

**THE IMPACT OF A PHYSICAL ACTIVITY INTERVENTION PROGRAMME ON  
FRAILTY SYNDROME IN ELDERLY CITIZENS IN MASERU DISTRICT,  
LESOTHO**

by

**Karabelo Mpeko**

**2006028480**

**Dissertation submitted in fulfilment of the requirements for the degree  
Master of Arts in Human Movement Sciences**

**Department of Exercise and Sport Sciences**

**School of Allied Health Professions**

**Faculty of Health Sciences**

**University of the Free State**

**Supervisor: Dr M.C. Opperman**

***(Department of Exercise and Sport Sciences, University of the Free State)***

**Co- supervisor: Prof. C. Walsh**

***(Department of Nutrition and Dietetics, University of the Free State)***

**January 2018**

## DEDICATION

---

### *In Memoriam:*



**Nthabiseng Gertrude Mpeko (18 October 1955 – 23 April 2014)**

*This study is dedicated to my late mother, Nthabiseng Gertrude Mpeko. Mom, I am immortalising you through this project.*

*Thank you for inspiring and modelling academic excellence to me. I am amazed at how much of you, is coming out in me. Thank you for always, always believing in me, sparing no expense and supporting every venture I took. When I sat terrified as a first-year student in the Mabaleng Auditorium on my first day of orientation, ready to quit and switch programs you said, “Just give it a chance.” 11 Years and 2 degrees later, look where we are now! I know you had huge dreams for me, but I know you are now cheering me on from heaven.*

## FOREWORD

---

Surprisingly, the part that I thought would be the easiest to write is proving a little challenging. After pouring 3 years of my life into this project, I hardly have the words to begin to summarise the experience or to voice my thanks to the people who have made this dream possible. Nevertheless, this is the part I am enjoying the most because I do not need to reference it, these are my words! As a writer, this is the sweetest moment. After writing about 150 pages of what other people think, it's refreshing to write my own thoughts.

I can only begin to thank the Alpha and Omega, the Almighty God who calls the things that are not as though they were. Lord, You conceived this project before it was ever an idea in my mind. You foresaw, preordained and predetermined the outcome before I typed the first word. You have been my confidence through every step because I knew that You are faithful to finish what You begin. You have done it again!

To my supervisor, Dr Marlene Opperman. If I should list all that the things I am thankful for that you have done for me throughout this study, it would be another dissertation altogether. Thank you for imparting your knowledge of Biokinetics and research. Thank you for stretching me and never allowing me to be substandard. Thank you for coaxing the potential in me and pushing where you knew I could be better. Above all, thank you for pouring your life into this project. I know it cost you your life as much as it cost me mine, thank you for never skimping out on the bill! I am immensely indebted to you for who I have become as a professional and researcher.

To my co-supervisor, Prof Corrina Walsh and my 'co-researcher' Rose Turkson. Thank you for inviting us to become part of a project you had already worked so hard and tirelessly for. Prof Walsh, thank you for intervening when it seemed that this project would end before it truly began. Thank you for your inputs and always being ready to help when needed. I would not be here without your contribution to my study. Rose, I will always be encouraged by your fight and your resilience. Thank you for opening your home to me. It was a privilege to meet your now late husband (George Turkson) and your lovely daughter (Favour Turkson). I am sad he will not be there to share in the success he stood so firmly by you for. For surviving the insurmountable odds to realise your dream... you are proof of God's strength in our weaknesses.

To our field assistants (Lineo Motsieloa, Liteboho Moeketsi, Mpho Sefong and Caza Motseko). I was grossly unprepared for the research field I was about to walk into. Without

you, this study would have been humanly impossible to run. May God bless the seed you have sown into our lives and our lives' work.

To my family and friends. Thank you for your constant support throughout the years of this study. Thank you for understanding when I could not visit or hang out because I had to work. Your unwavering faith in me is unmatched. Thank you for sharing me, encouraging me and believing in me. This is for you as much as it is for me.

To my UFS family and friends, thank you for the words of encouragement and the vote of confidence! Thank you, to the UFS postgraduate school for providing the support and funding that financed this study. God sent you just in time! Thank you, Prof Derik Coetzee, for your leadership of the Department of Exercise and Sport Science. Thank you for the tremendous support throughout this project and offering me the platform to grow and develop as a Biokineticist and researcher. Chrisna Francisco, thank you for being the voice of reason when it seemed chaos was overtaking my thoughts! Thank you for always steadying the boat with words of advice and giving me direction.

To my statistician, Riette Nel. Thank you for the tremendous effort of analysing the raw data and making sense of it. Thank you for always helping to clarify the results whenever I had a query.

To my language editor, Dr Luna Berg, thank you for refining my work.

Elmarie Robberts, thank you for adding the cosmetic make-over that made my study presentable. Thank you both, for your expertise.

To the Basotho people of Maseru, Lesotho who took part in this study. Thank you for sharing the wisdom of your years with us during this study. Ke lebohela mofutho oo le re amohetseng ka ona, le ho re dummella ho re re ithute ka lona le ho lona. Mosebetsi ona o phethahetse ka lebaka la lona. Ke leboha ho menahane.

## DECLARATION

---

I, Karabelo Mpeko (student number: 2006028480), am registered for a Masters' degree in the Department of Exercise and Sport Sciences, in the Faculty Health Sciences at the University of the Free State, Bloemfontein campus.

**Title of the project:** *The impact of a physical activity intervention programme on frailty syndrome in elderly citizens in Maseru district, Lesotho.*

I acknowledge the following:

- That plagiarism is the use of someone else's work without their consent and/or without acknowledgment of the original source of information
- That plagiarism is wrong.
- During the completion of this project I followed the required conventions on referencing others' thoughts and ideas
- I understand that the University of the Free State can establish disciplinary action against me if the belief is that it is not my own independent work or if I failed to acknowledge others' ideas or writings.

**With this I declare the following:**

- I declare that the work presented for the above-mentioned project is my own work, except where else mentioned.
- I declare that this work has not been used before by me or someone else with the aim to achieve credits or a qualification.
- I declare that I am well-known with the Department's assessment guidelines, rules and regulations.



---

The Author

2018/01/25  
Date

## SUMMARY

---

**Keywords:** ageing, chronic diseases, physical activity, frailty, cardiovascular endurance, muscle strength, flexibility, balance, speed and agility

**Introduction:** The global elderly population is increasing at an unexpected rate, the majority of which will reside in developing nations. Geriatric diseases such as frailty syndrome are difficult to differentiate from normal ageing. Scientific research into geriatric diseases such as frailty syndrome and the potential impact of interventions, could enable governments (especially those in developing nations) to prepare adequate infrastructure.

**Objectives:** The following objectives were investigated: cardiovascular fitness (6-minute walk test); upper body strength (arm curl- and handgrip test); lower body strength (chair stand test); flexibility (modified sit and reach test); balance, speed and agility (8-foot up and go test).

**Methods:** Participant recruitment followed a cross-sectional quantitative design. A pre-test – post-test control group design was used to implement and evaluate whether the physical activity intervention (approximately 12 weeks) could improve frailty.

Baseline testing was performed on 3 groups. Milk group [n=36 (milk intervention only)], both group [n=37 (milk and physical activity intervention)] and control group [n=35 (no intervention)]. A multicomponent physical activity programme was conducted 3 times a week, at low to moderate intensity, for 45 – 60 minutes. Descriptive statistics (namely, medians and percentiles for continuous data and frequencies and percentages for categorical data) were calculated per group. The change from baseline to post intervention, was also calculated per group. The groups were compared (inter-group) by means of 95% confidence intervals.

**Results:** An inter-group comparison between the groups from baseline to post intervention (95% CI for percentage difference) revealed a statistically significant difference ( $p \leq 0.05$ ) in the lower body muscle strength of the 'both' group compared to the milk group and control group respectively. These results indicate that the physical activity intervention could have benefited the participants more than if they had no intervention or if they had the milk only intervention. It is only in the chair stand that the improvement in the "both" group was significant when compared to the milk and the control group, indicating that physical activity was a significant factor in the improvement. For upper body strength (arm curl), a statistically

significant difference ( $p \leq 0.05$ ) was found in the “both” group when compared to the control group. Since no statistically significant difference was found between the milk and the control group or between the milk and the both group, it is conceivable that the combination of the interventions (milk and physical activity) was more effective for improvement than no intervention at all or either intervention implemented in isolation. In the handgrip, a statistically significant difference ( $p \leq 0.05$ ) was found when comparing the milk group to the control group as well as in the “both” group compared to the control group. The significant improvement in the intervention groups (milk and both) compared to the control likely means a combination of the interventions (milk and physical activity) improves upper body strength more than no intervention or the respective interventions in isolation.

The inter-group comparison (95% confidence interval for the percentage difference) from baseline to post intervention showed no statistically significant differences between the groups for cardiovascular endurance, flexibility, balance, speed and agility.

Although frailty status did not improve in the group receiving the milk and physical activity, improvement was observed in all the other variables contributing to the functional performance of the frail elderly.

**Conclusion:** The physical activity intervention did not improve frailty status. Since under-nutrition can also contribute to the development of sarcopenia; it is conceivable that if frailty was due to malnutrition more than sedentary lifestyle, a nutritional intervention can make a more significant contribution to frailty status than physical activity (such as is suspected in this study). Selecting a frailty scale sensitive enough to measure improvements in a physical activity intervention (a tool possibly lacking in this study) is essential.

Improvement was seen in the functional outcomes investigated, which contribute to the performance of ADLs and quality of life in the elderly. It is notable that of all the fitness components investigated, only muscle strength showed a statistically significant improvement. This is of particular importance as sarcopenia has been identified as a major problem in frailty and muscle strength is crucial in the fight against sarcopenia. Physical activity interventions are more effective in addressing the sedentary lifestyle factor - which is a contributor towards frailty. Once initiated, they can help target sarcopenia, slow gait speed and diminished endurance.

## TABLE OF CONTENTS

---

### CHAPTER ONE: PROBLEM STATEMENT AND AIM OF THE STUDY

---

1.1	INTRODUCTION.....	1
1.2	PROBLEM STATEMENT.....	1
1.2.1	Lesotho health status in context.....	3
1.3	RESEARCH QUESTION.....	4
1.4	OBJECTIVE.....	4
1.5	STRUCTURE OF DISSERTATION.....	4

---

### CHAPTER 2: THE IMPACT OF PHYSICAL ACTIVITY ON FRAILTY SYNDROME

---

2.1	INTRODUCTION.....	6
2.2	THE AGEING PROCESS.....	7
2.2.1	Concepts of physical activity and exercise.....	9
2.2.2	Effects of exercise on ageing.....	9
2.3	FRAILTY.....	13
2.3.1	The frailty syndrome.....	13
2.3.2	The frailty trajectory.....	15
2.3.3	Measuring frailty syndrome.....	16
2.3.4	Socio-demographics of frailty.....	17
2.3.4.1	<i>Gender</i> .....	17
2.3.4.2	<i>Marital status</i> .....	18
2.3.4.3	<i>Education</i> .....	18
2.3.5	Frailty in developing countries.....	19
2.3.6	Functional limitations/disability and frailty.....	20
2.3.7	The effect of physical activity on morbidity, mortality and disability.....	23
2.4	THE EFFECT OF PHYSICAL ACTIVITY ON FRAILTY.....	26
2.4.1	Summary of frailty interventions.....	28
2.5	CHRONIC DISEASES.....	31
2.5.1	Comorbidity.....	37
2.5.2	The effect of physical activity on comorbidity.....	38
2.5.3	Multimorbidity.....	39
2.5.4	The effect of physical activity on multimorbidity.....	41
2.5.5	Cardiovascular disease (CVD).....	41



2.5.6	The effect of physical activity on cardiovascular diseases (CVD) ..	42
2.5.7	Chronic respiratory disease (CRD).....	43
2.5.8	Effect of physical activity on chronic respiratory diseases (COPD)	44
2.5.9	Musculoskeletal related chronic diseases .....	45
2.5.9.1	<i>Osteoarthritis (OA)</i> .....	45
2.5.9.2	<i>Effect of physical activity on osteoarthritis (OA)</i> .....	46
2.5.9.3	<i>Balance, speed and agility</i> .....	47
2.5.9.4	<i>The effect of physical activity on balance, speed and agility</i> .....	48
2.5.10	Sarcopenia .....	50
2.5.10.1	<i>The effect of physical activity (strength training) on sarcopenia</i> ....	52
2.6	FLEXIBILITY .....	53
2.6.1	The effect of physical activity on flexibility.....	53
2.7	CONCLUSION.....	53

---

### CHAPTER 3: METHODS AND PROCEDURES

---

3.1	INTRODUCTION .....	54
3.2	RESEARCH DESIGN.....	55
3.2.1	Selection of participants .....	56
3.2.1.1	<i>Recruitment of participants</i> .....	56
3.2.1.2	<i>Selection criteria</i> .....	56
3.2.1.3	<i>Inclusion criteria</i> .....	57
3.2.1.4	<i>Exclusion criteria</i> .....	57
3.3	SELECTION INSTRUMENT .....	57
3.3.1	Socio-demographic information.....	57
3.3.2	Nutritional status .....	57
3.3.3	Frailty index scale .....	58
3.3.4	Informed consent .....	58
3.4	PRE-TEST AND POST-TEST PROCEDURES, MEASUREMENTS AND EQUIPMENT .....	58
3.4.1	Special considerations for exercise testing in frail elders .....	59
3.4.2	Endurance testing .....	60
3.4.2.1	<i>Scoring</i> .....	60
3.4.2.2	<i>Validity and reliability</i> .....	61
3.4.3	Muscular strength testing (upper body) .....	61
3.4.3.1	<i>Scoring</i> .....	62
3.4.3.2	<i>Validity and reliability</i> .....	62

3.4.4	The arm curl test.....	63
3.4.4.1	Scoring.....	64
3.4.4.2	Validity and reliability.....	64
3.4.5	Muscle strength testing (lower body).....	64
3.4.5.1	Scoring.....	65
3.4.5.2	Validity and reliability.....	65
3.4.6	Flexibility testing .....	66
3.4.6.1	Scoring.....	67
3.4.6.2	Validity and reliability.....	67
3.4.7	Balance, speed and agility testing .....	68
3.4.7.1	Scoring.....	69
3.4.7.2	Validity and reliability.....	69
3.5	<b>DESIGN AND IMPLEMENTATION OF THE PHYSICAL ACTIVITY INTERVENTION.....</b>	<b>69</b>
3.5.1	Physical activity intervention .....	70
3.5.2	Evaluation of the physical activity intervention .....	71
3.6	<b>PILOT STUDY.....</b>	<b>72</b>
3.7	<b>STATISTICAL ANALYSIS .....</b>	<b>72</b>

---

## CHAPTER 4: RESULTS AND DISCUSSION

---

4.1	<b>INTRODUCTION .....</b>	<b>73</b>
4.2	<b>SOCIO-DEMOGRAPHIC DATA .....</b>	<b>74</b>
4.2.1	Total participation.....	74
4.2.2	Age.....	75
4.2.3	Ethnicity .....	75
4.2.4	Gender .....	76
4.2.5	Marital status.....	77
4.2.6	Employment status and education.....	78
4.2.7	Body mass index (BMI).....	80
4.3	<b>BASELINE AND POST INTERVENTION RESULTS: IMPACT OF THE PHYSICAL ACTIVITY INTERVENTION .....</b>	<b>83</b>
4.3.1	6-minute walk.....	83
4.3.2	Chair stand.....	87
4.3.3	Arm curl.....	90
4.3.4	Handgrip.....	93
4.3.5	Modified sit and reach .....	97

4.3.6	8-Foot up and go.....	99
4.3.7	Frailty status .....	102
4.4	<b>SUMMARY OF THE FINDINGS OF THE IMPACT OF PHYSICAL ACTIVITY (BOTH GROUP VIZ MILK AND PHYSICAL ACTIVITY INTERVENTION) ON THE VARIOUS VARIABLES .....</b>	<b>104</b>
4.4.1	BMI .....	105
4.4.2	6-minute walk.....	105
4.4.3	Chair stand.....	106
4.4.4	Arm curl.....	106
4.4.5	Handgrip.....	107
4.4.6	Modified sit and reach .....	107
4.4.7	8-foot up and go.....	108
4.4.8	Frailty status .....	108

---

## CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

---

5.1	INTRODUCTION .....	109
5.2	OVERVIEW OF THE STUDY .....	109
5.3	CONCLUSIONS .....	110
5.4	LIMITATIONS OF THE STUDY AND RECOMMENDATIONS FOR FUTURE RESEARCH .....	112
5.5	RESEARCHER'S NOTE AND IMPACT OF THE STUDY.....	113
	REFERENCES .....	116

### LIST OF APPENDICES:

- Appendix A – Ethics approval letter
- Appendix B – Sociodemographic data collection form
- Appendix C – Miniature Nutritional Assessment form (MNA)
- Appendix D – Frailty Scale
- Appendix E – Study information (English)
- Appendix F – Study information (Sesotho)
- Appendix G – Consent form (English)
- Appendix H – Consent form (Sesotho)
- Appendix I – Physical activity data collection form
- Appendix J – Plagiarism Report
- Appendix K – Gallery

## LIST OF ABBREVIATIONS

---

<b>AAHPERD</b>	<b>American alliance for health, physical education, recreation and dance</b>
<b>ACSM</b>	<b>American College of Sports Medicine</b>
<b>ADLs</b>	<b>Activities of daily living</b>
<b>AHA</b>	<b>American heart association</b>
<b>AIDS</b>	<b>Acquired immunodeficiency syndrome</b>
<b>AMA</b>	<b>American medical association</b>
<b>BMD</b>	<b>Bone mineral density</b>
<b>BMI</b>	<b>Body mass index</b>
<b>CAD</b>	<b>Coronary artery disease</b>
<b>CI</b>	<b>Confidence Interval</b>
<b>CM</b>	<b>Cardio metabolic disease</b>
<b>COPD</b>	<b>Chronic obstructive pulmonary disease</b>
<b>CRD</b>	<b>Chronic respiratory disease</b>
<b>CVD</b>	<b>Cardiovascular disease</b>
<b>DALYs</b>	<b>Disability adjusted life years</b>
<b>DVD</b>	<b>Digital video disc</b>
<b>FICSIT</b>	<b>Falls and injuries: cooperative studies in intervention techniques</b>
<b>FITT</b>	<b>Frequency, intensity, time &amp; type</b>
<b>FM</b>	<b>Fat mass</b>
<b>FSQ</b>	<b>Functional status questionnaire</b>
<b>GBD</b>	<b>Global burden of disease</b>
<b>GoL</b>	<b>Government of Lesotho</b>
<b>GP</b>	<b>General practitioner</b>
<b>HDL</b>	<b>High density lipoprotein</b>
<b>HIV</b>	<b>Human immunodeficiency virus</b>
<b>HRR</b>	<b>Heart rate reserve</b>
<b>kg</b>	<b>Kilograms</b>
<b>LDL</b>	<b>Low density lipoprotein</b>
<b>LIFE-P</b>	<b>Lifestyle interventions and independence for elders – pilot</b>
<b>m</b>	<b>Meters</b>
<b>max</b>	<b>Maximum</b>
<b>MET</b>	<b>Metabolic equivalent</b>
<b>MFGM</b>	<b>Milk fat globule membrane supplementation</b>

<b>MOT</b>	<b>Mechanical orthopaedic disease</b>
<b>MNA</b>	<b>Miniature nutritional assessment</b>
<b>Mini</b>	<b>Miniature</b>
<b>NSDP</b>	<b>National strategic Development plan</b>
<b>OA</b>	<b>Osteoarthritis</b>
<b>PA</b>	<b>Physical activity</b>
<b>PASE</b>	<b>Physical activity scale for the elderly</b>
<b>PG</b>	<b>Psycho geriatric disease</b>
<b>PhD</b>	<b>Doctor of philosophy</b>
<b>PPT</b>	<b>Physical performance test</b>
<b>ROM</b>	<b>Range of motion</b>
<b>reps</b>	<b>Repetitions</b>
<b>sec</b>	<b>Seconds</b>
<b>TFM</b>	<b>Total fat mass</b>
<b>TUG</b>	<b>Timed up and go (test)</b>
<b>UFS</b>	<b>University of the Free State</b>
<b>UN</b>	<b>United nations</b>
<b>UNAIDS</b>	<b>Joint United Nations programme on HIV/AIDS</b>
<b>UNDP</b>	<b>United nations development program</b>
<b>US</b>	<b>United states</b>
<b>VO<sub>2</sub></b>	<b>Volume (of) oxygen</b>
<b>WBV</b>	<b>Whole body vibration</b>
<b>WHO</b>	<b>World health organisation</b>
<b>WHO</b>	<b>SAGE – World Health Organisation: Strategic Advisory Group of Experts</b>
<b>Yrs</b>	<b>Years</b>

## LIST OF FIGURES

---

Figure 1.1	Structure of the dissertation.....	5
Figure 2.1	Benefits of regular physical activity and or exercise.....	10
Figure 2.2	Benefits of regular physical activity and or exercise in older adults.....	10
Figure 2.3	The Frailty Trajectory .....	15
Figure 2.4	A model of the disablement process .....	22
Figure 2.5	Theoretical relation between musculoskeletal fitness and independent living across a person’s lifespan .....	25
Figure 2.6	Leading contributors to the burden of disease in people aged 60 years and older in 2010. DALYs (million) by cause and World Bank income DALYs (disability adjusted life years) .....	33
Figure 2.7	Relationship between dementia and age dependency .....	34
Figure 2.8	Relationship between education levels and dementia.....	34
Figure 2.9	Prevalence of stroke (A) and other diseases (B).....	35
Figure 2.10	Relationship between age and obesity & diabetes .....	35
Figure 2.11	Relationship between cardio-metabolic disease & education in urban vs rural areas .....	36
Figure 2.12	Prevalence of multimorbidity patterns by gender and age groups.....	40
Figure 2.13	Overlapping of multimorbidity patterns in men and women....	41
Figure 2.14	The vicious cycle of inactivity and symptoms .....	44
Figure 2.15	A model of the functional consequences of age-related sarcopenia and the positive feedback loop by which the result of reduced physical activity further exacerbates progression of the disorder .....	51
Figure 3.1	Distribution of duties.....	55
Figure 3.2	6-minute walk test .....	60
Figure 3.3	Handgrip test .....	62
Figure 3.4	Arm curl test .....	63
Figure 3.5	Chair stand test .....	65
Figure 3.6	Modified sit and reach test .....	66
Figure 3.7	8-foot up and go test .....	68
Figure 4.1	Gender.....	77
Figure 4.2	Marital status .....	78
Figure 4.3	Education.....	80



## LIST OF TABLES

---

Table 1.1	Variables investigated in the physical activity intervention on frailty syndrome in elderly citizens in Maseru district, Lesotho .....	04
Table 2.1	Physiological Changes of Ageing Modifiable by Exercise .....	11
Table 2.2	Summary of frailty interventions .....	28
Table 3.1	Recommendations for exercise testing .....	59
Table 3.2	Handgrip test male and female test scoring .....	62
Table 3.3	Arm curl male scoring .....	64
Table 3.4	Arm curl female scoring .....	64
Table 3.5	Chair stand male scoring .....	65
Table 3.6	Chair stand female scoring .....	65
Table 3.7	Modified sit and reach test male scoring .....	67
Table 3.8	Modifies sit and reach female .....	67
Table 3.9	8-foot up and go male scoring .....	69
Table 3.10	8-foot up and go female scoring .....	69
Table 3.11	Recommendations for exercise programming (Physical activity intervention) .....	70
Table 3.12	Physical activity session .....	71
Table 4.1	Total number of participants (baseline and post-intervention)	75
Table 4.2	Age .....	75
Table 4.3	Ethnicity .....	75
Table 4.4	Gender .....	76
Table 4.5	Marital status .....	77
Table 4.6	Educational level .....	79
Table 4.7	Employment status .....	79
Table 4.8	BMI continuous data at baseline and post intervention .....	81
Table 4.9	6-minute walk continuous data at baseline and post intervention .....	84
Table 4.10	6-minute walk categorical data at baseline and post intervention .....	85
Table 4.11	Chair stand continuous data at baseline and post intervention	87
Table 4.12	Chair stand categorical data at baseline and post intervention	88
Table 4.13	Arm curl continuous data at baseline and post intervention ...	90



<b>Table 4.14</b>	<b>Arm curl categorical data at baseline and post intervention....</b>	<b>91</b>
<b>Table 4.15</b>	<b>Handgrip continuous data at baseline and post intervention ..</b>	<b>94</b>
<b>Table 4.16</b>	<b>Handgrip categorical data at baseline and post intervention...</b>	<b>95</b>
<b>Table 4.17</b>	<b>Modified sit and reach continuous data at baseline and post intervention.....</b>	<b>97</b>
<b>Table 4.18</b>	<b>Modified sit and reach categorical data at baseline and post intervention.....</b>	<b>98</b>
<b>Table 4.19</b>	<b>8-foot up and go continuous data at baseline and post intervention.....</b>	<b>100</b>
<b>Table 4.20</b>	<b>8-foot up and go categorical data at baseline and post intervention.....</b>	<b>101</b>
<b>Table 4.21</b>	<b>Frailty status categorical data at baseline and post intervention.....</b>	<b>103</b>
<b>Table 4.22</b>	<b>Summary of the findings (categorical) of the both group (milk and physical activity) .....</b>	<b>105</b>

## CHAPTER 1

### PROBLEM STATEMENT AND AIM OF THE STUDY

---

#### 1.1 INTRODUCTION

The global population of the elderly is increasing at an unprecedented rate, with the United Nations (UN) reporting that the number of people aged over 65 years is expected to increase from 524 million in 2010 to 1.5 billion by the year 2050. To put this in perspective, this figure means the number of people over 65 years of age will have more than tripled since 2010 (WHO:2011).

It is evident that the rate at which the elderly population is increasing will have a direct impact on the population dynamics, economies and health systems globally and as such requires attention from different sectors of governments. The American Medical Association (AMA) already noted in 1990 that one of the most important tasks facing future medical care would be preparing adequate infrastructure and resources to care for the increasing elderly population (Fried *et al.*, 2004:255).

#### 1.2 PROBLEM STATEMENT

Nguyen *et al.* (2015:941), stated that in 2010, about two thirds of the world's population aged 60 years and older lived in developed countries. In a nation like Lesotho that is facing developmental challenges including chronic poverty, food insecurity and high rates of malnutrition, the problem of the increasing elderly population, coupled with an unemployment rate of 28.7% places added strain on an already high dependency ratio of 68:100. This means that for every 100 persons aged 15-59 years, there are 68 persons aged 0-14 years and over 60 years of age who are dependent on the working people to survive; 28.7% of which are not even employed. When you factor in that the number of food-insecure people in Lesotho jumped by 15.2% from 463 936 to 534 502 (a large portion of which is the elderly) and a multifactorial problem presents itself facing the elderly population as well as the government of Lesotho (United Nations Development Programme UNDP 2014; Lesotho Vulnerability Assessment Committee 2016:15).

Advancements in modern medicine continue to allow people to live longer. Conversely, as people age, an inevitable physiological cascade begins that is synonymous with chronological ageing. The ACSM (2018:188) notes that individuals age differently and at a

different pace. Consequently, differentiating between the effects of ageing and the effects of deconditioning and disease becomes nearly impossible to do. Some of the physiological parameters linked to age-related declines are a decreased maximum heart rate, increased resting and exercise blood pressure, decreased  $VO_2$  max, slower reaction time and decreased muscle strength and flexibility. Ageing is also associated with the development of certain non-communicable diseases/chronic diseases e.g. cardiovascular diseases (such as heart attacks and strokes), cancer, chronic respiratory diseases and diabetes; which increase health costs and the need for the use of medical facilities in the elderly - which has both an economical and medical impact. In Lesotho's ageing population, the burden of disease is further confounded by the Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) pandemic that is ravaging throughout the world. In Lesotho, the prevalence for this disease is 23.7%, the third highest in the world. The number of orphans who have lost 1 or both parents was 150 000, the responsibility of which will fall on living grandparents as is traditional in African families (Joint UN programme on HIV/AIDS (UNAIDS), 2013).

Frailty has also been identified as a geriatric disease common with but not consistent with ageing. Gobbens *et al.* (2010:175), remarked that there is currently no 'golden standard' for the definition of frailty. In their review of the literature on frailty, Chen *et al.* (2014:434), noted that frailty is "conceptually defined as a clinically recognizable state of older adults with increased vulnerability, resulting from age-associated declines in physiologic reserve and function across multiple system organs such that the ability to cope with everyday acute stressors is compromised". The ACSM (2016:130) defined frailty as "a complex interplay between ageing, physical and cognitive functioning, chronic disease, and in many cases habitual physical inactivity". Etman *et al.* (2012:1116), described frailty as a geriatric syndrome resulting from reduced functional reserve capacity of multiple organs that is initiated by either disease, stress, the natural physiologic changes of ageing, inadequate nutritional intake or physical inactivity. The ACSM (2016:130), further noted that frailty predisposes the elderly affected by it to increased risk of falls, disability, cognitive decline, hospitalization and loss of independence. The exact etiology of frailty is difficult to pinpoint due to its proximity to the physiological deterioration that occurs with ageing. There is belief, however, that multiple physiological factors are involved in the pathogenesis of frailty. Chronic inflammatory states, immune deficiencies, declining testosterone and growth hormone levels are some of the few. Sarcopenia resulting from poor nutrition and/or physical inactivity has especially been singled out as a contributing factor in the development of frailty syndrome. This possibly makes nutrition and physical activity important interventions against frailty.

