on two groups of participants using pre-test and post-test procedures. A total of 100 participants selected from five aged care homes. Participants were recruited for voluntary participation. Admittance to the group was based on the outcome of a medical assessment by a sports physician. A convenience sample of 20 was used at each site for standardization of groups. Ten participants were assigned to Group A –experimental group and 10 in Group B- observed group through fish bowl technique. Group A exercise 3 times a week and group B exercise 2 times a week for 12 weeks. Group based 12 weeks exercise intervention was implemented for both groups. Prior to the group exercise intervention dependents variables were assessed to obtain baseline results and after the intervention to ascertain the effect of the intervention.

A quasi-experiment is an empirical study that is often implemented to estimate the causal impact of an intervention on its target population (Mitchell & Jolley, 2012). Although quasi experimental research design is less stringent and lack generalisation as true experimental designs, it allows the control of extraneous variables by controlling, who receives the treatment and when the treatment is administered (Eliopoulos et al., 2004). As a result causation is enhanced due to the intervention being implemented under real life circumstances and local considerations are taken into consideration (Handley, Schillinger, & Shiboski, 2011) .

3.3 Medical Screening for Eligibility for Participation

Before participating in the exercise program, the participants underwent a history and physical examination by a sports medicine physician directed at identifying cardiac risk factors, exertional signs/symptoms, and physical limitations (Appendix C).

3.4 Participation Recruitment

Persons meeting the inclusion criteria were invited to participate voluntarily in the study. Details of the study including the screening process, pre-and post-intervention testing, exercise prescription, risks/ benefits and safety procedures were explained to interested individuals. Participants were made aware that they may withdraw from the study at any time if required. Confidentiality of the data was assured. Anonymity of the participants was assured through coding and the use of non-identifiers. Participation commenced with the study only after signed informed consent was obtained (Appendix B).

3.5 Research Setting

Five randomly selected elderly care homes within the 20 km radius of the eThekwini CBD. The elderly care homes caters for abled and frail residents and have scheduled appointments with doctors to assist in their function and wellbeing. The exercise intervention was implemented at the five aged care facilities simultaneously. The five randomly selected aged care homes were:

- Tafta on the Ridge
- Mary Asher Old Age Home
- Aryan Benevolent Old Age Home
- Clayton Gardens Old Age Home
- Ray Hulett Old Age Home

3.6 Population

The study population comprised individuals who were 60 years of age and older and residing in an elderly care facility within a 20 to 30 kilometre radius of the eThekwini CBD. Following a medical screening process, 20 participants per site became eligible for participation in the study.

3.7 Sampling Strategy and Size

A listing of all government supported elderly care facilities located within a 20 km radius of the Durban CBD was obtained from the Department of Social Development, from which five elderly care homes were randomly selected. There were no previous studies in this context to guide the sample size. In accordance with the performance of group exercise, a conservative number of not more than 20 participants were considered effective for monitoring changes during group exercise sessions. In this regard a quota of

20 participants per site was considered maximum, with a total of 100 for the study.

All residents who were interested in participating were invited to a medical assessment to establish whether or not they met the inclusion criteria. The outcome of a physical assessment conducted by a sports physician determined participation on the intervention. From those approved by the sports physician the first 20 in each facility were invited to participate. Each participant was requested to select a random number from 1-20. Participants bearing odd numbers were allocated to Group A and those with even numbers were allocated to Group B.

3.8 Inclusion / Exclusion Criteria

The following inclusion criteria applied:

- 60 years of age and older,
- male and female participants,
- independent in their activities of daily living,
- non-participants in a physical activity program for at least the last 3 months.

The following exclusion criteria applied:

- Individuals who were < 60 years of age,
- have undergone hormone supplementation,
- those who were judged unable to participate based on a medical assessment,
- individuals participating in other research/clinical trials.

3.9 Data Collection Tools

➢ **Anthropometric measures (objective 2 and 3):**

The 7-site skinfold technique was used to determine body composition (relative body fatness) using Harpenden© (West Sussex, UK- Quality Measurement, Ltd) skinfold callipers. Weight, waist circumference and height were measured. Body Mass Index (BMI) was then calculated as body mass divided by height squared. Values were recorded on data collection sheet (Appendix H). Anthropometric measurements were used to address objective 3 and 5.

➢ **Skinfolds:**

Purpose: Skin fold measurement determined the percentage body fat, with the thickness of the subcutaneous fat being a representation of the total fat present, based on the

assumption that 50% of body fat is subcutaneous fat (Wellman & Kamp, 2008)

Measurement: This was done by using the thumb and index finger to lift the skin at the site, perpendicularly to the surface of the body (Marfell-Jones, 2001). The calliper was then applied one centimeter away, at a right angle to the fold (Marfell-Jones, 2001). Each skinfold measurement was done on the right side of the individual whilst in an upright anatomical position (Marfell-Jones, 2001). Each fold was raised vertically, horizontally, or obliquely depending on the site (Marfell-Jones, 2001). The following skinfolds were taken according to standard procedures of the International Society for the advancement for Kinathropometry (ISAK) (ISAK, 2001):

Triceps: Vertical fold taken from the mid-acromiale-radiale line on the posterior surface of the arm.

Subscapular: Diagonal fold taken at a 45° angle from a horizontal perspective, at the most inferior portion of the scapula.

Biceps: Vertical fold taken at the mid-acromiale-radial line on the anterior surface of the arm.

Supraspinale: A diagonal fold at the intersecting point from the anterior axillary border to the anterior superior iliac spine and from the superior aspect of the iliac crest across the previous line.

Abdominal: Vertical folds 5cm adjacent to the umbilicus.

Front thigh: A vertical fold midway between patella and inguinal fold.

Calf: Vertical fold on the medial surface of calf along the largest circumference.

Interpretation: Due to percent body fat being specific to race and gender, errors can occur when calculating percentage body fat, therefore it is best to use the sum of the seven sites to monitor and compare body fat measures (Kinanthropometry, 2001). An excellent score for men was 60 -80 millimeters and a poor score for men was >150 millimeters. An excellent score for females was 70 -90 millimeters and a poor score for females was >150 millimeters (Kinanthropometry, 2001)

- **Waist circumference**

Purpose: According to World Health Organization (2002), waist circumference is a reliable and cost effective way of determining cardiovascular risk and metabolic risk.

Large accumulation of abdominal fat predisposing people to metabolic and cardiovascular disease (Charlton et al., 2008).

Measurement: The waist measurement was obtained by measuring the smallest area below the ribcage, above the umbilicus, with a non-stretchable tape (Charlton et al., 2008).

Interpretation: World Health Organization cut off points for metabolic complications (World Health Organization, 2011)

	Cut- off point	**Risk for metabolic syndrome**
Waist circumference	>94 cm (M) and >80 cm (F)	Increased
Waist circumference	>102 cm (M) and > 88cm (F)	Substantially increased

M-Males

F- Females

- **Waist to hip ratio**

Purpose- Waist to hip ratio is a frequent anthropometric tool to determine central or apple shape obesity, and determines the distribution of fat, with an elevated ratio being indicative of an increased risk of chronic disease, particularly among the elderly living in aged care homes (Tayie, Adjetey-Sorsey, Armah, Busolo, & Imaya, 2006).

Measurement- It was calculated by waist circumference divided by hip circumference [waist circumference (cm) / hip circumference (cm)].

Interpretation- World Health Organization Cut off points for metabolic complications (World Health Organization, 2011)

	Cut- off point	**Risk for metabolic syndrome**
Waist to hip ratio	>0.90 (M) and >0.85 (F)	Substantially Increased

M- Males

F-Females

- **Body Mass Index (BMI)**

Purpose: BMI is an index to determine height in relation to weight, frequently used to classify under-nutrition, over nutrition and obesity (Wellman & Kamp, 2008).

Measurement: It was calculated using the following formulae, BMI = Weight (kg) ÷ [Height (m)]² (Wellman & Kamp, 2008). There is a direct link between increased BMI index, physical disability and difficulty performing activities of daily living, especially among women (Rabaglietti et al., 2010).

Interpretation: A BMI ≤ 21 kg/m^2 can be considered an indication for nutrition support for the elderly living in long term aged care homes (Cereda et al., 2011).

B. Questionnaires (objective 4, 5, 6 and 7)

Data was produced through face-to-face structured interviews using the, MNA-SF, and SF-36 questionnaires were used to address objective 4, 5, 6 and 7 respectively. Interviews were conducted by trained research assistants / masters students in the preferred language of choice of the participants (English or isiZulu), by reading out questions to the participants and recording their responses.

Instrument: MNA-SF Questionnaire to address nutritional status (objective 4 and 5)

Purpose: Self-perception of nutritional status and malnutrition risk. It included, anthropometric measurements, dietary questionnaire and global assessment (questions related to lifestyle, medication and mobility) to determine nutritional status.

Interpretation: The MNA-SF classifies patients as, adequately nourished (MNA score > 24), at risk of malnutrition (MNA score 17-23) and malnourished (MNA score < 17) (Guigoz, 2006). Twelve points or greater indicates not at risk of malnutrition and no need to complete full assessment. Eleven points or below, possible malnutrition, complete full assessment (Rubenstein et al., 2001).

Instrument: SF-36 Questionnaire was used to address objective 6 and 7, being health related quality of life

ITEMS	SCALES
Improved vigorous activities Improved moderate activities Efficiency in lifting and carrying groceries Increased ability to climb several flights Increased ability to climb one flight Reduced limitation in Bending and kneeling Walking more than a kilometre Walk several blocks Walk one block Efficiency in bathing and dressing	**SCALE 1: PHYSICAL FUNCTIONING (PF)**
Increased time for work or activities Accomplished more Reduced limitation in kind work or activities Non difficulty in work or activities	**SCALE 2: ROLE PHYSICAL ACTIVITY (RP)**
No bodily pain Pain-Non interference with normal work	**SCALE 3: BODILY PAIN (BP)**
General health Excellent As healthy as anyone Reduced perception of easily falling sick Reduced perception of deterioration of Health	**SCALE 4: GENERAL HEALTH (GH)**
Increased pep/life Increased energy Reduced feeling of worn out Reduced feeling of tiredness	**SCALE 5: VITALITY (VT)**
Improved social extent and activities Increased social time	**SCALE 6: SOCIAL FUNCTIONING (SF)**
Increased time spent on work Accomplished -more in daily life Perform work and activities carefully	**SCALE 7: ROLE EMOTIONAL (RE)**
Reduced feeling of nervousness Reduced feeling of down in dumps Increased perception of peacefulness Reduced feeling of blue/sad Increased perception of happiness	**SCALE 8: MENTAL HEALTH (MH)**

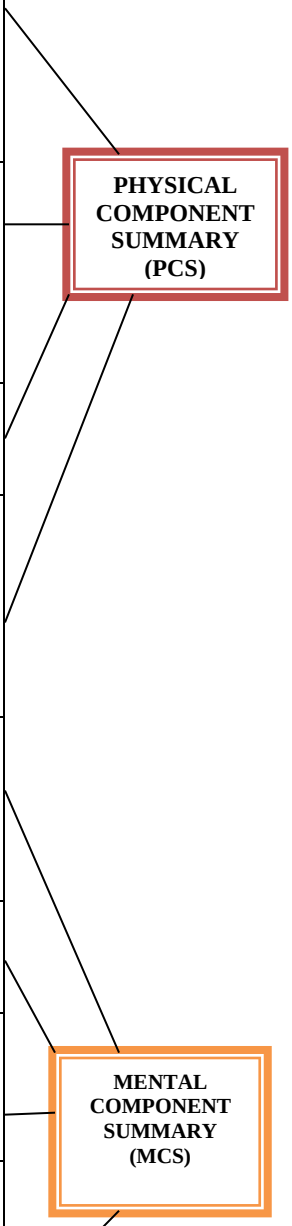


Figure 3.10: Health related quality of life measures as per SF-36 questionnaire Adapted from conceptual framework and item selection (Ware Jr & Sherbourne, 1992)

Purpose: The SF-36 questionnaire provides possible solutions to improve health-related quality of life in each of the eight dimensions. It provided an indication of self-efficacy of the elderly and the perception of health related quality of life. An overview of each of the eight scaled health-related quality of life dimensions assessed by the SF-36 questionnaire is as follows:

- **Physical functioning:** Physical functioning refers to the ability to perform activities of daily living such as running, walking up flights of stairs, bending, kneeling bathing and dressing themselves.
- **Physical roles limitation**: The respondent's activity of daily living that is impaired by their physical state of health.
- **Emotional roles limitation**: This scale assesses the respondent emotional and psychological state, e.g. feeling depressed or anxious.
- **Social functioning:** Refers to social interaction and cohesion with family members, friends, neighbours and other social relations.
- **Bodily pain**: Respondents' experience of bodily pain affects functional ability to perform daily tasks.
- **Mental health**: The feeling of happiness and peace and conversely a feeling of nervousness and fatigue.
- **Vitality:** Related to the respondent's experience of feeling energetic and full of pep, or worn out and tired.
- **General health**: Holistic view of health perceived by the respondent.

Interpretation- the SF-36 was scored by coding raw scores for each question, and transforming them into a scale from 0 (worst possible HRQoL) to 100 (best possible HRQoL). The scales were further summarized into a Physical Component Summary (PCS) and Mental Component Summary (MCS) (Ware & Kosinski, 2001). The scores ranged from 0 (worst possible level of functioning) to 100 (best possible level of functioning). All items were weighted equally (Mean 50 and SD 10). The mean averages for each of the eight scales were calculated. Summary of physical HRQoL (Physical Component Summary; PCS) and mental HRQoL (Mental Component Summary, MCS) was determined by the mean average of all of the physically relevant questions and all mental relevant items (Ware & Kosinski, 2001) (Figure 3.10).

Table 3.1: Represents a summary of the data collection instrumentation and exercise intervention

Procedure	Tool	Assessment
Patient Screening	Medical history questionnaire Examination by doctor (Appendix C)	Comprehensive medical examination
Pre- and post-intervention assessments	Objective 1: Data Collection Sheet (Appendix E)	Gender, age, marital status and race
	Objective 2 and 3: Anthropometric measurements (Appendix H)	Body Mass Index, waist circumference, waist to hip ratio and sum of skinfolds
	Objective 4 and 5: Mini Nutritional Assessment (MNA) – Nestlé Nutrition Institute (Appendix I)	Nutrition status
	Objective 6 and 7: Self-perceived health status assessment: SF-36 (Appendix J)	Health related quality of life (HRQoL)
Intervention	12 week program, Group A -3 X week; (Mon, Wed, Fri); Group B – 2 X week (Mon & Fri). Both exercise program were of 50-80 minutes duration (Appendix G)	American College of Sports Medicine (2006)

3.10 Pilot Study

A pilot study of the questionnaires was conducted by a trained researchers with an exercise background from the College of Health Sciences. The pilot was conducted at one of the five selected aged care homes on five voluntary participants who met the inclusion criteria above. The purpose of the pilot study was to evaluate the feasibility and reliability of the questionnaires.

3.11 Data Collection Process

No formal sample size was calculated at the start of the study. At the start of this phase baseline assessments of anthropometry, MNA-SF and SF-36 questionnaires were conducted and recorded respectively, the exercise programme was adapted from ACSM, and follow-up assessments were conducted at the end, on completion of the proposed intervention.

3.12 Group Exercise Intervention

Exercise Prescription (Appendix G)

The American College of Sport medicine recommends cardiac stress testing for sedentary and minimally active older adults wanting to participate in vigorous intensity exercise (Thompson et al., 2013). The exercise prescription used in this study is in accordance with current consensus recommendations of the ACSM. Table 3.12 outlines the guidelines for cardiac stress testing, however moderate endurance and resistance training can be conducted provided the exercise program begins at a low intensity and increases in intensity are gradual (Franklin, 2000). This study followed those guidelines when prescribing exercise for this population. One instructor per site led all the sessions of the intervention. The exercise program began at a low intensity and increases in intensity and duration were gradual over the period of 12 weeks. Exercise sets were interspersed by frequent breaks, participants were further encourage to discontinue exercise and seek medical intervention should they experience major warning signs/symptoms such as chest pain, palpitations or light-headedness.

Table 3.12 – Guidelines for Cardiac Stress Testing

Men ≥ 45 years old and women ≥ 55 years old who plan to exercise at 60% VO2 max.
Known coronary artery disease or cardiac symptoms.
Two or more coronary artery disease risk factors: Hypertension, smoking, hypercholesterolemia, obesity, sedentary lifestyle and family history of early coronary artery disease.
Diabetes
Known or major signs/symptoms of pulmonary or metabolic disease.

The total duration of exercise increased from 50 to 80 minutes per session. Sessions were conducted each morning between 08h00 and 10h00, at least 60 minutes after breakfast. Each class consisted of a 10 minute warm up, followed by 45 minutes of strength,

endurance and mobility/balance exercises, and concluded with a five minute cool down and stretching routine.

Warm-up (10minutes)

The warm-up included progressive exercises that involve dynamic stretching, which gradually builds challenge and intensity. Continuous, rhythmic endurance activities such as easy walking, light marching, toe and heel presses, low knee lifts and small kicks were utilized. The warm-up included rehearsal (step by step but slower tempo) of exercise sequences, as well as specific joint mobility exercises (e.g. arms overhead then circles along with low intensity endurance exercise). Intensity was monitored using Borg's Rating of Perceived Exertion (RPE) 6 – 20 point scale to assess level of exertion (Borg, 1998) (Appendix K). Accordingly, the RPE for this population was maintained between 9 and 10.

Endurance Exercise (15-30 minutes)

The desired intensity of endurance exercise was determined using the Borg RPE scale. An exercise program that begins with an intensity of light to somewhat hard (11 to 13 on the RPE scale) and never exceeding an intensity of hard (15 on the RPE scale), is most appropriate for previously sedentary older adults (Mazzeo, 1998). Endurance training involved walking, which required using the larger muscle groups, and requires rhythmic and continuous movement. Intensity for the first 3 weeks was equivalent to 10 to 11 on the RPE scale (light), while during weeks 4 to 9 the intensity was increased to 12 to 13 on the RPE scale (somewhat hard) and maintained for weeks 10 to 12. However, the duration of exercise was increased over the 12 week exercise program from three bouts of 5 minutes (week 1 to 3), to two bouts of 10 minutes (weeks 4 to 9), and finally two bouts of 15 minutes (weeks 10 to 12).

Resistance Exercise (15-30 minutes)

The study incorporated resistance exercises aimed at developing muscle endurance, strength and power. The following 10 exercises are deemed appropriate for the elderly (Fleck & Kraemer, 2004), and was used to train the entire body;

1. Leg press or squat
2. Knee extension
3. Knee curl
4. Calf raise
5. Chest press

6. Seated row
7. Upright row
8. Arm curl
9. Shoulder press
10. Abdominal/core exercise

Ten repetitions per set of exercise were performed over the 12 week program. The number of sets increased from one in the first 4 weeks to two sets during weeks 5 to 8, and to three sets from weeks 9 – 12. Abdominal strengthening exercises were used to develop the core and abdominal muscles.

Cool-Down (5 minutes)

Static flexibility and relaxation activities at a low intensity were performed to allow the body to adjust from exertion to rest. A stretch was applied twice to each muscle group of the body, while relaxation strategies (slow deep breathing) were encouraged between stretches and at the end of activity. Each stretch was held to a point of gentle tension but not pain, for a period of 15-30 seconds.

3.13 Data Analysis

The exercise program, as previously discussed, was implemented and follow-up assessments thereafter were conducted, at an elderly care facility within the eThekwini region. All results were entered into a database created and supported by excel 2010. Independent double entering of data was conducted to minimize error. All data entered was checked and cleaned prior to analysis.

Data was analysed using the Statistical Package for Social Science Version 18.0 (SPSS) for Windows software. A p-value of <0.05 was considered statistically significant. Descriptive (means and standard deviations) and interferential (paired t-tests) statistics were used to test variance among groups. A paired t-test and independent t-test was used to analyse parametric data. Wilcoxon signed rank test and Mann Whitney U test was used to analyse normally distributed and non-parametric data respectively.

3.14 Ethical Considerations

The study was derived from a larger study. Ethical clearance for this study was obtained from the University of KwaZulu-Natal, School of Health Sciences Research Committee and from the UKZN Biomedical Research Ethics Committee (BE251/11). Permission to conduct the study was granted by the Department of Social Development and each of the five participating elderly care facilities. Participation in the study was voluntary. Each participant was requested to sign an informed consent form prior to the commencement of the study. Participants were informed that they could withdraw from the study at any stage. Respect for participants were assured. Data was kept confidential for use by the researcher and supervisors only. Coding and non-use of identifiers were employed to protect the identity of participants. Information will be stored under lock and key for a period of five years, after which all information gathered will be destroyed.

CHAPTER 4. RESULTS AND DATA ANALYSIS

4. Introduction

This section provides a description of the study population and the effect of group exercise and exercise frequency on anthropometry, health related quality of life and nutritional status of the elderly residing in long term care facilities. A total of 100 participants were included in the study. As a result of hospital visits and illness during baseline and follow-up assessments, data was not obtained, for certain variables. The results are presented with respect to the seven objectives. The Kolmogorov–Smirnov test was used to determine normality of data.

1. To determine the demographic profile of older persons residing in elderly care facilities
2. To determine the effect of group exercise on anthropometry
3. Compare the effect of frequency on a group exercise program 3X/week vs. 2X/ week (for 12 weeks) on anthropometry
4. To determine the effect of group exercise (12 weeks) on nutritional status
5. Compare the effect of frequency on a group exercise program 3X/week vs. 2X/ week (for 12 weeks) on nutritional status
6. To determine the effect of group exercise on health related quality of life
7. Compare the effect of frequency on a group exercise program 3X/week vs. 2X/ week (for 12 weeks) on health related quality of life

4.1 Demographic Profile of Study Population

The study consisted of 79% females and 21% males, and the mean age was 73 years. The majority were Indian (72%) followed by white (16%), coloured (11%), with 1 % being African. Most of the respondents were widowed (53%) and 15% were married and residing in elderly care homes. The mean age of participants in the study was 73 years (SD 7.57) (Table 4.1).

Table 4.1: Demographics of the elderly (N=100)

Demographics		**N**	**%**
Gender	Males	21	**21.00**
	Females	79	**79.00**
Age	60-69	37	**37.00**
	70-79	42	**42.00**
	80-89	21	**21.00**
Racial Group	Indian	72	**72.00**
	Blacks	1	**1.00**
	Coloured	11	**11.00**
	White	16	**16.00**
Marital Status	Married	15	**15.00**
	Widowed	53	**53.00**
	Never married	19	**19.00**
	Divorced	13	**13.00**

4.2 The Effect of Group Exercise and Frequency on Anthropometry

There were no significant differences between mean BMI, waist circumference and waist to hip ratio before and after exercise. However, a tendency towards a decrease in waist circumference and waist to hip ratio was noted (Table 4.2).

The results indicated a significant difference between sum of skinfold before and following exercise. A direct relationship between 12 weeks of group exercise and sum of skinfold was noted, ($p<0.01$)) (Table 4.2).

Table 4.2: Effect of group exercise (12 weeks) on anthropometry. Paired sample t- test Before (B) and at Follow up (F)

B-Before Group Exercise F- Following Group Exercise	N	Mean	Std. Deviation	P Value
B-Body Mass Index (kg/m$^{2)}$	90	28.07	5.67	0.37
F-Body Mass Index (kg/m^2)	87	28.24	5.67	
B-Waist circumference (cm)	100	78.86	29.03	0.30
F-Waist circumference (cm)	100	76.30	32.72	
B-Waist to hip ratio	100	0.78	0.30	0.11
F-waist to hip ratio	100	0.73	0.31	
B-Sum of 7 site skinfold (mm)	90	140.71	38.14	***0.00**
F-Sum of 7 site skinfold (mm)	87	152.66	46.33	

*** Significant at P< 0.05**

4.3 The Effect of Participation in a Group Exercise Program 2x/Week vs. 3x/Week (for 12 Weeks) on Anthropometry

A trend was noted that the group that exercised twice a week had an increase in BMI (M: 29.09 kg/m^2, SD: 5.98 kg/m^2) compared to the group that exercised three times a week, which had a reduction in BMI (M: 27.37 kg/m^2, SD: 5.31 kg/m^2). There was no significant difference between frequencies of exercise (2 times vs. 3 times a week) with regards to BMI after controlling for baseline BMI ($p > 0.05$) (Table 4.3).

The group that exercised two times a week had an increase in waist circumference (M: 85.75 cm, SD: 22. 92 cm) compared to the group that exercised three times a week, which had a reduction in waist circumference (M: 84.32 cm, SD: 21.70 cm). There was no significant difference between frequencies of exercise (2 times vs. 3 times a week) with regards to waist circumference after controlling for baseline waist circumference ($p > 0.05$) (Table 4.3).

The group that exercised three times a week had a lower waist to hip ratio (M: 0.81, SD: 0.19) than the group that exercised twice a week (M: 0.82, SD: 0.21). There was no significant difference between frequencies of exercise (2 times vs. 3 times a week) with regards to waist to hip ratio and frequency of exercise after controlling for baseline waist to hip ratio ($p > 0.05$) (Table 4.3).

The group that exercised three times a week had a lower sum of skinfold score (M: 147.12 mm, SD: 45. 14 mm) than the group that exercise twice a week (M: 158.85 mm, SD: 48.01 mm). There was a positive trend but no significant difference between frequency of exercise (2 times vs. 3 times a week) with regards to sum of skinfold and frequency of exercise after controlling for baseline sum of skinfold ($p > 0.05$).(Table 4.3).

Table 4.3: Effect of group exercise frequency 2X/week vs. 3X/week on anthropometry following 12 weeks of group exercise

F-Follow up	Exercise frequency Weekly	N	Mean	Std. Deviation	P Value
F- BMI (kg/m^2)	Two times	40	29.09	5.98	0.30
	Three times	46	27.37	5.31	
F- Waist circumference (cm)	Two times	41	85.75	22.92	0.75
	Three times	46	84.32	21.70	
F- Waist to hip ratio	Two times	41	0.82	0.21	0.89
	Three times	46	0.81	0.19	
F- Sum of skinfold (mm)	Two times	40	158.85	48.01	0.64
	Three times	46	147.12	45.14	

*** Significant at P< 0.05**

There was a significant difference between sum of skinfold ($p = 0.01$) before and following training twice a week (Table 4.3.1).

Table 4.3.1: Effect of exercise frequency 2X/week on anthropometry comparing before and following 12 weeks of group training

Exercise Frequency	B-Before F-Follow up	Anthropometric Indices	Mean	P value
2X/week	B	BMI (kg/m^2)	28.92	0.15
	F	BMI (kg/m^2)	29.32	
	B	Waist Circumference (cm)	88.39	0.07
	F	Waist Circumference (cm)	90.44	
	B	Waist to hip ratio	0.89	0.56
	F	Waist to hip ratio	0.87	
	B	Sum of skinfolds (mm)	143.72	***0.01**
	F	Sum of skinfolds (mm)	159.73	

*** Significant at P< 0.05**

Exercising three times a week had no effect on waist to hip ratio (Table 4.3.2). The sum of skinfold was approaching level of significance ($p=0.05$) when comparing before and following exercised three times a week (Table 4.3.2).

Table 4.3.2: Effect of exercise frequency 3X/week on anthropometry comparing before and following 12 weeks of group training

Exercise Frequency	B-Before F-Follow up	Anthropometric Indices	Mean	P value
3X/week	B	BMI (kg/m^2)	27.49	0.82
	F	BMI (kg/m^2)	27.43	
	B	Waist Circumference (cm)	86.47	0.44
	F	Waist Circumference (cm)	87.53	
	B	Waist to hip ratio	0.85	0.70
	F	Waist to hip ratio	0.85	
	B	Sum of skinfolds (mm)	138.84	0.05
	F	Sum of skinfolds (mm)	148.65	

*** Significant at P< 0.05**

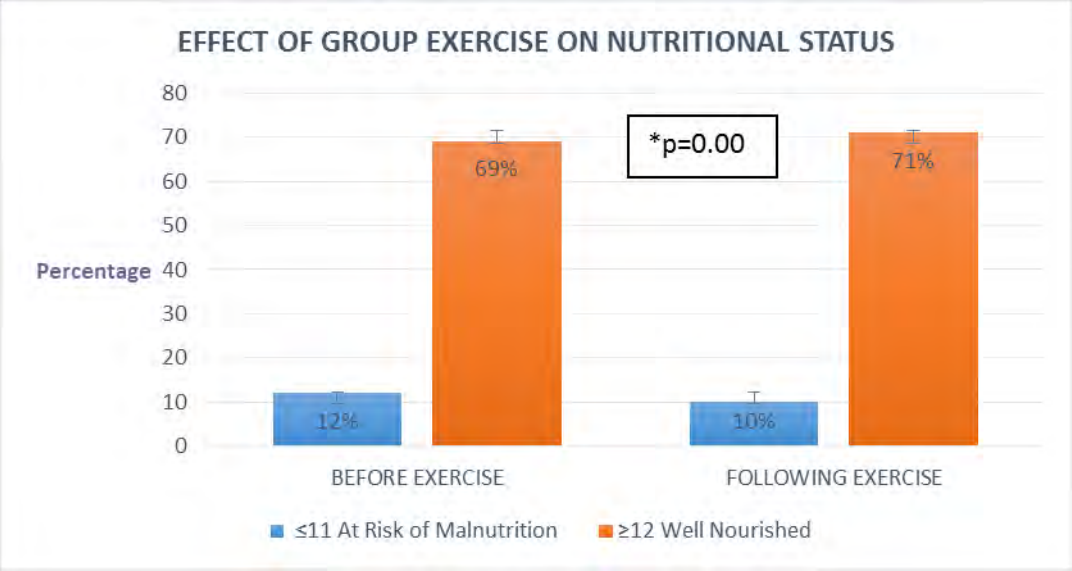
4.4 The Effect of Group Exercise on Nutritional Status

Analysis of results obtained from the Mini Nutritional Assessment Short Form questionnaire (MNA-SF) indicated that group exercise was effective in improving nutritional status, with fewer participants being at risk of malnutrition following the group exercise intervention and, more participants being well nourished, as indicated in table 4.4 and figure 4.4 ($p<0.01$).

Table 4.4: Nutritional status before and following 12 weeks of group exercise

	Frequency	Number	Mean	SD	P value
MNA- SF	Before Group Exercise	81	12.96	1.48	***0.00**
	After Group Exercise	81	13.02	1.11	

*** Significant at P< 0.05**



*** Significant at P< 0.05**

Figure 4.4: Effect of group exercise on nutritional status

4.5. The Effect of Participation in a Group Exercise Program 3x/Week vs. 2x/Week (for 12 Weeks) on Nutritional Status

Both groups obtained a mean score (table 4.5) of greater than 11 on the MNA-SF questionnaire following exercise, which indicated that they were not at risk of malnutrition (Rubenstein, Harker, Salva, Guigoz, & Vellas, 2001). Noticeably, the group that exercised twice a week had a better MNA-SF score than the group that exercised three times a week. No significant different was evident in relation to exercise frequency and MNA-SF (p = 0.23) (Table 4.5).

Table 4.5 Effect of exercise frequency 2X/week vs. 3X/week on MNA-SF following 12 weeks of group exercise

	Frequency	Number	Mean	SD	P value
MNA- SF	2X/Week	35	13.23	1.031	0.23
	3X/Week	45	12.84	1.147	

*** Significant at P< 0.05**

Component analysis of the MNA-SF was undertaken and the results are presented below. The components analysed include loss of appetite, weight loss, mobility, psychological or acute stress, neuropsychological problems and BMI.