Congruently, Fiatorone *et al.* (1994:1769), concluded that of all the potential factors that contribute to frailty such as chronic illness, sedentary lifestyle and the decline in health resulting from ageing itself, only skeletal muscle disuse and under-nutrition are potentially reversible and preventable. De Labra *et al.* (2015:166), also added that physical activity has been shown to protect against diverse components of frailty syndrome by increasing balance and mobility, reducing falls, institutionalization, hospitalization and mortality; resulting in an improved quality of life. The ACSM (2016:131), recognises a multicomponent programme as effective in improving gait speed, reducing the risk of falling and improving functional performance in the frail elderly.

As indicated in the introduction, developing nations will bear the brunt of the increase in the elderly population. This includes the burden of geriatric diseases such as frailty syndrome. Consequently, research into frailty syndrome becomes a matter that requires urgent attention in developing nations for future planning.

### **1.2.1 Lesotho health status in context**

In the document of Lesotho's Vision 2020, the Government of Lesotho set itself goals to improve the health of the nation. It stated the following: "By the year 2020 Basotho shall be a healthy nation with a well-developed human resource base. The country will have a good quality health system with facilities and infrastructure accessible and affordable to all Basotho, irrespective of income, disabilities, geographical location and wealth. Health personnel will provide quality health service and patient care. All Basotho will be conscious of healthy lifestyles and will engage in sporting and recreational activities." (National Vision Document 2020:5).

The National Strategic Development (NSDP) Plan 2012/2013-2016/2017 (GoL 2012:154), addresses various national issues including the challenges faced by the health system and the issue of the elderly population of Lesotho and has set out to reduce their vulnerability and improve access to services through various steps.

Despite these goals, the latest Human Development Index has shown that Lesotho is ranked 158 out of 186 (UNDP, 2014). With more than half the population living below the poverty line, the level of poverty has reached endemic proportions in recent years and is a cause of chronic food insecurity in the country. This makes the elderly population of Lesotho susceptible to conditions such as frailty.

### 1.3 RESEARCH QUESTION

The research question that was addressed in this study was the following:

- i. What is the impact of a physical activity intervention programme on frailty syndrome in elderly citizens in Maseru district, Lesotho?

### 1.4 OBJECTIVE

Considering the research question posed above, the aim of the study was to investigate the impact that a physical activity intervention might have on variables associated with frailty syndrome in elderly in Maseru district, Lesotho.

The aim of the study was divided into sub-divisions, namely:

- i. To investigate the impact of physical activity intervention on cardiovascular fitness i.e. the 6-minute walk in elderly citizens in Maseru district, Lesotho.
- ii. To explore the impact of physical activity intervention on lower and upper body strength i.e. chair stand test, the arm curl test and handgrip test in elderly citizens in Maseru district, Lesotho.
- iii. To investigate the impact of physical activity intervention on flexibility i.e. modified sit and reach test in elderly citizens in Maseru district, Lesotho.
- iv. To explore the impact of physical activity intervention on balance, speed and agility i.e. 8-foot up and go test in elderly citizens in Maseru district, Lesotho.

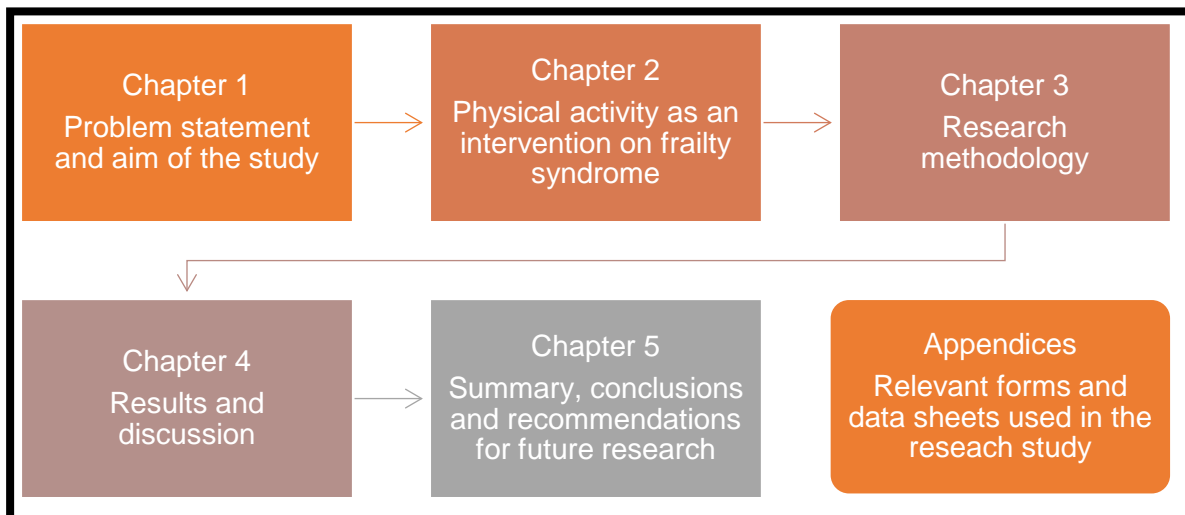
**Table 1.1: Variables investigated in the physical activity intervention on frailty syndrome in elderly citizens in Maseru district, Lesotho**

Variables associated with frailty syndrome	
Variable	Test
Cardiovascular endurance	6-minute walk
Lower and upper body strength	Chair stand, arm curl and handgrip
Balance, speed, agility	8-foot up and go
Flexibility	Modified sit and reach

### 1.5 STRUCTURE OF DISSERTATION

Four chapters will follow the current introduction as illustrated in Figure 1.1 below. They comprise a review of the applicable current literature (cf. Chapter 2), a chapter on testing procedures and the intervention strategy (cf. Chapter 3), one containing the results and discussion of results (cf. Chapter 4), and a conclusion with the recommendations for future

research (cf. Chapter 5). A complete bibliography of all the chapters will follow after chapter 5. Referencing will adhere to the regulations and conventions of the Department of Exercise and Sport Sciences at the University of the Free State, which uses the Harvard referencing method (Van der Walt 2006:1).



**Figure 1.1: Structure of the dissertation**

## CHAPTER 2

### THE IMPACT OF PHYSICAL ACTIVITY ON FRAILTY SYNDROME

---

#### 2.1 INTRODUCTION

As people age, the body undergoes a series of changes. Vulnerability resulting from ageing is common to the ageing process stemming from the accumulation of impairments to the physiological systems of the human body. To that extent, a measure of functional decline is inextricably linked to the ageing process (Bergman *et al.*, 2007:732). Fulop *et al.* (2010:549) and Bürkle *et al.* (2015:2) stated that ageing can be functionally defined as “a decrease in the physiological reserves, while still supporting acceptable functioning in the steady state, cannot adapt to any additional physiological stress.” As such, ageing can be viewed as: a dynamic process associated with progressive homeostatic/homeo-dynamic dysregulation. This dysregulation results in the organism becoming less able to cope with disturbances to homeostasis until it becomes non-resilient.

When referring to ageing people, terms such as old, elderly and frailty are often used interchangeably, but they have different meanings. The term ‘frail’ is often used to describe a variety of concepts related to the ageing process. It is, however, a distinct condition not to be confused with comorbidity or disability and certainly not a term to describe ‘really old people’ (Lang *et al.*, 2009:540). It is therefore important to distinguish the terms related to ageing. The following is an elucidation of some of the core terms related to ageing.

#### **Older Adults**

Bandeem-Roche *et al.* (2015:1427) and Fried *et al.* (2001:M146), categorised older adults as adults aged 65 years and older, while Cesari *et al.* (2014:1), and Collard *et al.* (2012:1487), categorised the older adults as being 60 years and older. According to the ACSM (2018:188), older adults are individuals aged  $\geq 65$  years.

#### **Elderly**

Vermeulen *et al.* (2011:1-11) and Boulos *et al.* (2016:139), categorised the elderly as adults aged 65 years and older while Son *et al.* (2015:413), considered the elderly as adults aged 60 years and older. Lahousse *et al.* (2014:420), even included participants of 55 years and older in a study of frailty in the Dutch elderly.

It is evident that there is great variability from researchers regarding the age categories. Since the term elderly is used to describe an individual more advanced in years than an

older adult, for the purposes of this study, the following chronological age progression terminology will be used: the term older adult will refer to adults between 60 – 65 years of age and the term elderly will refer to adults  $\geq 65$  years.

### **Frail**

Frailty is a syndrome and not necessarily a marker of age. It commonly associated with increased vulnerability and inability to recover from external stressors (Dent *et al.*, 2016:3). Statistically, frailty can start at varying ages but is significantly prevalent in the ages  $>85$  years and older (Clegg *et al.*, 2013:756).

### **Physical disability**

Disability is defined as “difficulty or dependency in carrying out activities essential to independent living, including essential roles, tasks needed for self-care and living independently in a home and desired activities important to one’s quality of life” (Fried *et al.*, 2004:255) and (Abizanda *et al.*, 2014:622). The role of frailty in advancing disability was emphasized by Gale *et al.* (2015:162). Physical disability is most often diagnosed from subjective testing but there are objective tests as well. It is most often tested through observation of ability to carry out activities of daily living (ADLs). Fried *et al.* (2004:255), also noted that physical disability and frailty overlap because of the risk factors for physical ability that arise from certain age-related diseases and comorbidities such as muscle weakness and sarcopenia – which, in turn, can lead to decreased exercise intolerance and frailty.

Now that the terms related to ageing have been distinguished, the ageing process can be discussed in further detail.

## **2.2 THE AGEING PROCESS**

It is important to distinguish between chronological age and biological age since persons of the same chronological age can have vast differences in their biological manifestations of ageing. Chronological age refers to the number of years an individual has been alive while biological age is the measure of the impact of your chronological age on your biological/physiological systems. Biological age is a functional determinant often compared to the functionality of peers of the same chronological age (De Labra *et al.*, 2015:155). Fulop *et al.* (2010:549) believe chronological ageing can briefly estimate a person’s expected vulnerability to adverse outcomes. Beyond that, they may become frail at a younger age (e.g. age 70) or at a more advanced age e.g. age 90. There are many assumptions around



the ageing process, many of which are negative and paint a picture of hopelessness around the elderly. While disability is common with ageing, the elderly should not be painted as a homogenous group (Bürkle *et al.*, 2015:2). This creates an outlook on the ageing and the elderly as one of loss and declining functional abilities. Focus should rather shift toward determining the capacity for autonomy, independence and maximizing the person's strengths (Markle-Reid & Browne., 2003:64).

Successful ageing has roots that go back as far as Plato (Kahana *et al.*, 2014:466). Physical activity has been attributed towards 'successful ageing'. It has been shown to have an impact on longevity, chronic disease as well as functional and cognitive disability (Savelle *et al.*, 2010:1171-1172). De Labra *et al.* (2015:166), added that physical activity has also been shown to protect against diverse components of frailty syndrome by increasing balance and mobility, reducing falls, institutionalization, hospitalization and mortality; resulting in an improved quality of life. Collard *et al.* (2012:1487), contended that not everyone can achieve successful ageing. Cosco *et al.* (2014:373), however, stated that the idea of successful ageing was an aim to view ageing as a positive occurrence rather than an accumulation of deficits. This is a paradigm shift away from viewing ageing as an existing sickly state of disease and more toward a state of decreased functionality at risk of developing disease and disability. Successful ageing is about more than survival, but an assertion towards mastery of function in the elderly across various constructs at social, cognitive and emotional levels.

Lang *et al.* (2009:541), have documented that people become less active as they age. One of the contributing factors is that as individuals age, the lactate threshold increases, which results in the older individual having to exercise at a greater percentage of their maximal capacity. As the elderly realise that the effort required to exercise is increased, it can lead to avoidance of exercise altogether. Although some research projects have shown a lack of adherence to physical activity programs (De Labra *et al.*, 2015:166); the work of Rejeski *et al.* (2009:462), from the LIFE-P study, dispelled doubts about whether the elderly can maintain an active lifestyle. Results from two years after the intervention was implemented in that study, have shown that physical activity interventions in the elderly can have a lasting impact which can sustain the benefits gained. This view was further advanced by Sun *et al.* (2010:1172-1173), who found that even in the face of fears of injury resulting from vigorous physical activity in the elderly, it has been shown that even moderate intensity physical activity is sufficient to produce health benefits in the elderly population.

### **2.2.1 Concepts of physical activity and exercise**

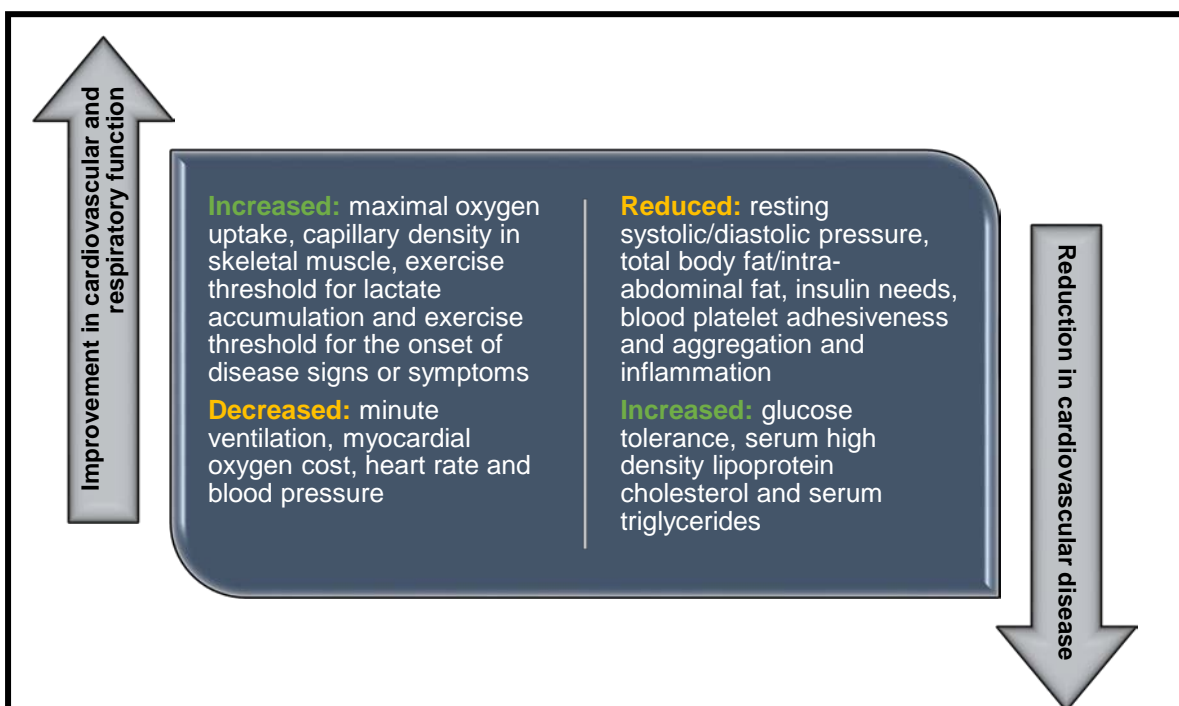
To effectively discuss the effects of physical interventions on ageing, it is necessary to define and distinguish between some of the common terms used. Keysor (2003:129-136), highlighted why this is important especially in research. Clearly defining and differentiating between exercise and physical activity is critical for future research. The terms are often used interchangeably but have different meanings (Cartee *et al.*, 2016:1034). Confusing the terms creates a challenge for the researcher trying to describe the variables involved in the study. Reviews of the literature often encounter this problem as different studies can define an activity such as walking as both exercise and as physical activity.

Physical activity has traditionally been defined as any bodily movement produced by contraction of skeletal muscle that substantially increases energy expenditure, ACSM (2018:1). Singh (2002:M262), noted that some of the exercises that are relevant for the ageing population may not necessarily fit this definition (e.g. balance training). Watz *et al.* (2014:1522), further explained that exercise is a subcategory of leisure time physical activity, in which structured planned repetitive bodily movements are performed with or without the explicit intent of improving one or more components of physical fitness. The ACSM (2018:1), defines physical fitness as “the ability to carry out daily tasks with vigour and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and meet unforeseen emergencies”. Fitness basically describes a set of attributes that contribute to the ability to perform physical activity. Physical fitness can further be broken down into health-related physical fitness components and skill-related physical fitness components according to the ACSM (2018:2). The health-related physical fitness components include: cardiorespiratory endurance, body composition, muscular strength, muscular endurance and flexibility. The skill related components include: agility, coordination, balance, power, reaction time and speed.

### **2.2.2 Effects of exercise on ageing**

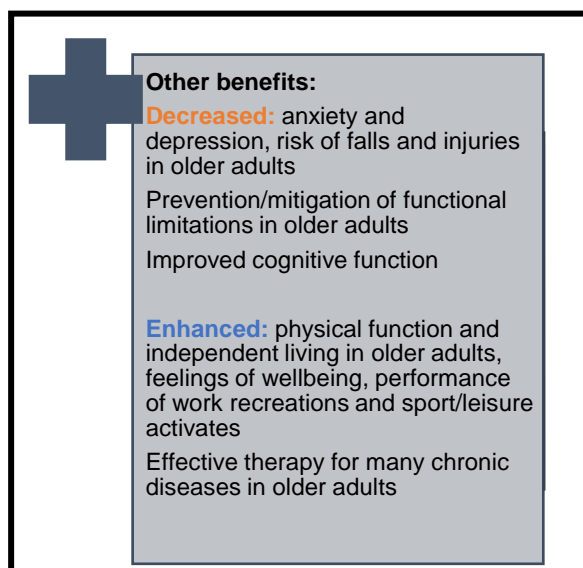
Physiologic/biologic ageing does not follow the exact path of chronological ageing. Thus, two older adults of the same chronological age can age quite differently biologically. The effects of ageing on the physiology of the ageing individual are often hard to differentiate from the effects of inactivity and morbidity (Collard *et al.*, 2012:187). This makes it challenging to accurately measure the elderly’s response to exercise. The ACSM (2018:193) and Sparling *et al.* (2015:350), stated that the current recommended targets for the elderly are a minimum of 150 minutes a week of moderate intensity and up to 300

minutes a week of vigorous intensity activity consisting of 10-minute bouts or more. For the elderly, accumulating the total activity limit in bouts is encouraged. Long periods of physical activity can seem unattainable to some individuals and inadvertently result in physical inactivity. The benefits of exercise in the elderly ( $\geq 65$  yrs.) are mainly in counteracting the effects of ageing. These benefits as listed by the ACSM (2018:9), include the following in Figure 2.1 below:



**Figure 2.1: Benefits of regular physical activity and or exercise (ACSM, 2018:9)**

The ACSM (2018:9), notes additional benefits of exercise which are particularly of great benefit in older adults as is illustrated in Figure 2.2 below:



**Figure 2.2: Benefits of regular physical activity and or exercise in older adults (ACSM, 2018:9)**

Singh (2002:M264), further noted the physiological changes brought about by ageing that are modifiable by exercise, which are put forward in Table 2.1 below:

**Table: 2.1: Physiological Changes of Ageing Modifiable by Exercise (Singh, 2002:M264)**

Physiological Parameter	Ageing/Disuse	Effect Physical Activity/Exercise Effect
<b>1. Exercise/Work Capacity</b>		
Maximal aerobic capacity	Decrease	Increase
Heart rate and blood pressure response to submaximal exercise	Increase	Decrease
Maximal heart rate	Decrease	No change
Tissue elasticity	Decrease	Increase
Muscle strength, power, endurance	Decrease	Increase
Motor coordination	Decrease	Increase
Neural reaction time	Decrease	Increase
Oxidative and glycolytic enzyme capacity, mitochondrial volume density	Decrease	Increase
Gait speed, step length, cadence, gait stability	Decrease	Increase
<b>2. Cardiovascular Function</b>		
Resting heart rate	No change	No change or decrease
Maximal cardiac output	Decrease	Increase*
Endothelial reactivity	Decrease	Increase
Maximal skeletal muscle blood flow	Decrease	Increase
Capillary density	Decrease	Increase
Arterial dispensability	Decrease	Increase
Vascular insulin sensitivity	Decrease	Increase
Plasma volume, hematocrit	No change, decrease	Increase
Impaired baroreflex function, postural hypotension in response to stress	Increase	Decrease
<b>3. Pulmonary Function</b>		
Vital capacity	Decrease	No change
Maximal flow rates	Decrease	No change, increase
<b>4. Nutritional Status</b>		
Resting metabolic rate	Decrease	No change, increase
Total energy expenditure	Decrease	Increase
Thermic effect of meals	Decrease, no change	Increase, no change
Total body water	Decrease	Increase
Total body potassium, nitrogen, calcium	Decrease	Increase
Protein synthesis rate, amino acid uptake into skeletal muscle, nitrogen retention, protein turnover		
Gastrointestinal transit time	Decrease	Increase

Appetite, energy intake	Decrease, no change	Increase, no change
<b>5. Metabolic, Miscellaneous</b>		
Glycogen storage capacity, glycogen synthase, GLUT-4 transporter protein content, and translocation to membrane	Decrease	Increase
Lipoprotein lipase activity	Decrease	Increase
Total cholesterol, LDL cholesterol	Increase	Decrease or no change
HDL cholesterol	Decrease or no change	Increase or no change
Hormonal and sympathetic nervous system response to stress	Increase	Decrease
Growth hormone, IGF-1	Decrease	Increase, no change
REM and slow wave sleep duration	Decrease	Increase
Heat and cold tolerance, temperature regulatory ability	Decrease	Increase
Cognitive processing speed, accuracy	Decrease	No change, increase
Attention span	Decrease	Increase
Memory	No change, decrease	No change
Glomerular filtration rate	Decrease	No change

**Notes:** LDL =low-density lipoprotein; HDL= high-density lipoprotein; IGF-1=insulin-like growth factor 1; REM=rapid eye movement. Aging/Disuse effects are not completely separable in most studies. Direction of effects represents a synthesis of the findings in a majority of the available observational and experimental data in each domain.

\*Due to changes in exercise-augmented cardiac contractility and stroke volume; observed only in endurance-trained men so far.

Table 2.1 above displays the physiological changes that exercise brings to the ageing body. The indicated benefits of exercise/physical activity further reinforce the argument for exercise prescription in both the elderly and the pre-frail elderly particularly (Ahmed *et al.* 2011:288-295). The frailty index by Rockwood and Mitnitski (2011:17-26), already acknowledges the coexistence of comorbidities with frailty syndrome. Exercise has a positive impact on some of these conditions as indicated in Table 2.1 e.g. hypertension (via increased capillary density and arterial dispensability), diabetes (via increased glycogen storage capacity) and obesity (via increased energy expenditure). Exercise causes an increase in high density lipoprotein (HDL, viz good cholesterol) and a decrease in low density lipoprotein (LDL, viz bad cholesterol) which is often a problem in hypercholesterolemia patients (increased LDL levels and decreased HDL levels). Van der Bij *et al.* (2002:121), concluded that it is therefore evident that the early initiation into habitual physical activity and the maintenance thereof, plays a critical role in the promotion of good health, the prevention of early onset of disease and the deceleration of existing disease. While ageing seems to make a notable contribution to frailty, it is also worth noting that not all elderly persons develop frailty. This brings into question the role of ageing in the

development of frailty as well as raising the need to better conceptualize frailty (Botz., 2002:285). Conceptualizing frailty can shine light on the heterogeneity of the functional decline in chronological ageing. According to Bergman *et al.* (2007:732), the ability to quantify frailty may allow future research, as well as the clinical applications thereof, to better understand the heterogeneous nature of ageing in every individual. Frailty shares many of its markers (sarcopenia, balance and gait disorders, increased inflammation) with ageing, making it nearly impossible to distinguish between where one begins and the other one ends. With ageing comes an accumulation of impairments in a variety of physiological systems resulting in the individual becoming increasingly vulnerable and less able to cope with stressors (Lang *et al.*, 2009:544). Distinguishing between where chronological ageing ends and frailty begins can become difficult if not impossible as they can be inextricably linked with one another (Bergman *et al.*, 2007:732).

## 2.3 FRAILITY

### 2.3.1 The frailty syndrome

According to the ACSM (2016:130), Gobbens *et al.* (2010:175) and Ginè-Garriga *et al.* (2014:753), it is well established in literature that there is currently no consensus for the definition of frailty. In their review of the literature on frailty, Chen *et al.* (2014:434), noted that frailty is “conceptually defined as a clinically recognizable state of older adults with increased vulnerability, resulting from age-associated declines in physiologic reserve and function across multiple system organs such that the ability to cope with everyday acute stressors is compromised”. Similarly, Singh *et al.* (2014:1727), recognised frailty as ‘a complex clinical syndrome of increased vulnerability to stressors which results from multiple impairments across different systems and accounts, at least in part, for the heterogeneity between chronological and biological age.

According to Bergman *et al.* (2007:732-734), there are recognizable challenges with regards to defining frailty, namely:

- i. *What is the distinction, if any between frailty and ageing?*
- ii. *What is the relationship between frailty and chronic disease?*
- iii. *Is frailty a syndrome or a series of age-related impairments that predicts adverse outcomes?*
- iv. *What are the critical domains that should be included in the operational definition of frailty? and*

v. *How can frailty be measured?*

Giné-Garriga *et al.* (2014:754), summarised that of the numerous definitions for frailty that exist, there are two mainly recognised definitions. The first was developed by Fried *et al.* (2001:M146-M156), and recognised frailty as a physical phenotype that can be identified through physical components/markers. An individual is considered frail when 3 or more of the identified markers are present (self-reported exhaustion, weakness, slow walking speed and low levels of physical activity). The second is the Frailty Index which considers frailty a result of multiple interacting factors e.g. difficulties in ADLs and social and psychological factors. This definition allowed clinicians to calculate the sum of accumulated deficits, grading of the patient's status (mild to severe stages) as well as the susceptibility of the patient towards adverse outcomes.

De Labra *et al.* (2015:154), remarked that frailty consequently affects various domains such as gait, mobility, balance, muscle strength, motor processing, cognition, nutrition, endurance and physical activity. Likewise, Malmstrom *et al.* (2014:721), underscored the fact that frailty puts elderly persons at risk of adverse outcomes and can also be a predictor of functional deterioration and mortality. With regards to the contributing factors of frailty, Bales and Ritchie (2002:310), noted several factors have been identified to contribute to the development of frailty. These include reduced food intake, loss of lean body mass (also known as sarcopenia), illness and subsequent functional impairment which limit mobility. The ACSM (2016:130), also recognised the role of physical inactivity in frailty and the interplay with sarcopenia. They stated that the loss of muscle mass led to reduced muscle power output, which in turn made it difficult for those predisposed to sarcopenia to partake in physical activity. Clegg *et al.* (2013:752), stated that a notable difference between normal ageing and the decline in the physiologic process of the body is the accelerated state of the decline that is seen in frailty. Theou *et al.* (2011:1), warned that although it has already been stated that frailty is a complex mix of components such as sarcopenia and functional impairment; the interaction of some psychosocial elements such as cognitive impairment and depression should also be investigated as it has not been paid adequate attention in the literature. The importance of the cognitive and psychological state of the frail individual is also highlighted by the ACSM (2016:132); they especially emphasize the role of depression in exercise. They stress that the presence of depression in individuals with a poor prognosis and deteriorating health plays a crucial role in any intervention that is introduced to manage frailty. Creativity may be required in instances where conventional methods are unlikely to succeed.

### 2.3.2 The frailty trajectory

Lally and Crome (2007:16) highlighted that there are varying opinions about frailty and ageing. Ageing and frailty commonly coexist, but not always; representing the heterogeneity of ageing. Frailty has emerged as a measure of biological age and has been shown to correlate with outcomes, independent of age, gender, and comorbidities. Rockwood *et al.* (2006:979), were of the view that a measure of frailty that incorporates a diverse range of deficits including functional limitations, morbidity, psychosocial status and cognitive ability is a better predictor of autonomy, institutionalization and mortality than sequential age alone. Buchner and Wagner (1992:8), also proposed that some or all manifestations of frailty are caused by underlying factors, separate from ageing, but most likely to develop and progress with ageing.

The frailty trajectory, as illustrated in Figure 2.3 below, aims to explain the development of frailty and its progression by means of its relationship with the physiologic process of ageing. It is described as occurring on the age continuum in interaction with the natural physiologic processes of ageing. This interaction is progressive and features at various points of the ageing continuum, such that some elders may age without developing frailty even in the presence of comorbidities and disability, while some will go on to develop frailty.