Fewer (87 %; n=32) participants who exercised twice a week reported having no loss of appetite compared to 87% of those who exercised three times a week. There was no significant difference in reports of loss of appetite between those who exercised twice a week compared to three times a week. (Mann Whitney U, z = -.062 p = 0.95) (Table 4.5.1)

Table 4.5.1 Effect of exercise frequency 2X vs. 3X per week on loss of appetite following (F) 12 weeks of group exercise

	Appetite						P Value
	Severe loss of appetite		Moderate loss of appetite		No loss of appetite		
	No.	%	No.	%	No.	%	
F-2X/Week	0	0.0%	5	13.5%	32	86.5%	0.95
F-3X/Week	1	2.1%	5	10.6%	41	87.3%	

*** Significant at P< 0.05**

Fewer participants (14%, n=5) that exercise twice a week reported moderate loss of appetite. More participants reported no loss of appetite following group exercise twice a week (86%, n=30). There was no significant difference in reports of appetite pre and post training in the group that exercised twice a week (p = 0.66) (Table 4.5.2)

Table 4.5.2: Effect of exercise frequency 2X/week on appetite comparing before (B) and following (F) 12 weeks of group training

	Appetite: Group That Exercised 2X/Week						P Value
	Severe loss of appetite		Moderate loss of appetite		No loss of appetite		
	No.	%	No.	%	No.	%	
B- 2X/Week	0	0.0%	6	17.1%	29	82.9%	0.66
F-2X/Week	0	0.0%	5	14.3%	30	85.7%	

*** Significant at P< 0.05**

Fewer participants (13%, n=6) that exercised twice a week reported moderate loss of appetite following 12 weeks of group exercise. More participants reported no loss of appetite following group exercise (87%, n=39). There was no significant difference in

reports of appetite when comparing before and following training in the group that exercised twice a week (p = 0.27) (Table 4.5.3)

Table 4.5.3: Effect of exercise frequency 3X/week on appetite comparing before (B) and following (F) 12 weeks of group training

	Appetite: Group That Exercised 3X/Week						P Value
	Severe loss of appetite		Moderate loss of appetite		No loss of appetite		
	No.	%	No.	%	No.	%	
B-3X/Week	3	6.7%	6	13.3%	36	80.0%	0.27
F-3X/Week	1	2.2%	5	11.1%	39	86.7%	

*** Significant at P< 0.05**

Fewer (62%, n=24) of participants who exercised thrice a week reported having no weight loss compared to 65% of those who exercised two times a week. There was no significant difference in reports of weight loss between those who exercised twice a week compared to three times a week (Mann Whitney U, z = -.401 p = 0.69) (Table 4.5.4)

Table 4.5.4 Effect of exercise frequency 2X/week vs. 3X/week on weight loss following (F) 12 weeks of group exercise

	Weight Loss								P Value
	Weight loss greater than 3 kg		Does not know		Weight loss between 1 and 3 kg		No weight loss		
	No.	%	No.	%	No.	%	No.	%	
F-2X/Week	1	2.7%	2	5.4%	10	27.0%	24	64.9	0.69
F-3X/Week	1	2.1%	5	10.6%	12	25.6%	29	61.7	

*** Significant at P< 0.05**

More participants reported weight loss of 1 and 3 kg following group exercise (29%, n=10). There was a noticeable trend indicating that exercise may be directly related to weight loss. There was no significant difference in reports of weight loss before and following training in the group that exercised twice a week (p = 0.93) (Table 4.5.5)

Table 4.5.5: Effect of exercise frequency 2X/week on weight loss comparing before (B) and following (F) 12 weeks of group training

	Weight Loss: Group That Exercised 2X/Week								P Value
	Weight loss greater than 3 kg		Does not know		Weight loss between 1 and 3 kg		No weight loss		
	No.	%	No.	%	No.	%	No.	%	
B-2X/Week	3	8.6%	2	5.7%	5	14.3%	25	71.4	0.93
F-2X/Week	1	2.9 %	2	5.7%	10	28.6%	22	62.9	

*** Significant at P< 0.05**

More participants reported weight loss of 1 and 3 kg following group exercise (27%, n=12). There is a noticeable trend indicating that exercise may be directly related to weight loss irrespective of frequency 2X/week or 3X/week. There was no significant difference in reports of weight loss pre and post training in the group that exercised twice a week (p = 0.16) (Table 4.5.6)

Table 4.5.6: Effect of exercise frequency 3X/week on weight loss comparing before (B) and following (F) 12 weeks of group training

	Weight Loss: Group That Exercised 3X / Week								P Value
	Weight loss greater than 3 kg		Does not know		Weight loss between 1 and 3 kg		No weight loss		
	No.	%	No.	%	No.	%	No.	%	
B-3X/Week	2	4.4%	2	4.4%	6	13.3%	35	77.8	0.16
F-3X/Week	1	2.2 %	5	11.1%	12	26.7%	27	60.0	

*** Significant at P< 0.05**

All participants reported no loss in mobility. There was no statistically significant difference in mobility in those who exercised twice a week compared to those who exercised three times a week. (Mann Whitney U, z = 0.000 p = 1.00) (Table 4.5.7)

Table 4.5.7 Effect of exercise frequency 2X/week vs. 3X/week on mobility following (F) 12 weeks of group exercise

	Mobility		
	Ability to get out of chair and go out		P Value
	No.	%	
F- 2X/Week	37	100%	1.00
F- 3X/Week	47	100%	

*** Significant at P< 0.05**

All participants reported no loss in mobility (100%, n=35). There was no statistically significant difference in mobility in those who exercised twice a week (p=1.00) (Table 4.5.8)

Table 4.5.8: Effect of group exercise frequency 2X/week on mobility comparing before (B) and following (F) 12 weeks of group training

	Mobility: Group That Exercised 2X / Week		
	Ability to get out of chair and go Out		P Value
	No.	%	
B- 2X/Week	35	100%	1.00
F- 2X/Week	35	100%	

*** Significant at P< 0.05**

All participants reported no loss in mobility (100%, n=45). There was no statistically significant difference in mobility in those who exercised thrice a week (p=1.00) (Table 4.5.9)

Table 4.5.9: Effect of group exercise frequency 3X/week on mobility comparing before (B) and following (F) 12 weeks of group training

	Mobility: Group That Exercised 3X / Week		
	Ability to get out of chair and go Out		P Value
	No.	%	
B- 3X/Week	45	100%	1.00
F- 3X/Week	45	100%	

*** Significant at P< 0.05**

All participants who exercised twice a week reported no experience of psychological or acute stress compared to 93% of those who exercised three times a week. However, there was no statistically significant difference in psychological or acute stress between the groups. (Mann Whitney U, z =-1.556 P = 0.120) (Table 4.5.10)

Table 4.5.10 Effect of exercise frequency 2X/week vs. 3X/week on psychological or acute stress following (F) 12 weeks of group exercise

	Psychological or Acute Stress				P Value
	Yes		No		
	No.	%	No.	%	
F- 2X/Week	0	0.0 %	37	100.0 %	0.120
F- 3X/Week	3	6.4 %	44	93.6 %	

*** Significant at P< 0.05**

More participants reported no psychological or acute stress (100%, n=35) following training. There was no significant difference in psychological or acute stress before and following training in the group that exercised twice a week (p = 0.32) (Table 4.5.11)

Table 4.5.11: Effect of exercise frequency 2X/week on psychological or acute stress comparing before (B) and following (F) 12 weeks of group training

	Psychological or Acute Stress: Group That Exercised 2X / Week				P Value
	Yes		No		
	No.	%	No.	%	
B-2X/Week	1	2.9 %	34	97.1 %	0.32
F-2X/Week	0	0.0 %	35	100 %	

*** Significant at P< 0.05**

No difference in psychological or acute stress was noted. There was no significant difference in reports of psychological or acute stress before and following training in the group that exercised thrice a week (p = 1.00) (Table 4.5.12)

Table 4.5.12: Effect of exercise frequency 3X/week on psychological or acute stress comparing before (B) and following (F) 12 weeks of group training

	Psychological or Acute Stress: Group That Exercised 3X / Week				P Value
	Yes		No		
	No.	%	No.	%	
B- 3X/Week	3	6.7 %	42	93.3 %	1.00
F- 3X/Week	3	6.7 %	42	93.3 %	

*** Significant at P< 0.05**

None of the participants who exercised twice a week reported any problems of a neuropsychological nature compared to 96% of those who exercised three times a week. However, there was no statistically significant difference in the experience of psychological or acute stress between the groups. (Mann Whitney U, z =-1.262 p = 0.207) (Figure 4.5.13)

Table 4.5.13 Effect of exercise frequency 2X/week vs. 3X/week on neuropsychological problems following (F) 12 weeks of group exercise

	Neuropsychological Problems						P Value
	Severe dementia or depression		Mild Dementia		No psychological problems		
	No.	%	No.	%	No.	%	
F- 2X/Week	0	0.0%	0	0.0%	37	100.0%	0.207
F- 3X/Week	1	2.1%	1	2.1%	45	95.7%	

*** Significant at P< 0.05**

More participants reported no psychological problems (100%, n=35) following training. There was no significant difference in neuropsychological problems before and following training in the group that exercised twice a week (p = 0.32) (Table 4.5.14)

Table 4.5.14: Effect of exercise frequency 2X/week on neuropsychological problems comparing before (B) and following (F) 12 weeks of group training

	Neuropsychological Problems: Group That Exercised 2X / Week						P Value
	Severe dementia or depression		Mild Dementia		No psychological problems		
	No.	%	No.	%	No.	%	
B- 2X/Week	0	0.0%	1	2.9%	34	97.1%	0.32
F- 2X/Week	0	0.0%	0	0.0%	35	100%	

*** Significant at P< 0.05**

Fewer participants reported mild dementia following training (2%, n=1). More participants reported no psychological problems following group exercise three times a week (96%, n=43). There was no significant difference in neuropsychological problems before and following training in the group that exercised thrice a week (p = 0.23) (Table 4.5.15).

Table 4.5.15: Effect of exercise frequency 3X/week on neuropsychological problems comparing before (B) and following (F) 12 weeks of group training

	Neuropsychological Problems: Group That Exercised 3X / Week						P Value
	Severe dementia or depression		Mild Dementia		No psychological problems		
	No.	%	No.	%	No.	%	
B- 3X/Week	0	0.0%	6	13.3%	39	86.7%	0.23
F- 3X/Week	1	2.2%	1	2.2%	43	95.6%	

*** Significant at P< 0.05**

In the group that exercised twice a week (90%, n=34), more participants had a BMI in the range of >23Kg/m^2, than those that exercise three times a week (83%, n=39). However, there was no statistically significant difference in BMI between the groups. (Mann Whitney U, z =-8.62 p = 0.389) (Table 4.5.16)

Table 4.5.16 Effect of exercise frequency 2X/week vs. 3X/week on BMI following (F) 12 weeks of group training

	Body Mass Index (BMI)								P Value
	BMI less than 19 Kg/m²		BMI 19 to less than 21 Kg/m²		BMI 21 to less than 23 Kg/m²		BMI 23 Kg/m² or greater		
	No.	%	No.	%	No.	%	No.	%	
F- 2X/Week	0	0.0%	2	5.3%	2	5.3 %	34	89.5	0.389
F- 3X/Week	1	2.1%	3	6.4%	4	8.5%	39	83.0	

*** Significant at P< 0.05**

No differences in BMI 23kg/m^2 or greater were noted. There was no significant difference in BMI before and following training in the group that exercised twice a week (p = 0.66) (Table 4.5.17)

Table 4.5.17: Effect of exercise frequency 2X/week on BMI comparing before (B) and following (F) 12 weeks of group training

	Body Mass Index (BMI) :Group That Exercised 2X / Week								P Value
	BMI less than 19 Kg/m²		BMI 19 to less than 21 Kg/m²		BMI 21 to less than 23 Kg/m²		BMI 23 Kg/m² or greater		
	No.	%	No.	%	No.	%	No.	%	
B- 2X/Week	1	2.9%	1	2.9%	1	2.9 %	32	91.4	0.66
F- 2X/Week	0	0.0%	2	5.7%	1	2.9%	32	91.4	

*** Significant at P< 0.05**

Fewer participants reported a BMI 23 kg/m^2 or greater (84%, n= 38) following training. More participants reported a BMI of 19 to less than 21 kg/m^2 following group exercise (9%, n=4). There was no significant difference BMI before and following training in the group that exercised thrice a week (p = 1.00) (Table 4.5.18)

Table 4.5.18: Effect of exercise frequency 3X/week on BMI comparing before (B) and following (F) 12 weeks of group training

	Body Mass Index (BMI): Group That Exercised 3X / Week								P Value
	BMI less than 19 Kg/m²		BMI 19 to less than 21 Kg/m²		BMI 21 to less than 23 Kg/m²		BMI 23 Kg/m² or greater		
	No.	%	No.	%	No.	%	No.	%	
B- 3X/Week	2	4.4%	1	2.2%	3	6.7 %	39	86.7	1.00
F- 3X/Week	1	2.2%	2	4.4%	4	8.9%	38	84.4	

*** Significant at P< 0.05**

4.6 The Effect of Group Exercise on Health Related Quality of Life

There was a significant difference in the following items namely vigorous activity ($p<0.01$), climbing several flights of stairs ($p=0.01$), climbing one flight ($p=0.05$), walking a mile ($p=0.01$) and walking one block ($p=0.02$) after the exercise intervention (Table 4.6.1). Participation in vigorous activities had improved following the group exercise intervention (Table 4.6.1).

Table 4.6.1: Effect of group exercise (12 weeks) on health related quality of life (Physical functioning). Paired sample t- test before (B) and Follow up (F)

Item	Mean Scores	N	Std. Deviation	P value
B Improved vigorous activities	17.86	84	33.512	***0.00**
F Improved vigorous activities	71.43	84	39.793	
B Improved moderate activities	92.86	84	22.148	0.25
F Improved moderate activities	95.83	84	13.902	
B Efficiency in lift carry groceries	87.50	84	26.746	0.15
F Efficiency in lift carry groceries	92.26	84	22.621	
B Increased ability to climb several flights	83.33	84	31.368	***0.01**
F Increased ability to climb several flights	73.21	84	37.582	
B Increased ability to climb one flight	95.24	84	18.398	***0.05**
F Increased ability to climb one flight	89.29	84	25.825	
B Reduced limitation in bending and kneeling	85.12	84	26.639	0.37
F Reduced limitation in bending and kneeling	82.14	84	27.597	
B Walk more than a mile	87.50	84	28.911	***0.01**
F Walk more than a mile	76.19	84	39.175	
B Walk several blocks	82.14	84	31.664	0.87
F Walk several blocks	81.55	84	33.635	
B Walk one block	95.24	84	18.398	***0.02**
F Walk one block	88.10	84	28.643	
B Efficiency in bathing and dressing	99.40	84	5.455	0.66
F Efficiency in bathing and dressing	98.81	84	10.911	

*** Significant at P< 0.05**

There do appear to be some promising trends in the items of physical activity scale before and after the exercise programme (p >0.05) (Table 4.6.2). Fewer participants reported no difficulty in work or activities after 12 weeks of group exercise (p=0.05) (Table 4.6.2)

Table 4.6.2 Effect of group exercise (12 weeks) on health related quality of life (Role of physical activity). Paired sample t- test before (B) and Follow up (F)

Items	Mean Scores	N	Std. Deviation	P value
B-Increased time for work or activities	91.67	84	27.805	0.80
F-Increased time for work or activities	90.48	84	29.531	
B-Accomplished more	89.29	84	31.115	0.23
F- Accomplished more	83.33	84	37.492	
B- Reduced limitation in kind work or activities	91.67	84	27.805	0.09
F- Reduced limitation in kind work or activities	83.33	84	37.492	
B--Non difficulty in work or activities	92.86	84	25.909	0.05
F--Non difficulty in work or activities	84.52	84	36.385	

*** Significant at P< 0.05**

There was a significant difference in the "pain interference with normal work" ($p<0.01$). Group exercise may increase pain interference with normal work (Table 4.6.3).

Table 4.6.3 Effect of group exercise (12 weeks) on health related quality of life (Bodily pain). Paired sample t- test before (B) and Follow up (F)

Items	Mean Scores	N	Std. Deviation	P value
B- -No bodily pain	71.08	84	28.840	0.84
F- No bodily pain	71.81	84	28.291	
B-Pain-Non-interference with normal work	91.37	84	23.763	***0.00**
F-Pain-Non-interference with normal work	73.81	84	40.125	

*** Significant at P< 0.05**

There was no significant difference in the items of the general health scale before and after exercise ($p >0.05$) (Table 4.6.4).

Table 4.6.4 Effect of group exercise (12 weeks) on health related quality of life (General health). Paired sample t- test before (B) and Follow up (F)

Items	Mean Scores	N	Std. Deviation	P value
B-General health	66.37	84	21.430	0.90
F-General health	66.07	84	21.129	
B-Excellent health	86.61	84	20.331	0.22
F-Excellent health	82.74	84	27.978	
B-As healthy as anyone	86.31	84	21.044	0.86
F-As healthy as anyone	85.71	84	26.686	
B-Reduced perception of easily falling sick	94.05	84	19.643	0.10
F- Reduced perception of easily falling sick	88.69	84	26.436	
B-Reduced perception of deterioration of health -	84.23	84	29.242	0.94
F- Reduced perception of deterioration of Health	83.93	84	28.423	

*** Significant at P< 0.05**

There was a significant difference in the following item participant score of feeling "worn out" (p=0.01) after the exercise intervention. Exercise was effective in reducing the feeling of being "worn out" (Table 4.6.5). A trend was noted that exercise reduced a feeling of tiredness and increased energy and a perception of pep and zest for life (Table 4.6.5).

Table 4.6.5 Effect of group exercise (12 weeks) on health related quality of life (Vitality). Paired sample t- test before (B) and Follow up (F)

Items	Mean Scores	N	Std. Deviation	P value
B-Increased pep/life	58.10	84	27.175	0.22
F- Increased pep/life	63.10	84	26.615	
B- Increased energy	64.76	84	25.149	0.12
F-Increased energy	69.76	84	24.346	
B - Reduced feeling of worn out	76.19	84	24.143	***0.01**
F- Reduced feeling of worn out	83.57	84	21.320	
B-Reduced feeling of tiredness	68.33	84	26.014	0.32
F-Reduced feeling of tiredness	71.19	84	24.118	

*** Significant at P< 0.05**

There was a significant difference in social functioning ($p<0.01$) after the exercise intervention. Group exercise was effective in improving social functioning of the elderly (Figure 4.6.6).

Table 4.6.6 Effect of group exercise (12 weeks) on health related quality of life (Social functioning). Paired sample T- Test before (B) and Follow up (F)

Item	Mean Scores	N	Std. Deviation	P value
B-Improved social extent and activities	69.35	84	45.149	***0.00**
F-Improved social extent and activities	94.94	84	18.924	
B-Increased social time	95.83	84	16.841	0.55
F-Increased social time	97.32	84	14.530	

*** Significant at P< 0.05**

Notably an increased number of participants focused more time on work after completing 12 weeks of group exercise (Figure 4.6.7).

Table 4.6.7 Effect of group exercise (12 weeks) on health related quality of life (Role emotional). Paired sample t- test before (B) and Follow up (F)

Items	Mean Scores	N	Std. Deviation	P Value
B--Increased time spent on work	96.43	84	18.669	
F-Increased time spent on work	98.81	84	10.911	0.32
B-Accomplished -more in daily life	96.43	84	18.669	
F-Accomplished more in daily life	94.05	84	23.802	0.48
B- Perform work and activities carefully	97.62	84	15.337	
F-Perform work and activities carefully	97.62	84	15.337	1.00

*** Significant at P< 0.05**

There was a significant difference in the following items namely perception of peacefulness ($p<0.01$) and happiness ($p<0.01$) after the exercise intervention. Exercise was effective in improving a feeling of peacefulness and happiness of the participants (Table 4.6.8)

Table 4.6.8 Effect of group exercise (12 weeks) on health related quality of life (Mental health). Paired sample t- test before (B) and Follow up (F)

Items	Mean Scores	N	Std. Deviation	P Value
B- Reduced feeling of nervousness	94.05	84	16.942	
F-Reduced feeling of nervousness	90.95	84	21.376	0.11
B- Reduced feeling of down in dumps	92.62	84	17.775	
F-Reduced feeling of down in dumps	92.14	84	16.724	0.85
B- Increased perception of peacefulness	74.76	84	23.464	
F- B-Increased perception of peacefulness	82.86	84	19.670	***0.00**
B-Reduced felling of blue/sad	83.13	83	26.408	
F-reduced feeling of blue/sad	87.71	83	20.442	0.10
B-Increased perception of happiness	80.95	84	18.603	
F-Increased perception of happiness	87.86	84	19.640	***0.00**

*** Significant at P< 0.05**

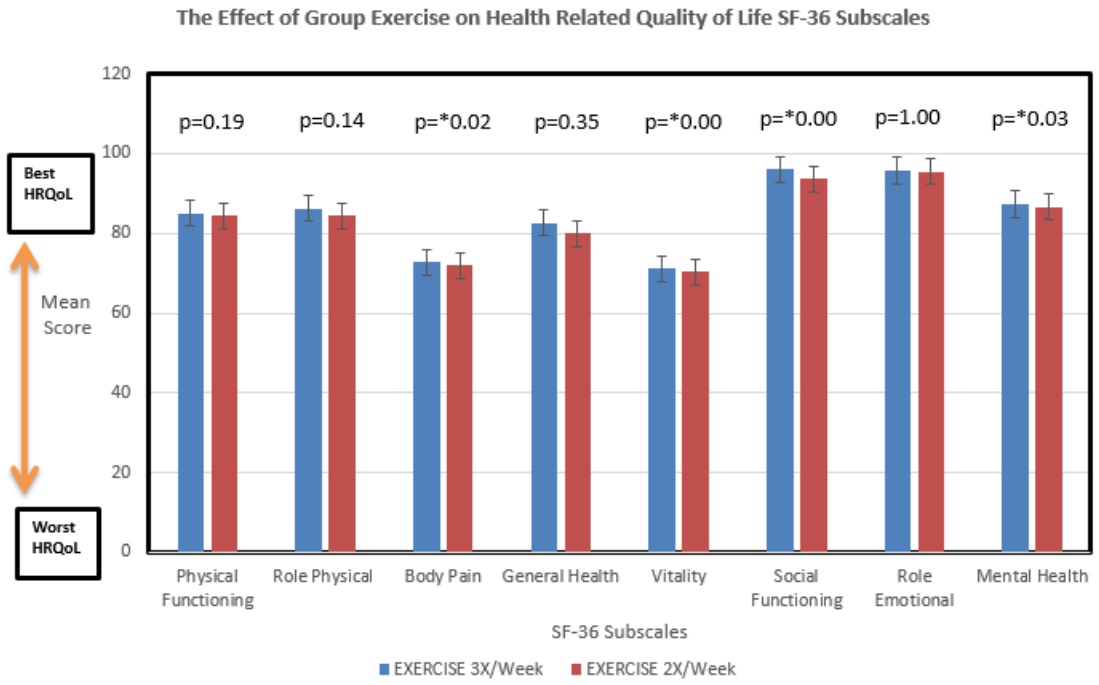
There was a significant difference in change in reported health ($p<0.01$) following the exercise intervention. Exercise was effective in improving the reported health of the participants (Figure 4.6.9).

Table 4.6.9 Effect of group exercise (12 weeks) on health related quality of life (Change in reported health). Paired sample t- test before (B) and Follow up (F)

Item	Mean Scores	N	Std. Deviation	P value
B-Change in reported health	61.01	84	28.610	***0.00**
F-Change in reported health	74.70	84	27.025	

*** Significant at P< 0.05**

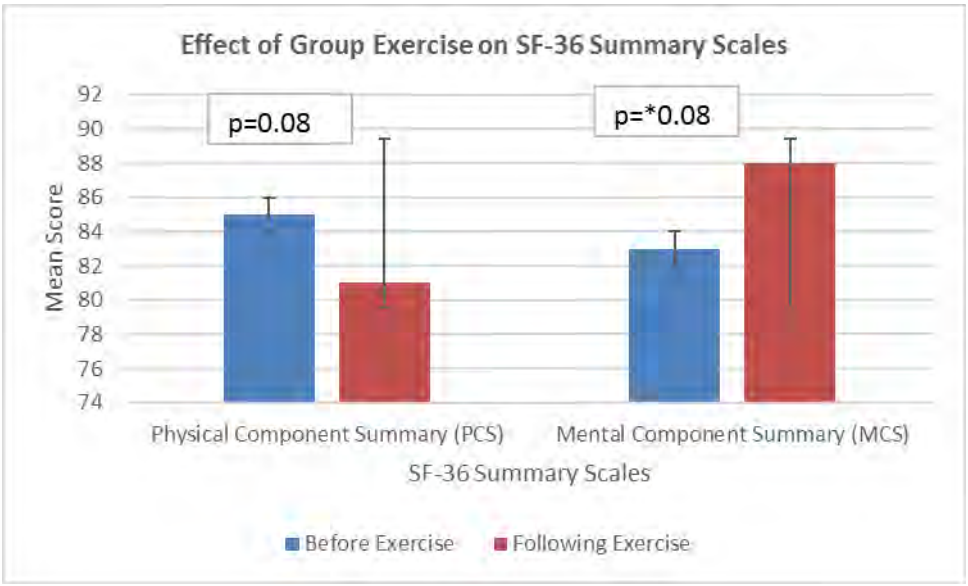
There was a significant difference in the following scales namely: mental health ($p=0.03$), Social functioning ($p<0.01$), Vitality ($p<0.01$) and Bodily pain ($p=0.02$). Exercise was effective in improving change in reported mental health, social functioning and vitality however an inverse relationship was noted for body pain (Figure 4.6).



*** Significant at P< 0.05**

Figure 4.6: Effect of 12 weeks group exercise on health related quality of life of various subscales (comparing before vs. follow up)

There was a significant difference in the mental component summary (p<0.01) following 12 weeks of group exercise. Exercise was effective in improving mental health component summary of the short form health survey (Figure 4.6.1)

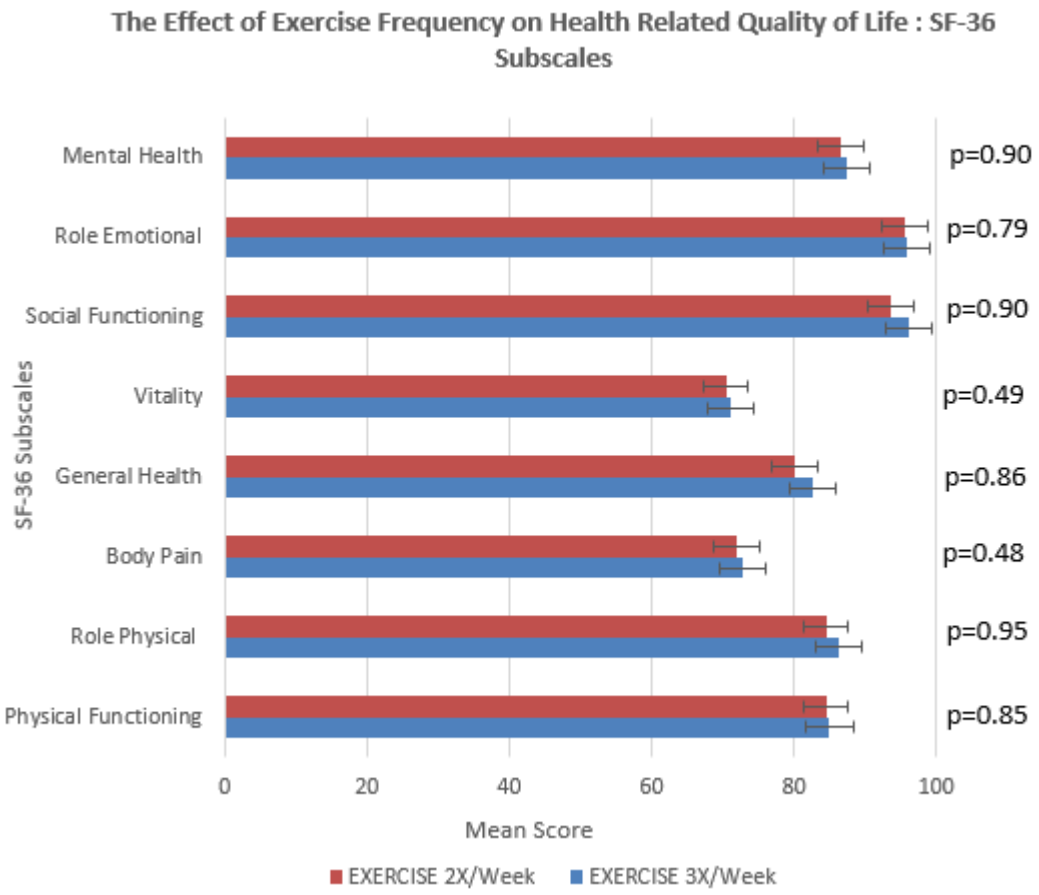


*** Significant at P< 0.05**

Figure 4.6.1: Effect of 12 weeks group exercise on SF-36 Summary Scales (comparing before vs. follow up)

4.7 The Effect of Participation in a Group Exercise Program 3x/Week vs. 2x/Week (for 12 Weeks) on SF-36 Subscales Following Exercise

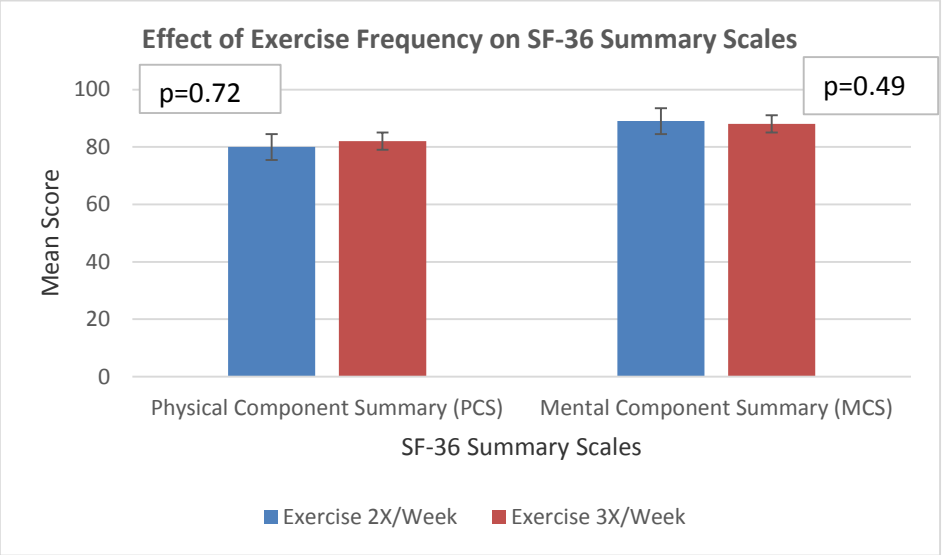
There was no significant difference between frequency of exercise and health related quality of life ($p > 0.05$). However, the group that exercised three times a week reported greater benefits in physical functioning, role physical, bodily pain, general health, vitality, role emotional and mental health compared to the group that exercised twice a week (Figure 4.7)



*** Significant at P< 0.05**

Figure 4.7 Effect of exercise frequency 2X/week vs. 3X/week on SF-36 subscales following (F) 12 weeks of group exercise

There was no significant difference between frequency of exercise and SF-36 summary components of the Short Form Health Survey (SF-36) ($p > 0.05$). However a trend was noted that frequency of exercise thrice a week may provide physical benefits and exercising twice a week may be beneficial for mental health (Figure 4.7.1)



*** Significant at P< 0.05**

Figure 4.7.1: Effect of exercise frequency 2X/week vs. 3X/week on SF-36 summary scales following (F) 12 weeks of group exercise

There was a significant difference in social functioning subscale (p=0.02) following training. Group exercise twice a week may improve social functioning. Promising trends were noted among physical functioning, vitality and mental health subscales (table 4.6.10)

Table 4.6.10 Effect of participation in a group exercise program 2X/week (for 12 weeks) on SF-36 subscales comparing before (B) and following (F) training

Scales B-Before : 2X/Week F-Follow up: 2X/Week	Mean Scores	Standard Deviation	P Value
B-Physical Functioning F-Physical Functioning	84.17 84.31	13.91 20.67	0.96
B-Role Physical F-Role Physical	94.44 84.03	17.02 31.71	0.06
B-Bodily Pain F-Bodily Pain	82.78 72.57	20.25 29.02	0.08
B-General Health F-General Health	82.78 80.14	15.34 16.79	0.27
B-Vitality F-Vitality	70.14 72.36	14.37 13.96	0.34
B-Social Functioning F-Social Functioning	84.03 96.18	25.29 11.50	***0.02**
B-Role Emotional F-Role Emotional	99.07 98.15	5.56 11.11	0.66
B-Mental Health F-Mental Health	87.89 89.00	11.99 13.84	0.55

There was a significant difference in physical component summary (p= 0.03) and mental component summary component (p= 0.04) following training twice a week. Exercise may be effective in improving mental health (Table 4.6.11 and figure 4.4)

Table 4.6.11 Effect of participation in a group exercise program 2X/week (for 12 weeks) on SF-36 physical and mental component summary comparing before (B) and following (F) training

SF-36 Summary Scales B-Before: 2X/ Week F-Follow up: 2 X/ Week	N	Mean Scores	Std. Deviation	P Value
B- Mental Component Summary F- Mental Component Summary	36 36	85.28 88.92	10.05 7.94	***0.04**
B-Physical Component Summary F-Physical Component Summary	36 36	86.04 80.26	11.15 17.39	***0.03**

*** Significant at P< 0.05**

There was a significant difference in social functioning, vitality, and mental health comparing before and following training thrice a week. Promising trends were noted among social functioning and role emotional subscales. (Table 4.6.12)

Table 4.6.12 Effect of participation in a group exercise program 3X/week (for 12 weeks) on SF-36 subscales comparing before (B) and following (F) training

Scales B-Before: 3X / Week F-Follow up: 3X / Week	Mean Scores	Standard Deviation	P Value
B-Physical Functioning F-Physical Functioning	81.06 85.00	16.32 17.63	0.11
B-Role Physical F-Role Physical	90.43 86.17	25.83 27.49	0.44
B-Bodily Pain F-Bodily Pain	78.67 72.71	23.81 24.96	0.20
B-General Health F-General Health	83.62 82.55	13.94 16.87	0.71
B-Vitality F-Vitality	63.62 71.17	19.94 19.95	***0.00**
B-Social Functioning F-Social Functioning	82.71 96.06	23.54 11.97	***0.00**
B-Role Emotional F-Role Emotional	95,04 95.74	20.83 13.22	0.85
B-Mental Health F-Mental Health	82.21 87.32	15.22 15.23	***0.03**

*** Significant at P< 0.05**

There was a significant difference in mental component summary scale ($p<0.01$) following training thrice a week. Exercise was effective in improving mental health (Table 4.6.13, Figure 4.7.2 and Figure 4.7.3).