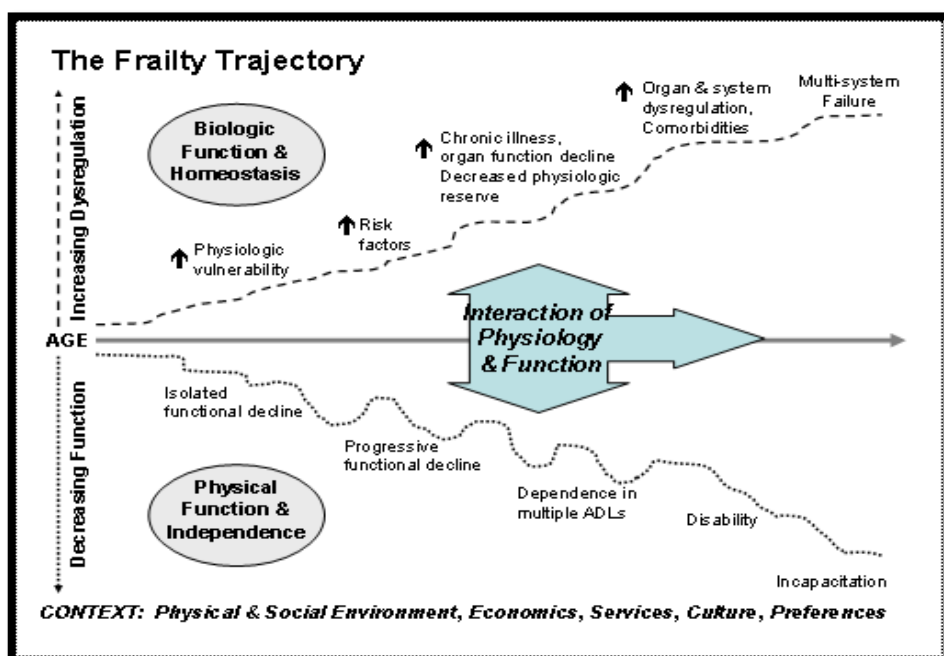


Figure 2.3: The Frailty Trajectory (Lekan, 2009:3)

Figure 2.3 above, depicts ageing along a continuum that moves towards decreased physical functionality and independence and biologic instability. As biologic function and



homeostasis suffer increasing dysregulation, it leads to a breakdown in the body's, processes which ultimately leads to multisystem failure. This has an obvious impact on the elderly's ability to function physically as well as on their level of independence. As the physical function of the elderly declines, it leads towards greater risk for dependency and ultimately towards incapacitation (Lekan, 2009:3).

As simple as the logic may sound, Lahousse *et al.* (2014:420), recognised that the functional decline unfolds in different ways and at different rates in every individual; making it difficult to plot the trajectory or to assume a direct causal relationship between physiologic decline and physical function. Clegg *et al.* (2013:752), also noted that some elderly persons may progress quickly towards incapacitation, while some may move at a much slower rate of progressive decline towards incapacitation. Therefore, an important perspective for frailty is to consider how these interactions of ageing establish a platform for aggregated decline in physiologic function; as well as how frailty results in dysregulation and diminished homeostasis such that the body is unable to cope with minor stressor events or experiences exaggerated outcomes relative to the triggering events.

### **2.3.3 Measuring frailty syndrome**

Bouillon *et al.* (2013:1-11), conducted research on the measures of frailty used in population-based studies such as in this study, as well as the validity and reliability of each study. Of the studies included in the review, 69% of them used Fried *et al.* (2001:M146-M156), Clinical Frailty Scale, 12% used the Frailty Index developed by Rockwood *et al.* (2005:489), 4% used the Edmonton Frailty Scale (Rolfson *et al.*, 2006:526-529) and  $\leq 2\%$  used other instruments. When testing the reliability and validity of these frailty measures, only the Frailty Scale/Index had an acceptable reliability and good concurrent and predictive validity. In terms of frequency of use, the instruments created by Fried *et al.* (2001:56A), and Rockwood *et al.* (2005:489) are the two that have been assessed against adverse health outcomes, thus increasing their external validity. The key difference between the frailty phenotype as developed by Fried *et al.* (2001:56A), and the Frailty scale/index developed by Rockwood *et al.* (1999:205-206), is the following: the phenotype frailty model considers frailty a set of observable traits related to the effects of ageing on multiple systems in the body. The frailty index, on the other hand, considers frailty an accumulation of deficits related to ageing. For the purposes of this study, the frailty index by Rockwood *et al.* (1999:205-206), will be used due to its simplicity and straightforward application.

Fried *et al.* (2001:56A), recognized frailty as being separate from disability and comorbidity. In their research, they observed frailty as meeting three of the five criteria, namely:

- i. Weakness;
- ii. Slowness;
- iii. Low level of physical activity;
- iv. Exhaustion or poor endurance; and
- v. Unintentional weight loss.

Rockwood *et al.* (1999:205-206), also proposed a definition of frailty that does not need sophisticated clinical measurements (cf. Appendix D). According to this scale, persons are classified as **fit** (walks without help; performs basic ADLs e.g. eating, dressing, bathing & bed transfer; continent of bowel and bladder; not cognitively impaired); **fit but bladder incontinent** (walks without help; performs basic ADLs e.g. eating, dressing, bathing & bed transfer; continent of bowel but not of bladder; not cognitively impaired), **pre-frail** (1 or more of the following, 2 if incontinent: needs assistance with ADLs or mobility; bowel or bladder incontinent; cognitive impairment without dementia); **frail** (2 of the following, 3 if incontinent: totally dependent for transfers; totally dependent with one or more ADLs; bowel or bladder incontinent; demented). In their study, Rockwood and colleagues aimed to develop a more accepted and easy-to-use clinical frailty scale which had the ability to predict death or need for institutional care, and correlated the results with those obtained from other established tools. For the purposes of this study, the Frailty index of Rockwood *et al.* (1999:205-206), will be used due to its simplicity.

#### 2.3.4 Socio-demographics of frailty

Grden *et al.* (2017:e2886), studied the relationship between frailty and socio demographic variables and found a statistically significant relationship between age and education. They also found that generally there appears to be an association between frailty and age, low educational level, low income and the female gender. There is also a tendency of those suffering from frailty to typically be those with low levels of education. Garcia-Garcia *et al.* (2011:855), also found that frailty was more common in rural than urban settings. The variability between rural and urban lifestyle was advanced as a possible reason for the difference in frailty prevalence in different living settings.

##### 2.3.4.1 Gender

Etman *et al.* (2012:1118), found that women were at higher risk for developing frailty. The work of Runzer-Colmenares *et al.* (2014:72) and Gonzalez-Vaca *et al.* (2013:80), also

indicated that greater frail indices have been observed for women. Grden *et al.* (2017:25e2886), put forward some of the following reasons as an explanation for this tendency in women: prevalent factors such as lower muscle strength, worse nutritional status, worse socio-economic status and health status compared to men. The decreasing hormone levels in women due to menopause leads to decreased muscle mass and strength in the elderly female. Where females are more physically active than males, as in the study of BATTERY *et al.* (2015:15-22), there was no statistically significant difference between males and females in the frail status. This advances the argument for physical activity as a protective factor against frailty and as a potential modifier of frailty status.

#### **2.3.4.2 Marital status**

Avila-Funes *et al.* (2008:1095) and Son *et al.* (2015:414), found frailty status was more common in individuals who were living alone. In their study, Avila-Funes *et al.* (2008:1095), went as far as describing living alone as 'adverse living conditions'. This view was rejected by Sanchez-Garcia *et al.* (2014:400), whose research showed that although pre-frailty status was prevalent among those living alone, individuals living alone were less likely to be frail. Although the research does not point to the reasons for this occurrence, the authors postulated that independent living may be a protective factor in the development of frailty. The results of the research of BATTERY *et al.* (2015:15-22), were congruent with those of Avila-Funes *et al.* (2008:1095), where no significant associations were found between frailty and living alone. Another explanation for this occurrence is offered by Boulos *et al.* (2016:140), who argued that cultural differences should be taken into consideration when evaluating the independent living variable.

They argued that cultural habits provide context to the variable e.g. in some cultures individuals living alone may have hired help. This negates the need for all their ADLs to be done by the individual themselves. Without this context, the variable is of 'independent living' can be easily misrepresented.

#### **2.3.4.3 Education**

Son *et al.* (2015:414) and Etman *et al.* (2012:1118), found a significant association between physical frailty and education, with the level of education being inversely proportional to the condition of frailty. The low educational level status was evident in both developed and developing nations and reflected the deprivation of opportunities, access to healthcare and various other inequalities throughout the individuals' lives. Boulos *et al.* (2016:140), further

added that poor cognitive function was a risk factor both for pre-frail status and for frailty. The belief is that the educational level is an effect modifier in the association between frailty and cognitive performance.

### 2.3.5 Frailty in developing countries

A search into the studies performed on frailty in developing nations produced far less results than that of studies performed in developed nations. Of these results, 3 were selected that were done in developing nations, two investigated the prevalence of frailty in that nation and one studied the risk of mortality in the frail elderly of that nation. The above-mentioned studies were respectively performed by Moreira and Lourenco (2003:979-985), Garcia-Gonzalez *et al.* (2009:47-55) and Chen *et al.* (2010:S43-S47).

The study performed in Rio de Janeiro in Brazil by Moreira and Lourenco (2003:979-985), investigated the prevalence of frailty as well as its association with factors such as cognitive status, functional capacity, self-reported comorbidities, social and demographic factors. The study included 847 participants older than 65 years of age and the data was collected between 2009 and 2010. Prevalence was determined as the number of participants who scored three out of the five factors on the Clinical Frailty Scale:

- i. weakness;
- ii. slowness;
- iii. low level of physical activity;
- iv. exhaustion or poor endurance and
- v. unintentional weight loss.

Results showed prevalence in the elderly to be 9.1% which fell within the value ranges for frailty in Europe, Asia and North America (4.9%-27.3%). The frail status was also associated with advanced age, Caucasian race, female gender, single or widower status, low income, low educational level, poor cognitive performance, poor health and functional status and increased number of comorbidities.

The next study was done in Mexico by Garcia-Gonzalez *et al.* (2009:47-54), with the aim of creating a frailty index to predict the mortality risk in Mexican adults. This index was constructed by using 34 variables linked to the study by Rockwood *et al.* (2001:109-117), in identifying the deficits associated with frailty. Four thousand eight hundred and two participants (4802) took part in the study all aged 65 years and older with the average age

being 73 years and more than half the participants were women. Results showed that the risk of mortality increased with the frailty index level scored. Two hundred and seventy-nine of the participants (279) had died by follow up, 710 days after the study was done. This showed an increased need towards identifying elderly people who are at risk for frailty, as well as developing interventions and support for the severely frail; with the aim of slowing the progress of frailty or even reversing it if possible to decrease the risk of mortality.

The final study considered was done in Taiwan by Chen *et al.* (2010: S43-S47), with the aim of identifying the prevalence of subjective frailty as well as factors associated with frailty. The study comprised of 2238 participants aged 65 years and older and interviewed during 2003. This study used the frailty phenotype as described by Fried *et al.* (2001:56). The results indicated that 40% of the participants were pre-frail and 4.9% were frail while well over half of the participants were non-frail at 55%. Similar to the results in the study conducted by Moreira and Lourenco (2003:979-985), these researchers also found the prevalence of frailty increased with age and was closely associated with social and environmental factors such as less education, lack of social support, disability and higher comorbidities. They did, however, report that the prevalence was lower in Taiwan than in western countries. As with the two previously discussed studies of Garcia-Gonzalez *et al.* (2009:47-54) and Moreira and Lourenco (2003:979-985) as well as Chen *et al.* (2010:S43-S47), they also highlighted the need to identify those at risk to prevent mortality and provide adequate support to slow or reverse frailty.

### **2.3.6 Functional limitations/disability and frailty**

Frailty can lead to adverse outcomes including morbidity and disability, (Paw *et al.*, 2008:762). According to Topinková (2008:7), functional capacity peaks in early adulthood and will steadily decrease over time with advancing age. The rate of decline will vary per individual, but it could be modified by intrinsic factors (physiologic changes with comorbid diseases and impairments) and environmental factors (social, economic and behavioural factors). As a result, De Labra *et al.* (2015:155), pointed out that interventions that target specific factors resulting in disability can possibly slow down age-associated functional capacity decline and in turn increase the number of years that an individual can live disability-free.

Finally, Drewnowski and Evans (2001:89), cautioned that although previous research had measured the success of health promotion in the elderly population as a reduction in morbidity and mortality, it has become more apparent that the quality of life in the elderly

population is as important a goal as reduced morbidity and mortality. The complete mental, physical and social well-being of the individual is now considered a more holistic goal as opposed to the mere absence of infirmity or disease.

Despite some reports of a decline in the number of disabled elderly persons, it is predicted that the number of disabled elderly persons (both community dwelling and institutionalized) will triple in the period 1985 – 2050 (Stuck *et al.* 1999:445). Liu and Fielding (2011:102), followed to indicate that an important goal in the interventions with the elderly, is trying to prevent loss of independence that leads to institutionalization. The key to reducing disability in late life lies in reducing morbidity at a faster rate than mortality and in the prevention of chronic diseases that lead to disability. Figure 2.4 below illustrates the disablement process as adapted from Verbrugge and Jette (1994:2).

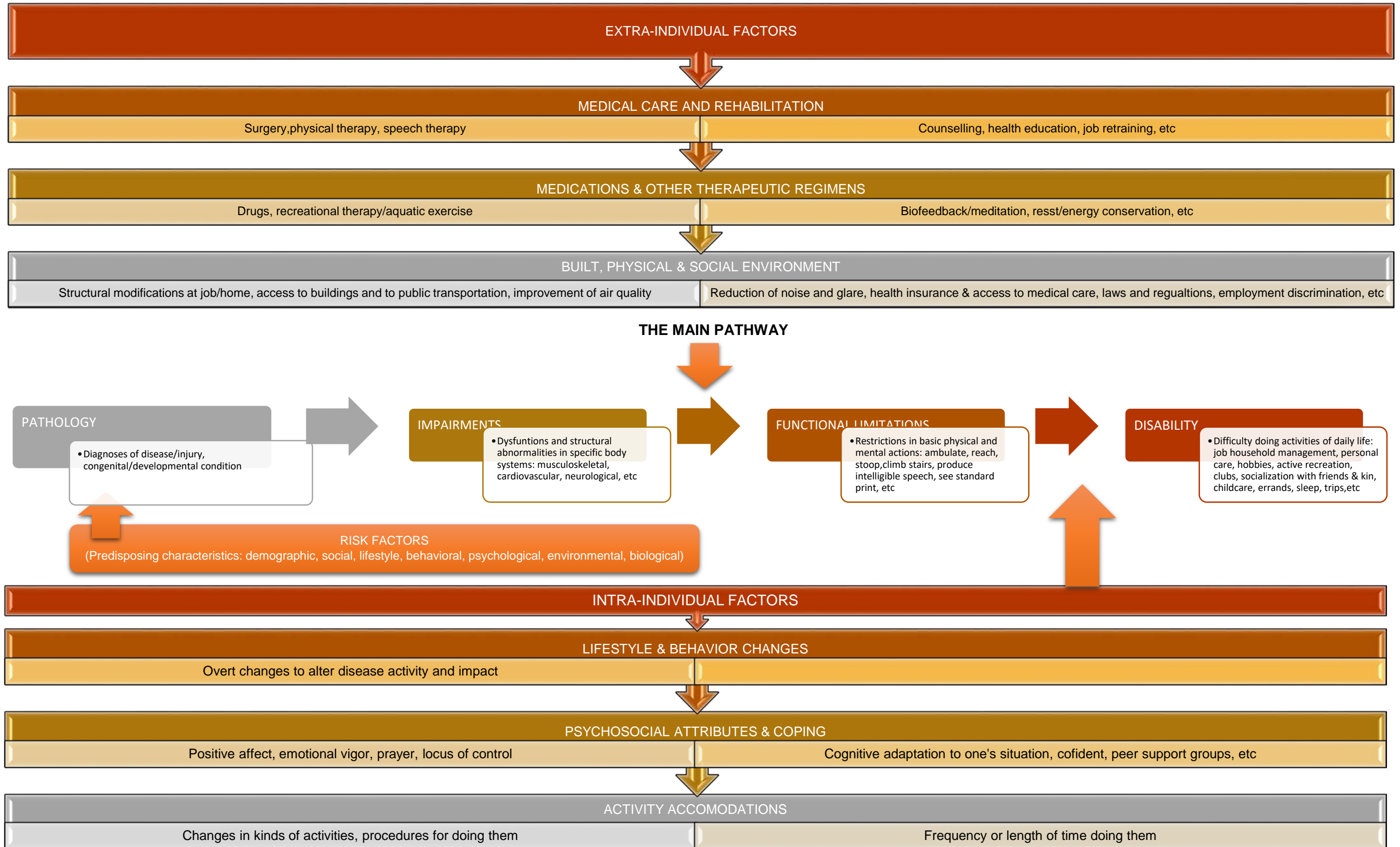


Figure 2.4: A model of the disablement process (Verbrugge & Jette, 1994)

Verbrugge and Jette (1994:2), explained (as illustrated in Figure 2.4 above) that an important goal in the development of the disablement process model was to move away from pathology and towards functional outcomes. This school of thought is keeping in line with the views raised by Cosco *et al.* (2014:373), regarding 'successful ageing' as a means of moving away from viewing ageing as an accumulation of deficits and more as aiming to maintain independent living in functionally declining individuals. The main pathway begins with the diagnosis of disease or pathology. The pathology progresses to affect the systems of the body e.g. motor, nervous or skeletal resulting in an impairment in the functioning of that system. Unimpeded, the impairment progresses to affect the performance of ADLs eventually leading to disability when the impairment exceeds the body's reserves to perform the activity. At any given point, the main pathway is constantly being influenced by extra-individual and intra-individual factors, both of which have the potential to mitigate or exacerbate the progression of the main pathway.

The extra-individual factors are interventions outside of the individual that can potentially negate the effects of the pathology, e.g. surgery, medications/physical rehabilitation and changes within the physical, social and physical environment that offer the individual support and enable them to cope with the pathology. Intra-individual factors on the other hand are all connected to the individual's internal resources to cope, e.g. resilience, making lifestyle changes to adapt, keeping a positive disposition and changes in activities both to adapt to the pathology and to potential modify the effects of the pathology.

Yu *et al.* (2015:272), pointed to the fact that early indications reveal that any frustrations in performing ADLs may be indicative of the beginning of functional decline. Being able to predict when these difficulties arise, can provide great insight into the start of functional decline that leads to disability. Further, Peterson *et al.* (2009:61), supplemented that physical inactivity is also considered a major contributor to disability. As a result, Cesari *et al.* (2014:1), stressed that medical and health care professionals have recently devoted copious amounts of time towards designing, developing and implementing interventions that impeded the disability cascade.

### **2.3.7 The effect of physical activity on morbidity, mortality and disability**

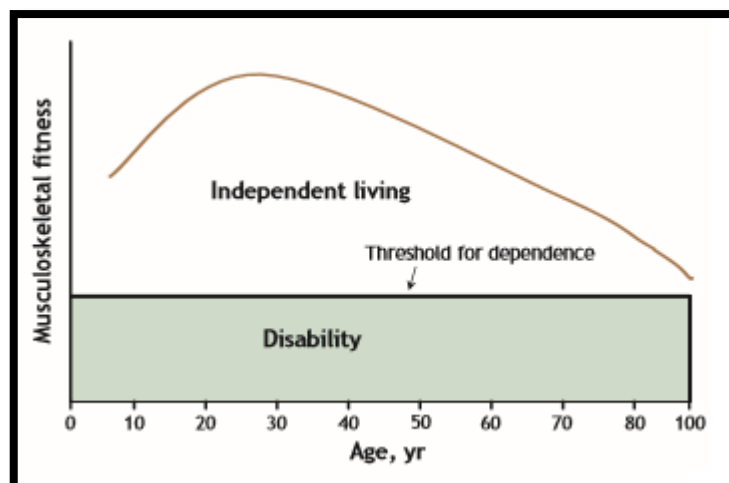
Miller *et al.* (2000:1265), proposed that physical activity could be instrumental in the delay of disability by changing the way in which functional limitations progress into disability. The idea being that, improving the way the elderly perform their ADLs may further improve the benefit that physical activity has on disability associated with ADLs. This view was also



supported by Taaffe *et al.* (1999:1213), who found that a resistance training programme that resulted in gains in quadriceps strength, also resulted in the improvement of the ability to rise from a chair, which is a movement highly dependent on lower extremity strength. Strength gains resulted in functional improvement, which delays impairments that can lead to disability. Additional evidence to support the positive impact of physical activity was also provided by Pahor *et al.* (2014:2392). Their work suggested that structured physical activity (exercise) can be an effective intervention in reducing the burden of disease among vulnerable older persons. In their review of the literature on the role of physical activity in the maintenance of functional independence in the elderly, Paterson and Warburton (2010:1-2), noted several aspects, namely: that there is clear evidence that exercise (even at a relatively low intensity) may delay both mortality and the incidence of disease for older adults, which plays an important role in improving the quality of life and life expectancy in older adults. What is unclear however, is the requisite minimum intensity necessary to produce health benefits in the older adult. It is noted that the priority for older adults with regards to physical activity, is linked to the ability to perform functional tasks and ADLs that are essential for independent living as opposed to disease prevention. Vermeulen *et al.* (2011:1-11), further stated that although physical activity benefits both disease prevention and improving the physical capacity to carry out ADL, further insight is required to point health professionals in the direction of designing and implementing interventions.

Vermeulen *et al.* (2011:33), pointed to the fact that, performing ADLs places a greater demand on the musculoskeletal system and requires musculoskeletal fitness more than aerobic fitness. Figure 2.5 below adapted from Warburton *et al.* (2006:805), illustrates the theoretical relationship between musculoskeletal fitness and independent living across an individual's lifespan. It shows that most elderly people are living on the threshold of their functional capacity to independently perform their ADLs. This places them in jeopardy of disability once the serious decline of their musculoskeletal fitness begins to deteriorate with age, leading to the loss of independence and institutionalization. Presently, resistance training programmes have proven to be an effective method of preventing functional limitations; reducing the risk of falls; chronic disease prevention; and improving physical capacity (Seguin & Nelson, 2003:146). This notion of that 'the fear of disability is greater than the fear of death or ill health' in old age, was also supported by Leveille *et al.* (1999:654). They found that the most consistent predictor of disability in the elderly is the level of physical activity. Fifty-eight percent (58%) of the men that were physically active were not disabled ante mortem compared to 43% of their least active counterparts. In women, the difference doubled, with 41% of the physically active female avoiding disability compared to 22% of the least active females. Physical activity works in different ways to

reduce disability: disease prevention, reducing the impact of existing diseases and slowing down or even reversing the functional and physiologic declines resulting from ageing and disuse. Hamer *et al.* (2014:239) and Brown *et al.* (2000:964), also found that targeted exercise programmes that addressed any of the markers associated with decreased functionality (decreased strength and range of motion ROM, balance, reaction time, sensory processing and coordination), had positive outcomes in remediating these markers and frailty overall.



**Figure 2.5: Theoretical relation between musculoskeletal fitness and independent living across a person's lifespan (Warburton *et al.*, 2006:805)**

Makizako *et al.* (2015:1) and Vita *et al.* (1998:1040) found that, overall, persons with lower health risks had decreased lifetime disability as well as decreased disability at any age. This indicates that the increased number of elderly in the coming years and possible increased burden on public health due to chronic illness associated with old age can be mitigated by primary prevention of modifiable health risk factors in the elderly. Despite the fears that the increase in this population would increase in the number of frail and disabled persons, their study showed that decreasing the health risks results will lead to less lifetime disability overall.

Vita *et al.* (1998:1035), noted that some researchers contended that late life morbidity may be increased in low-risk older adults, thus increasing the number of years spent with chronic illness and cumulative lifetime disability. The compression of morbidity hypothesis, however, suggests that cumulative lifetime disability can be reduced by delaying the onset of chronic illness through primary preventative measures. The prediction being that the age at which disability initially sets in, will increase lifespan - resulting in decreased number of years of disability and lower lifetime of cumulative disability. In their review of the literature supporting late life exercise, Keysor and Jette (2001:M412), argued that despite all the

known benefits of exercise, it has yet to be proven that exercise can in fact reduce disability, even though some researchers have in fact found that physical activity produces significant health benefits in the elderly (Wen *et al.* 2011:1244).

## 2.4 THE EFFECT OF PHYSICAL ACTIVITY ON FRAILITY

Aguirre and Villareal (2015:83) and Brown *et al.* (2000:960), remarked that due to the nature of frailty, which is marked by declines in multiple components of physical fitness (strength, balance, flexibility, reaction time, coordination, muscular and cardiovascular endurance), physical activity has the potential to counteract and improve some of these declining components. Although exercise was once presumed to be dangerous to the frail elderly, current research has since disproved that assertion (Chou *et al.*, 2012:237). Through the work of the Lifestyle Interventions and Independence for Elders pilot study (LIFE-P study), Rejeski *et al.* (2009:462), argued that physical activity interventions in the elderly can have a lasting impact. Despite doubts whether the frail elderly can maintain an active lifestyle, results of this pilot study indicated that two years after the initial intervention, the benefits gained during the intervention were sustained. The intervention had focused on aerobic walking exercise, along with strength, balance, and flexibility training; walking was the primary component, given its widespread popularity among the elderly. The focus of the LIFE-P study, was mobility disability/impairment. Sun *et al.* (2010:1172-1173), also supported the evidence of the LIFE-P study, stating that even in the face of fears of injury (usually orthopaedic in nature) resulting from vigorous physical activity in the elderly, it has been shown that even moderate intensity physical activity is sufficient to produce health benefits in the elderly population. Given the fact that physical activity is a proven health benefit for the elderly (Roberts *et al.*, 2017:27), it is a modality worth pursuing for the continued health and wellbeing of the elderly.

Kim *et al.* (2015:2) and Liu & Fielding (2011:102), maintained that since physical inactivity plays an important role in the development of frailty, exercise prescription remains a viable strategy in the prevention of frailty. Of the proposed modes to combat frailty (based on intervention studies), only physical activity had the most apparent potential to improve physical function. This view was supported by Singh *et al.* (2014:1730) and Fiatarone *et al.* (1994:1769), who stated that of all the potential factors that contribute to frailty, such as chronic illness, sedentary lifestyle and the decline in health resulting from ageing itself; only skeletal muscle disuse and under-nutrition are potentially reversible and preventable.

Cesari *et al.* (2015:216-222), implemented a physical activity intervention programme to investigate if it can reduce the prevalence and severity of frailty as part of the LIFE-P study. The study comprised a physical activity (PA) group and a successful ageing/ education group. Overall, the PA group that regularly participated in exercise had better functional performance (gait speed, chair rise and long-distance walk) as opposed to the education group. These results support the argument that physical activity not only has a positive impact on frailty, but that it can also reverse one of the major causes of frailty (sedentary lifestyle). Simonsick *et al.* (1993:1443) also pointed to the fact that those who regularly participated in exercise, over time, maintain higher levels of functional reserve and have improved functional outcomes (e.g. improved sit to stand, balance and reduced falls). Cadore *et al.* (2013:780), also added that the physically active elderly is less likely to develop frailty and progress slower toward severe frailty once diagnosed. No associations were found between the dose of physical activity or exercise and the progression to severe frailty. This is important to note, because it indicates that once diagnosed, neither the type nor the amount of activity an individual engages in can mitigate the development of frailty, except for the physical activity status the individual was in prior to developing frailty. This is a critical motivation for exercise in the elderly population (pre-frail) as a means of possibly slowing the progression towards frailty in those susceptible to developing it. Beyond the diagnoses of frailty, physical activity at that point may no longer be able to intervene in the progression of the disease.

Giné-Garriga *et al.* (2014:754), advanced that interventions on frailty would be most beneficial to community dwelling elderly people without disability or in the early stages of disability who are at risk of functional dependence. Daniels *et al.* (2008:2) further remarked that, 'interventions for physical frailty stem from the idea that the casual pathway towards frailty is a negative downward spiral in which inflammation, neuroendocrine deregulation and sarcopenia play a role implying that interventions can be targeted at physical frailty independent of specific diseases'. In their review of the effectiveness of physical activity interventions for older adults, Van der Bij *et al.* (2002:121), found that the success of these interventions depended on individual factors such as motivation, social support, health, beliefs and education as well as organizational factors such as number of participants, resources, accessibility and type of physical activity involved. The Intervention on Frailty Working Group recommended that preventative interventions on frailty be based on any of the following screening criteria, namely: mobility, strength, balance, motor processing, nutrition endurance or physical activity. Lang *et al.* (2009:545-546), put forward five modes as a means of combating frailty including regular physical exercise done in a group setting or alone (e.g. Flexibility, dancing, balance exercises, walking and lifting weights). Of these

proposed modes to combat frailty (based on intervention studies), only physical activity had the most apparent potential to improve physical function. While it is important to measure the biomedical endpoints of interventions, Drewnowski and Evans (2009:89), added that factors such as perceived mastery and control, enjoyment of the diet or satisfaction with the exercise programme are as crucial to quality of life as reduced cholesterol and improved grip strength.

De Labra *et al.* (2015:166), Sing *et al.* (2014:1730) and Fiatorone *et al.* (1994:1769), postulated that of all the potential factors that contribute to frailty (such as chronic illness, sedentary lifestyle and the decline in health resulting from ageing itself), only skeletal muscle disuse and under-nutrition are potentially reversible and preventable.

#### 2.4.1 Summary of frailty interventions

A few interventions on frailty are presented in Table 2.2 below. The interventions selected either used similar study methods to those used in this study or investigated similar variables to the variables investigated in this study (e.g. chair stand, handgrip strength, 6-min walk, etc). Interventions that also offered any other valuable information regarding interventions in frailty, were also included.