Table 4.6.13 Effect of participation in a group exercise program 3X/week (for 12 weeks) on SF-36 physical and mental component summary comparing before and following training

SF-36 Summary Scales B-Before: 3X/ Week F-Follow up: 3 X/ Week	N	Mean Scores	Std. Deviation	P Value
B- Mental Component Summary	47	80.89	13.55	***0.00**
F- Mental Component Summary	47	87.56	9.63	
B-Physical Component Summary	47	83.44	14.04	0.52
F-Physical Component Summary	47	81.61	16.14	

*** Significant at P< 0.05**

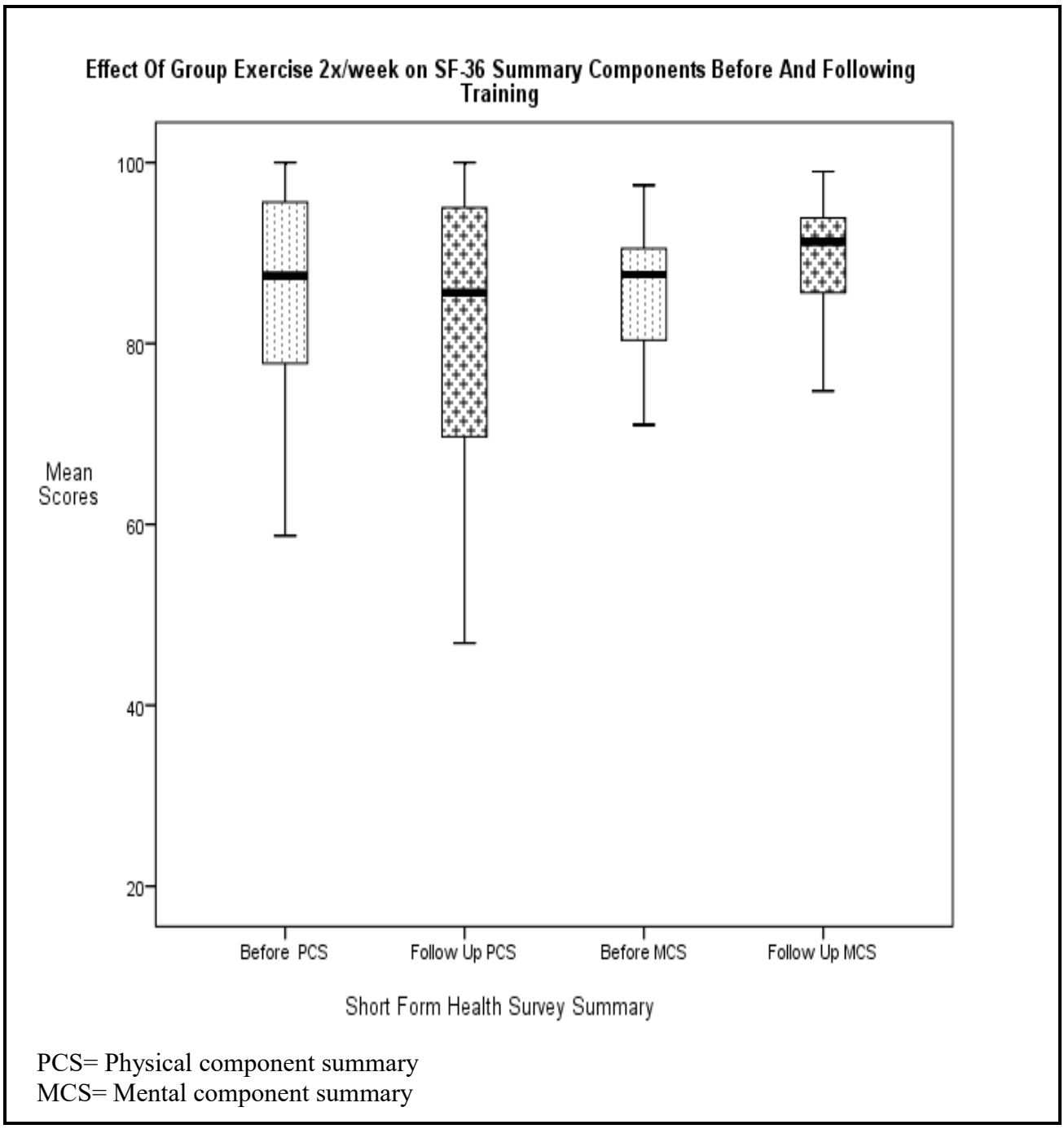


Figure 4.7.2 Effect of participation in a group exercise program 2 ×/ week (for 12 weeks) on SF-36 physical and mental component summary scales comparing before and following training

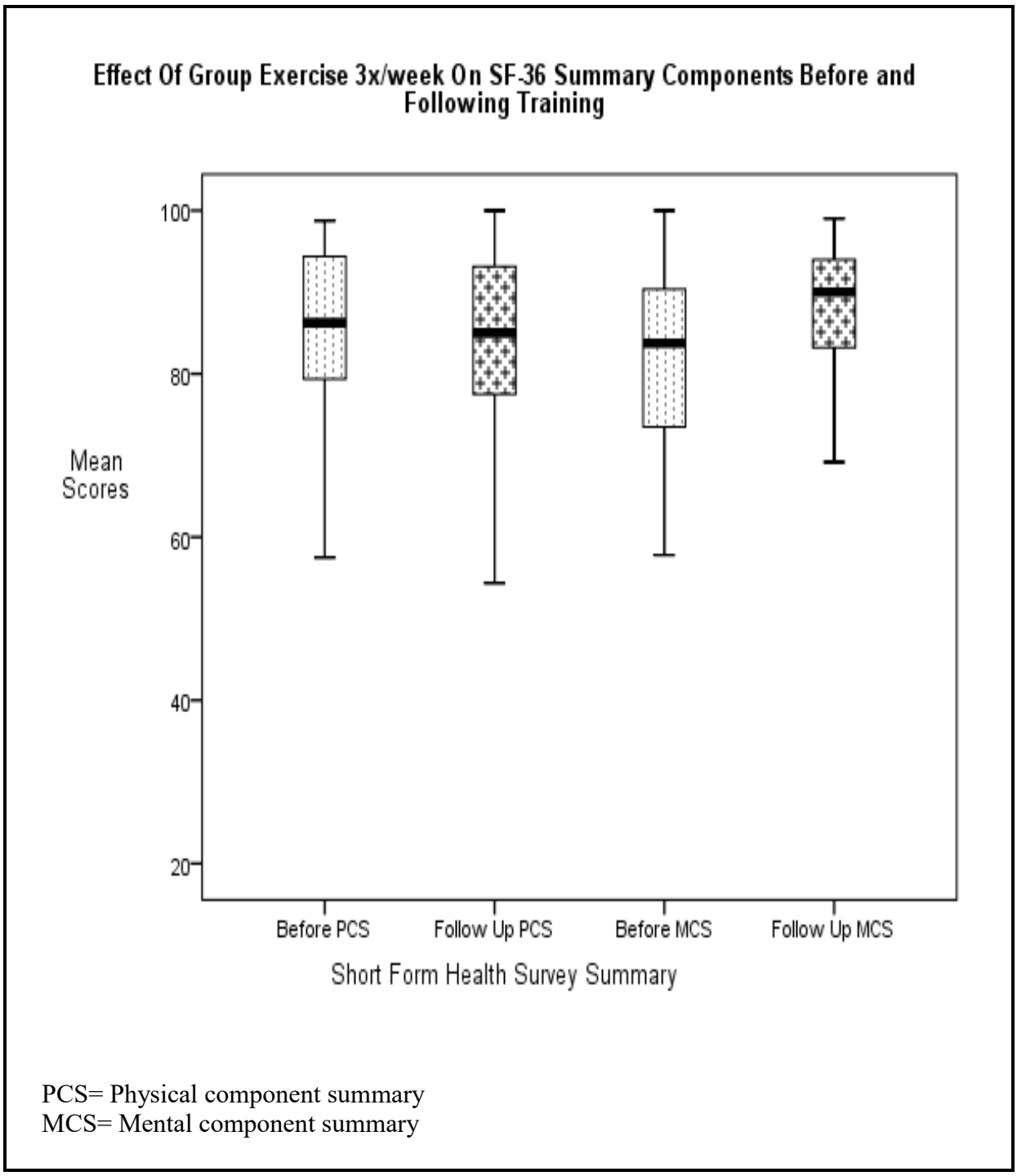


Figure 4.7.3 Effect of participation in a group exercise program 3 ×/ week (for 12 weeks) on SF-36 physical and mental component summary scales comparing before and following training

4. 8 Conclusion and Summary of Results

A total of 100 participants were included in the study. The study consisted of 79% females and 21 % males. There was no significant difference between mean BMI, waist circumference and waist to hip ratio before and after exercise ($p > 0.05$). However, notably there was a decrease in waist circumference and waist to hip ratio. An inverse relation was also evident between 12 weeks of group exercise and sum of skinfold. The baseline sum of skinfolds was significantly related to sum of skinfold after exercise ($p < 0.01$). This can be attributed to an inverse relationship between fat free mass and age (Carlsson et al., 2009) and lack of equal representation of ethnicity. Dietary intake was not controlled, which may have had an impact on the results obtained.

There was no significant difference between frequencies of exercise (2 times vs. 3 times a week) following 12 weeks of training with regards to BMI, waist circumference and waist to hip ratio following exercise. However there was a significant difference between sum of skinfold comparing before and following training twice a week ($p=0.01$). Interesting a trend was noticed were participants who exercised twice a week had a lower waist to hip ratio while there was no change in waist to hip ratio in the group that exercised three times a week when comparing before and following training.

Group exercise was effective in improving nutritional status, with fewer participants being at risk of malnutrition following the group exercise intervention, and more participants were well nourished. The group that exercised twice a week had a better MNA-SF score than the group that exercised three times a week. There was no significant difference in reports of components of the MNA-SF between those who exercised twice a week vs. three times a week ($p>0.05$). However the following similar noticeable trend were observed in the groups that exercised 2X/week (comparing before and following training) and 3X/week (comparing before and following training) namely, more participants reported no loss of appetite, exercise may be directly related to weight loss irrespective of frequency 2X/week or 3X/week and more participants reported no neuropsychological problems and dementia following training.

The group exercise intervention further produced benefits in health related quality of life in the elderly residing in elderly care facilities. Participation in vigorous activities had improved following the 12 week group exercise intervention ($p<0.01$). Exercise was effective in reducing a feeling of worn out ($p=0.01$), improving social functioning ($p<0.01$), and improved feeling of peace ($p<0.01$) and happiness ($p<0.01$). Notably exercise reduced a feeling of tiredness and increased energy and a perception of pep and zest for life. Exercise was effective in improving change in the reported health of the participants ($p<0.01$).

There was a significant difference in the following subscales of the SF-36 namely: mental health ($p=0.03$), Social functioning ($p<0.01$), Vitality ($p=0.01$) and Bodily pain ($p=0.02$). Exercise was effective in improving change in reported mental ($p=0.03$), social functioning ($p<0.01$) and vitality $p=0.01$) however an inverse relationship was noted for body pain ($p=0.02$). There was no significant difference between frequency of exercise and health related quality of life following training (2X/week vs. 3X/week). However, the group that exercised three times a week reported greater benefits in physical functioning, vitality, role emotional and mental health compared to the group that exercise twice a week.

There was a significant difference in social functioning ($p<0.01$), vitality ($p<0.01$) and mental health ($p=0.03$) comparing before and following training thrice a week. Group exercise twice a week may improve social functioning. There was a significant difference in social function comparing before and following training twice a week ($p=0.02$). Exercise twice a week may improve social functioning. Therefore social functioning benefits can be obtained irrespective of exercise frequency 2X/week or 3X/week (comparing before and following training).

There was a significant difference in the mental component summary ($p<0.01$) following 12 weeks of group exercise. Exercise was effective in improving mental health component summary. There was no significant difference between frequency of exercise and SF-36 Summary components (3X/week vs. 2X/week). However a tendency was noted that frequency of exercise thrice a week may provide physical benefits and exercising twice a week may be beneficial for mental health.

There was a significant difference in physical component summary scale ($p= 0.03$) and mental component summary ($p= 0.04$) comparing before and following training twice a week. Exercise may be effective in improving mental health in the group that exercised twice a week. There was a significant difference in mental component summary scale ($p<0.01$) comparing before and following training thrice a week. Therefore mental health benefits can be obtained irrespective of exercise frequency 2X/week or 3X/week (comparing before and following training).

CHAPTER 5. DISCUSSION

5. Introduction

The detailed analysis of results provides comprehensive and detailed knowledge about the demographical profile of the elderly living in aged care homes as well as the effect group exercise has on anthropometry, nutritional status and health related quality of life in this population. In this chapter the results will be discussed and compared with findings from national and international studies.

5.1 Demographic Profile of Study Population

The sample size comprised of 100 participants, predominantly female participants with a mean age of 73 years. A large percentage of the population was of Indian race. Most of the participants were widowed and residing in elderly care homes. The demographic profile was similar to the study conducted by Govender (2011) who investigated the nutritional status and dietary intake of a group of elderly at the day and frail care centre in Verulam. Furthermore the largest population of Indians reside in Durban and this may be reflected in the demographic profile of the study sample.

5.2 The Effect of Group Exercise on Anthropometry

Data was combined and did not distinguish between gender and ethnic groups, due to the large disparity in the sample of males and females and ethnic differences. This can be attributed to the inherent biological process that longevity is more prominent in women when compared to men (World Health Organization, 2003). The lack of scientific data on ethnicity related to anthropometrical profile in the South African population further substantiates the combination of data presented. Few studies reports on the effect of obesity in South Africa and provides ethnic normative data for Body Mass Index, however does not indicate anthropometrical profile specific to the elderly (Goedecke & Jennings, 2005).

The WHO defines Body Mass Index as a simple index of weight and height, used to classify people as being overweight, underweight and obese. Of the group of institutionalized elderly that exercised for 12 weeks, the mean Body Mass Index before exercise intervention was 28.07 kg/m^2 and following 12 weeks of group exercise was

28.24 kg/m^2 respectively. Clinically Body Mass Index increased slightly after 12 weeks of exercise, because an increase in lean body mass in these individuals is important.

An international study reported that a low Body Mass Index negatively affected quality of life of the elderly living in long term care homes (Crogan & Pasvogel, 2003). A BMI of ≤21 kg/m^2 dictates that the elderly living in nursing homes may require nutritional support (Cereda et al., 2011). Considering these conclusions, a high BMI before and following exercise (>21 kg/m^2) in this study may have had a desirable effect on health related quality of life and nutritional status of the elderly. The findings support an international Italian study that reported institutionalized elderly aged 82 years old , males and females, with a BMI of >25.4 had a 40% lower risk of mortality over a 4 year period (Volpato et al., 2004). Bohannon et al. (2005) investigated the relationship between BMI and physical ability related to walking in residents living in old elderly homes aged 74 years for a period of 9 years. They concluded a high BMI was related to greater loss of physical ability in walking. Controversy exists regarding Body Mass Index and healthy values for the elderly living in long term aged care homes (Grieger et al., 2007). Body Mass Index cannot distinguish between fat mass and lean muscle. An increase in visceral fat predisposes the elderly to disease and disability (Deschenes, 2004; Ferraro et al., 2002). Hence percentage of fat mass cannot be ascertained by BMI. As a result BMI when used independently is an inconclusive measure in providing an indication of disease and disability in the elderly living in aged care homes.

There is a direct relationship between mortality risk and BMI (Borrell & Samuel, 2014). Beyond 80 years this relationship weakens, because it is difficult to distinguish weight loss as a result of lifestyle factors namely exercise or ill health that may surface as a result of inactivity (Han, Tajar, & Lean, 2011). Therefore BMI is a poor indicator of mortality risk, functional status and general health indicators such as chronic disease in nursing home residents (Tsai, Lai, & Chang, 2012). Furthermore in the context of elderly living in old aged homes, mid arm circumference was effective in reporting follow up mortality risk (Lunney, Lynn, Foley, Lipson, & Guralnik, 2003). Calf circumference was effective in reporting general health and nutritional status compared with BMI in institutionalized men (Tsai et al., 2012). Mid arm circumference measures provided an indication of accelerated functional decline (e.g. acute illness) (Lunney, Lynn, Foley, Lipson, &

Guralnik, 2003) and calf circumference indicated muscle related disability (Rolland et al., 2003). Mid arm circumference and calf circumference was not measured in the current study. Future studies focusing on institutionalized elderly, should obtain mid arm and calf circumference measures to provide a holistic view of functional decline and muscle related disability in this population.

Waist circumference as a measure of abdominal fat is a better indicator of disease and mortality than BMI (Visscher et al., 2001). Fat is metabolically active in the abdomen, resulting in receptor blockage and type 2 diabetes (Han et al., 2011). Notably with exercise there was a reduction in waist circumference and waist to hip ratio. Waist circumference provides an indication of fat distribution especially along the truncal region. There is a direct relationship between increase abdominal fat and increase risk of metabolic abnormalities (Zamboni et al., 2008). A reduction in waist circumference in the current study indicates that group exercise may be effective in reducing the risk of metabolic disease e.g. hypertension, glucose intolerance, insulin resistance and central obesity. Although waist circumference is a better determinant of disease and mobility in the elderly, one should be cautioned that an inherent loss in abdominal muscle tone in the elderly may affect the reliability of the results (Han et al., 2011).