**Table 2.2: Summary of frailty interventions**

SUMMARY OF FRAILITY INTERVENTIONS			
STUDY	PARTICIPANTS	INTERVENTION	OUTCOME MEASURES
Peterson <i>et al.</i> (2009)	cohort n=2964	Observational study: PA levels were observed in the cohort and the development of frailty was measured in each participant.	Frailty status
<b>SUMMARY:</b> Participants who did not regularly exercise, the odds of developing frailty increased. A dose response association between the type of activity and the development of frailty. Number of diseases present = strongest predictor for developing frailty (independent of exercise or physical activity). The odds of progressing to severe frailty once diagnosed, tripled in the sedentary and lifestyle active groups compared to the exercise active group. The presence of multiple diseases also attenuated the potential benefits of exercise on frailty.			
Tarazona-Santabalbina <i>et al.</i> (2016)	Ex: n=38 Con: n=38 Age: ≥70 yrs	Ex: Multicomponent exercise program and nutritional supplementation. Con: Nutritional supplementation. No training.	Functional outcomes: Frailty score, Barthel Index, Lawton & Brody, Tinetti, TUG, 6-min walk test, SPPB, PPT, functional ambulation categories, Crichton and handgrip. D0Dimer and Calcidol Assay, protein

			carbonylation and brain derived neuropathic factor serum levels.
<b>SUMMARY:</b> Functional activity improved in the exercise group and the frailty score also decreased. Frailty status reversed in the exercise group but not in the control group. There was a statistically significant improvement in the performance of ADLs as measured by the Barthel Index, while the control group seemed to deteriorate. Cognition also improved in the exercise group while the control group remained constant or showed a slight decrease. Fat mass decreased significantly in the exercise group.			
Ng <i>et al.</i> (2015)	Nutrition group: n=49 Cognitive training: n=50 Exercise group: n=48 Combination group: n=49 Control group: n=50 Age: ≥65 yrs	Nutrition intervention: Commercial formula supplied over 24 weeks. Cognitive intervention: First 12 weeks – memory and attention span exercises and information processing skills. Ex intervention: 12 weeks of home based strength and balance exercises. Combination: combination of all 3 interventions. Control: Access to standard care and nutritional supplementation.	Primary outcome: Frailty status Secondary outcomes: self-reported hospitalizations, self-reported falls and instrumental ADLs.
<b>SUMMARY:</b> Frailty reduction was noted across all the groups but was significantly higher in the intervention groups. No significant differences were observed between the intervention and control groups for ADLs.			
Binder <i>et al.</i> (2005)	Ex: n=69 Con: n=50 Age: ≥78 yrs	Ex: 9 month low-intensity exercise training program (multicomponent) Con: 9-month low intensity home exercise program (mainly stretching)	Modified PPT score, VO <sub>2</sub> Peak, performance of ADLs measured by Older Americans Resources and Services Instrument and Functional Status Questionnaire (FSQ).
Ex=Exercise group, Con=Control group. <b>SUMMARY:</b> The results showed greater improvements in the outcomes of the exercise group (modified PPT, VO <sub>2</sub> Peak and FSQ score) as compared to the control group who did a home-based program. The only outcome that did not show significant changes was in the activities of daily living (ADL) scales.			
Cesari <i>et al.</i> (2015)	Ex: n=213 Con: n=211 Age: 70 – 89 yrs	Ex: 12 months, 3 phase multicomponent exercise program Con: 12 months 'successful aging' education classes	Frailty status
Ex=Exercise group, Con=Control group. <b>SUMMARY:</b> The results showed an improvement in frailty status and that the greatest benefits were found in the participants were frail at baseline and presenting with multimorbidity. The study also showed improvement on the frailty status (as determined by the frailty phenotype) in that it modified sedentary behaviour.			
Rydwick <i>et al.</i> (2010)	Ex: n=23 Nut: n=25 Ex+Nut: n=25 Con: n=23	Ex: 12 weeks multicomponent exercise program	Primary: Habitual PA level measured by the Classification of Physical Activity scale.

	Age: ≥75 yrs	Nut: Customized nutritional counselling and eating plan Con: General advice on physical activity and nutrition	Secondary: Personal ADL measure by Functional Independence Measure. Instrumental ADL measured by Instrumental Activity Measures.
Ex=Exercise group, Con= Control group. SUMMARY: Results from this study showed improvements in habitual physical activity levels but no improvement in ADL, there were however associated improvements between increased activity levels and ADL. This improvement was attributed to an increase in their confidence to perform some of the ADLs. The reasons for the lack of improvement in ADL effects were attributed to behavioural and environmental factors. The authors noted that if there are barriers in the personal or social environments that impact on the ADL of the participants, these will not improve despite the improvements in physical fitness.			
Ginè-Garriga <i>et al.</i> (2014)	*Systematic review and meta-analysis.	Randomized controlled trials of community-dwelling older adults, comparing exercise and control groups.	Assess performance based measures of physical function. E.g. gait, disability or ADL.
<b>SUMMARY:</b> The exercise intervention groups have been shown to have improvements in gait speed, mobility, muscle strength, weight change, nutritional intake and physical activity levels. They also noted that although there remains uncertainty over the exact FITT principles to use in exercise interventions, multicomponent interventions seem to work best.			
Theou <i>et al.</i> (2011)	*Systematic review	Randomized controlled trials of frail older adults, using exercise interventions.	Frailty Status
<b>SUMMARY:</b> They concluded that the most effective exercise protocol for frail older adults is a multicomponent training with the following FITT principles: performed 3 times a week at a low-moderate intensity for 60 minutes for a duration of 3 months, addressing aerobic capacity, muscle strength and endurance, flexibility and balance. Exercise was found to be more effective in institutionalised frail elderly than in community living frail elderly. Multicomponent exercise also had a better impact on functional ability while resistance training alone had greater influence on physical and psychosocial determinants. Overall, they found interventions that last longer than 5 months to be effective in improving adverse health outcomes than shorter duration interventions. Not all studies included a follow up period but it is recommended to study the retainability and sustainability of these interventions.			
Cadore <i>et al.</i> (2013) (b)	*Systematic Review	Randomised controlled trials for frail Older adults, using exercise interventions comparing exercise and control groups.	Functional parameters: incidence of falls, gait, balance and lower body strength.
<b>SUMMARY:</b> Regarding the incidence of falls, they found intervention groups to have decreased incidence of falls compared to control groups. Multicomponent exercise interventions appeared to also be more effective in addressing balance than exercises that target balance on its own. On gait ability, exercise seemed to have a positive effect on gait ability and an improvement in gait speed. Exercise was also found to be effective in improving balance and muscle strength.			
Cameron <i>et al.</i> (2015)	Ex: n=116 Control: n=121 Age: ≥70 yrs	Ex: 12 month multifactorial and multidisciplinary intervention. Individualised program (exercise, nutritional & psychological treatment). Con: Usual care provided by GP for 12 months.	Primary: Frailty status Secondary: 1. Hospitalisations and admissions to institutions of care. 2. ADLs measured by Barthel Index. 3. Quality of life measured by EuroQol.

			<p>4. Psychological status measured by Geriatric Depression Scale.</p> <p>5. Falls Risk Assessment measured by Physiological Profile Assessment.</p> <p>6. Balance and mobility measured by step test.</p> <p>7. Participation measured by Reintegration into Normal Living Index</p> <p>8. Occurrence of falls measured by recorded falls calendar.</p> <p>9. Deaths</p> <p>10. Health and community service.</p>
<p>Ex=Exercise group, Con= Control group. SUMMARY: The authors concluded the following: individuals who are frail or those who are exhibiting early signs of frailty (pre-frail) can be identified and included in randomised trials for treatment. A multidisciplinary and multicomponent approach to any intervention is the most effective way to proceed in treating frailty. Exercise interventions have shown improvements in those with disability and in preventing early disability in those susceptible to frailty status. They concluded that interventions that reduce frailty also impact on reducing morbidity, disability, hospitalisation and institutionalization in the general population.</p>			
De Labra <i>et al.</i> (2015)	*Systematic review	Randomized controlled trials for frail older adults using exercise interventions using an exercise and control group.	Frailty as a primary outcome. Physical or functional capacity as secondary outcomes.
<p><b>SUMMARY:</b> The authors found the effects of exercise on the incidence of falls to be controversial based on the studies included in their review. Overall, they found the results to be heterogeneous but clearly detect whether the interventions are effective or not. Mobility results were also relatively mixed but the exercise interventions showed improvement in the following mobility tests: variations of the walk test e.g. 10-meter walk test or 6-minute walk test, significant improvement was also found in the timed up and go test (TUG) and in chair rising ability. Interventions also showed positive results in various functional ability measurements. The authors noted that most interventions tend to focus on lower limb muscle strength and insufficient focus on upper body strength. Exercise was effective in improving muscle strength measured through various test e.g. knee flexion or grip strength. Multicomponent exercise programs featuring muscle strength and power training were found to be more effective in affecting body composition and reducing fat mass. Lastly, regarding frailty status they found that in one study a 3-month intervention program reversed frailty compared to the control group but concluded that a combination of exercise and nutrition maximises this reversal effect on frailty status.</p>			

When frailty does occur, it seldom occurs in the absence of other diseases that are common with ageing. Accordingly, the other diseases associated with ageing will be discussed next, including the effect of exercise on those conditions.

## 2.5 CHRONIC DISEASES

The risk of developing non-communicable chronic health conditions (diabetes, obesity, hypertension, cardiovascular diseases) increases with age (Taylor., 2014:26). Marventano

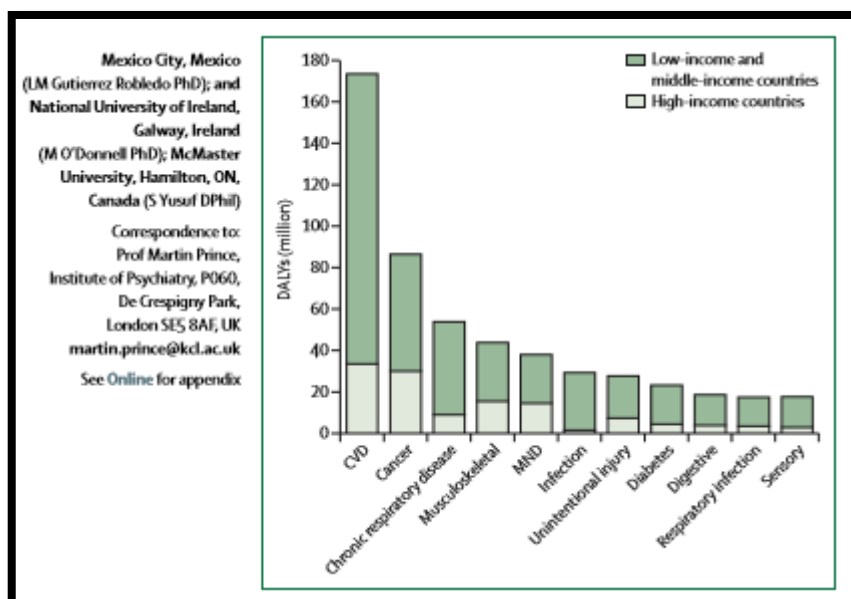


*et al.* (2014:610), stated that the presence of chronic diseases in the elderly also plays a role in advancing the ageing process as well as increasing their morbidity. In some cases, more than one chronic disease is present (multimorbidity) and sometimes certain chronic diseases interact with one another (comorbidity). Bergman *et al.* (2007:732), further noted the role chronic diseases play in precipitating the frail state. The presence of chronic diseases places an additional and continuous strain on the functional and physiological reserves in the elderly. This strain can lead to the functional reserves of various systems being exhausted. Van der Wiel *et al.* (2002:1405) also noted that chronic diseases can lead to mobility impairment.

The reduction in mortality from non-communicable diseases (i.e. Type 2 diabetes mellitus, obesity, coronary heart disease, breast and colon cancer) has largely contributed to the increase in the life expectancy of older adults since 1970 in high income countries. Mortality statistics in the Middle East, North Africa and sub-Saharan Africa are more difficult to obtain due to unreliable death registration data. Estimates from the WHO put life expectancy for women at age 60 years in sub Saharan Africa at an average of 17.2 years compared to 21.5 years worldwide. Life expectancy for men at age 60 averaged at 15.7 years in sub-Saharan Africa compared to 18.5 years worldwide. The gap between low-income and high-income nations is demonstrated as follows: life expectancy has increased by 1.6 years for men and by 1.4 years for women per decade in high-income nations. As compared to 0.9 years for men and 0.8 years for women in low-income nations (Mathers *et al.*, 2015:540). In the face of these overwhelming statistics, Lee *et al.* (2012:226), contended that the removal of physical inactivity had the potential to avert at least 15 000 deaths in Africa from coronary heart disease.

The downside to an increased global life expectancy is explained by Pahor *et al.* (2014:2388), via the following argument: As people live longer, the balance of maintaining independent living and functional capacity must be kept. Meanwhile, the cost of health care in the elderly population is also seen as a threat to economic stability worldwide when that balance is not maintained and disability and morbidity set in. As a result, an understanding of morbidity in the elderly and its relationship to mortality, disability and loss of independence is empirical for successful planning in health care. Prince *et al.* (2015:550), explored the statistics for the global burden of disease (GBD) in 2010 that indicated that 49.2% of the burden in low-and middle-income nations is attributable to people over the age of 60 years. Diseases contributing to this burden (as illustrated in Figure 2.6 below), are cardiovascular diseases, malignant neoplasms, chronic respiratory diseases, musculoskeletal disorders, mental and neurological disorders, infectious and parasitic

diseases, unintentional injuries, diabetes mellitus, digestive diseases, respiratory infections and sense organ disease.



**Figure 2.6: Leading contributors to the burden of disease in people aged 60 years and older in 2010. DALYs (million) by cause and World Bank income DALYs (disability adjusted life years), (Prince *et al.*, 2015:550)**

CVD= cardiovascular and circulatory disease. MND=mental and neurological disorders, combining the IHME (Institute for Health Metrics and Evaluation) GBD (Global Burden to Disease) mental and behavioural disorders and neurological disorder groups.

The GBD varies between high-income and middle-low income countries. The GBD is higher per person in older people in middle-low income countries, averaging at 827 disability adjusted life years (DALYs) per 1000 persons compared to 590 DALYs per 1000 in the high-income countries. CVD, chronic respiratory disease and infectious disorders markedly make up with the increase in the burden (Prince *et al.*, 2015:551).

Data extracted from the World Health Organization – Strategic Advisory Group of Experts (WHO-SAGE) population survey and the Dementia Research Group done in 12 low- income nations in Africa, Asia and Latin America; showed the independent effect of age and education on dementia as illustrated in Figure 2.7 and 2.8 below:

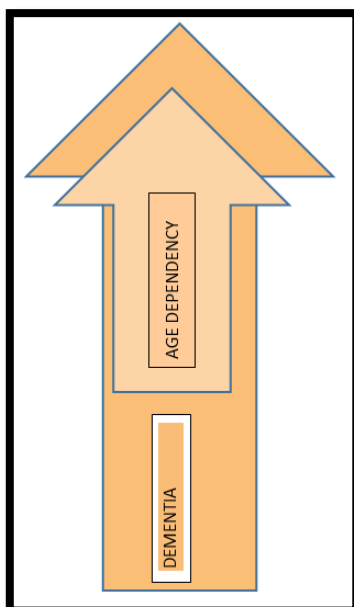


Figure 2.7: Relationship between dementia and age dependency (Adapted from Prince *et al.* 2015)

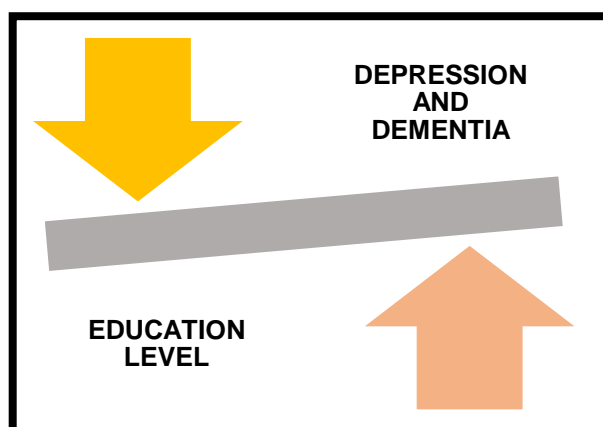
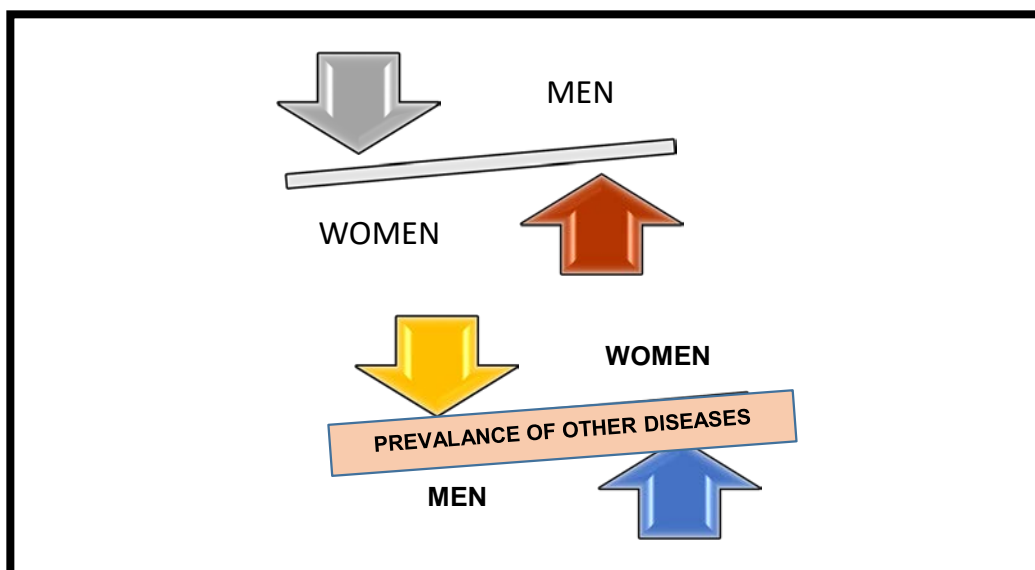


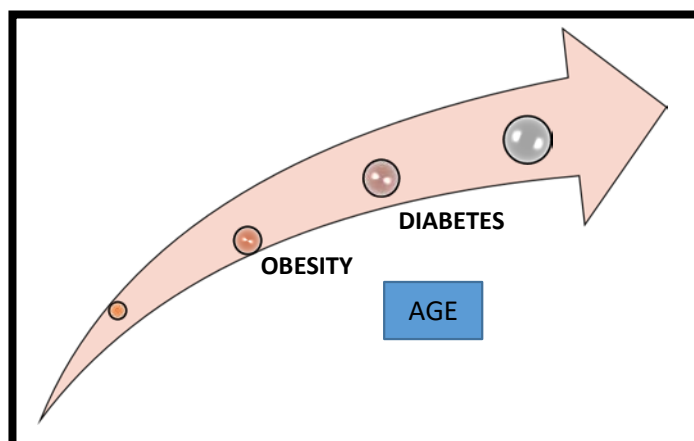
Figure 2.8 Relationship between education levels and dementia (Adapted from Prince *et al.* 2015)

Figure 2.9 below shows the relationship between the prevalence of stroke and gender. Stroke was more common in men than in women. All other disorders were consistently more common in women than in men.



**Figure 2.9: Prevalence of stroke (A) and other diseases (B) (Adapted from Prince *et al.*, 2015)**

Diabetes and obesity also showed a slight increase with increasing age (Figure 2.9).

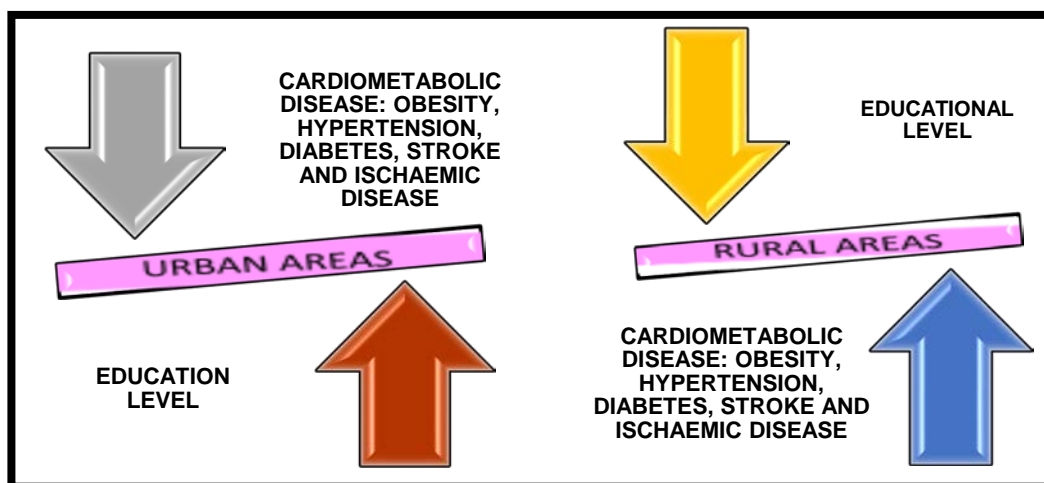


**Figure 2.10: Relationship between age and obesity & diabetes (Adapted from Prince *et al.*, 2015)**

Prince *et al.* (2015:552-554), explained that the association between disease and education levels showed a sensitivity towards the development status i.e. rural vs urban areas. The prevalence of cardio-metabolic diseases such as obesity, hypertension, diabetes, stroke and ischaemic heart disease, increased with low levels of education in urban areas. In rural areas, the association went in the opposite direction; the prevalence of the cardio-metabolic diseases increased in those with higher levels of education. The association between cardio-metabolic diseases and education could be explained by the following rationale: Increased levels of education often represent people with increased opportunities for employment and income while decreased levels of education often represent people with far less opportunities towards employment and income. The ACSM (2018:9) recognises some of the cardio-metabolic diseases identified by Prince *et al.* (2015:552-554), namely

obesity, hypertension and diabetes as modifiable risk factors for CVD. This means that the development of one of these diseases could be averted by adjusting lifestyle and diet.

The association between cardio-metabolic diseases and educational levels illustrated in Figure 2.11 below, can further be explained in this way: In urban areas where the population is likely affluent and well educated, employed and of high-income have access to healthy food; those with low educational levels, low-income and possibly unemployed have a propensity toward unhealthy diets with easy access to fast and processed foods, which are deemed as cheaper. This may explain why those with low education levels have an increased prevalence towards developing cardio-metabolic diseases.



**Figure 2.11: Relationship between cardio-metabolic disease & education in urban vs rural areas (Adapted from Prince *et al.*, 2015)**

Boulos *et al.* (2016:140) found that, conversely, in rural areas (often occupied by those with low levels of education) where access to fast and processed foods may be limited and the population ‘lives off the land’; their diet is likely healthier and they are less prone to cardio-metabolic disease. Those with high income who dwell in rural areas, with means of transportation to urban areas and increased access towards fast and processed foods will be highly susceptible to developing cardio-metabolic disease.

The complex relationship between frailty and chronic diseases was researched by Bergman *et al.* (2007:732), where results indicated that 7% of the elderly diagnosed with frailty did not have any of the nine most common chronic diseases (myocardial infarction, angina, claudication, congestive heart failure, arthritis, diabetes, cancer, hypertension and chronic obstructive pulmonary disease) while >90% who had two or more chronic diseases did not have frailty. This outcome pointed to the fact that while most frail people may develop chronic diseases, there are instances where they do not. The authors further went on to dichotomise frailty into primary and secondary frailty. Primary frailty being frailty occurring

in the presence of chronic diseases and secondary frailty as frailty occurring in the absence of chronic diseases.

There are modifiable (e.g. smoking, obesity, sedentary lifestyle) and non-modifiable risk factors (e.g. age, family history) attributed to the development of chronic diseases. Sedentary lifestyle is one of the modifiable risk factors in the development of chronic disease (ACSM 2018:48). Sun *et al.* (2010:1172-1173), alluded to the fact that physical activity has been attributed towards 'successful ageing' as it has an impact on longevity, chronic disease as well as functional and cognitive disability. Moreover, physical activity can not only reverse conditions such as obesity, but it can also lead to improved quality of life and life expectancy (Lee *et al.*, 2012:228).

The most prevalent chronic diseases are cardiovascular diseases (CVD) e.g. myocardial infarction, type 2 diabetes, cardiorespiratory diseases [e.g. chronic obstructive pulmonary disease (COPD)] and osteoarthritis (OA). Physical inactivity has been identified as being one of the factors responsible for the development of early onset of chronic disease (Watz *et al.*, 2014:1522). Despite the importance of the role of physical activity in disease prevention, sedentary lifestyle (physical activity with an energy cost below 1.5 METs per day) continues to increase, with some countries recording above 50% of the population as sedentary. When used for disease prevention, physical activity produces various health benefits, including improving the quality of life of participants. When initiated in the treatment of existing chronic diseases, physical activity improved symptoms associated with certain chronic diseases such as fatigue and reduced angina symptoms. In the case of type 2 diabetes, physical activity has been shown to slow the progress of the disease or even halt its progress completely (Durstine *et al.*, 2013:3-5).

While investigating the relationship between changes in physical activity and mortality rates in women, Clegg *et al.* (2013:752), found that higher levels of physical activity in women were associated with about 40% – 50% lower all-cause-, CVD- and cancer mortality rates when compared to women with lower physical activity levels. These results were supported by the work of Taylor (2014:28) that showed that when combined with strength exercises, aerobic exercises can be effective in improving physical function and the maintenance of functional independence in the elderly.

### **2.5.1 Comorbidity**

Salive (2013:75), defined comorbidity as “any distinct additional clinical entity that has existed or may occur during the course of a patient who has the index disease under study.

Jakovljević and Ostojić (2013:18), added on, pointing out that comorbidity is in contrast to multimorbidity, which refers to “the simultaneous presence of two or more diseases which appear randomly (the accidental side) not having any connection to each other through pathogenic mechanisms”. This presents a challenge in treating the primary condition as well as the interaction various diseases have on each other.

Fillenbaum *et al.* (2000:M84-M89), conducted a study to establish the extent of comorbidity among community dwelling elderly persons and explored the following:

- i. correlating demographics;
- ii. the risk of incident comorbidity;
- iii. determining the impact of these conditions; and
- iv. the comorbidity among them on mortality.

The study focused on the following five chronic conditions: coronary artery disease (CAD), cerebrovascular disease and cancer (three leading causes of death), diabetes (4<sup>th</sup> leading cause in blacks and six<sup>th</sup> in whites) and hypertension (the most prevalent condition in elderly persons). Their results indicated the following: Of the study population, over 25% did not report having any of the conditions mentioned in the study, 42% reported having at least one condition and 29% reported having more than one of the conditions. The highest reported condition was hypertension, which agrees with statistics as the most prevalent condition amongst the elderly, followed by diabetes (20%), CAD (15%), cancer (9%) and CVD (9%). Regarding demographics, the prevalence varied per race. Hypertension was more reported among black people (63%), followed by diabetes at (24%), CAD (13%), CVD (10%) and cancer (8%). Amongst the white elderly population, hypertension was the most reported at (50%), followed by CAD at (17%), cancer (16%), diabetes (15%) and CVD (8%).

### **2.5.2 The effect of physical activity on comorbidity**

Dekker *et al.* (2015:905), noted that while the positive effect of exercise on individual chronic diseases is well established, patients with comorbidity are often excluded from treatment. The reduction in the intensity of the exercise to accommodate the presenting chronic disease, often leads to the exercise being ineffective. Although comorbidity patients may exercise, the exercises must be adapted adequately to the presenting comorbidity. Recommendations regarding how exercise for the index disease must be adapted in the presence of another disease are currently lacking and are necessary. Emphasis should be placed on a holistic approach to the patient; integrated body structures; functions and

activities should be considered as a unit, not as separate organs. According to Durstine *et al.* (2012:5), the most crucial role physical activity plays, is in disease prevention. Even in the case of comorbidity, physical activity will notably influence each presenting chronic disease. In individuals presenting with comorbidity, however, each condition must be considered and exercise must be beneficial for both conditions, which can be challenging. Consider, for an example, an individual presenting with heart disease and osteoarthritis. Walking may be indicated in the management of heart disease, but in the presence of osteoarthritis, this individual may already be experiencing mobility problems due to joint pain and inflammation. A reduction in the intensity of walking to accommodate the osteoarthritis may result in the intensity being too low to have a beneficial impact on heart disease. Since the presence of both disease alters the risk profile of these individuals as explained by (Fried *et al.*, 2004:258), special caution must be exercised in the development of exercise programmes. An individual with knee osteoarthritis alone has a risk of 4.4% of developing mobility disability, but in the presence of heart disease, the risk increases to 13.6%. Once again, an individual with osteoarthritis (in the absence of another condition) can be limited in performing exercise but not as limited as when they also present with heart disease - which may further impact on their ability to exercise and the intensity at which they can exercise, leading to increased risk of disability and mortality.

### **2.5.3 Multimorbidity**

Multimorbidity refers to the co-existence of multiple chronic diseases in one individual. It is differentiated from comorbidity in that there is no one disease that is identified as the primary/index disease. It is linked to mortality, hospitalization, institutionalization, lower quality of life, loss of physical function, depression, multiple drug use (polypharmacy), increased healthcare facility-use and costs (Abizanda *et al.*, 2014:622) and (Boeckxstaens *et al.*, 2015:40).

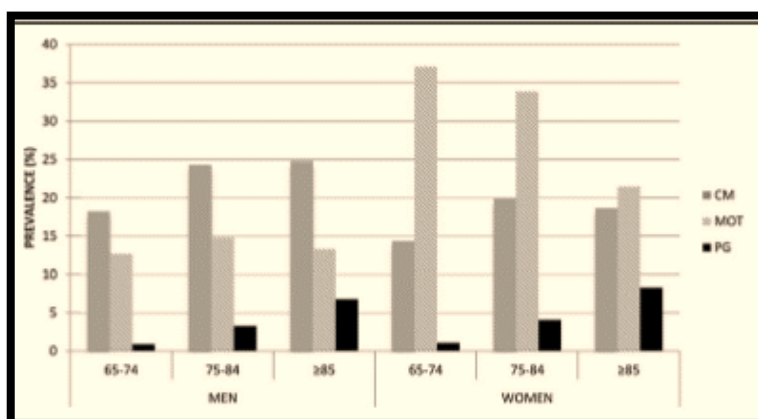
Viola *et al.* (2014:1), presented the impact of multimorbidity on the elderly as follows: increased risk towards premature death, hospitalization, loss of physical function, depression, polypharmacy and worsening quality of life. Furthermore, Abizanda *et al.* (2014:622) and Barnett *et al.* (2012:37), noted that the implications of multimorbidity on health care service as well as the treatment of patients, are largely still being investigated. This is primarily since health care systems have been designed to treat patients with single diseases. The resulting rise in patients with multimorbidity places demands on the health infrastructure to cope with the number of patients needing care as well as rising cost of treatment.



Some insight into the complexity of multimorbidity is offered by Abizanda *et al.* (2014:626) and Marventano *et al.* (2014:610). They surmised that a few aspects have contributed towards the lack of consensus in defining multimorbidity, namely:

- i. there is inadequate consensus on which diseases should be included to measure the burden of disease; and
- ii. including too few diseases in the definition can lead to an underestimation of the disease, conversely, including too many diseases may make the definition less sensitive towards contributing diseases.

In their study of the prevalence of multimorbidity in the elderly population, Abad-Diaz *et al.* (2014:76), clustered the prevalent chronic diseases into 3 groups namely, cardio-metabolic (e.g. atherosclerosis, hypertension, diabetes, ischemic heart disease, etc.); mechanical (osteoporosis, low back pain, arthropathy, varicose veins, etc.) and psychogeriatric (behavioural problems, dementia and delirium, Parkinson's disease, etc.). The results are illustrated in the Figure 2.12 below.



**Figure 2.12: Prevalence of multimorbidity patterns by gender and age groups. Adapted from Abad-Diaz *et al.* (2014:78)**  
**CM=cardio-metabolic, MOT=mechanical orthopaedic, PG=psychogeriatric.**

Figure 2.12 above indicates that the prevalence of cardio-metabolic diseases was found to be higher in males. This could possibly be from the failure to detect chronic diseases early in the female population, poor referrals and poor treatment, leading to poor patient outcomes in females. The chronic diseases most prevalent in females are shown in Figure 2.13 below. The results demonstrate a higher prevalence of mechanical and psychogeriatric disorders as well as more overlapping of the diseases amongst woman. This has been attributed to women living longer and displaying worse health status than their male counterparts.

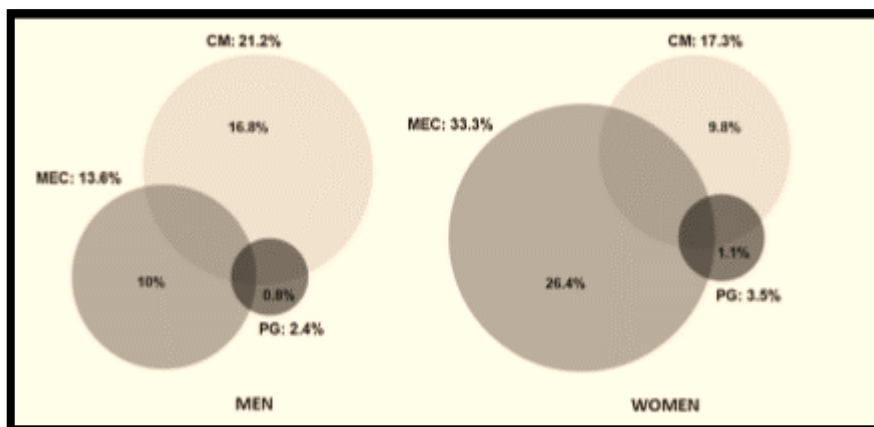


Figure 2.13: Overlapping of multimorbidity patterns in men and women. Adapted from Abad-Diaz *et al.* (2014:76)  
 CM=cardiometabolic, MOT=mechanical orthopaedic, PG=psychogeriatric.

#### 2.5.4 The effect of physical activity on multimorbidity

According to Groll *et al.* (2005:595-602), individuals presenting with more than one chronic disease (multimorbidity) are at a greater risk of decreased physical ability, while Loprinzi (2015:395), reiterated the fact that physical activity is associated with improved health. Muscle strengthening activities have been shown to reduce the risks associated with various chronic diseases and thus reduce the risk of early mortality, disability and diminished quality of life. While the effect of physical activity on individual chronic conditions has been well investigated, its impact of multiple chronic conditions (multimorbidity) occurring in the same individual is less well understood. Dankel *et al.* (2015:54), found that participation in muscle strengthening activities showed improvements in the musculoskeletal system of those who reported participation in such activities. Aside from the improvements in the musculoskeletal system, improvement in cardiac, vascular and respiratory function have also been documented. The benefit of increased muscle strength and reduced body fat play an important role in reducing the risk of diseases such as obesity, hypertension and high blood cholesterol.

#### 2.5.5 Cardiovascular disease (CVD)

Cardiovascular disease is a group of diseases that include disease of the blood vessels and the heart itself. The most common cardiovascular diseases include the following: coronary artery disease, high blood pressure, cardiac arrest, congestive heart failure, arrhythmia, peripheral artery disease, stroke and congenital heart disease, (AHA:2017). Interestingly, Marventano *et al.* (2014:613), found that synergy in multi-morbidity only occurred between cardiovascular disease and hypertension. This synergistic relationship meant that the risk of disability and ADL impairment was higher in individuals that had both chronic diseases

(CVD and hypertension). They further alluded to the fact that hypertension may cause left ventricular hypertrophy and atherosclerosis progression, leading to eventual heart failure. Singh *et al.* (2014:1726), explained that cardiovascular disease arises from atherosclerosis, a process from which plaque accumulates in the blood vessels causing stenosis of the vessels, restricted blood flow, ischemia and eventual tissue/organ damage and/or death. If blood clots (thrombi) form, it can result in myocardial infarction (heart attack) or stroke.

Cardiovascular diseases (CVD) represent the number one cause of death worldwide with 17.7 million people dying from them in 2015. It accounts for over  $\frac{3}{4}$  of the deaths in middle-low-income countries and greater efforts are needed to tackle its impact in these countries, WHO (2017). Ischemic heart disease, specifically, is the leading cause of death, but its effects largely increase with its association with congestive heart failure and atrial fibrillation in old age (Prince *et al.*, 2015:553).

According to Sparling *et al.* (2015:1) and the ACSM (2018:48), CVD has modifiable or behavioural risk factors, which include unhealthy diet, physical inactivity, tobacco use and alcohol abuse. These risk factors often give rise to hypertension, high cholesterol, diabetes, overweight and obesity. Villareal *et al.* (2011:1218) noted that obesity can accelerate age-related decline in physical function. Early detection of these risk factors at primary health care facilities plays an important role in the fight against CVD's. Modifications such as cessation of tobacco use, dietary modifications (less salt intake, increased consumption of fresh fruits and vegetables, decreased intake of animal fats), regular physical activity and avoiding alcohol abuse can decrease the risk of CVD's. Where necessary, pharmacological interventions can also be launched to control some of the risk factors such as hypertension and diabetes (WHO:2017).

### **2.5.6 The effect of physical activity on cardiovascular diseases (CVD)**

Durstine *et al.* (2012:6), commented that the increase in life expectancy brings the threat of disease as people age. Chronic diseases remain one of the culprits of causing the highest amount of deaths in the world. In the past, chronic diseases used to be most common among the elderly but with the change in lifestyle, they are becoming increasingly common among younger individuals as well. Physical inactivity has been singled out as one of the leading causes of the early onset of chronic disease (Watz *et al.*, 2014:1522). Lee *et al.* (2012:227), further pointed out that worldwide statistics indicate that physical inactivity causes 6-10% of major non-communicable diseases (Type 2 diabetes, coronary heart disease, cancer). Worldwide, life expectancy could increase by 0.68 years with the

elimination of physical inactivity. Therefore, an elimination of physical inactivity is a critical step that can potentially curb non-communicable diseases.

Vigoritto and Giallauria (2014:1) and Ahmed *et al.* (2011:289-289), also stated that physical activity has proven to be effective in reducing the risk towards developing CVD. This is thought to be brought about by the reduction in the size of LDL particles through sustained, regular aerobic exercise. Although exercise appears to have no impact on the total level of LDL, reduction in the particle size of LDL presumably plays an important role in decreasing atherogenicity. Moderate intensity exercise also has an impact on the levels of triglycerides and HDL by lowering triglycerides and increasing HDL levels.

Regular physical activity also has an antithrombotic effect. For exercise to be effective in producing the antithrombotic effect, it must be sustained and over a long-term period to counteract the acute prothrombotic effects of exercise (Ahmed *et al.*, 2011:291). Similarly, Wang *et al.* (1995:1668-1674), published studies with evidence of decreased platelet aggregation and adhesiveness following long-term moderate intensity exercise. More importantly, the antithrombotic effects reversed to previous values within 4 weeks of cessation exercise. Therefore, continuation with the exercise programme is critical in maintaining the benefits thereof.

### **2.5.7 Chronic respiratory disease (CRD)**

Chronic respiratory diseases are diseases of the airways and of the lung itself. Some of the most common diseases include the following: chronic obstructive pulmonary disease (COPD), asthma, lung cancer, cystic fibrosis, sleep apnoea and occupational lung diseases e.g. coal worker's pneumoconiosis a.k.a. black lung disease and silicosis a.k.a. grinder's asthma or potter's rot, (WHO:2017). The most common CRD in the elderly is COPD and will thus receive special focus. Troosters *et al.* (2013:115), defined COPD as "a debilitating and progressive disease that primarily affects the respiratory system." They also noted that in some COPD patients, there are extra-pulmonary effects e.g. weight loss and skeletal muscle wasting. This is a critical reason why physical activity can often be useful in the treatment of COPD.

The WHO (2017) stated that three million of the global population dies from COPDs, which accounts for about 6% of deaths across the world; of those >90% occur in middle-low-income countries. In older people COPD accounted for 86% of the burden of disease in middle-low cost countries. The global prevalence is 10% in people under 40 years, but it

doubles with every 10-year increment in age estimated to reach between 19 and 47% in men and between 6 and 33% in women 70 years and older (Prince *et al.*, 2015:555).

Risk factors for CRDs include air pollution, occupational exposure to dangerous chemicals/air borne particles or pollutants and tobacco use. While there remains no cure for CRDs, there are various forms of treatment available. These treatments help dilate the air passages, improve dyspnoea symptoms and improve the quality of life of those affected, WHO (2017). Although smoking is flagged as the most important risk factor to COPD, Prince *et al.* (2015:555) caution that the substantial prevalence of COPD in non-smokers points to other risk factors such as exposure to biomass fuels and tuberculosis as important risk factors in the development of COPD. This is especially true in middle-low-income countries.

### 2.5.8 Effect of physical activity on chronic respiratory diseases (COPD)

As previously stated (cf. point 2.5.7), of the CRDs most commonly experienced by the elderly, COPD is the most prevalent and will receive special emphasis. Physical activity levels are notably lower in COPD patients than in healthy individuals. Physical inactivity has been identified as a characteristic of many chronic diseases, both as a cause as well as a consequence. Figure 2.14 below illustrates the vicious cycle between inactivity and symptoms in COPD patients.

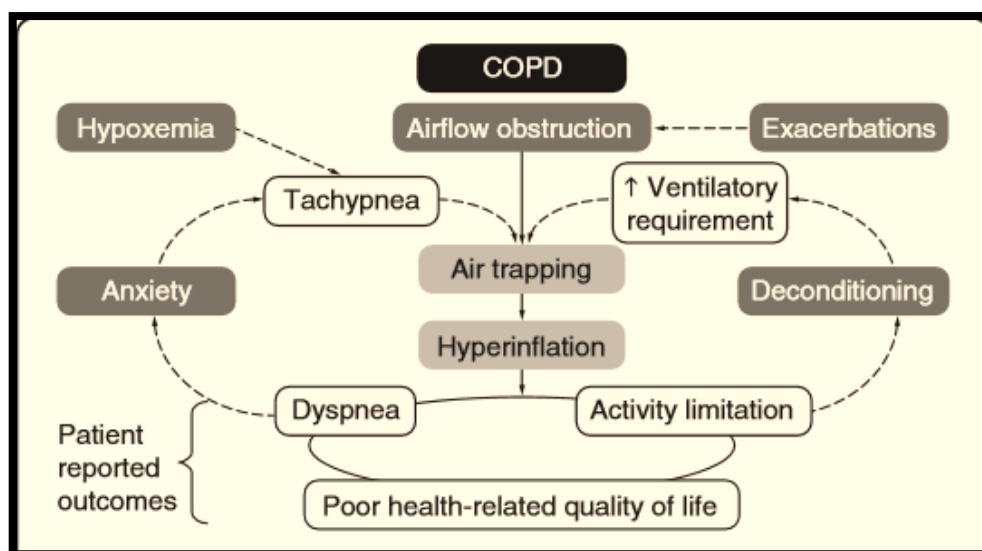


Figure 2.14: The vicious cycle of inactivity and symptoms (adapted from Troosters *et al.*, 2013:1-8)

As a cause of COPD, physical inactivity predisposes individuals to chronic diseases such as obesity, diabetes, CVD and cancer, to name a few.

The resulting chronic diseases lead to limitations in performing physical activity (stemming from anxiety to be physical active) → which eventually leads to increased physical inactivity → and a poor quality of life. As a consequence of chronic disease, physical inactivity may result from worsening health status, physical limitations brought on by disease (e.g. amputations) and declining physiological reserve (Troosters *et al.*, 2013:2). Watz *et al.* (2014:1522-1523), also noted that COPD studies show an inverse relationship between and the magnitude of lung function decline in at least one of the population groups studied. An inconsistent association exists between low physical activity levels and faster lung function decline.

Although the ACSM (2018:193), the recommended physical activity dose is a minimum of 150 minutes of moderate intensity aerobic activity per week; Taylor (2014:26), is of the opinion that people with medical conditions that restrict their ability to be active, should be encouraged to do as much as their health allows. The American Thoracic Society and the European Respiratory Society released a joint statement in 2006 stating that pulmonary rehabilitation should form an integral part of the clinical management of patients with chronic respiratory disease. This is a shift from previous views that saw pulmonary exercise as a last resort in the management of the patient (Troosters *et al.*, 2013:116). The ACSM (2016:98) lists the following benefits of exercise in persons with COPD:

- Facilitation of ADLs;
- Cardiovascular reconditioning;
- Improved ventilatory efficiency;
- Improved lactate and ventilatory threshold;
- Desensitization to dyspnoea and the fear of exertion;
- Increased muscle strength and endurance;
- Improvements in flexibility and balance; and
- Enhance body image

## **2.5.9 Musculoskeletal-related chronic diseases**

### **2.5.9.1 Osteoarthritis (OA)**

Prince *et al.* (2015:557), stated that musculoskeletal disorders account for 43.3 million disability adjusted life years (DALYs) in older people in 2010. Sixty-six percent (66%) of the 43.3 million represents middle-low-income countries. The main contributors to these disorders are low back pain and osteoarthritis. Global statistics estimate that 9.6% of men

and 18.0% of women over 60 years have symptomatic OA. Osteoarthritis also known as degenerative joint disease, is a common chronic disease of the joints that is closely associated with ageing. The cause is idiopathic in that the exact cause of the degeneration of the cartilage that leads to pain, stiffness and swelling is unknown. Several factors have been identified as crucial in the development of OA, including excess weight, acute injury - especially to the articulating cartilage of joints, overuse and genetic factors. Nelson *et al.* (2014:702) reported that arthritis, rheumatism and back/spine problems make up the leading causes of disability in the United States (US). Osteoarthritis presented as the most common form of arthritis affecting more than 27 million people.

Treatment for OA according to Prince *et al.* (2015:557), has centred around self-management (exercise, pacing of activities, joint protection, weight reduction and any other measures to reduce stress to the joints as well as unloading the joints). Fransen *et al.* (2015:1554), explained that these treatment methods stem from the fact that factors such as impaired muscle function are amenable to exercise therapy. Pharmacological interventions can also prove helpful in improving the symptoms of pain. As a last resort, surgical intervention can be sought, where a joint replacement can be done when no other conservative measures have proven effective in reducing pain and improving the quality of life.

#### **2.5.9.2 Effect of physical activity on osteoarthritis (OA)**

Osteoarthritis is one of the most prevalent chronic conditions affecting the elderly. Elderly persons afflicted with OA were once warned against various forms of physical activity, out of concern that they may increase pain, advance joint destruction and incur other injuries. Fransen *et al.* (2015:1554-1557), suggested that exercise is now considered an effective treatment in the management of OA. Bean *et al.* (2004: S34-S36), discouraged the approach of ceasing physical activity that resulted in reductions in aerobic capacity, which can be counteracted by walking programmes, stationary cycling or aquatic exercise. Low to high intensity progressive resistance exercise has also proven effective in increasing muscle strength. This has also led to reductions in disability among the elderly.

With regards to the impact of exercise on bone mineral density (BMD), Vogel *et al.* (2009:311-313), noted that the results of various randomized trials showed great disparity. The benefits seem to depend on the type of physical activity. Some exercises e.g. swimming, seem to have little to no impact on bone structure, while others appeared to slow down age related bone loss (e.g. walking, low-moderate intensity exercise). Activities such

as running and vigorous/high intensity exercise seemed to increase bone mineral density. At any rate, the benefit of increased bone mineral density benefits the bones involved in the specific activity e.g. Upper arms in squash (although not indicated for elderly/frail) or any other upper body dominant activity. Long-term physical activity of high intensity and high impact also showed favourable benefit to persons with osteoporosis. The ACSM (2018:345), also argued that exercise can delay the onset of the osteoporosis and reduce the risk of fractures. Benefits from exercise lead to increases in BMD, volume and strength, increase in muscle strength and improved balance. They recommend the following frequency, intensity, time and type (FITT) principle regarding exercise prescription: 4-5 days a week of moderate intensity beginning with 20 minutes and progressing to a minimum of 30 minutes and a maximum of 45-60 minutes. Activity type can be walking, cycling or any other weight bearing aerobic activity.

### **2.5.9.3 Balance, speed and agility**

The ACSM (2018:2), defines speed as 'the ability to perform a movement within a short period of time' and agility is defined as 'the ability to change the position of the body in space with speed and accuracy'. Speed and agility are beneficial in respect of the fact that they help improve efficiency of movement, decrease risk of injury, improve the ability to perform ADLs and as such improve the quality of life. As individuals age, the decrease in the muscle/sensory output brought on by muscle atrophy decreases the neurologic input of body position and movement. Other physiologic declines leading to decreased bone mass, lowered cardiovascular functional capacity and medications also contribute to the decline of speed and agility in the ageing individual. According to Rubenstein (2006:ii37) the loss of balance leading to falls is among the highest causes of injuries in the elderly and fifth cause of death after CVD, cancer, stroke and pulmonary diseases. The resulting falls are the cause of both morbidity and mortality in this population; serious falls leading to death constitute more than two-thirds of unintentional injuries and the rest can result in serious disability.

Pollock *et al.* (2012:916) stated that falls are the leading cause of morbidity and mortality in the elderly. Coupled with conditions such as osteoporosis and arthritis, the falls can result in fractures and further damage to joints. It is not merely the incidence of falls within this population that creates concern, but the combination of incidence with their high susceptibility towards injury because of diseases and their slowed protective reflexes makes it a dangerous combination. Landi *et al.* (2010:539), noted that physical activity can be useful against functional impairment by providing gains in functional autonomy whilst



lowering the risks of potential morbidity. Furthermore, Giné-Garriga *et al.* (2014:754), also supplement the following benefits of exercise in older adults, namely: improving physical functions such as sit to stand performance, balance, agility and ambulation.

#### **2.5.9.4 The effect of physical activity on balance, speed and agility**

Since balance, speed and agility are skill-related components of physical fitness, improvement in their performance is reliant on improvement in the systems that support and execute them such as muscle strength. With the resultant loss of muscle mass and strength associated with ageing, a measure of speed and agility is also lost. Miller *et al.* (2001:62), commented that maintenance of muscle strength is critical to maintenance of speed, while agility is more closely tied to muscle strength and a measure of balance for execution. Deterioration in balance will also affect agility; therefore, any improvement in balance is supportive of executing agility. The colloquial principle of 'use it or lose it' strongly applies to maintaining skills. Continued exercise of these skills in short bouts is critical for the maintenance of the skill. Exercise that improves reaction time and coordination improves agility. Furthermore, Reed-Jones *et al.* (2012:586), concur that agility can prevent falls and improve the execution of ADLs both of which are critical to independent living in the elderly.

Sibley *et al.* (2014:1), stated that falls and the resulting injuries from falls in the elderly population are common and one of the leading causes of longstanding pain, functional impairment, disability and death. Kannus *et al.* (2005:1885), also mentioned that of the falls that result in injury, 20% require medical attention, 5% result in fracture and other serious injuries e.g. severe head injuries, joint distortions and dislocations, soft tissue bruises, contusions and lacerations. The danger that falls pose to the health of the elderly make fall prevention programmes a vital tool in injury prevention. Kannus *et al.* (2005:1885-1893), found that fall prevention programmes have typically used one of two approaches: a single intervention strategy (exercise, Vitamin D supplementation or the withdrawal of psychedelic drugs) or multifactorial intervention programmes that aim to assess and treat the individual's predisposing and situational risk factors towards falls. One of the traditional approaches has also been the treatment of osteoporosis (Cho *et al.*, 2014:1771-1774). The multifactorial approach is favoured due to its effectiveness in targeting the various factors that predispose a person to falls.

Exercise has been proven to be effective in reducing falls in the elderly (Vigoritto & Giallauria 2014:51) and (Lord *et al.*, 2003:1685). The Falls and Injuries: Cooperative studies in Intervention Techniques (FICSIT) trials (seven randomised controlled trials assessing

various exercise interventions: e.g. endurance, flexibility, platform balance, tai chi and resistance) (Cho & An 2014:1773), have so far provided the greatest evidence of this fact. Their study of the effects of a fall prevention exercise programme on muscle strength and balance of the 'old-old' elderly (over the age of 75) showed that resistance exercises resulted in improvement of both muscle strength and balance. Their study used elastic resistance exercises and balance exercises in combination to target falls. The decreasing muscle mass that comes with ageing (sarcopenia) is a contributing factor that leads to reduced muscle strength and function that makes it harder to anticipate, prevent and recover from falls.

Similarly, Shimada *et al.* (2013:472-479), conducted a study to monitor the specific effects of balance and gait exercises on physical functioning among the frail elderly. The outcome measures were: the one leg standing test, functional reach test, manual perturbation test, functional balance scale, performance-oriented mobility assessment, timed 'up and go' test and the stair climbing/descending test. Participants were divided into three groups, viz balance exercise group, gait group and the control group and participated in a 12-week intervention of balance or gait exercises 2-3 times a week for 40 minutes. The results indicated that the balance group performed better in the one leg standing test, functional reach and functional balance scale test while the gait group showed improvement in the functional balance test, timed 'up and go' as well as the stair climbing/descending test. The control group did not show any improvement in any of the outcome measurements. In summary, the balance group performed better at the balance-oriented tests while the gait group performed better at the balance and mobility-oriented tests. The conclusion was that a combination of both balance and gait training will lead to greater functional outcome in the elderly.

Tousignant *et al.* (2013:1429) recognised the use of tai chi as an exercise for fall prevention. The FICSIT trials mentioned in the work of Cho and An (2014:1773), also highlighted the use of tai chi as an exercise modality for balance training. Wolf *et al.* (2001:689-704), further explored this modality in the clinical trial that sought to investigate the effect of intense tai chi in reducing falls among older adults transitioning into frailty. Participants in the randomised, masked clinical trial were divided into two groups (viz tai chi group and the wellness group). The intervention was carried out twice a week over a period of 48 weeks progressing from 60 to 90 minutes over the 48 weeks.

Primary outcomes measured the number of fall events during the intervention and secondary outcomes measured functionality through the following tests: the functional

reach test, bending to pick up a slipper and a 360° turn, single limb support, three chair stands and the ten-meter walk. Results showed fall events were prevented in the exercise participants.

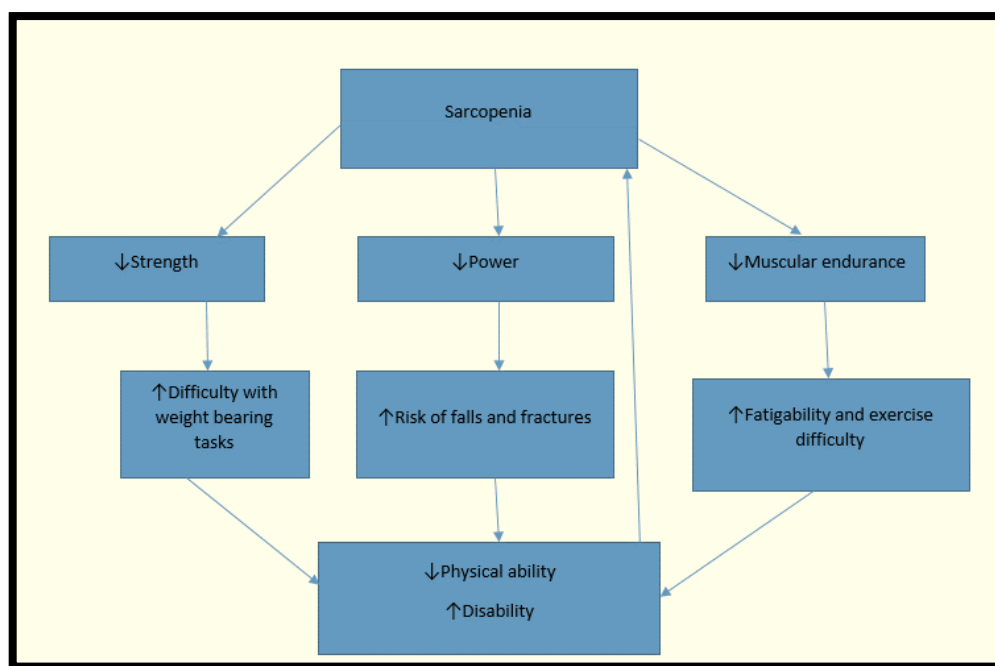
### 2.5.10 Sarcopenia

According to Clegg *et al.* (2013:755), the relationship between sarcopenia and frailty has received special attention for the following reasons: 'both are (i) highly prevalent in the elderly (ii) associated with negative health-related events (iii) potentially reversible and (iv) relatively easy to implement in the clinical practice. The role of sarcopenia in leading to physical inactivity is explained by Lang *et al.* (2009:541), as follows: As the older individual perceives the increased effort required to exercise and perform physical activities, they may develop avoidance of these activities. As physical performance declines, it decreases physiological functional reserve capacity which in turn leads to sarcopenia with the result being restriction in physical activity. The ACSM (2016:130), notes that the decline in physiological reserve in individuals who are physically inactive makes them highly susceptible to the following:

- Risk of falls;
- Disability;
- Cognitive decline;
- Hospitalization;
- Need for assistive living or institutionalization; and
- Other conditions associated with physical inactivity.