There is an inverse relationship between fat free mass and age (Carlsson, Gustafson, Eriksson, & Håglin, 2009). Interestingly there was a significant increase in sum of skinfold, however this could be attributed to the lack of technical error measurement obtained from the study, which lacked the authenticity in providing an indication of inter tester and intra tester variability. Lack of dietary control can be another contributing factor for this result. Adiposity increases the incidence of dyslipidemia, hypertension and resistance to insulin, predisposing the elderly living in elderly care facilities to the pathogenesis of metabolic syndrome and cardiovascular disease (Hazzard, 2005). Contrary to this finding, adiposity alone is not enough to substantiate metabolic risk. Waist and thigh girths instead of skinfold thickness are better indicators of abdominal obesity and sarcopenia (Hughes et al., 2004). Skinfold thickness cannot be used to predict changes in fat mass due to age related fat redistribution (Hughes et al., 2004). For example android obesity, which is characterized by larger distribution of abdominal or trunk fat, is associated with an increased risk of hypertension, type 2 diabetes and

dislipidemia when compared with gynoid or gynecoid obesity (fat distribution in hip and thigh) (Kang et al., 2011). Therefore one should be cautious when interpreting skinfold measurement. Furthermore an increase in the sum of skinfold cannot be attributed to exercise alone but as a result of the inherent inverse relationship that exist with fat free mass and age. Increase in physical activity (>500Kcal/week) resulted in a reduction in thigh (Hughes et al., 2004), triceps and subscapula skinfold thickness (Woo, Ho, & Sham, 2001). This contradicts the findings of the current study in that after 12 weeks of group exercise triceps, thigh and subscapula skinfolds increased.

Longitudinal data supports the use of waist and hip girth measurements as important indicators of fat redistribution in the elderly (Hughes et al., 2004). Another Australian study reported that elderly Caucasians women living in aged care homes had a higher BMI, lower lean body mass and increase in fat mass compared to younger control group (Woods, Iuliano-Burns, King, Strauss, & Walker, 2011). An important finding in the study supports hip strength as a superior indicator for physical functioning than lean mass relevant to this population (Woods et al., 2011)

Interestingly a trend was noticed were participants who exercised twice a week had a lower waist to hip ratio while there was no change in waist to hip ratio in the group that exercised three times a week when comparing before and following training. However the results were not statistically significant. The results of this study supports the finding to achieve the desired positive effects on body composition frequency of exercise should be three times a week for a duration of 12 weeks (Nakamura, Tanaka, Yabushita, Sakai, & Shigematsu, 2007).

5.3 The Effect of Group Exercise and Exercise Frequency on Nutritional Status

Exercise increases food intake in the elderly living in aged care homes (Morley, 2001b). Group exercise was effective in increasing MNA-SF score and had a significant effect in reducing the risk of malnutrition. Risk factors for malnutrition include psychological factors (depression, anxiety), social factors (isolation, loneliness) and physical disability (poor mobility) to name a few (Hickson, 2006). A possible explanation for group exercise reducing the risk of malnutrition, can be attribute to the modification of psychological, social and physical disability risk factors promoting a desirable effect on nutrient intake (Drewnowski & Evans, 2001) . Exercise increases gastric empting and could alter cholecystokinin release, explaining the desirable effect of group exercise on nutritional status of the elderly living in aged care homes (Morley, 2001b) . Leptin is a hormone that is produced by adipose cells. There is an inverse relationship between leptin levels and energy intake (Morton, Cummings, Baskin, Barsh, & Schwartz, 2006). High leptin and insulin levels indicate reduced food intake. Aging is associated with reduced glucose tolerance and increased insulin release, promoting elevated leptin levels and reduced food intake (Zamboni et al., 2004). Therefore group exercise improves glucose tolerance and may reduce leptin activity encouraging an increase in food intake.

However an international study suggested that oral supplementation increases energy intake, protein levels and anthropometric measures, however studies of oral supplementation in long term care facilities are of poor quality (Kwok, Woo, & Kwan, 2000; Ödlund Olin et al., 2003) . An older study postulated that the elderly that performed progressive resistance exercise with supplement use had greater improvements in energy intake, however no change was noted in the elderly that had nutritional supplementation or performed resisted exercise in isolation (Fiatarone et al., 1994). A recent study indicated to maintain lean mass in the elderly ≥ 65 years, ≥1g of protein per kg of weight per day is required (Morley et al., 2010). Oral feeding and diet rich in oral nutritional supplementation is the first choice of treatment in malnourished elderly (Hamilton & Boyce, 2013). When oral nutritional supplementation is inadequate , nutrition can be provided via enteral tube feeding (Correia et al., 2014). Therefore oral supplementation

may improve nutritional status which was not measured in the current study. Further studies should address supplementation use in aged care homes.

The type and geographical location of long term care facilities can affect nutritional status. There is a strong correlation that indicates the elderly living in urban or large town nursing homes had an increased risk of under nutrition (Challa, Sharkey, Chen, & Phillips, 2006). In Helsinki nursing homes the following patient related factors such as dementia, impaired activities of daily living, swallowing difficulties and constipation contributed to malnutrition (Suominen et al., 2005). In UK nursing homes low Body Mass Index, disease, loss of thirst and appetite, swallowing problems and medication affected intake of food and inevitably affected quality of life (Hickson & Frost, 2004). Therefore when considering nutritional status of the elderly in long term aged care homes, the finding are not dependent on one variable but many components.

In the South African context a study of 11 old elderly homes suggest that they are well aware about the relationship between physical activity and quality of life, but were less knowledgeable about the influence of exercise on cholesterol, diabetes and hypertension (Pienaar et al., 2004). Most participants felt they did not receive enough information about the effect that exercise has on nutritional status. Despite this finding group exercise promoted a desirable effect on the nutritional status of the elderly living in aged care homes.

Noticeable trend were observed in the group that exercised 2X/week (before and following training) and 3X/week (before and following training) namely, more participants reported no loss of appetite, exercise may be directly related to weight loss irrespective of frequency 2X/week or 3X /week and more participants reported no neuropsychological problems and dementia before and following training. The finding supports a Korean study, that less regular exercise was reported to be directly related to poor nutrition in Koreans elderly 50 years and older (Yim, 2007).

5.4 The Effect of Group Exercise and Exercise Frequency on Health Related Quality of Life SF-36 Subscales

Group exercise for 12 weeks was effective and significant in improving vigorous activity, reduced feeling of worn out, increased social extent, an elevated feeling of peacefulness and happiness and reported health in the elderly residing in aged care homes. Similar findings were noted in a study that concluded physical activity improves physical functioning and overall health (Vagetti et al., 2014). However group exercise in the current study had a significantly inverse effect on the following items namely climb several flights of stairs, climb one flight, walk a mile, walk one block. This could be due to a small sample size and lack of consensus on the optimal dose that was required to obtain the above benefits (Kelley et al., 2009) . High intensity group based exercise (>60 % to 84 % of HRR) was associated with better quality of life in elderly subjects 65 years and over, which may act as a protective factor against chronic disease in the elderly (Mura, Sancassiani, Migliaccio, Collu, & Carta, 2014). Therefore another explanation is that the current study was of moderate intensity and lacked sufficient intensity to achieve benefits of the above items.

An international study postulated that physical health, mental health and vitality had a better correlation with men than woman when assessed with the SF-36 questionnaire (West & Wallberg-Jonsson, 2009). The findings of this study supports the current study of a positive and significant effect of group exercise on mental and vitality scales (Lobo et al., 2008). Another population based study reported lower scores associated with the SF-36 questionnaire with increased age, especially the physical components and mental components of the SF-36 questionnaire (Perkins et al., 2006). However in the current study group exercise improved mental components.

Clinically the following trends were noted after completion of 12 weeks of group exercise which were a reduced pain interference with daily activity, improvements in general health, feeling less sick, focusing more time on work and reduced feeling of nervousness. Group exercise improves mental stimulation, prevents cognitive decline (Baum, Jarjoura, Polen, Faur, & Rutecki, 2003), and processing speed which preserves memory function (Smith et al., 2010) aiding the elderly in focusing more time on work and stimulating a sense of independence. The current study of group exercise is similar to the finding that

physical activity promotes independence by improving physical functioning and physical health, thus improving autonomy (Vagetti et al., 2014). Other cross sectional studies concluded that moderate or high intensity was associated with benefits in the following , vitality (Acree et al., 2006; Aoyagi & Shephard, 2010; Lobo et al., 2008) and mental health (Aoyagi & Shephard, 2010). The current study had similar findings, that group exercise was effective in improving change in reported mental and vitality scales.

Previous studies reported that supervised group exercise with a frequency of two times a week with a 45 minute duration improved mental health related quality of life (Windle, Hughes, Linck, Russell, & Woods, 2010). However in the current study a frequency of three times a week produced desirable benefits clinically of the different SF-36 sub-scales. High quality of life has been associated with healthy nutrition, reduced lethargy from myocardial infarction, obesity, type 2 diabetes, osteoporosis and colon cancer (McNaughton, Crawford, Ball, & Salmon, 2012). Recently exercise was found to improve metabolic and preserve function of the aging brain (Kirk-Sanchez & McGough, 2014). Exercise increases brain derived neurotrophic factors in the hippocampus (Seifert et al., 2010). Brain derived neurotrophic factors may be an important mediators in the reduction of cognitive decline and reduced autonomy (Mura et al., 2014). Supporting the finding of the current study that group exercise may have a desirable effect on mental health in the elderly residing in long term aged care homes.

There was a significant difference in social functioning, vitality, and mental health comparing before and following training thrice a week. Group exercise twice a week may improve social functioning. Exercise twice a week may improve social functioning. Therefore social functioning benefits can be obtained irrespective of exercise frequency 2X/week or 3X/week. Clinically exercising three times a week resulted in improvements in the following scales namely, physical functioning, vitality, role emotional and mental health. Exercising two times a week had an improvement in general health following exercise. Similar improvement in social functioning was noted in both groups. Therefore it could be postulated that there is a direct relationship between frequency of exercise and health related quality of life. Frequency of participation in physical activity at least 5 times a week was associated in better domains of quality of life namely physical and

social domains (Grimmett et al., 2011) . Similar finding were noted in the current study, indicating favourable outcomes of the physical and social HRQoL scales associated with more frequent structured exercise.

Similar trend was noted in a study that reported, moderate accumulation of physical activity was an important determinant in health related quality of life in the older Japanese men (Yasunaga et al., 2006). Another study indicated that frequency of participation in physical activity at least five times a week improved physical health and social functioning in colorectal cancer survivors (Grimmett et al., 2011). Therefore clinically greater exercise frequency per week may have a direct relationship between health related quality of life and elderly residing in aged care homes.

There was a significant difference in the mental component summary following 12 weeks of group exercise. Exercise was effective in improving mental health component summary of the SF-36. There was a significant difference in the mental component summary comparing before and following training twice a week and thrice a week (comparing before and follow up). Therefore mental health benefits can be obtained irrespective of exercise frequency 2X/week or 3X/week. The findings are related to a study conducted among institutionalized elderly residing in Seremban, Negeri Sembilan and Malaysia which indicated that a multi component exercise programme statistically improved mental health component summary and physical component health summary (Justine, Hamid, Kamalden, & Ahmad, 2010). The results are similar to the current study with respect to mental health but not physical health. This could be attributed to different contextual factors such as geographic location, ethnicity and socioeconomic status.

CHAPTER 6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Following analysis and discussion of results the following can be obtained:

- The purpose of the study was to determine the effect of group exercise and frequency of group exercise on anthropometry, health related quality of life and nutritional status of the elderly living in aged care homes. The study objectives were achieved. Hence a structured group exercise program provided insight on Body Mass Index, waist circumference, waist to hip ratio, sum of skinfold, health related quality of life and nutritional status of the elderly living in aged care homes.

- The study findings indicate a direct relationship that may exist between group exercise and sum of skinfold. However this cannot be attributed to group exercise independently, but as a result of the inherent direct relationship that exists between fat free mass and age. Furthermore skinfold thickness cannot be used to predict changes in fat mass due to age related fat redistribution (Hughes et al., 2004). Longitudinal data supports the use of waist and hip girth measurements as important indicators of fat redistribution in the elderly (Hughes et al., 2004).

- Furthermore in the context of elderly living in elderly care facilities mid arm circumference was effective in reporting follow up mortality risk, general health , nutritional status and accelerated functional decline (Lunney et al., 2003). Calf circumference provides an indication of muscle related disability (Rolland et al., 2003). Therefore in conjunction with BMI, skinfold measurements, waist circumference, and waist to hip ratio, mid arm and calf circumferences should be obtained in the context of elderly living in aged care homes.

- There was no significant difference between frequencies of exercise (2X/week vs. 3X/week) with regards to BMI, waist circumference and waist to hip ratio.

However the group that exercise three times a week showed a decrease in BMI, waist circumference and waist to hip ratio. To achieve the desired positive effects on body composition frequency of exercise may be prescribed three times a week for a duration of 12 weeks (Nakamura et al., 2007).

- Group exercise may improve nutrition of elderly living in elderly care facilities. An explanation for this result may be attributed to group exercise modifying psychological, social and physical disability risk factors of malnutrition and promoting a desirable effect on nutrient intake (Hickson, 2006).

- Exercising 2X/week and 3X/week may result in reduced loss of appetite, increased weight loss and a reduction in neuropsychological problems and dementia.

- Group exercise significantly improved vigorous activity, reported health, a reduced feeling of worn out, improved social extent and produced an elevated feeling of happiness and peacefulness following 12 weeks of group exercise. This may assist the elderly in accomplishing activities of daily living safely and effectively. Furthermore group exercise significantly improved social function, vitality and mental health subscales.

- Group exercise had a significantly inverse effect on the following items namely climb several flights of stairs, climb one flight, walk a mile, and walk one block. This could be attributing, lack of consensus of the optimal dose that was required to obtain the above benefits (Kelley et al., 2009).

- Clinically exercising three times a week resulted in improvements in the following scales namely, physical functioning, vitality, role emotional and mental health. Exercising three times a week may have a desirable effect on health related quality of life of the elderly living in aged care homes.

- Exercise frequency two times and three times a week may have a desirable effect on mental health in the elderly residing in long term care facilities. Mental health

and social health benefits can be obtained irrespective of exercise frequency 2X/week or 3X/week. The finding may be attributed to the effectiveness of group exercise in improving mental stimulation and preventing cognitive decline (Baum et al., 2003).

6.2 Study Limitations

Large distribution of women present in the sample, therefore biased towards women and not representative of the sample. Many elderly women found it difficult to perform exercises seated on the floor. Therefore the intervention was designed to be implemented in a standing and seated positions on chairs. More comprehensive anthropometric measures namely calf circumference, mid arm circumference should be obtained in future studies investigating anthropometry in institutionalized elderly. None of the analysis addressed confounding factors such as fatigue, changes in physical activity during the intervention and nutrition.

6.3 Recommendations

Based on the conclusions the following recommendations are warranted:

- In the South African context a multidisciplinary medical team is required to aid in holistic wellbeing. The team should comprise of medical doctors, nutritionists, social workers, physiotherapists and biokineticists.

- Local facility initiative promoting active aging and patient education on the importance of physical activity, exercise and nutrition has on health related quality of life.

- The environment should be spacious and well ventilated to ensure safe implementation of group exercise. This may encourage adherence to exercise on a regular basis and create awareness about the benefits of structured exercise.

- Supervised structured group exercise program encompassing the following components, which include, warm up, endurance, resisted, balance and cool down activities. The exercise program should be supervised by an exercise specialist. (Czerniewicz & Nicholson, 2004).

- Mid arm and calf circumference should be part of the anthropometrical measurements in the context of the elderly living in elderly care facilities.

- An exercise prescription of 2X/week or 3X/week may be beneficial to achieve a reduction in neuropsychological problems and dementia.

- Exercises should be implemented in an upright and standing position. Eliminating the exercises that entail the patient moving from a prone/supine to standing positions.

- To achieve mental health and social health benefits an exercise frequency of 2X/week or 3X/week is recommended.

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8. APPENDICES

Appendix A: Ethical Approval Letter

Appendix B: Informed Consent Letter

Appendix C: Medical History Questionnaire

Appendix D: Physical Activity Readiness Questionnaire (PAR-Q)

Appendix E: Administration Data Collection Sheet

Appendix F: Data Collection Sheet Prior Each Exercise Session

Appendix G: Exercise Prescription

Appendix H: Anthropometrical Assessment Sheet

Appendix I: Mini Nutritional Assessment Questionnaire (MNA)

Appendix J: Short Form Health Survey (SF-36)

Appendix K: Borg Rating of Perceived Exertion Scale

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

28 February 2014

Mr Nivash Rugbeer
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PROTOCOL: The effect of group exercise and nutritional status in relation to anthropometry and health related wellbeing of older persons living in aged care homes within eThekwini Municipality.
REF: BE078/14

EXPEDITED APPLICATION

A sub-committee of the Biomedical Research Ethics Committee has considered and noted your application received on 07 November 2013. The Committee has noted that this is a **sub-study of BE251/11.**

The conditions have now been met and the study is given full ethics approval and may begin as from 28 February 2014.

This approval is valid for one year from **28 February 2014.** To ensure uninterrupted approval of this study beyond the approval expiry date, an application for recertification must be submitted to BREC on the appropriate BREC form 2-3 months before the expiry date.

Any amendments to this study, unless urgently required to ensure safety of participants, must be approved by BREC prior to implementation.