Landi *et al.* (2013:1363), described sarcopenia as the loss of muscle mass which occurs naturally with ageing. Strength exercises have been suggested by Hunter *et al.* (2004:330), to counter the effects of sarcopenia. Lustosa *et al.* (2011:319) stated that strength peaks in the 3<sup>rd</sup> decade of life and remains unchanged until the 5<sup>th</sup> decade of life, where decline begins. Rapid decline follows at a rate of 12%-15% per decade of life with the evidence being most noticeable in the weight bearing lower limb muscles. It is this rapid progression of sarcopenia in late life that leads to a decline in function and towards frailty and loss of independence. As mentioned previously, most of the loss in muscle strength is expedited in the 5<sup>th</sup> or 6<sup>th</sup> decade of life. The subsequent result of loss in muscle strength starts a cascade of physical limitations beginning with reduced energy expenditure through movement, which in turn can result in accumulation of visceral fat and central adiposity, which predisposes the individual to metabolic conditions such as metabolic syndrome,

diabetes and cardiovascular disease. Decreased movement also led to increased bone density loss which eventually led to osteoporosis, further limiting the older adult in their ADL and ultimately paving the way towards physical disability. Fried *et al.* (2004:255) stated that the ability of physical activity (resistance exercise in particular) to counteract the effects of sarcopenia by increasing muscle mass, makes exercise a useful tool in the prevention of frailty. Drewnowski and Evans (2001:91) and Landi *et al.* (2013:1363), supported this view that targeted exercise training in the form of progressive resistance exercise can deal with weakness and frailty. Figure 2.15 below, illustrates the cascade triggered by sarcopenia towards disability. Sarcopenia directly affects the muscles by decreasing power, strength and endurance. This decline in muscle output leads to falls, difficulty in performing tasks and ADLs and general physical movements. Further decline eventually results in disability. The continued state of disability feeds back into sarcopenia and reinforces the cascade towards disability even further, unless an intervention is made. The mediating force that is sarcopenia in the inability to perform ADLs, is also stressed by the ACSM (2016:131). Exercise test results in the frail individual usually present with muscle weakness, low endurance and easy fatigability. Despite the emphasis on strength training for the improvement of sarcopenia, they advocate for a multicomponent exercise program that comprises of aerobic and strength training. They argue that challenging the motor control of multiple segments used in ADLs have shown greater improvement of balance indices and fall rates.



**Figure 2.15: A model of the functional consequences of age-related sarcopenia and the positive feedback loop by which the result of reduced physical activity further exacerbates progression of the disorder (Hunter *et al.*, 2004:330)**

### **2.5.10.1 The effect of physical activity (strength training) on sarcopenia**

Taaffe *et al.* (1999:1208), noted that resistance training had been found to be a safe and effective method for maintaining and developing muscle strength. It has also been found to be an important contributor to independent living and the ability to perform essential ADLs. Brown *et al.* (2000:964), found that elderly men and women with some degree of frailty were capable of gains in strength, flexibility and balance with a low intensity exercise programme which can improve their total functional capacity.

Seguin and Nelson (2003:142), stated that resistance training can oppose the debilitating effects of weakness and frailty. For an understanding of how resistance training works, the associated anatomy and physiology must be understood. "Muscle strength" is defined as "the ability of a muscle to generate force against some resistance" (Prentice., 2014:99). The amount of force a muscle can generate is directly proportional to the cross-sectional diameter of the individual muscle fibres that comprise that muscle, so the larger the muscle fibres the more force the muscle can generate. Weight/resistance training causes increases in muscle fibres through progressive loading of the muscle, resulting in hypertrophy of the muscle. It is hypothesised that hypertrophy comes as a result of the increase in number and size of the protein contractile unit of the muscle fibre called the myofilament in response to resistance training. Hunter *et al.* (2004:334), observed that the older skeletal muscle subjected to resistance training 2-3 times a week over a period of 9-52 weeks showed gains of 10%-62%. This points to the fact that ageing skeletal muscles can in fact adapt to resistance training and mitigate the effects of sarcopenia. This then raises the question: "how much of functional decline that occurs with ageing is due to sarcopenia vs chronic inactivity?"

Strength training also improves the strength of other non-contractile units in the musculoskeletal system e.g. tendons and ligaments. Increased weight bearing also increases bone density and strength, making bones less prone to being brittle or breaking (osteoporosis) which can lead to disability. An important characteristic of hypertrophy is reversibility, which is simply the loss of any gain in muscle strength and size due to seizure of training resulting in atrophy of the muscle. Reverses can begin as soon as 48 hours after training stopped and activity is discontinued; thus, the key to avoiding loss in muscle strength, atrophy and sarcopenia is in consistent exercise (Prentice., 2014:99). Taaffe *et al.* (1999:1212), also found that gains in muscle fibre hypertrophy become more apparent with

extended training durations. The scientific community agrees that habitual physical activity puts older adults at a lower risk of functional limitations and disability, (Buchner., 2003:214).

## **2.6 FLEXIBILITY**

The ACSM (2018:102), details the importance of flexibility in all individuals. They define flexibility as “the ability to move a joint through the entire range of motion.” Flexibility plays an important role in physical performance for an individual to compete in any activity or perform ADLs. The loss of flexibility can lead to movement restrictions and eventual injury. Loss and/or restrictions in ROM can result from associated structures surrounding the joint such as ligaments, tendons and the joint capsule where applicable e.g. the shoulder joint. Stathokostas and Vandervoort (2016:169), stated that flexibility decreases with age but that older adults can regain lost ROM. Stretching is the recommended method for maintaining and improving flexibility.

### **2.6.1 The effect of physical activity on flexibility**

The ACSM (2018:168), makes the following recommendation for the FITT principle applicable for flexibility: Each major muscle group should be stretched 2-3 days a week at 60%-70% of a 1 RM (repetition maximum) and held for 10-30 seconds in static stretching. The type of stretching involved will depend on the activity being pursued. Although various stretching methods can be deployed, static stretching has been a mainstay of most exercise programmes despite the lack of conclusive evidence on its effectiveness in injury prevention. Aside from stretching, programmes (called flexibility training) engaging in activities such as Pilates are planned, structured regular exercise programs that can improve flexibility in older adults. Ultimately, despite its obvious importance in physical functioning, the value of improved flexibility in functional performance has produced varied and inconclusive results. Roberts *et al.* (2017:30) concluded that strength and balance may in fact be more important for physical functioning than flexibility.

## **2.7 CONCLUSION**

Current research has already proven that physical activity has a positive impact on frailty and can potentially reverse some of the symptoms of frailty. It has also highlighted the need to research other factors that can impact on the improvement of ADL in frail elders, such as environmental and social factors. The call for multicomponent or multiprofessional research in frailty is one that needs to be heeded to advance our understanding of this multisystemic

syndrome and create effective interventions to counter its deleterious effects and acceleration towards disability and death in the elderly.

A foundation has been laid for future studies in this area; however, considering the disparities in the dynamics of developed and developing nations, there is a need to conduct frailty and frailty intervention studies in developing nations. As stated in the introduction, developing nations will bear the brunt of the unprecedented increase in the elderly population. With this increase comes the burden of disease associated with this population group that is susceptible to multiple chronic diseases that can result not only in death but also in rising medical costs and health infrastructure burden. A better understanding of frailty and developing successful intervention strategies in developing nations can better prepare developing nations for the rising numbers of the elderly that are projected to come in future.

## CHAPTER 3

### METHODS AND PROCEDURES

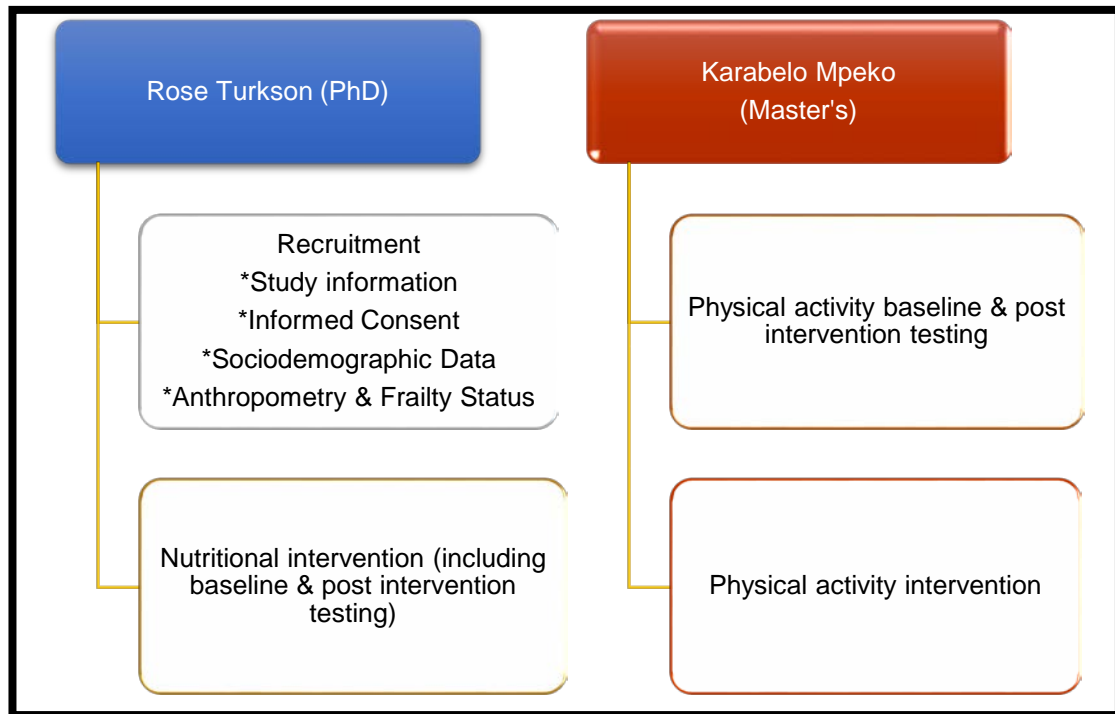
---

#### 3.1 INTRODUCTION

As already established in the previous chapter, interventions on frailty have been proven to be an effective method of managing frailty syndrome (De Labra *et al.* 2015:166). This chapter describes the protocol designed to investigate the research outcomes as stated in Chapter 1. The instruments used in this study will also be discussed. In preparation for this dissertation, literature was collected from electronic databases such as Kovsiekat, Pubmed, EbscoHost (Academic Search Elite and Medline), academic journals and textbooks. A brief background of the study follows below.

This study consisted of two legs that were investigated by two researchers (Figure 3.1 below). The dietetics PhD candidate Rose Turkson investigated the impact of a nutritional intervention on frailty syndrome. This was the initial leg of the study and included the recruitment of the participants and screening of the participants via questionnaires to see if they met the criteria of the study. When participants were recruited for the study, they had to complete informed consent forms, which were explained to them in English or Sesotho. Participants had the choice to decline participation in the study if they did not wish to participate. The information regarding the purpose of the study is contained in the Study Information Document which was thoroughly explained to the participants before they signed consent. That part of the methodology will be briefly highlighted, prior to discussing the physical activity intervention methodology. The physical activity intervention was initiated after the participants were recruited and the baseline tests were performed (second leg of the research, performed by second researcher, which is also the author of this document). Therefore, this chapter will describe the methods and procedures applicable to the investigation of the impact of the physical activity intervention programme on frailty syndrome in elderly citizens in Maseru district, Lesotho.





**Figure 3.1: Distribution of duties**

Ethical approval to perform the study was obtained from the Human Studies Research Ethics Committee of the Faculty for Health Sciences, UFS [(ECUFS 217/2014B) cf. Appendix A]. All information was kept strictly confidential. Codes instead of names were used on all questionnaires. Only the researcher had access to the list of the codes and names of participants.

The researcher was responsible for the training of field workers on how to implement the testing and exercise programme as well as overall supervision of the data collection process.

### **3.2 RESEARCH DESIGN**

The participant recruitment followed a cross-sectional quantitative design. The participants were subjected to a baseline testing followed by a 12-weeks intervention programme. After the intervention period, a post intervention testing was performed. In this way the impact of a physical activity intervention programme on frailty syndrome in elderly citizens in Maseru, Lesotho could be determined.

The physical activity intervention constituted of the following phases:

- **Phase 1**

This was the pre-intervention phase (baseline testing) which was conducted to establish baseline values. These values were used to design an exercise intervention programme for the participants.

- **Phase 2**

This phase was the implementation of the physical activity intervention programme. A pre-test – post-test control group design was used to implement and evaluate whether the physical activity intervention (for approximately 12 weeks) can improve frailty in the elderly citizens in Maseru district, Lesotho (Thomas *et al.*, 2011:72).

### **3.2.1 Selection of participants**

As previously indicated in Figure 3.1, this part of the study followed a cross-sectional quantitative design and was conducted by the Ph.D. candidate, Rose Turkson. This section simply provides background regarding how the final numbers were obtained for the control, milk and the milk and physical activity intervention groups.

#### **3.2.1.1 Recruitment of participants**

The elderly participants were identified by going from community to community and obtaining a list of the prospective elderly people in that community from the community chiefs; that later served as a guide to locate their homes. Permission to enter the community and talk to the elderly was obtained from the chief per community.

#### **3.2.1.2 Selection criteria**

The sample size for recruitment into the study included 320 participants (as determined by the biostatistician to be a representative amount of the population), which was eventually filtered to 120 for the intervention. The intervention ran for approximately three months and was constructed as follows: the milk only group received sour milk for five days of the week for three months; the physical activity intervention group received sour milk for three days of the week after every exercise session for three months and the control group did not receive any intervention for three months.

For the baseline testing and intervention phase, participants that met the inclusion criteria of the study were included to comprise 40 participants for experimental group (milk only), 40 for the 2<sup>nd</sup> experimental group (milk and exercise) and 40 participants for the control group (no intervention). Participants were randomized into the various groups.

#### **3.2.1.3 Inclusion criteria**

The elderly included in the study met the following criteria:

- Elderly aged 65 years and older were included in the study if they lived in a selected community and were not planning to relocate during the time that the study was implemented.
- Elderly who were classified as frail according to Frailty Index.
- Elderly who were willing and consented to participate in the testing and intervention process.

#### **3.2.1.4 Exclusion criteria**

- Elderly who failed to provide consent.
- Elderly who were physically challenged and could not stand upright.
- Elderly who had been hospitalized within the previous 6 months.
- Elderly who were bedridden.
- Elderly who were not classified as frail.

### **3.3 SELECTION INSTRUMENT**

Once identified, the prospective participants completed the following questionnaires:

#### **3.3.1 Socio-demographic information**

For this study, the socio-demographic and household parameters included: age (date of birth), sex, educational level, employment status and marital status (cf. Appendix B).

#### **3.3.2 Nutritional status**

Nutritional status included the dietary intake (i.e. individual dietary diversity score), and the information obtained with the mini nutritional assessment MNA) (**anthropometric assessment for BMI calculation**, global evaluation, dietetic assessment and subjective assessment) (cf. Appendix C).

### 3.3.3 Frailty Index Scale

The frailty scale developed by Rockwood *et al.* (1999:205-206), was used to rapidly assess the elderly for functional status. The frailty status of the elderly will be assessed. According to this scale, persons are classified as **fit** (walks without help; performs basic ADLs e.g. eating, dressing, bathing & bed transfer; continent of bowel and bladder; not cognitively impaired); **fit but bladder incontinent** (walks without help; performs basic ADLs e.g. eating, dressing, bathing & bed transfer; continent of bowel but not of bladder; not cognitively impaired), **pre-frail** (1 or more of the following, two if incontinent: needs assistance with ADLs or mobility; bowel or bladder incontinent; cognitive impairment without dementia); **frail** (two of the following, three if incontinent: totally dependent for transfers; totally dependent with one or more ADLs; bowel or bladder incontinent; demented) (cf. Appendix D).

### 3.3.4 Informed consent

The testing procedures, risks, benefits, and confidentiality of information were explained to each participant in their preferred language (cf. English version Appendix E); (cf. Sesotho version Appendix F). Participants then signed an informed consent form (cf. English version Appendix G; cf. Sesotho version Appendix H) declaring the giving of accurate information, voluntary participation, and the use of information for scientific purposes.

## 3.4 PRE-TEST AND POST-TEST PROCEDURES, MEASUREMENTS AND EQUIPMENT

Pre-test and post-test procedures refer to baseline testing conducted prior and post intervention respectively. Pre-test procedures will be referred to as baseline testing and it was conducted 2-3 weeks prior to the intervention. Participants were tested individually within a group setting at one of the homes of the participants. Specific equipment required per test will be named in the respective tests. For all the tests where time was kept, a Century clock and timer was used.

The testing protocol (cf. Appendix I), was adapted from the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) functional fitness test and performed under the recommendations of exercise testing in the frail elderly as set out by ACSM (2009:205) in the table below:

**Table 3.1: Recommendations for exercise testing (ACSM, 2009:205)**

Methods	Measures	Endpoints	Comments
<b>Endurance</b>			
6-minute walk	*Distance	*Volitional fatigue	6min walk is good for measuring progress in exercise programs
	*Speed	Unsteadiness	
<b>Strength</b>			
Arm curl test			*Used to determine intensity of strength training and progress in strength training programmes
			*Sometimes contraindicated in people with osteoporosis
<b>Flexibility</b>			
Chair sit and reach test	*ROM		
	*Distance		
<b>Agility</b>			
8-foot up and go	Time and distance		
<b>Neuromuscular</b>			
Chair sit to stand	Time	*Volitional fatigue	Walk tests are good for measuring gait and balance disorders
		*Unsteadiness	

### 3.4.1 Special considerations for exercise testing in frail elders

According to the ACSM (2018:194) and ACSM (2016:130-132), there are several conditions which may place frail elderly at risk for medical emergency during exercise testing; hence the following concerns were considered during exercise testing.

- a) Balance should be monitored during the execution of exercises (to prevent falls).
  - Standing exercise tests: It was in consideration of this fact that the 30 sec sit to stand test (aka chair stand) was selected instead of the 30 sec one legged stance test which places the elderly at risk of falls.
  - Sitting exercise tests: In all the tests where chairs were involved, care was taken to secure the chair against a wall or else ensure that it was on an even surface.
  - Walking exercise test: In the case of the 6-minute walk test, special care was taken to select an even surface, free of rocks or any grass that may cause the participants to trip and fall. Participants were always supervised in case they lost their balance, but also to ensure they kept a 'normal' walking pace as instructed.
- b) Caution is warranted regarding the length of exercise stages. One should ensure that stages are short because older frail individuals fatigue more quickly than others, and this could serve as negative reinforcement.

- All the tests except for the 6-minute walk, modified sit and reach and the handgrip test are based on the number of repetitions each participant can complete at their own pace within 30sec.

The 6-minute walk was conducted only as far as the participant can walk within 6-minutes and they could rest or retire completely if they could no longer continue.

### 3.4.2 Endurance testing

The 6-minute walk test was used to assess cardiovascular endurance/aerobic capacity, ACSM (2018:84). No specialised equipment is required for this test. A measuring tape to mark out the exercise area and cones were used to guide the participants. The recommended walking course was laid out in a 46m rectangular area (dimensions 41.1 x 4.6m), with cones placed at regular intervals to indicate distance walked (illustrated in Figure 3.2 below). The aim of this test was to walk as quickly as possible for six minutes to cover as much distance as possible. Participants set their own pace and could stop for a rest if they desired.

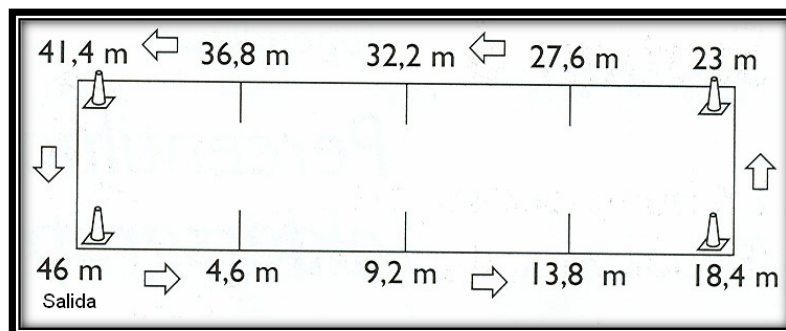


Figure 3.2: [6-minute walk test image *n.d*]

- Testing was conducted from community to community. The aim was to try to gather as many people as possible at one common area in the community. Where the distance between the houses was too great for the nearest neighbour to walk, house-to-house testing was conducted. The 6-min walk test had to be conducted outside, on a flat area of demarcated land. As a result, adjustments were made to the walking course, because the testing area per household varied. So, the course was laid out to the measurements of the largest area that could be found per testing area.

#### 3.4.2.1 Scoring

The distance walked in 6-minutes to the nearest meter was measured. The following regression equations were determined by (Jenkins *et al.*, 2009:516-522).

**Males:** Walk Distance (meters) =  $867 - (5.71 \text{ age, yrs}) + (1.03 \text{ height, cm})$

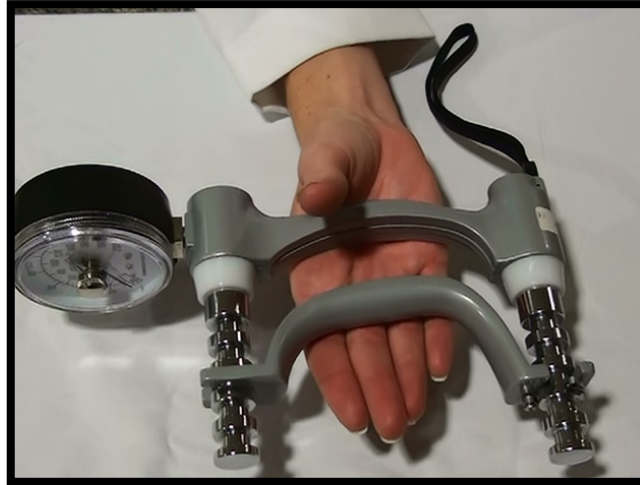
**Females:** Walk Distance (meters) =  $525 - (2.86 \text{ age, yrs}) + (2.71 \text{ height, cm}) - (6.22 \text{ BMI})$

#### **3.4.2.2 Validity and reliability**

The 6-minute walk test has good test-retest reliability ( $.88 < R < .94$ ), particularly when a practice trial preceded the test trial. Convergent validity of the 6-minute walk test was demonstrated by its moderate correlation ( $.71 < r < .82$ ) with treadmill performance. Construct validity was assessed by determining the ability of the test to detect differences between different age and activity level groups. As expected, walking scores decreased significantly across decades and were significantly lower for low active subjects compared to high activity subjects. There was a moderate relationship between 6-minute walk scores and self-reported functional ability. It was concluded that the 6-minute walk can be used to obtain reasonably reliable and valid measures of physical endurance in older adults and it moderately reflects overall physical functional performance, (Rikli & Jones., 1998:338-343).

#### **3.4.3 Muscular strength testing (upper body)**

Two tests were conducted to measure upper body strength namely, arm curl test and the handgrip test. To measure handgrip strength, the Saehan SH Hydraulic Dynamometer was used during this study (illustrated in Figure 3.3 below). The participant held the dynamometer in the hand to be tested, with the arm at right angles and the elbow at the side of the body. The handle of the dynamometer was adjusted if required – so that the base rested on first metacarpal (heel of palm), while the handle rested on the middle of four fingers. When ready, the participant squeezed the dynamometer with maximum isometric effort, which was maintained for about 5 seconds. No other body movement was allowed. The participant was strongly encouraged to perform a maximum effort, (Wood, 2008).



**Figure 3.3:** [Handgrip test image *n.d*]

- As far as possible, this test was performed indoors, otherwise provision was made to test in the shade if it had to be performed outside. Participants did not use the same kind of chair, but it was checked that the chairs met the dimension requirements for the test. Pictures were also taken of the chairs to ensure that the same chairs were used for re-testing at the end of the intervention.

#### **3.4.3.1 Scoring**

The best result from 3 trials for each hand was recorded, with at least 15 seconds' recovery between each effort. The values listed below supply a guide to expected scores for adults. These values are the average of the best scores of each hand, (Wood, 2008).

**Table 3.2: Handgrip test male and female test scoring, (Wood, 2008).**

<b>Rating</b>	<b>Males (kg)</b>	<b>Females (kg)</b>
Excellent	> 64	> 38
Very good	56-64	34-38
Above average	52-55	30-33
Average	48-51	26-29
Below average	44-47	23-25
Poor	40-43	20-22
Very poor	< 40	< 20

#### **3.4.3.2 Validity and reliability**

For the average person, handgrip strength correlates moderately ( $r=.69$ ) with the total strength of 22 other muscles of the body. Static tests of strength are more valid for static muscle actions than they are for dynamic actions. With regards to reliability, one group of



investigators reported no significant differences in reliability [Interclass Correlation Coefficients, (ICC)] between the maximal force of one trial, the mean maximal force of two trials and the mean maximal force of three trials and the highest maximal force of three trials. Another group reported the highest reliability when the mean of three maximal trials was used. Individual daily variations in strength range from 2% to 12% in women and 5% to 9% in men. Reliability coefficients for strength testing are .90 or higher. The objectivity, or inter-rater reliability, is very high when two technicians follow standard procedures ( $r=.97$ ), (Hamilton *et al.*, 1994:163–170).

#### 3.4.4 The arm curl test

The arm curl test (as indicated above) was also used to test upper body strength. The test procedure used was described by Jones & Rikli. (2002:24-30). Dumbbells were used in this test, 3.5 kg for males and 2 kg for females respectively. The aim of this test was to perform as many arm curls as possible in 30 sec. This test was performed using the dominant arm (or stronger side). The participant sat on the chair, holding the weight in the hand using a suitcase grip (palm facing towards the body) with the arm in a vertically downward position beside the chair. The upper arm was braced against the body so that only the lower arm was moving (tester may assist to hold the upper arm steady). The arm was curled up through the full range of motion, gradually turning the palm up (flexion with supination). The arm was lowered through the full range of motion, gradually returned to the starting position. The arm was fully bent and then fully extended at the elbow (illustrated in Figure 3.4 below).



Figure 3.4: [Arm curl test image *n.d*]

- As far as possible, this test was performed indoors, otherwise provision was made to test in the shade if it had to be performed outside. Participants did not use the same kind of chair but it was checked that the chairs met the dimension requirements for the test. Pictures were also taken of the chairs to ensure that the same chairs were used for re-testing at the end of the intervention.

### 3.4.4.1 Scoring

The score is the total number of controlled arm curls performed in 30 sec. Values classifying performance with regard to age groups are presented in Table 3.3 and 3.4 below.

**Table 3.3: Arm curl male scoring (Jones & Rikli., 2002:24 -30)**

Age	Below average	Average	Above average
60-64	< 16	16 to 22	> 22
65-69	< 15	15 to 21	> 21
70-74	< 14	14 to 21	> 21
75-79	< 13	13 to 19	> 19
80-84	< 13	13 to 19	> 19
85-89	< 11	11 to 17	> 17
90-94	< 10	10 to 14	> 14

**Table 3.4 Arm curl female scoring (Jones & Rikli., 2002:24 -30)**

Age	Below average	Average	Above average
60-64	< 13	13 to 19	> 19
65-69	< 12	12 to 18	> 18
70-74	< 12	12 to 17	> 17
75-79	< 11	11 to 17	> 17
80-84	< 10	10 to 16	> 16
85-89	< 10	10 to 15	> 15
90-94	< 8	8 to 13	> 13

### 3.4.4.2 Validity and reliability

Arm curl test scores were moderately related ( $r=0.84$  for men and  $0.79$  for women) to combined 1-RM values for the chest, upper back and biceps (criterion-based validity). Average arm curl test scores of physically active older adults were significantly greater than those of sedentary older adults (construct validity). Test–retest reliability was  $r=0.81$ , (Heyward & Gibson., 2014:175).

### 3.4.5 Muscle strength testing (lower body)

The 30 second sit to stand test (aka chair stand) was performed to measure lower body muscle strength. The procedure used was described by Jones & Rikli. (2002:24-30). A chair was placed against a wall, or otherwise stabilized for safety. The participants sat in the middle of the seat, with their feet shoulder width apart, flat on the floor. The arms were crossed at the wrists and held close to the chest. From the sitting position, the participant stood up completely, then completely back down, and this was repeated for 30 sec. The total number of complete chair stands (up and down is equal to one stand) were counted.

If the participant completed a full stand from the sitting position when the time is elapsed, the final stand was counted in the total. The testing procedure is depicted in figure 3.5 below.



Figure 3.5: [Chair stand test image *n.d*]

### 3.4.5.1 Scoring

The score is the number of completed chair stands in 30 sec. Values classifying performance with regard to age groups are presented in Table 3.5 and 3.6 below.

Table 3.5: Chair stand male scoring (Jones & Rikli., 2002:24 -30)

Age	Below average	Average	Above average
60-64	< 14	14 to 19	> 19
65-69	< 12	12 to 18	> 18
70-74	< 12	12 to 17	> 17
75-79	< 11	11 to 17	> 17
80-84	< 10	10 to 15	> 15
85-89	< 8	8 to 14	> 14
90-94	< 7	7 to 12	> 12

Table 3.6: Chair stand female scoring (Jones & Rikli., 2002:24 -30)

Age	Below average	Average	Above average
60-64	< 12	12 to 17	> 17
65-69	< 11	11 to 16	> 16
70-74	< 10	10 to 15	> 15
75-79	< 10	10 to 15	> 15
80-84	< 9	9 to 14	> 14
85-89	< 8	8 to 13	> 13
90-94	< 4	4 to 11	> 11

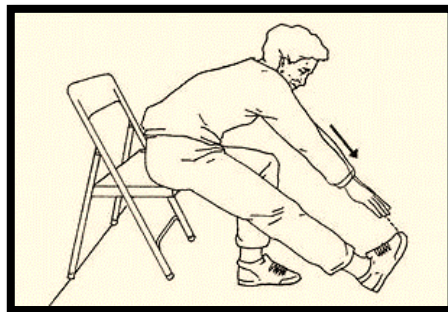
### 3.4.5.2 Validity and reliability

Scores for the sit to stand (aka chair stand) test were moderately related to the 1-RM leg press (criterion related validity) in older men ( $r=0.78$ ) and women ( $r=0.71$ ). Average scores were lower for older adults (80+ year olds) than for relatively younger adults (60 – 69-year olds) and higher for physically active older adults compared to sedentary older adults

(construct validity). Test-retest reliability was  $r=0.86$  and  $r=0.92$  for older men and women respectively, (Heyward & Gibson., 2014:176).

### 3.4.6 Flexibility testing

The chair sit-and-reach test (aka the modified sit and reach test) was used to assess hamstring and trunk flexibility. A Seca measuring tape was used in this test. The participant sat on the edge of a chair (placed against a wall for safety). One foot remained flat on the floor. The other leg was extended forward with the knee extended, heel on the floor, and ankle bent at  $90^\circ$ . One hand was placed on top of the other with the tips of the middle fingers even. The participant was instructed to inhale, and then as they exhaled, reached forward toward the toes by bending at the hip. The back was kept straight and the head up. Bouncing or quick movements were avoided, and the stretch was never allowed to be held to the point of pain. The knee was extended, and the reach held for two seconds. The distance was measured between the tip of the fingertips and the toes. If the fingertips touched the toes, then the score is zero. If they do not touch; the distance between the fingers and the toes was measured (a negative score) and if they overlap, measured by how much (a positive score). The testing procedure is depicted in figure 3.6 below, (Wood, 2008).



**Figure 3.6:** [Modified sit and reach test image *n.d*]

- As far as possible, this test was performed indoors, otherwise provision was made to test in the shade if it had to be performed outside. Participants did not use the same kind of chair, but it was checked that the chairs met the dimension requirements for the test. Pictures were also taken of the chairs to ensure that the same chairs were used for re-testing at the end of the intervention.

### 3.4.6.1 Scoring

The score is recorded to the nearest 1/2 inch or 1cm as the distance reached, either a negative or positive score. The leg used for measurement was recorded. Values classifying performance with regard to age groups are presented in Table 3.7 and 3.8 below.

**Table 3.7: Modified sit and reach test male scoring, (Wood, 2008).**

Age	Below average	Average (cm)	Above average (cm)
60-64	< -6.35	-6.35 to 10.16	> 10.16
65-69	< -7.62	-7.62 to 7.62	> 7.62
70-74	< -8.89	-8.89 to 6.35	> 6.35
75-79	< -10.16	-10.16 to 5.08	> 5.08
80-84	< -13.97	-13.97 to 3.81	> 3.81
85-89	< -13.97	-13.97 to 1.27	> 1.27
90-94	< -16.51	-16.51 to -1.27	> -1.27

**Table 3.8: Modifies sit and reach female scoring, (Wood, 2008).**

Age	Below average	Average (cm)	Above average (cm)
60-64	< -1.27	-1.27 to 12.7	> 12.7
65-69	< -1.27	-1.27 to 11.43	> 11.43
70-74	< -2.54	-2.54 to 10.16	> 10.16
75-79	< -2.54	-3.81 to 8.89	> 8.89
80-84	< -5.08	-5.08 to 7.62	> 7.62
85-89	< -6.35	-6.35 to 6.35	> 6.35
90-94	< -11.43	-11.43 to 2.54	> 2.54

### 3.4.6.2 Validity and reliability

Many investigators agree that there is no such phenomena as general flexibility. In other words, one joint's range of motion is specific with respect to the same joint, but on different sides of the body. For example, one shoulder is usually more flexible than the other shoulder. The interclass correlations ranged from 0.15 to 0.42 when the lower back criterion was compared with the classic (Traditional) Back-Saver, and V-Sit SR Tests. The validity coefficients ranged from 0.39 to 0.58 when the same three SR tests were compared with the hamstring criterion. The test-retest reliability of the SR test can be as high as 0.98 and is usually greater than 0.70, based upon the testing of more than 12 000 boys and girls 6-18 years of age; the test-retest correlation over an 8-month period in older persons (45-75 years of age) was 0.83, (Beam., 2010:246).

### 3.4.7 Balance, speed and agility testing

#### Neuromuscular/balance testing:

- Having considered the high probability of balance impairments in this population group as well as the increased probability for conditions such as osteoporosis which placed the participants at risk of fractures in the case of a fall, balance was observed in the 8-foot up and go test in conjunction with speed and agility.

The 8-foot up and go test (aka timed up and go) was used to observe balance and test speed and agility. The testing procedure was described by Jones & Rikli. (2002:24-30). A chair was placed next to a wall (for safety) and the distance of 8 feet (2.4m) marked in front of the chair. The path between the chair and the marker was cleared. The subject started fully seated, hands resting on the knees and feet flat on the ground. On the command, "Go," timing was started and the subject stood up and walked (no running) as quickly as possible (and safely) to and around the cone, returning to the chair to sit down. Timing stopped as they sat down. Two trials were performed. The testing procedure is depicted in Figure 3.7 below.



Figure 3.7: [8-foot up and go test image *n.d*]

- As far as possible, this test was performed indoors, otherwise provision was made to test in the shade if it had to be performed outside. Participants did not use the same kind of chair, but it was checked that the chairs met the dimension requirements for the test. Pictures were also taken of the chairs to ensure that the same chairs were used for re-testing at the end of the intervention.

### 3.4.7.1 Scoring

Take the best time of the two trails to the nearest 1/10th of a second. Values classifying performance with regard to age groups are presented in Table 3.9 and 3.10 below.

**Table 3.9: 8-foot up and go male scoring, (Jones & Rikli., 2002:24 -30)**

Age	Below average	Average	Above average
60-64	> 5.6	5.6 to 3.8	< 3.8
65-69	> 5.7	5.7 to 4.3	< 4.3
70-74	> 6.0	6.0 to 4.2	< 4.2
75-79	> 7.2	7.2 to 4.6	< 4.6
80-84	> 7.6	7.6 to 5.2	< 5.2
85-89	> 8.9	8.9 to 5.3	< 5.3
90-94	> 10.0	10.0 to 6.2	< 6.2

**Table 3.10: 8-foot up and go female scoring, (Jones & Rikli., 2002:24 -30)**

Age	Below average	Average	Above average
60-64	> 6.0	6.0 to 4.4	< 4.4
65-69	> 6.4	6.4 to 4.8	< 4.8
70-74	> 7.1	7.1 to 4.9	< 4.9
75-79	> 7.4	7.4 to 5.2	< 5.2
80-84	> 8.7	8.7 to 5.7	< 5.7
85-89	> 9.6	9.6 to 6.2	< 6.2
90-94	> 11.5	11.5 to 7.3	< 7.3

### 3.4.7.2 Validity and reliability

Although there is no one gold standard criterion measure for this test, it has been found to be significantly related to the Berg balance scale ( $r=.81$ ), to gait speed ( $r=.61$ ), and to the Barthel index of ADLs ( $r=.78$ ), a composite measure involving transfer actions. Timed up and go performance has also been found to be a good predictor of recurrent falling, can discriminate among various functional categories, and is responsive to changes resulting from activity interventions. The test resulted in better scores for individuals who were regular exercisers than those who were not (Rikli & Jones., 2013:34).

## 3.5 DESIGN AND IMPLEMENTATION OF THE PHYSICAL ACTIVITY INTERVENTION

The specific exercise programme was designed after the testing stage was completed so it could be tailored to the study population. The physical activity intervention was implemented in six communities (haBosofo, haNelese, Makhwakhoeng, maPetla, haPenaPena and haMatala) with the assistance of trained field workers for three days of the week for an approximated period of three months. The intervention programme followed the

recommendations of ACSM (2009:206) for exercise prescription for the elderly as displayed in Table 3.11.

**Table 3.11: Recommendations for exercise programming (Physical activity Intervention) (ACSM, 2009:206)**

Modes	Goals	Intensity / frequency / duration
<b>Aerobic</b>		
Large muscle activities (walking, cycling, rowing, swimming: chair exercise may be indicated for some clients)	Increased functional capacity and independence	*Monitor RPE (Intensity should not be the main focus) *3-5 times / week *5-60 min session
<b>Strength</b>		
Low-level, progressive resistance free weights, weight machines, (Isokinetic machines)	*Increase overall muscular strength	*Start program without weights, add slowly *3 days/week *Approximately 20min per session
Ball machines	*Increase hand strength	
<b>Flexibility</b>		
Stretching / yoga	*Improved joint ROM	
	*Improved muscle flexibility	
<b>Neuromuscular</b>		
*One-foot stand *Stair climbing *Practice falling techniques *Balloon activity	*Increase neuromuscular coordination, gait, balance, flexibility and lower body strength	
Tandem gait	*Prevent falls	
Chair stand exercise	*Increase hand-eye coordination and reaction time	

### 3.5.1 Physical activity intervention

Tarazona-Santabalbina *et al.* (2016:432), suggested that programmes that have proven to be the most effective in the intervention of frailty bear the following characteristics [frequency, intensity, time, type, volume and progression (FITT-VP)] principles:

- Frequency: 3 times a week;
- Intensity: moderate [40 – 60% of heart rate reserve (HRR)];
- Time: 30 – 45 minutes;
- Type: multicomponent training;
- Volume: 5 months or longer; and
- Progression: not provided.

The intervention programme of this study followed the following FITTV principle:

- F: 3 times a week;
- I: moderate intensity [40 – 60% of heart rate reserve (HRR)];



- T: 30 – 45 minutes;
- T: multicomponent training (cardio, flexibility, balance and strength);
- V: approximately three months;
- P: as tolerated by participants (progressed every month on average); and
- Example of the session of the physical activity intervention programme.

An example of a physical activity session used in this intervention is displayed in table 3.12 below:

**Table 3.12: Physical activity session**

Component	Exercise	Sets	Repetitions
Cardiovascular Endurance	10 Minutes walking (warm up)	1	-
Flexibility	Stretching	Quadriceps, Hamstrings, Gastrocnemius, rotator cuff. Hold for 30 secs	2
Muscle strength (lower body)	Sit to stand	1 – 2	6 – 8
Muscle strength (upper body) and balance	Standing march	1 – 2	6 – 8
<b>Rest (5 min)</b>			
Muscle strength	Lateral raises	1 – 2	6 – 8
Muscle strength	Triceps extensions	1 – 2	6 – 8
<b>Rest (5 min)</b>			
Speed and agility	Cone drills	1	-
Flexibility (cool down)	Stretching	Quadriceps, Hamstrings, Gastrocnemius, rotator cuff. Hold for 30 secs	1
Neuromuscular	Sit to stand	1 – 2	12

Although the heterogeneity of exercise programmes implemented in intervention studies has produced inconclusive results regarding the best type of programme, it is generally accepted that a multicomponent exercise programme including resistance training leads to improved global functioning in the elderly, (De Labra *et al.*, 2015:166). The programme was updated every month (4 weeks) according to the progression of the participants. The programme began as a slight variation of the testing protocol as those were movements the participants were already familiar with. The exercise programme later progressed those movements to varying degrees of complexity and difficulty as tolerated by the participants.

### 3.5.2 Evaluation of the physical activity intervention

- An attendance register was kept throughout the intervention by the trained field workers who assisted in the implementation of the intervention programme.
- After about three months of implementing the physical activity intervention programme, the post-intervention testing was performed on all the participants; and
- Data was captured, analysed and compared between the experimental and control groups.

### **3.6 PILOT STUDY**

A pilot study is defined as a test of methods and procedures to be used in a bigger anticipated study conducted to enable the researcher to improve upon the main study. Pilot studies are done to make sure that tools that are to be used for the large-scale study are comprehensive and suitable. This may include questionnaire and consent forms, (Thomas *et al.*, 2011:73).

A pilot study was undertaken in the Maseru district on the first ten elderly persons. The elderly was identified using a list from the community chief and a site map to locate them. The purpose of the pilot study was to ensure that respondents clearly understood the questions and that the translation from the English language to the local language (Sesotho) was consistent. The average time used to complete the questionnaires was also determined to improve the flow of the testing.

### **3.7 STATISTICAL ANALYSIS**

The Department of Biostatistics at the Faculty of Health Science (UFS) performed the statistical analysis. Descriptive statistics (namely, medians and percentiles for continuous data and frequencies and percentages for categorical data) were calculated per group. The change from baseline to post intervention (approximately three months), was also calculated per group. The groups were compared (inter-group) by means of 95% confidence intervals.

## CHAPTER 4

### RESULTS AND DISCUSSION

---

#### 4.1 INTRODUCTION

The global population of elderly individuals is expected to rise dramatically over the next couple of years. Most of these individuals will be from less developed countries. As advances in modern medicine continue to allow people to live longer and physical inactivity remains on the rise, the number of older people with chronic diseases associated with ageing has also increased. Geriatric diseases such as frailty syndrome have come to the fore and with limited research in developing nations (which will encounter more of these cases with the rising elderly population based in these nations), the need for research on how to manage conditions such as frailty syndrome has become essential. This study sought to investigate the impact of a physical activity intervention programme on frailty syndrome in elderly citizens in Maseru, Lesotho.

The results and the discussion of the results will be presented simultaneously in this chapter. The socio-demographic data will be presented first. Each variable's continuous data will be presented first in tables, with its baseline and post intervention medians and inter-group comparison from baseline to post intervention for the median difference. This will be followed by the categorical data containing the percentage of participants in a category selected for improvement at baseline, the inter-group comparison at baseline, improvement percentages post intervention and inter-group comparison for percentage difference (improvement) from baseline to post intervention. The discussion of all the results related to that variable will be last. Succeeding from this juncture, the groups will be identified by these names in the reporting of the results:

- Milk only group will be identified only as '**milk**';
- The group that received both the milk and the physical activity intervention will be identified only as '**both**'; and
- The control group will be identified only as '**control**'.

For many of the variables, data distribution was skew, therefore the tables with the continuous data will display the median values with the range (minimum – maximum). Significance ( $p \leq 0.05$ ) will be indicated with a single asterisk (\*).

Descriptive statistics (namely, medians and percentiles for continuous data and frequencies and percentages for categorical data) was calculated per group. The change from baseline to post intervention (approximately three months), was also calculated per group. The groups were compared (inter-group) by means of 95% confidence intervals.

The baseline and post intervention data was collected by the researcher for the variables being investigated. The test battery (adapted from the AAHPERD functional fitness test) included the following variables linked to the study objectives listed in Chapter 1 (these variables will be identified by the bold print titles proceeding from this juncture):

- Cardiovascular endurance (**6-minute walk**);
- Lower body muscle strength (**chair stand**);
- Upper body muscle strength (**arm curl**);
- Upper body muscle strength (**handgrip**);
- Flexibility (**modified sit**); and
- Balance, speed and agility (**8-foot**).

Additionally, results of the body mass index (BMI) and the frailty status will also be provided and discussed in this chapter.

Henceforth, the socio-demographic data of all three groups (milk, both and control) will be presented first, followed by the variables investigated with the discussion of the results per variable. A conclusion paragraph reflecting the outcomes of the study and a summary of the main findings will be presented last.

## **4.2 SOCIO-DEMOGRAPHIC DATA**

Socio-demographic information for all three groups (milk, both and control) included the race, gender, ethnicity, marital status, employment status and level of education of each participant. The results are displayed in the tables below.

### **4.2.1 Total participation**

The total number of participants envisaged to participate in this study was 120, constituting 40 participants in each of the groups (milk, both and control). Table 4.1 below displays the actual numbers obtained for the study.

**Table 4.1: Total number of participants (baseline and post-intervention)**

Total participation (n=)		
	Baseline	Post intervention
Milk	36	32
Both	39	31
Control	35	28

The total number of participants who were included at baseline was 110, and 91 completed the post intervention (dropout=19). The number of post intervention participants varied per variable. As a result, the numbers presented in Table 4.1 above represents the smallest number of participants per group at any given variable.

#### 4.2.2 Age

The age requirement for inclusion in the study included individuals who fell in the elderly category (aged  $\geq 65$  years). The age distribution of the participants in the study is displayed in Table 4.2 below.

**Table 4.2: Age**

Age (yrs)		
Group	Median	Median (range)
Milk	74.2	(64.3 - 86.0)
Both	76.1	(65.5 - 91.0)
Control	74.0	(65.0 - 94.0)

The elderly constitutes 5.47% of Lesotho's population, Lesotho Demographics Profile (2017). The minimum age was 64 years (the participant later turned 65 before the intervention started), while the oldest person was 94 years old. The median age of participants in both the milk and control group was 74 years, while the median age of participants in the group that received both milk and physical activity was 76 years.

#### 4.2.3 Ethnicity

The ethnic constitution of the groups is described in Table 4.3 below.

**Table 4.3: Ethnicity**

Ethnicity			
Group (n)	Black n= (%)	Coloured n= (%)	Indian n= (%)
Milk (35)	34 (97.1%)	0 (0.0%)	1 (2.9%)
Both (36)	36 (100%)	0 (0.0%)	0 (0.0%)
Control (34)	33 (97.1%)	1 (2.9%)	0 (0.0%)
<b>Frequency Missing = 5</b>			

Black people make up 99.7% of Lesotho's population, with white and other races making up the remaining 0.3%, Lesotho Demographics Profile (2017). The statistics from the sample group (black participants constitute well over 90% of the total participants per group) indicating that the population was accurately represented in the sample group.

#### 4.2.4 Gender

The gender representation within the groups is described in Table 4.4 below.

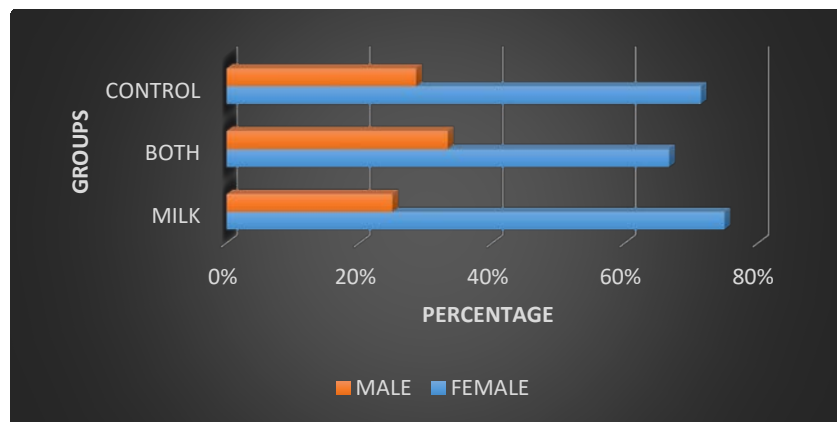
**Table 4.4: Gender**

Gender		
Group (n=)	Female n (%)	Male n (%)
Milk (36)	27 (75.0%)	9 (25.0%)
Both (39)	26 (66.7%)	13 (33.3%)
Control (35)	25 (71.4%)	10 (28.5%)
<b>Total</b>	<b>78%</b>	<b>32%</b>

The female representation across the 3 groups was over 50% (milk 75%, both 66.7% and control 71.4%) The total female representation in the study was 78%. The male representation was less than 30% in the milk (25%) and the control (28.5%). The both group had a male representation of 33.3%, with the total male representation in the study equalling 32%. The work of Runzer-Colmenares *et al.* (2014:72) and Gonzalez-Vaca *et al.* (2013:80), supports these statistics, indicating that more females present with frailty. As females tend to live longer than males, this results in more females being elderly and as such more of them being susceptible to geriatric diseases like frailty. Runzer-Colmenares *et al.* (2014:72), conducted their study in Peru in retired community-dwelling Navy Veterans older adults and relatives of 60 years and older. The study of Gonzalez-Vaca *et al.* (2013:80), was based in Spain, in institutionalised older adults aged 65 years and older. Grden *et al.* (2017:25e2886), researched community dwelling elderly persons aged 80 years and older in Brazil. They put forward some of the following reasons as explanations for this tendency for frailty to be more prevalent in females than in males: prevalent factors such as lower muscle strength in females, worse nutritional status, worse socioeconomic status and health status compared to men.

The decreasing hormone levels in women due to menopause were also pointed out, as they led to decreased muscle mass and strength in the elderly females. Where females were more physically active than males, as was in the study of Buttery *et al.* (2015:1-9), there was no statistically significant difference between males and females in their frailty status. Their study was based in Germany and comprised community dwelling elderly aged 65 – 79 years. Their findings add to the argument for physical activity as a protective factor for

frailty and as a potential modifier of frailty status. The graphical representation of Table 4.4, is given in Figure 4.1 below.



**Figure 4.1: Gender**

#### 4.2.5 Marital status

The information regarding the marital status of the participants is displayed in Table 4.5 below.

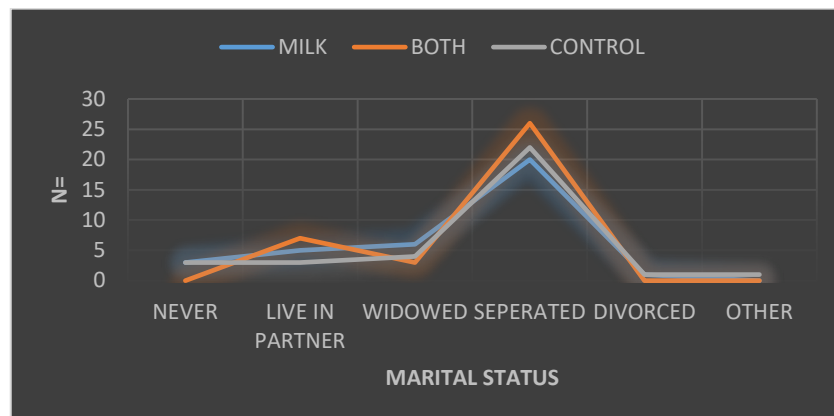
**Table 4.5: Marital status**

Marital status						
Group	Never n= (%)	Live-In Partner n= (%)	Widowed n= (%)	Separated n= (%)	Divorced n= (%)	Other n= (%)
Milk	3 (8.6%)	5 (14.3%)	6 (17.1%)	20 (57.1%)	1 (2.9%)	0 (0.0%)
Both	0 (0.0%)	7 (19.4%)	3 (8.3%)	26 (72.2%)	0 (0.0%)	0 (0.0%)
Control	3 (8.8%)	3 (8.8%)	22 (64.7%)	22 (64.7%)	1 (2.9%)	1 (2.9%)
<b>Frequency Missing = 5</b>						

Most of the participants in the study indicated their marital status as 'separated' as displayed in Table 4.5 above. This information gives insight as to whether participants possibly had any assistance in the home or if they were the only person responsible for housekeeping and their other ADLs. Avila-Funes *et al.* (2008:1095) and Son *et al.* (2015:414), found that frailty was more common in individuals who were living alone. Son *et al.* (2015:414) conducted their study in South Korea amongst community dwelling elderly aged 65 years and older. The study of Avila-Funes *et al.* (2008:1086-1096), consisted of French elderly aged 65 years and older who formed part of a cohort that was originally not institutionalised. Their study described living alone as 'adverse living conditions'. In contrast, Sanchez-Garcia *et al.* (2014:400), showed that although pre-frailty status was prevalent among those living alone, individuals living alone were less likely to be frail. Their study was conducted among the Mexican elderly aged 60 years and older who formed part of a cohort study to

investigate the prevalence of dementia in the elderly. Although their research does not point to the reasons for this occurrence, the authors postulated that independent living may be a protective factor in the development of frailty. Individuals who are institutionalised with around-the-clock care have less and less to do for themselves and this may further confound their symptoms and accelerate the pre-frail state towards frailty.

The results of the research of Buttery *et al.* (2015:15-22), were congruent with those of Gonzalez where no significant associations were found between frailty and living alone. Their data was extrapolated from a cohort study conducted among community dwelling German citizens aged 65-79 years. They offer some cultural context towards living alone being either a protective factor in frailty or a contributor to frailty. Participants who report feeling socially isolated and unsupported whilst living alone are often predisposed towards frailty. In cultures where 'self-sufficiency' is common, such as in the German population in their study, living alone can prove to be a protective factor towards frailty as these individuals are still able to conduct the ADLs unassisted. The graphical representation of Table 4.5 is given in Figure 4.2 below.



**Figure 4.2: Marital status**

#### 4.2.6 Employment status and education

Since the level of education directly impacts on the employment status, these socio-demographic factors will be discussed simultaneously as displayed in Table 4.6 and Table 4.7 below.



**Table 4.6: Educational level**

Education					
Group	None n= (%)	Primary n= (%)	Secondary n= (%)	Tertiary n= (%)	Unknown n= (%)
Milk	3 (8.6%)	25 (71.4%)	4 (11.4%)	3 (8.6%)	0 (0.0%)
Both	3 (8.3%)	29 (80.6%)	3 (8.3%)	0 (0.0%)	1 (2.8%)
Control	2 (5.9%)	23 (67.7%)	6 (17.7%)	3 (8.8%)	0 (0.0%)
<b>Frequency Missing = 5</b>					

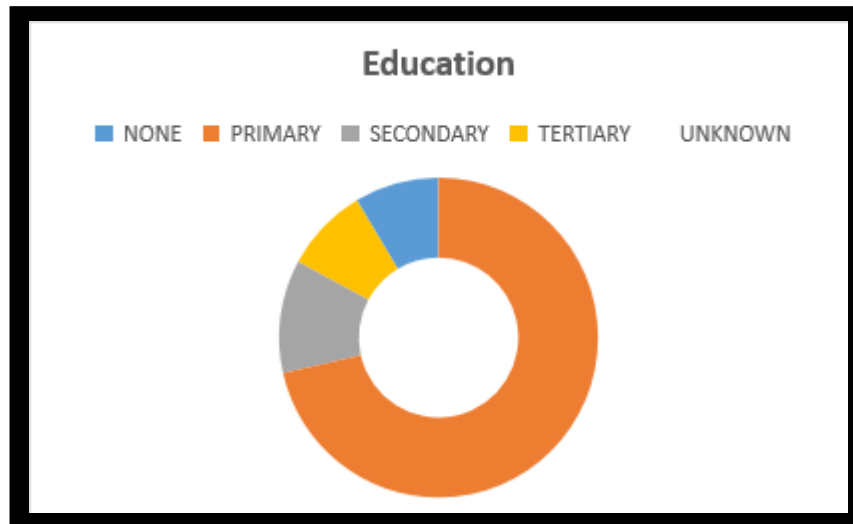
**Table 4.7: Employment status**

Employment Status						
Group	House- wife n= (%)	Unemployed n= (%)	Self employed n= (%)	Full time n= (%)	Pension n = (%)	Other (part time) n= (%)
Milk	9	15	2	1	0	7
Both	3	9	2	1	0	21
Control	2	11	1	0	2	18
<b>Frequency Missing = 5</b>						

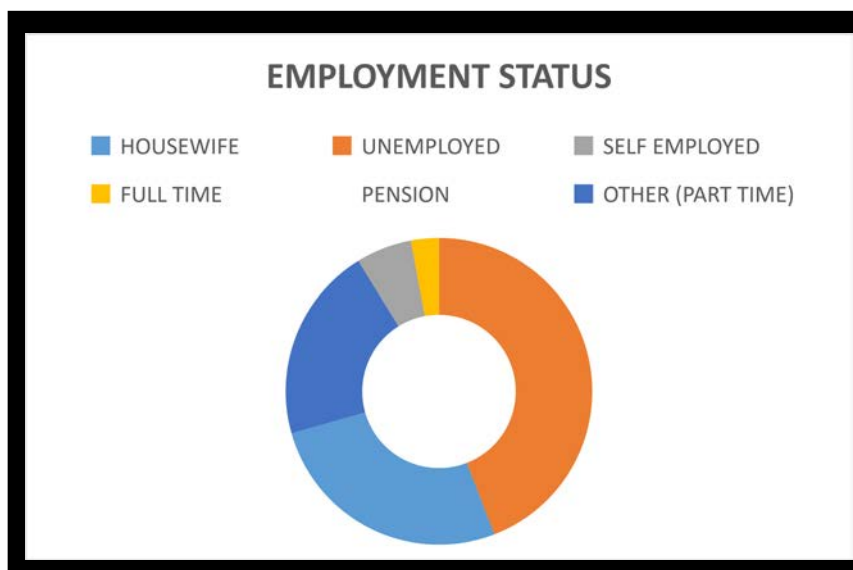
Most of the participants in this study (as displayed in Table 4.5 above), indicated an educational level no higher than primary school education and subsequently most of them indicated their current occupation as either unemployed or having some other kind of part-time employment. Since most of the participants in this study were women, an option for 'housewife' was included and a significant number of them indicated 'housewife' as their occupation. The relationship between the educational level and occupation must be viewed in context and interpreted cautiously. The way the questions are posed is also of importance (cf. Appendix B). A more accurate manner of approaching the question of employment in the elderly population must be asked in retrospect as the study population was already of retirement age; perhaps including 'retired' as an option. Considering this fact, most of the participants being unemployed at this stage does not necessarily indicate previous employment or exposure to formal employment.

Lenardt *et al.* (2015:588), Son *et al.* (2015:414) and Boulous *et al.* (2016:140), found a significant association between physical frailty and level of education, with the level of education being inversely proportional to the condition of frailty. Lenardt *et al.* (2015:588), conducted their study in Brazil in community dwelling elderly  $\geq 60$  years and the research of Son *et al.* (2015:414), was conducted in South Korea amongst community dwelling elderly aged  $\geq 65$  years. The study of Boulous *et al.* (2016:140), was undertaken among community dwelling Lebanese elderly aged 65 years and older. The authors noted that a low educational level is evident in both developed and developing nations. They further explained its significance in every population, as it reflects the individuals deprived of opportunities, lack of access to healthcare and various other inequalities throughout the lives of those predisposed to lack of education. These circumstances often lead to poverty,

poor health status and an increased susceptibility towards frailty. Boulous *et al.* (2016:140), further adds that poor cognitive function is a risk factor both for pre-frail status and for frailty. Their supposition being that the educational level, is an effect modifier in the association between frailty and cognitive performance. The graphical representation of Table 4.6 and Table 4.7 is given in Figure 4.3 and Figure 4.4 below.