Your acceptance of this approval denotes your compliance with South African National Research Ethics Guidelines (2004), South African National Good Clinical Practice Guidelines (2006) (if applicable) and with UKZN BREC ethics requirements as contained in the UKZN BREC Terms of Reference and Standard Operating Procedures, all available at http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx.

BREC is registered with the South African National Health Research Ethics Council (REC-290408-009). BREC has US Office for Human Research Protections (OHRP) Federal-wide Assurance (FWA 678).

The sub-committee's decision will be **RATIFIED** by a full Committee at its next meeting taking place on **08 April 2014.**

We wish you well with this study. We would appreciate receiving copies of all publications arising out of this study.

Yours sincerely

Professor D.R Wassenaar
Chair: Biomedical Research Ethics Committee

cc: Supervisor: Ramklasss@ukzn.ac.za

APPENDIX B: INFORMED CONSENT LETTER

CONSENT DOCUMENT
Consent to Participate in Research
Good-day
I, Mr Nivash Rugbeer am a biokineticist and masters students in the College of Health Sciences at the University of Kwazulu-Natal. I am doing research on persons living in old aged homes. This study will be conducted at five old aged homes within a 20-30km radius of the Ethekwini CBD. A 60-80 minute structured group exercise programme will be conducted 2X or 3Xweek for 3 months amongst 20 participants who are 60 years and older. You will first be examined by a doctor to assess if you are suitable to participate. Exercise prescription will include warm-up, endurance, mobility/ balance training, resistance, and cool-down. Assessments of your health status, nutrition, anthropometrical measurements and cardiovascular measures will be conducted before the start of the exercise programme and at the end, after 3 months.

Participation is entirely voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time.
Every effort will be made to keep personal information confidential. Your responses will be coded and all personal identifiers will be removed. Personal information may be disclosed if required by law.
You have been informed about the study by Mr Nivash Rugbeer. You may contact Mr Nivash Rugbeer on 0845020440 or **Dr Serela Ramklass on 0312604123 / 0826548936** at any time if you have questions about the research or if you are injured as a result of the research.

You may contact the **Biomedical Research Ethics Office** on **031-260 4769 or 260 1074** or Email BREC@ukzn.ac.za if you have questions about your rights as a research participant.
If you agree to participate, you will be given a signed copy of this document and the participant information sheet which is a written summary of the research.

The research study, including the above information, has been described to me orally. I understand what my involvement in the study means and I voluntarily agree to participate. I have been given an opportunity to ask any questions that I might have about participation in the study.

_____ _____
Signature of Participant **Date**

_____ _____
Signature of Witness **Date**

_____ _____
Signature of translator (Where applicable) **Date**

MEDICAL HISTORY QUESTIONNAIRE

Explain "Yes" answers on second page		Y	N			Y	N
1	Has a doctor even denied or restricted your participation in sports for any reason?	☐	☐	17	Have you ever used an inhaler or taken asthma medicine?	☐	☐
2	Do you have an ongoing medical condition (like diabetes or asthma)?	☐	☐	18	Were you born without or are you missing a kidney, an eye, a testicle, or any other organ?	☐	☐
3	Are you currently taking any prescription or non-prescription (over-the-counter) medicines or pills?	☐	☐	19	Have you had infectious mononucleosis (mono) within the last month?	☐	☐
4	Do you have allergies to medicines, pollens, foods, or stinging insects?	☐	☐	20	Do you have any rashes, pressure sores, or other skin problems?	☐	☐
5	Have you ever passed out or nearly passed out DURING exercise?	☐	☐	21	Have you had a herpes skin infection?	☐	☐
6	Have you ever passed out or nearly passed out AFTER exercise?	☐	☐	22	Have you ever had a head injury or concussion?	☐	☐
7	Have you ever had discomfort, pain, or pressure in your chest during exercise?	☐	☐	23	Have you been hit in the head or been confused or lost your memory?	☐	☐
8	Does your heart race or skip beats during exercise?	☐	☐	24	Have you ever had a seizure?	☐	☐
9	Has a doctor ever told you that you have (check all that applies)? ☐ High Blood pressure ☐ High Cholesterol ☐ A heart murmur ☐ A heart infection	☐	☐	25	Do you have headaches with exercise?	☐	☐
10	Has a doctor ever ordered a test for your heart?(for e.g. ECG)	☐	☐	26	Have you ever had numbness, tingling, or weakness in your arms or legs after being hit or falling?	☐	☐
11	Has anyone in your family died for no apparent reason?	☐	☐	27	Have you ever been unable to move your arms or legs after being hit or falling?	☐	☐
12	Does anyone in your family have a heart problem?	☐	☐	28	When exercising in the heat do you have severe muscle cramps or become ill?	☐	☐
13	Has any family member or relative died of heart problems or of sudden death before age 50?	☐	☐	29	Has a doctor told you that you or someone in your family has sickle trait or sickle cell disease?	☐	☐
14	Does anyone in your family have Marfan's syndrome?	☐	☐	30	Have you had any problems with your eyes or vision?	☐	☐
15	Have you ever spent the night in a hospital?	☐	☐	31	Do you wear glasses or contact lenses?	☐	☐
16	Have you ever had surgery?	☐	☐	32	Do you wear protective eyewear,		

				such as goggles or a face shield?	☐ ☐
33	Are you happy with your weight?	☐ ☐	40	Do you cough, wheeze or have difficulty breathing while you exercise?	☐ ☐
34	Are you trying to gain or lose weight?	☐ ☐	41	Is there anyone in your family who has asthma?	☐ ☐
35	Has anyone recommended you change your weight or eating habits?	☐ ☐	42	Do you limit or carefully control what you eat?	☐ ☐
36	Have you ever had a stress fracture?	☐ ☐	43	Do you have any concerns that you would like to discuss with a doctor?	☐ ☐
37	Have you been told that you have or have you had an x-ray for atlantoaxial (neck) joint?	☐ ☐	44	FEMALES ONLY Have you ever had a menstrual period?	☐ ☐
38	Do you regularly use a brace or assistive device?	☐ ☐	45	How old were you when you had your first menstrual period?	☐ ☐
39	Has a doctor ever told you that you have asthma or allergies?	☐ ☐	46	How many periods have you had in the last year?	☐ ☐

Explain "Yes" answers from previous page here:

_____

_____

_____

_____

_____

List all *previous injuries* and *approximate dates*. Check N/A if not applicable

N/A ☐	Previous Injury	Date:
N/A ☐	Shoulder/elbow (dislocation, rotator cuff, AC separation)	Date:
N/A ☐	Arm/wrist/Hand (fractures)	Date:
N/A ☐	Neck(burners, pinched nerve)	Date:
N/A ☐	Ribs/Abdomen	Date:
N/A ☐	Low back pain (herniated disc)	Date:
N/A ☐	Leg (Quadriceps, hamstring pain)	Date:
N/A ☐	Knee (Ligament, meniscus, patella)	Date:
N/A ☐	Lower leg (shin splints, calf strain)	Date:
N/A ☐	Ankle/calf/foot (sprain, Archilles)	Date:
N/A ☐	Stress Fractures	Date:
N/A ☐	Concussions	Date:
	If "yes" have you ever been knocked out (unconscious)	Yes ☐ No ☐
	How many times?_____	
	How long were you unconscious?_____	

	Have you ever lost your memory?	Yes ☐ No ☐
	How many times?_____	
	Did you have problems in the days afterward (confusion, headache, concentration?)	Yes ☐ No ☐
	How long did it take you to recover?_____	
	Are you still having problems?	Yes ☐ No ☐
	Do you have any unhealed or chronic injuries? Please list: _____ _____ _____	

I hereby state that, to the best of my knowledge, my answers to the above questions are complete and correct.
Signature of participant _____Date_____

2.2 DOCTOR'S REPORT – INDICATE RESPONSE WITH A CROSS

Subject is eligible for participation on exercise program	
Subject is not eligible for participation on exercise program	
Date	
Signature	
Name in full	

APPENDIX D: PHYSICAL ACTIVITY READINESS QUESTIONNAIRE (PAR-Q)

PHYSICAL ACTIVITY READINESS QUESTIONNAIRE (PAR-Q)

ANSWER YES OR NO TO THE QUESTION IF IT APPLIES TO YOU.
IF YES, PLEASE EXPLAIN

		YES	NO	EXPLAIN
1.	Has your doctor ever said you have heart trouble?			
2.	Do you frequently have pains in your heart and chest?			
3.	Do you often feel faint or have spells of severe dizziness?			
4.	Has a doctor ever said your blood pressure was too high?			
5.	Has your doctor ever told you that you have a bone or joint problem(s), such as arthritis that has been aggravated by exercise, or might be made worse with exercise?			
6.	Is there a good physical reason, not mentioned here, why you should not follow an activity program even if you wanted to?			
7.	Do you suffer from any problems with your lower back, i.e. chronic pain or numbness?			
8.	Are you currently taking any medications? If yes, please specify.			
9.	Do you have disability or a communicable disease? Specify			

APPENDIX E: ADMINISTRATION DATA COLLECTION SHEET

ADMININISTARTION

1. STUDY ID

1.1 AREA	
1.2 NAME OF FACILITY	
1.3 ADDRESS	
1.4 TELEPHONE NUMBER	
1.5 NAME OF RESEARCHER	
1.6 DATE OF INTERVIEW	
1.7 TIME OF INTERVIEW	

2. DEMOGRAPHICAL INFORMATION

CIRCLE APPROPRIATE RESPONSE

2.1 DATE OF BIRTH(DD/MM/YEAR)	
2.2 AGE	
2.3 GENDER	1=MALE 2=FEMALE
2.4 RACE	1=AFRICAN 2=WHITE 3=COLOURED 4=INDIAN
2.5 MARITAL STATUS	1=MARRIED 2=WIDOWED 3=DIVORCED 4=NEVER MARRIED

APPENDIX F: DATA COLLECTION SHEET PRIOR EACH EXERCISE SESSION

DATA RECORDING SHEET: DATA COLLECTED PRIOR TO EACH EXERCISE SESSION

STUDY ID: _____

GENDER: ____

AGE: ____

NAME OF AGED CARE FACILITY: _____

DATE OF BIRTH (DD/MM/YEAR):_____

DATE	SESSION NUMBER	MEDICATION	RESTING HEART RATE(BPM) BEFORE EXERCISE	RESTINGBLOOD PRESSURE(MM HG) BEFORE EXERCISE	RESTING HEART RATE(BPM) AFTER EXERCISE	RESTING BLOOD PRESSURE (MMHG) AFTER EXERCISE

EXERCISE PRESCRIPTION

Phase 1: Weeks 1-4 (Frequency: Group A – 3X/week; Group B – 2X/week)

ACTIVITY	REPS	SETS	RESISTANCE	INTENSITY (RPE)
Warm Up & Stretch				
• Forward Walk & Turn	2 min			1-2
• Semi Tandem Walk (Stride Balance)	2 min			1-2
• Tandem Walk (Heel-toe)	2 min			1-2
• Circle Walking	2 min			1-2
• Sit to Stand	10	1		1-2
• Double Side Arm Raise (seated)	10	1		1-2
• Neck Flexion (seated)	10	1		1-2
• Neck Rotation (seated)	10	1		1-2
• Ankle – 4 way (seated)	10	1		1-2
Endurance – 2.5 minutes/station				
• Weaving (Station 1)				1-2
• Step Up and Over (Station 2)				1-2
• Shuttle Walk (Station 3)				1-2
• High Knees/Butt Kicks (Station 4)				1-2
Resistance Circuit				
• Ball Squat	10	1	Body Weight	1-2
• Wall Push up	10	1	Body Weight	1-2
• Hip Extension	10	1	Theraband (Yellow/Red)	1-2
• Seated Bicep Curl	10	1	1-2 kg	1-2
• Calf Raises	10	1	Body Weight	1-2
• Seated Tricep Extension	10	1	1-2 kg	1-2
• Seated Lateral Shoulder Raises	10	1	Theraband (Yellow/Red)	1-2
• Seated Arm/Leg March	10	1	No Weight	1-2
• Seated Rowing	10	1	Theraband (Yellow/Red)	1-2
• Seated Abdominal Crunches	10	1	Theraband (Yellow/Red)	1-2
Cool Down & Stretch				
• Forward Walk/March	2 min			1-2
• Neck/Shoulder/Chest	15 sec	2		1-2
• Seated Rhomboid	15 sec	2		1-2
• Seated Tricep	15 sec	2		1-2
• Lats/Oblique	15 sec	2		1-2
• Hamstring	15 sec	2		1-2
• Gastrocnemius	15 sec	2		1-2

Phase 2: Weeks 5-8 (Frequency: Group A – 3X/week; Group B – 2X/week)

ACTIVITY	REPS	SETS	RESISTANCE	INTENSITY (RPE)
Warm Up & Stretch				
• Forward Walk & Turn	2 min			3-4
• Semi Tandem Walk (Stride Balance)	2 min			3-4
• Tandem Walk (Heel-toe)	2 min			3-4
• Circle Walking	2 min			3-4
• Sit to Stand	10	2		3-4
• Double Side Arm Raise (seated)	10	2		3-4
• Neck Flexion (seated)	10	2		3-4
• Neck Rotation (seated)	10	2		3-4
• Ankle – 4 way (seated)	10	2		3-4
Endurance – 3.5 minutes/station				
• Weaving (Station 1)				3-4
• Step Up and Over (Station 2)				3-4
• Shuttle Walk (Station 3)				3-4
• High Knees/Butt Kicks (Station 4)				3-4
Resistance Circuit				
• Ball Squat	10	2	Body Weight	3-4
• Wall Push up	10	2	Body Weight	3-4
• Hip Extension	10	2	Theraband (Green/Blue)	3-4
• Seated Bicep Curl	10	2	3-4 kg	3-4
• Calf Raises	10	2	Body Weight	3-4
• Seated Tricep Extension	10	2	3-4 kg	3-4
• Seated Lateral Shoulder Raises	10	2	Theraband (Green/Blue)	3-4
• Seated Arm/Leg March	10	2	No Weight	3-4
• Seated Rowing	10	2	Theraband (Green/Blue)	3-4
• Seated Abdominal Crunches	10	2	Theraband (Green/Blue)	3-4
Cool Down & Stretch				
• Forward Walk/March	2 min			3-4
• Neck/Shoulder/Chest	15 sec	2		3-4
• Seated Rhomboid	15 sec	2		3-4
• Seated Tricep	15 sec	2		3-4
• Lats/Oblique	15 sec	2		3-4
• Hamstring and Gastrocnemius	15 sec	2		3-4

Phase 3: Weeks 9-12 (Frequency: Group A – 3X/week; Group B – 2X/week)

ACTIVITY	REPS	SETS	RESISTANCE	INTENSITY (RPE)
Warm Up & Stretch				
• Forward Walk & Turn	2 min			5-6
• Semi Tandem Walk (Stride Balance)	2 min			5-6
• Tandem Walk (Heel-toe)	2 min			5-6
• Circle Walking	2 min			5-6
• Sit to Stand	10	2		5-6
• Double Side Arm Raise (seated)	10	2		5-6
• Neck Flexion (seated)	10	2		5-6
• Neck Rotation (seated)	10	2		5-6
• Ankle – 4 way (seated)	10	2		5-6
Endurance – 5 minutes/station				
• Weaving (Station 1)				5-6
• Step Up and Over (Station 2)				5-6
• Shuttle Walk (Station 3)				5-6
• High Knees/Butt Kicks (Station 4)				5-6
Resistance Circuit				
• Ball Squat	10	2	Body Weight	5-6
• Wall Push up	10	2	Body Weight	5-6
• Hip Extension	10	2	Theraband (Green/Blue)	5-6
• Seated Bicep Curl	10	2	3-4 kg	5-6
• Calf Raises	10	2	Body Weight	5-6
• Seated Tricep Extension	10	2	3-4 kg	5-6
• Seated Lateral Shoulder Raises	10	2	Theraband (Green/Blue)	5-6
• Seated Arm/Leg March	10	2	No Weight	5-6
• Seated Rowing	10	2	Theraband (Green/Blue)	5-6
• Seated Abdominal Crunches	10	2	Theraband (Green/Blue)	5-6
Cool Down & Stretch				
• Forward Walk/March	2 min			5-6
• Neck/Shoulder/Chest	15 sec	2		5-6
• Seated Rhomboid	15 sec	2		5-6
• Seated Tricep	15 sec	2		5-6
• Lats/Oblique	15 sec	2		5-6
• Hamstring	15 sec	2		5-6
• Gastrocnemius	15 sec	2		5-6

Warm-Up Exercises

Exercise Program For: Date:2013/02/07
Warm-up Page:1

Sit to stand

- Begin by sitting on the front half of a chair, feet shoulder width apart.
- Stand up with a straight back to full upright position.
- Sit back down.
- Repeat.

Perform 1 set of 10 Repetitions, M,W,F.

Ankle 4 way

- Sit with good posture, one leg straight out.
- Move foot up (toward shin), then down (pointing toes).
- Move foot to left, then to right.
- Repeat 5x.
- Perform 5x with other leg out.

Perform 1 set of 10 Repetitions, M,W,F.

Walking

- Walk around a circle at a comfortable pace.
- Maintain good posture.
- Walk for 1 min..

Perform 1 set of 1 Minute, M,W,F.

Neck forward bend

- Sit with good posture, back supported, head facing forward.
- Move chin down to chest.
- Return to start position.
- Repeat.

Special Instructions:

Move in painfree range.

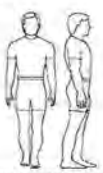
Perform 1 set of 10 Repetitions, M,W,F.

Double side arm raise

- Sit with good posture, arms at side, palms forward.
- Lift arms out and upward above head as shown.
- Return to start position.

Perform 1 set of 10 Repetitions, M,W,F.

Standing stride balance



- Stand with good posture, feet in contact with heel of left foot in line with big toe of right.
- Step forward with heel of right foot in line with bog toe of left, keeping feet in contact.
- Walk for 1 min.
- .

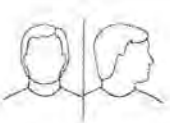
Perform 1 set of 1 Minute, M,W,F.

Heel toe walk

- Begin by standing as shown (left foot in front, in line with right, heel and toe in contact).
- Step forward with right foot, placing it in line with left foot.
- Continue to step, placing left foot in front of right.
- Repeat sequence for 1 min..

Perform 1 set of 1 Minute, M,W,F.

Neck twist



- Sit with good posture, back supported, head facing forward.
- Turn head to right, return to start.
- Turn head to left, return to start
- Repeat.

Special Instructions:

Stay in painfree range.

Perform 1 set of 10 Repetitions, M,W,F.

Endurance Exercises

Exercise 1 – Weaving between cones

- Participants weave between 6 cones set approximately 1 meter apart.
- Participants continue to weave until they are requested to stop.

Exercise 2 – Step up and over

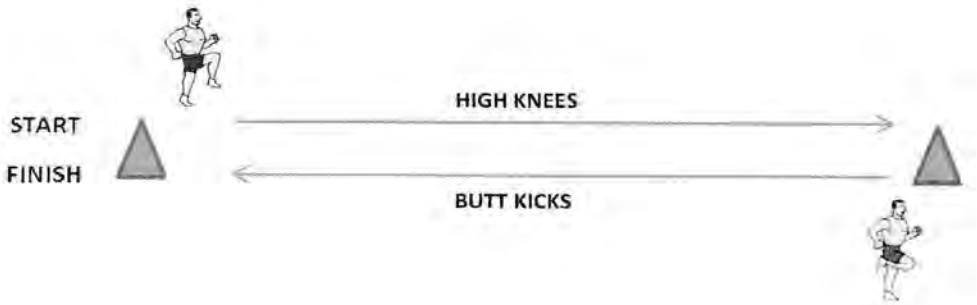
- Participants step up and over 5 aerobic steps whilst walking. The aerobic steps are placed 1 meter apart. The start is designated by a cone, placed 1 metre before the first step.

Exercise 3 – Shuttle walk

- 6 cones are placed 1 meter apart. Cone 1 is the start (designated by a different colour). Participants are instructed to walk to cone 2 and return to the start, then to cone 3 and return to the start, then to cone 4 and return to the start, then to cone 5 and return to the start and finally cone 6 and back to the start. This sequence is continued until the participant is requested to stop.

Exercise 4 – High knees/butt kicks

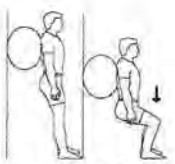
- Two cones are placed approximately 6 meters apart. Participants proceed to cone 2 whilst performing high knees and return to cone 1 performing butt kicks. This sequence is continued until the participant is requested to stop.



Resistance Exercises

Exercise Program For: Date:2013/02/08
Resistance exercises (weeks 1- 4) Page:1

Ball 90 wall slide



- Place ball between back and wall, feet shoulder width apart.
- Slowly bend knees to 60-90 degrees.
- Keep knees behind line of toes during bend.
- Return to standing position.
- Repeat.

Special Instructions:

Maintain proper low back posture.

Perform 1 set of 10 Repetitions, M,W,F.

Use Ball.

Elastic thigh extend

- Stand with good posture alongside a wall.
- Use the wall for balance and support.
- Attach elastic to secure object at knee level in front.
- Loop elastic around thigh just above knee.
- Stand, facing toward the pull.
- Extend leg backward, keeping knee straight.
- Return to start position and repeat.

Special Instructions:

Keep knee slightly bent on leg that you are standing on.

Perform 1 set of 10 Repetitions, M,W,F.

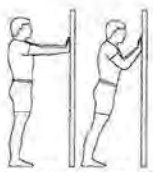
Use yellow/red Elastic.

Double heel raise

- Stand with good posture, using chair for balance.
- Raise up on toes, through full range.
- Return to start position and repeat.

Perform 1 set of 10 Repetitions, M,W,F.

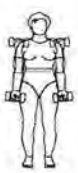
Wall push up



- Stand facing wall, 30-45 cm away, feet shoulder width apart.
- Place hands slightly wider than shoulder width on wall at shoulder height.
- Slowly bend elbows, bringing face and chest to wall.
- Push back up to start position and repeat.

Perform 1 set of 10 Repetitions, M,W,F.

Double DB biceps curl



- Sit with good posture.
- Begin with arms at side, elbows straight, palms up, weights in hand.
- Bend elbows upward.
- Return to starting position.

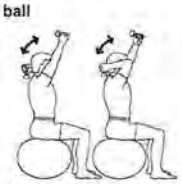
Special Instructions:

Keep elbows close to sides through entire movement.

Perform 1 set of 10 Repetitions, M,W,F.

Use 1-2 Kilograms.

DB Triceps lift on ball



- Sit on chair with good posture, back supported, weights in hands.
- Raise arms as shown, with elbows bent.
- Straighten one elbow, return to start.
- Straighten other elbow, return to start.
- Alternate arms.

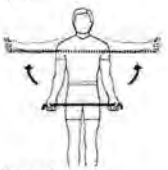
Special Instructions:

Maintain proper low back position.

Perform 1 set of 10 Repetitions, M,W,F.

Use 1-2 Kilograms.

Tubing double arm raise



- Sit forward on chair with good posture.
- Begin with arms at side, elbows straight, holding elastic which is beneath thighs, palms forward.
- Raise arms upward, out to side to shoulder height.
- Return to starting position.

Perform 1 set of 10 Repetitions, M,W,F.

Use yellow/red Elastic.

Close elbow rows

- Sit with good posture.
- Secure elastic at waist level.
- Hold elastic in hands with arms extended.
- Pull back, bending elbows and squeezing shoulder blades together, keeping elbows close to sides.
- Return to start position and repeat.

Perform 1 set of 10 Repetitions, M,W,F.

Use yellow/red Elastic.

Supine marching arm salute

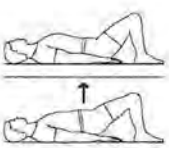
- Lie on back with knees bent, low back in neutral.
- Tighten abdominal muscles.
- Raise left leg and right arm off floor as shown.
- Return to start position.
- Repeat with right leg and left arm.

Special Instructions:

Maintain neutral spine without twisting or rotating hips. Move in smooth and controlled movements.

Perform 1 set of 10 Repetitions, M,W,F.

Bridging



- Lie on back with knees bent.
- Tighten abdominal muscles.
- Lift buttocks off floor, maintaining neutral spine.
- Return to start position.

Special Instructions:

Maintain neutral spine.

Perform 1 set of 10 Repetitions, M,W,F.

Cool Down Exercises

Exercise Program For: Date:2013/02/0E
Cool down stretches Page:1

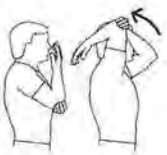
Rhomboid stretch

- Sit with good posture, back supported.
- Bring left arm across in front of body as shown.
- Hold elbow with right arm.
- Gently pull across chest until a stretch is felt in the back of shoulder.
- Repeat with other arm

Perform 1 set of 1 Repetition, M,W,F.

Hold exercise for 15 Seconds.

Triceps stretch



- Sit with good posture, back supported.
- Lift arms overhead.
- Bend elbow of one arm.
- With other arm, slowly push down on ebow, keeping elbow bent
- Repeat with other arm.

Perform 1 set of 1 Repetition, M,W,F.

Hold exercise for 15 Seconds.

Plexus stretch

- Stand with good posture, left arm on wall, hand backward as shown, feet shoulder width apart.
- Slowly turn body outward until as stretch is felt across chest.
- Slowly turn neck to right until a stretch is felt down the front of arm.
- Repeat on other side.

Perform 1 set of 1 Repetition, M,W,F.

Hold exercise for 15 Seconds.

Sidebend stretch

- Stand with good posture, feet shoulder width apart.
- Raise right arm overhead behind head, holding with left arm.
- Bend knees slightly to provide better balance.
- Pull arm as you bend trunk to left.
- Repeat with other side.

Perform 1 set of 1 Repetition, M,W,F.

Hold exercise for 15 Seconds.

Bent 90 ham stretch

- Stand in front of table with feet shoulder width apart.
- Place hands on table.
- Bend at hips and tighten the muscles in fronts of thighs, keeping the knees straight.
- Keep low back straight.

Perform 1 set of 2 Repetitions, M,W,F.

Hold exercise for 15 Seconds.

Runner stretch

- Stand facing wall, hands on wall, elbows straight.
- Step forward with foot of one leg, bending knee and leaning hips toward wall.
- Keep rear leg straight with heel on floor.
- Keep feet facing forward.
- Repeat on other side.

Perform 1 set of 1 Repetition, M,W,F.

Hold exercise for 15 Seconds.

APPENDIX H: ANTHROPOMETRICAL ASSESSMENT SHEET

DATA RECORDING SHEET – ANTHROPOMETRICAL ASSESSMENT

Name of Participant: _____

Sex: ____

Age: ____

Name of Aged Care Facility: _____

Anthropometrical Measurements

		Before Intervention	**After Intervention**
1	*Height (m)*		
2	Weight (kg)		
3	*BMI (kg/m^2)*		
4	Waist Circumference (cm)		
5	Hip Circumference (cm)		
6	*Waist to hip ratio*		
7	Skinfold body composition		
7.1	*Triceps (mm)*		
7.2	Pectorals (mm)		
7.3	*Midaxilla (mm)*		
7.4	Subscapula (mm)		
7.5	*Abdomen (mm)*		
7.6	Suprailiac (mm)		
7.7	Quadricep (mm)		
8	Sum of skinfold		

APPENDIX I: MINI NUTRITIONAL ASSESSMENT QUESTIONNAIRE (MNA)

MINI NUTRITIONAL ASSESSMENT

Complete the screen by filling in the boxes with the appropriate numbers.
Add the numbers for the screen. If score is 11 or less, continue with the assessment to gain a Malnutrition Indicator Score.

SCREENING

A. Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?
0 = severe loss of appetite
1 = moderate loss of appetite
2 = no loss of appetite ☐

B. Weight loss during the last 3 months
0 = weight loss greater than 3 kg (6.6 lbs)
1 = does not know
2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
3 = no weight loss ☐

C. Mobility
0 = bed or chair bound
1 = able to get out of bed/chair but does not go out
2 = goes out ☐

D. Has suffered psychological stress or acute disease in the past 3 months
0 = yes 2 = no ☐

E. Neuropsychological problems
0 = severe dementia or depression
1 = mild dementia
2 = no psychological problems ☐

F. Body Mass Index (BMI) (weight in kg) / (height in m2)
0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater ☐

Screening score (subtotal max. 14 points) ☐
12 points or greater Normal – not at risk – no need to complete assessment
11 points or below Possible malnutrition – continue assessment

ASSESSMENT

G. Lives independently (not in a nursing home or hospital)
0 = no 1 = yes ☐

H. Takes more than 3 prescription drugs per day
0 = yes 1 = no ☐

I. Pressure sores or skin ulcers
0 = yes 1 = no ☐

J. How many full meals does the patient eat daily?
0 = 1 meal
1 = 2 meals ☐

2 = 3 meals

K. Selected consumption markers for protein intake
• At least one serving of dairy products
(milk, cheese, yogurt) per day yes ☐ no ☐
• Two or more servings of legumes
or eggs per week yes ☐ no ☐

• Meat, fish or poultry every day yes ☐ no ☐
0.0 = if 0 or 1 yes
0.5 = if 2 yes
1.0 = if 3 yes ☐.☐

L. Consumes two or more servings
of fruits or vegetables per day?
0 = no 1 = yes ☐

M. How much fluid (water, juice, coffee, tea, milk...) is consumed per day?
0.0 = less than 3 cups
0.5 = 3 to 5 cups
1.0 = more than 5 cups ☐.☐

N. Mode of feeding
0 = unable to eat without assistance
1 = self-fed with some difficulty
2 = self-fed without any problem ☐

O. Self view of nutritional status
0 = views self as being malnourished
1 = is uncertain of nutritional state
2 = views self as having no nutritional problem ☐

P. In comparison with other people of the same age,
how does the patient consider his/her health status?
0.0 = not as good
0.5 = does not know
1.0 = as good
2.0 = better ☐.☐

Q Mid-arm circumference (MAC) in cm
0.0 = MAC less than 21
0.5 = MAC 21 to 22
1.0 = MAC 22 or greater ☐.☐

R Calf circumference (CC) in cm
0 = CC less than 31 1 = CC 31 or greater ☐

Assessment (max. 16 points) ☐☐.☐

Screening score ☐☐

Total Assessment (max. 30 points).

APPENDIX J: SHORT FORM HEALTH SURVEY (SF-36)

SF-36 QUESTIONNAIRE – HEALTH STATUS
ANSWER THE 36 QUESTIONS OF THE HEALTH SURVEY COMPLETELY, HONESTLY, AND WITHOUT INTERRUPTIONS

1.GENERAL HEALTH

1.1 In general, would you say your health is:

Excellent		Very good		good		fair		poor	

1.2 Compared to a year ago, how would you rate your health in general now?

Much better now than one year ago	
Somewhat better now than one year ago	
About the same	
Somewhat worse now than one year ago	
Much worse than one year ago	

2. LIMITATIONS OF ACTIVITIES
The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Activity	Yes, limited a lot	Yes, limited a little	No, not limited at all
2.1	Vigorous activities such as running, lifting heavy objects, participating in strenuous sports			
2.2	Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling or playing golf?			
2.3	Lifting or carrying groceries			
2.4	Climbing several flights of stairs			
2.5	Climbing one flight of stairs			
2.6	Bending, kneeling or stooping			
2.7	Walking more than a kilometer			
2.8	Walking several blocks			
2.9	Walking one block			
2.10	Bathing or dressing yourself			

3. PHYSICAL HEALTH PROBLMS

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

		YES	NO
3.1	Cut down on the amount of time you spent on work or other activities		
3.2	Accomplished less than you would like		
3.3	Were limited in the kind of work or other activities		
3.4	Had difficulty performing the work or other activities (for example, it took extra effort)		

4. EMOTIONAL HEALTH PROBLEMS

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

		YES	NO
4.1	Cut down on the amount of time you spent on work or other activities		
4.2	Accomplished less than you would like		
4.3	Didn't do work or other activities as carefully as usual		

5. SOCIAL ACTIVITIES

Emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?

	Not at all		Slightly		Moderately		Severe		Very severe

6. PAIN

6.1 How much bodily pain have you had during the past 4 weeks?

	None		Very mild		Mild		Moderate		Severe		Very severe

6.2 During the past 4 weeks how much did pain interfere with your normal work (including both work outside the house and housework)?

	Not at all		A little bit		Moderately		Quite a bit		Extremely

7. ENERGY AND EMOTIONS

These questions are about how you feel and how things have been with you during the last 4 weeks. For each question, please give the answer that comes closest to the way you have been feeling

		All the time	Most of the time	A good bit of the time	Some of the time	A little bit of the time	None of the time
7.1	Do you feel full of pep?						
7.2	Have you been a very nervous person?						
7.3	Have you felt so down in the dumps that nothing could cheer you up?						
7.4	Have you felt calm and peaceful?						
7.5	Did you have a lot of energy?						
7.6	Have you felt						

	downhearted and blue?						
7.7	Did you feel worn out?						
7.8	Have you been a happy person?						
7.9	Did you feel tired?						

8. SOCIAL ACTIVITIES

During the past 4 weeks how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc)?

	All of the time		Most of the time		Some of the time		A little bit of the time		None of the time

9. GENERAL HEALTH

How true or false is each of the following statements for you?

		Definitely true	Mostly true	Don't know	Mostly false	Definitely false
9.1	I seem to get sick a little easier than other people					
9.2	I am as healthy as anybody I know					
9.3	I expect my health to get worse					
9.4	My health is excellent					

APPENDIX K: BORG RATING OF PERCEIVED EXERTION SCALE

Borg Rating of Perceived Exertion Scale

6	NO EXERTION AT ALL
7	EXTREMELY LIGHT
8	
9	VERY LIGHT
10	
11	LIGHT
12	
13	SOMEWHAT HARD
14	
15	HARD
16	
17	VERY HARD
18	
19	EXTREMELY HARD
20	MAXIMAL EXERTION