**Figure 4.3: Education**



**Figure 4.4: Employment status**

#### 4.2.7 Body Mass Index (BMI)

Body mass index (BMI) describes body weight in relationship to height. The calculation is made by dividing body weight in kilograms by height in meters squared ( $\text{kg.m}^{-2}$ ). As per the Expert Panel on the Identification, Evaluation and Treatment of Overweight and Obesity in Adults (ACSM 2018:70), BMI of  $<18.5 \text{ kg.m}^{-2}$  is underweight,  $18.5 - 24.9 \text{ kg.m}^{-2}$  is normal,

25.0 – 29.9 kg.m<sup>-2</sup> is overweight and ≥30 kg.m<sup>-2</sup> is obese. One of the shortcomings of BMI is that it fails to distinguish the body type of an individual i.e. content/distribution of muscle/lean body mass, fat mass and bone mass. A close correlation has been found between a BMI > 30.0 kg.m<sup>-2</sup> and obesity-related diseases as well as mortality.

Total fat percentage is derived by a measurement of whole body density through calculating the ratio of body mass to body volume. Of the two values, while the calculation of body weight is considered highly accurate, the determination of body volume is less so. In the determination of body volume, since bones and muscles are denser than fat tissue, a person with more fat free mass (FFM) [i.e. body mass – fat mass (FM)] is heavier in water than an individual with a lower FFM.

Table 4.8 below contains the continuous data for the variable BMI (kg.m<sup>-2</sup>). The median is reported along with the range at baseline and post intervention. An inter-group comparison between the groups at baseline and post intervention with the 95% confidence interval for the median difference is also demonstrated. The data for BMI was analysed differently to provide better results specific to BMI and will contain data that is not contained in other variables. As a result, the table for BMI will look different from the other variables discussed in this chapter.

**Table 4.8: BMI continuous data at baseline and post intervention**

Summary of baseline measurements			Summary of post intervention measurements		
Variable	Category	Median (range)	Variable	Category	Median (range)
BMI kg.m <sup>-2</sup>	Milk	24.5 (14.6 - 46.1)	BMI kg.m <sup>-2</sup>	Milk	25.9 (15.4 - 47.1)
	Both	26.1 (16.2 - 44.3)		Both	28.4 (17.9 - 39.6)
	Control	23.7 (14.5 - 36.7)		Control	24.9 (16.5 - 37.1)
<b>Baseline and post intervention 95% CI for Median difference</b>					
	<b>Variable</b>	<b>(Milk - both)</b>	<b>Milk – control</b>	<b>Both - control)</b>	
	Baseline BMI	[-4.1 ; 1.9]	[-3.6 ; 3,0]	[-2,8 ; 4.0]	
	Post BMI	[-4.9 ; 1.8]	[-1.9 ; 4.5]	[-0.3 ; 6.0]	

Difference in BMI (baseline BMI - post intervention BMI)		
DIF- BMI	<b>Milk</b>	- 2.0 (-8.4 - 1.4)
	<b>Both</b>	-0.9 (-10.5 - 3.9)
	<b>Control</b>	-1.7 (-6.2 - 5.4)

95% CI for the median difference		
(Milk - both)	Milk – control	(Both - control)
[-2.1 ; -0.2]*	[-1.7 ; 0.4]	[-0.8 ; 1.7]

\*p≤0.05

An improvement in BMI from (as applicable in this study), would be a decrease in the BMI value and can be indicative of weight loss. As indicated in Table 4.8 above, the median for the BMI increased across all three groups from baseline to post intervention (milk 24.5 – 25.9 kg.m<sup>-2</sup>) (both 26.1 – 28.4 kg.m<sup>-2</sup>) and control (23.7 – 24.9 kg.m<sup>-2</sup>). The greatest increase in the median of the BMI post intervention was in the both group (28.4 kg.m<sup>-2</sup>) with the milk (25.9 kg.m<sup>-2</sup>) and the control group (24.9 kg.m<sup>-2</sup>) producing similar gains. The inter-group comparison for the median difference found no statistically significant difference between any of the groups at baseline and post intervention, indicating the groups were similar. When the inter-group change from baseline to post intervention in the BMI was calculated (difference-BMI), no statistically significant difference was found. When the 95% confidence interval for the median difference was calculated, a statistically significant difference (p≤0.05) was found in the both group (milk and physical activity) when compared to the milk group. Since no statistically significant difference was found between either intervention group and the control group, the physical activity and milk intervention can possibly be a more significant contributing factor in the change in the BMI than the milk or physical activity intervention when implemented alone. As already stated, the Expert Panel on the Identification, Evaluation and Treatment of Overweight and Obesity in Adults (ACSM 2018:70), BMI of <18.5 kg.m<sup>-2</sup> is classified as underweight, 18.5 – 24.9 kg.m<sup>-2</sup> as normal, 25.0 – 29.9 kg.m<sup>-2</sup> as overweight and ≥30 kg.m<sup>-2</sup> as obese. According to the ACSM classification, the median values across the three groups post intervention show the participants of the milk group (25.9 kg.m<sup>-2</sup>) to be at the lower border of overweight. The both group (28.4 kg.m<sup>-2</sup>) falls within in the overweight classification and the control group (24.9 kg.m<sup>-2</sup>) in the upper border of normal weight.

In their review of the literature, Theou *et al.* (2011:12), found no improvement in BMI in any of the studies in their review. This is in contrast to the results from the study of Villareal *et al.* (2011:1222), conducted in Washington with community dwelling elderly participants aged 65 years and older. The study sought to investigate if diet alone, exercise alone or a combination of both had a greater impact on obesity. They observed a decrease in body weight in the group who underwent a diet intervention only, closely followed by the group who underwent a diet and an exercise intervention. Since their participants were already obese (inclusion criteria of the study), the weight loss is expected and not in contradiction to the findings of this study as the participants of this study were classified as normal to overweight on the BMI classification scale.

Tarazona-Santabalbina *et al.* (2016:430), conducted a study in Spain with community dwelling elderly aged 70 years and older. They found a decrease in the total fat mass (TFM) of frail participants who took part in the multicomponent exercise programme. The program design was similar to that used in this study, with the exception of the FITT principles. It is possible that the decrease in TFM observed in their study was due to their intervention running for a longer duration (24 weeks compared to the 12 weeks of this study), the time spent on the exercises 65 minutes (compared to 45 minutes of this study) and the frequency of five times a week (compared to three times a week in this study). As already explained in the introduction to BMI, it does not distinguish body composition. As a result, the increase in BMI observed in the milk group can possibly be due to an increase in fat mass (subjects ingested full cream sour milk). The reason for the increase in BMI observed in the both group could possibly be either due to an increase in fat mass (due to the ingested full cream sour milk) and/or an increase in muscle/lean body mass (due to the resistance training as part of the physical activity intervention), as the both group had both the milk and physical activity as intervention, (Prentice., 2014:99).

Aguirre and Villareal (2015:86), in their systematic review, found that progressive resistance training can have a positive effect on weight loss (TFM) on overweight frail men and women when combined with a dietary intervention. Resistance training can be targeted to decrease TFM through increasing muscle/lean body mass. Once again, this is only relevant to studies where weight loss (TFM) is an outcome of the study. Villareal *et al.* (2011:1226), concluded that a combination of diet and exercise interventions is far more effective in targeting obesity in the elderly than diet only or exercise only interventions (despite their effectiveness as a standalone intervention). Although diet only interventions are effective in targeting weight loss (TFM), adding an exercise component to the intervention is effective in the retention of lean muscle mass, which is important in the fight against age-related sarcopenia. Moreover, weight loss (TFM) can lead to improved functional status in the elderly and increase independence.

### **4.3 BASELINE AND POST INTERVENTION RESULTS: IMPACT OF THE PHYSICAL ACTIVITY INTERVENTION**

#### **4.3.1 6-minute walk**

The 6-minute walk test was used as a measure of cardiovascular/aerobic endurance. While investigating the relationship between changes between physical activity and mortality rates in women, Clegg *et al.* (2013:752), found that higher levels of physical activity in women were associated with about 40% – 50% lower all-cause-, CVD- and cancer mortality rates when compared to women with lower physical activity levels. These results were supported

by the work of Taylor (2014:28) which showed that when combined with strength exercises, aerobic exercises have shown to be effective in improving physical function and the maintenance of functional independence in the elderly.

Table 4.9 below contains the continuous data for the variable 6-minute walk (meters). The median is reported along with the range at baseline and at post intervention. An inter-group comparison between the groups at baseline and post intervention with the 95% confidence interval for the median difference is also demonstrated.

**Table 4.9: 6-minute walk continuous data at baseline and post intervention**

Summary of baseline measurements			Summary of post intervention measurements		
Variable	Category	Median (range)	Variable	Category	Median (range)
6-minute walk (meters)	Milk	258.5 (0 - 341.3)	6-minute walk (meters)	Milk	295.8 (0 - 412.8)
	Both	265.5 (0 - 360.0)		Both	296.5 (0 - 403.4)
	Control	253.0 (0 - 400.0)		Control	260.0 (0 - 464.6)
<b>Baseline and post intervention 95% CI for median difference</b>					
<b>VARIABLE</b>		<b>(Milk - both)</b>	<b>Milk - control</b>	<b>(Both - control)</b>	
Baseline 6-min walk		[-48.6 ; 10.0]	[-39.1 ; 4.6]	[-23.1 ; 55.5]	
Post 6-min walk		[-10.7 ; 48.2]	[-29.6 ; 1.0]	[-45.8 ; 66.7]	

As indicated in Table 4.9 above, all three groups (milk, both and control) showed an improvement in the median post intervention values (milk 258.5m – 295.8m; both 265.5m – 296.5m; control 253m – 260.0m). The inter-group comparison for median difference of the three groups from baseline to post intervention showed no statistically significant difference, indicating the groups were similar.

Table 4.10 below indicates the categorical data for the 6-minute walk at baseline and post intervention. To determine improvement, focus was placed on the participants who were classified as 'below average' according to the norms (cf. 3.4.2.1) at baseline (males <867m and females <525m). The percentage of participants who improved describes participants who were 'poor' at baseline and is represented in the table and the percentage of participants who improved to the 'average' category (males >867 m and females >525m). An inter-group comparison from baseline to post intervention and the 95% confidence interval for the percentage difference (improvement) is also presented in the table below.

**Table 4.10: 6-minute walk categorical data at baseline and post intervention**

Baseline 6-minute walk		Post intervention 6-minute walk		Post intervention 95% CI for percentage difference	
Group	% of participants in poor category	Group	% of participants who improved	Group	95% CI for percentage improvement
Milk	13.9%	Milk	3.1%	Milk – both	[-13.3% ; 12.8%]
Both	23.1%	Both	3.2%	Milk - control	[-19.7% ; 9.6%]
Control	17.1%	Control	7.1%	Both - control	[-19.6% ; 10.0%]
Baseline 95% CI for percentage difference					
Group	95% CI for percentage difference				
Both – control	[-26,3% ; 8.9%]				
Both – milk	[-20.6% ; 14.1%]				
Control – milk	[-12.8% ; 23.7%]				

\*p≤0.05

As indicated in Table 4.10 above, the both group recorded the highest percentage of participants categorised as poor at baseline (23.1%). The milk group recorded 13.9% and the control recorded 17.1% of participants at baseline categorised as those with poor cardiovascular endurance. The inter-group comparison for percentage difference at baseline did not show a statistically significant difference at baseline, indicating the groups were similar. Post intervention, 7.1% of the participants in the control group recorded an improvement. The intervention groups (milk and both) had 3.1% and 3.2% respectively of participants improve post intervention. The inter-group comparison for percentage difference (improvement) from baseline to post intervention also showed no statistically significant differences between the groups, indicating similarity in the groups. A possible reason for the improvement in all the groups is that, except for the control group which was in a more urban area, where some of the participants had access to motor vehicles, most of the participants were not drivers; walking was their primary mode of transportation within their community. During the intervention, the participants walked to the meeting points for their exercise or to collect their milk as in the milk group. Even though most of the participants in the control group had better access to private motor vehicles, they also walked within town to run their errands. In this regard, all the groups were exposed to the activity of walking and would possibly improve. Although the exercise intervention programme included walking as a warm up, it was probably not of a significant duration, intensity or frequency to bring about a significant improvement when compared to the other groups (milk and control).

In their reviews of the literature, Ginè-Garriga *et al.* (2014:760), Chou *et al.* (2012:239) and Theou *et al.* (2011:13), stated that generally, exercise (particularly walking) appeared to have a significant and homogeneous effect on gait speed. In contrast, Lord *et al.* (2003:1690) found a decrease in the gait velocity of the control group in the walk test and there was no change observed in the intervention group. The participants in the study of Lord *et al.* (2003:1690), aged 62 - 95 years old, were in retirement villages and were a mixture between self-care and intermediate-care which offers some assistance compared to the community dwelling participants of this study. The frequency of the exercise intervention was also less (twice a week) compared to this study. The authors also noted the younger control group as having outperformed the intervention group due to their age and large proportion of men included in the group. Using WBV training as intervention, Pollock *et al.* (2012:921), found increases in the gait speed of the exercise intervention group. They concluded that improvements were greater in individuals that had a slower walking speed at baseline. The importance of gait speed in frailty as a precipitator of falls in the frail elderly was highlighted by Chou *et al.* (2012:241) and Van der Wiel *et al.* (2002:1405-1410). Slow gait speed is strongly associated with poor balance and an increased incidence of falls; therefore, improving gait speed is one modality that targets decreasing fall occurrences.

Ng *et al.* (2015:1230), found improved gait speed measures in their intervention group compared to the control group. Their study was conducted in Singapore on elderly citizens aged 65 years and older. The 246 participants were divided into a nutritional supplementation group, a cognitive training group, a physical training group, a combination group and a control group. They investigated the impact of either intervention on frailty reversal. Furthermore, their study included a follow up period and the improvement in the gait speed was maintained in the follow up period. Interestingly, they also observed that participants who ceased performing the exercises immediately after the intervention period showed declines in their gait speed. This is similar to the results found in the review of Ginè-Garriga *et al.* (2014:760), which also confirmed that the benefits of exercise are short lived when exercise is discontinued. Aguirre and Villareal (2015:86) further argued that physical activity can effectively be used as a modifier for disability in walking. Cameron *et al.* (2015:4), however, warned that further studies needed to be conducted regarding the translation of gains obtained in the clinical setup into their practical value within the community and the ADLs of the participants. They argued that some of these clinically significant gains, may in fact be meaningless within the community setup of the participants.



### 4.3.2 Chair stand

The chair stand test was implemented to test lower body muscle strength. Loss of muscle strength in the elderly is strongly associated with age related declines and sarcopenia (age-related loss of muscle mass). Clegg *et al.* (2013:755), highlighted why the relationship between sarcopenia and frailty has received special attention and supplied the following reasons: 'both are (i) highly prevalent in the elderly (ii) associated with negative health-related events (iii) potentially reversible and (iv) relatively easy to implement in the clinical practice. Fried *et al.* (2004:255) observed that physical activity, especially resistance exercise, could counteract the effects of sarcopenia by increasing muscle mass - which makes exercise a useful tool in the prevention of frailty.

Table 4.11 below contains the continuous data for the variable chair stand (maximum repetitions per 30 seconds). The median is reported along with the range at baseline and at post intervention. An inter-group comparison between the groups at baseline and post intervention with the 95% confidence interval for the median difference is also demonstrated.

**Table 4.11: Chair stand continuous data at baseline and post intervention**

Summary of baseline measurements			Summary of post intervention measurements		
Variable	Group	Median (range)	Variable	Group	Median (range)
Chairstand (max reps per 30 sec)	Milk	6.0 (0 - 11.0)	Chairstand (max reps per 30 sec)	Milk	7.75 (0 - 12.5)
	Both	7.0 (0 - 11.5)		Both	10.5 (4.5 - 15.0)
	Control	7.0 (0 - 12.5)		Control	7.5 (0 - 12.5)
<b>Baseline and post intervention 95% CI for median difference</b>					
	<b>Variable</b>	<b>(Milk - both)</b>	<b>Milk - control</b>	<b>(Both - control)</b>	
	Baseline chairstand	[-1.5 ; 0.5]	[-2.0 ; 0.5]	[-1.5 ; 1.0]	
	Post chairstand	[-3.5 ; -1.0]*	[-1 ; 2]	[1 ; 4]*	

\*  $p \leq 0.05$

As indicated in Table 4.11 above, there was an improvement in the median value for chair stand across all three groups from baseline to post intervention. The greatest improvement in the median occurred in the "both" group which showed an increase from 7.0 to 10.5 maximum repetitions per 30 seconds. The milk group came in second increasing from 6.0 to 7.75 and the control with a slight increase from 7.0 to 7.5 maximum repetitions per 30seconds. When an inter-group comparison was conducted for the median difference from baseline to post intervention, a statistically significant difference was found in the median of the "both" group when compared respectively to the milk group and the control group. The assumption is that the group that received both the milk and physical activity intervention

benefited more than the group that received the milk only and the group that received no intervention at all (control). Since the difference between the milk only (milk group) and the milk and physical activity group (both group) was the physical activity intervention, it can be concluded that the physical activity intervention potentially contributed more to the improvement than the milk intervention.

Table 4.12 below indicates the categorical data for the chair stand at baseline and post intervention. To determine improvement, focus was placed on the participants who were classified as 'below average' according to the norms (cf. 3.4.5.1) at baseline: range from (age  $\geq 65$  years: males  $< 12$  reps in 30sec; females  $< 11$  reps in 30sec) to (age  $\geq 90$  years: males  $< 7$  reps in 30sec; females  $< 4$  reps in 30sec). The percentage of participants who improved describes participants who were 'below average' at baseline represented in the table and the percentage of participants who improved to the 'average' category: range from (age  $\geq 65$  years: males 12 - 18 reps in 30sec; females 11 - 16 reps in 30sec) to (age  $\geq 90$  years: males 7 - 12 reps in 30sec; females 4 - 11 reps in 30sec). An inter-group comparison from baseline to post intervention and the 95% confidence interval for the percentage difference (improvement) is also presented in the table below.

**Table 4.12: Chair stand categorical data at baseline and post intervention**

Baseline chair stand		Post intervention chair stand		Post intervention 95% CI for percentage difference	
Group	% of participants in below average category	Group	% of participants who improved	Group	95% CI for percentage improvement
Milk	86.1%	Milk	18.8%	Milk – both	[-54.9% ; -12.35]*
Both	84.6%	Both	54.8%	Milk - control	[-6.8% ; 29.0%]
Control	77.1%	Control	7.1%	Both – control	[24.6% ; 64.5%]*
Baseline 95% CI for percentage difference					
Group	95% CI for percentage difference				
Both - control	[-15.4% ; 17.8%]				
Both – milk	[-9.3% ; 26.9%]				
Control – milk	[-10.5% ; 25.6%]				

\* $p \leq 0.05$

Well over 80% of the participants in the intervention groups registered in the 'below average' category at baseline (milk 86.1% and both 84.6%), while 77.1% of the participants in the control group registered as 'below average'. An inter-group comparison for the percentage difference at baseline revealed no statistically significant difference between the groups, indicating that all three the groups were similar at baseline. Post intervention, the "both" group recorded the greatest percentage of improved participants (54.8%). The milk (18.8%) and the control group (7.1%) also recorded improved participants, with the control group recording the lowest percentage of improved participants. An inter-group comparison between the groups from baseline to post intervention for the percentage difference revealed a statistically significant difference ( $p \leq 0.05$ ) in the "both" group compared to the milk group and the control group respectively. Similar to the results in the median values, these results show more improved participants in the group that received the physical activity intervention than in the milk or control group. The improvement in the control group was not expected, but it could be due to the 'Hawthorne Effect' or the participants simply being au fait with the testing protocol and they may have been better prepared and more encouraged to perform better the second time around. These results indicate that the physical activity intervention could have benefited the participants more than if they had no intervention (control) or if they had the milk only intervention. This is a significant finding for physical activity.

This finding is partly consistent with the results of the systematic review of Cadore *et al.* (2013:318-324), where in interventions using a treatment and a control group the exercise groups' performance improved in the chair stand test whereas there was no improvement observed in the control groups. Repeat performances of the test targets the muscles of the lower limb, leading to improved strength (Cadore *et al.* 2013:108). Concurrently, Ginè-Garriga *et al.* (2014:765), reported a correlation between decreased muscle strength/poor balance and slow gait speed. This points to the fact that any improvement in muscle strength (especially of the lower limbs) can potentially lead to gains in gait speed and improved balance.

Lustosa *et al.* (2011:322), conducted a study on the impact of a resistance exercise programme on functional capacity and muscular strength in pre-frail Brazilian women. Their study included only community dwelling women aged 65 years and older. They attributed the improvement in functionality (such as witnessed from the chair stand) to gains in muscle strength and power. Since the test is timed and requires the participants to perform as many

'sit down' manoeuvres as possible within 30sec, there is a muscle endurance component that is also trained during the execution of the test.

### 4.3.3 Arm curl

The arm curl test was used as a measurement for upper body strength. Muscle strength is crucial in the fight against sarcopenia, which is a major problem in the frail elderly. The role of sarcopenia in leading to physical inactivity is explained by Lang *et al.* (2009:541), as follows: As the older individual perceives the increased effort required to exercise and perform physical activities, they may develop avoidance of these activities. Exercise test results in the frail individual usually present with muscle weakness, low endurance and easy fatigability. Despite the emphasis on strength training for the improvement of sarcopenia, the ACSM (2016:131), however, advocated for a multicomponent exercise program that comprises aerobic and strength training. They argue that challenging the motor control of multiple segments used in ADLs have shown greater improvement of balance indices and fall rates.

Table 4.13 below contains the continuous data for the variable arm curl (maximum repetitions per 30 seconds). The median is reported along with the range at baseline and at post intervention. An inter-group comparison between the groups at baseline and post intervention with the 95% confidence interval for the median difference is also demonstrated.

**Table 4.13: Arm curl continuous data at baseline and post intervention**

Summary of baseline measurements			Summary of post intervention measurements		
Variable	Category	Median (range)	Variable	Category	Median (Range)
Arm curl (max reps per 30 sec)	Milk	9.75 (3.5 - 14.5)	Arm curl (max reps per 30 sec)	Milk	10.5 (5.0 - 15.0)
	Both	9.5 (5.0 - 13.5)		Both	11.0 (4.5 - 16.0)
	Control	8.5 (3.0 - 15.0)		Control	9.5 (3.0 - 16.5)
	Baseline and post intervention 95% CI for median difference				
	Variable	(Milk - both)	Milk - control	(Both - control)	
	Baseline Arm curl	[-1.5 ; 1.0]	[-1.5 ; 1.5]	[-1.0 ; 1.5]	
Post Arm curl	[-2,5 ; 0.5]	[-1.2 ; 2]	[0 ; 3]		

\*p≤0.05

As indicated in Table 4.13 above, there was an improvement in the median across all three groups from baseline to post intervention. The greatest improvement in the median was noted in the “both” group (9.5 to 11.0 maximum repetitions per 30sec) which was closely followed by the control group (8.5 to 9.5 maximum repetitions per 30sec). The milk group recorded a slight increase from (9.75 to 10.5 maximum repetitions per 30sec). An inter-group comparison from baseline to post intervention for the median difference, revealed no statistically significant improvement between the groups, indicating that the groups were similar.

Table 4.14 below indicates the categorical data for the arm curl at baseline and post intervention. To determine improvement, focus was placed on the participants who were classified as ‘below average’ according to the norms (cf. 3.4.4.1) at baseline: range from (age ≥65 years: males <15 reps in 30sec; females <12 reps in 30sec) to (age ≥90 years: males <10 reps in 30sec; females <8 reps in 30sec). The percentage of participants who improved describes participants who were ‘below average’ at baseline represented in the table and the percentage of participants who improved to the ‘average’ category range from (age ≥65 years: males 15 - 21 reps in 30sec; females 12 - 18 reps in 30sec) to (age ≥90 years: males 10 - 14 reps in 30sec; females 8 - 13 reps in 30sec). An inter-group comparison from baseline to post intervention and the 95% confidence interval for the percentage difference (improvement) is also presented in the table below.

**Table 4.14: Arm curl categorical data at baseline and post intervention**

Baseline arm curl		Post intervention arm curl		Post intervention 95% CI for percentage difference	
Group	% of participants in below average category	Group	% of participants who improved	Group	95% CI for percentage improvement
Milk	75.0%	Milk	18.8%	Milk – both	[-36.9% ; 5.2%]
Both	74.4%	Both	35.48%	Milk – control	[11.2% ; 26.0%]
Control	85.7%	Control	10.7%	Both – control	[2.9% ; 43.7%]*
Baseline 95% CI for percentage difference					
Group	95% CI for percentage difference				
Both - control	[-18.9% ; 19.7%]				
Both – milk	[-28.7% ; 8.1%]				
Control – milk	[28.8% ; 7.4%]				

\*p≤0.05

As indicated in Table 4.14 above, more than 70% of the participants in the intervention groups were below average (milk, 75% and both, 74.4%), while 85% of the participants in the control group were classified as 'below average'. An inter group comparison between the groups at baseline for percentage difference showed no statistically significant difference, indicating that the groups were similar at baseline. Post intervention, the both group recorded the highest percentage of improved participants (35.48%). One participant (both group) recorded an improvement above average (>21 repetitions in 30seconds). Both categories (average and above average were merged for the purposes of reporting). The milk group recorded the second highest number of improved participants (18.8 %) followed by the control group with 10.7% of improved participants.

The improvement in the control group was unexpected and could be due to the 'Hawthorne effect'. It is worth noting, however, that the percentage of improved participants in the control is still smaller than that recorded in the intervention groups. Therefore, whatever lead to the increase in the control group, the interventions appeared to afford greater improvements and can therefore be considered a contributing factor to the improvement in the strength, and more specifically upper body strength. The inter-group comparison from baseline to post intervention for percentage difference showed a statistically significant difference ( $p \leq 0.05$ ) in the 'both' group when compared to the control group. Since no statistically significant difference was found between the milk and the control group or between the milk group and the both group, it is conceivable that the combination of the interventions (milk and physical activity) is more effective for improvement than no intervention at all or either intervention implemented on its own.

In their review of the literature, Theou *et al.* (2011:13), found an improvement in the performance of the 30sec arm curl timed test in exercise intervention groups. The results from the study of Villareal *et al.* (2013:1223) varied slightly but were congruent with those found in this study. Their study was conducted at the Washington University School of Medicine with obese ( $BMI \geq 30 \text{ kg.m}^{-2}$ ) participants aged 65 years and older. The 52-week intervention comprised four groups: a control group, (diet) weight-management group, exercise training group, a group with both diet and exercise management (both). They utilized a one repetition maximum instead of the 30-sec timed test. The results in the arm curl one repetition maximum improved more in the diet-exercise group and the exercise group. The diet only group simply maintained their strength. Additionally, Roberts *et al.* (2017:30) also found an improvement in upper body strength in an intervention where an exercise programme was delivered through a DVD program. The six-month intervention included community dwelling older adults from Illinois (US). The participants were divided

into either an exercise group with a DVD and exercise equipment or a control group with an educational DVD on healthy ageing.

Any gains in muscle strength contributes to the improvement in the functionality of the frail elderly (Binder *et al.*, 2005:1429). This potentially reduces their risk for disability and loss of independence. The risk of participants towards injury or other adverse events while engaging in strength programmes is well documented, but adequate supervision and individually tailored/adjusted programmes appear to successfully counteract this problem. Furthermore, Aguirre and Villareal (2015:85), noted the fact that a reduced  $VO_{2peak}$  contributes to physical inactivity in the elderly. Improved  $VO_{2peak}$  through the participation of multicomponent exercise interventions that include both strength and aerobic/cardiovascular training, subsequently increase physical activity participation, which may improve physical activity performance, exercise tolerance and increase exercise compliance. Binder *et al.* (2002:1926), implemented a high intensity strength exercise programme and found a 14% increase in  $VO_{2peak}$  in men and 13% in women. This improvement in the  $VO_{2peak}$  is expected to translate in the better performance in endurance training as improved functioning in endurance ADLs. The effectiveness of high intensity resistance programmes is also noted by Peterson *et al.*, (2009:66).

#### **4.3.4 Handgrip**

The handgrip test was used as a measure of upper body strength. The principle method for improving muscle strength is through resistance training. Taaffe *et al.* (1999:1208), noted that resistance training had been found to be a safe and effective method for maintaining and developing muscle strength. It has also been found to be an important contributor to independent living and the ability to perform essential ADLs. Brown *et al.* (2000:964) found that elderly men and women with some degree of frailty were capable of gains in strength, flexibility and balance with a low intensity exercise programme that can improve their total functional capacity.

Table 4.15 below contains the continuous data for the variable handgrip (kg). The median is reported along with the range at baseline and at post intervention. An inter-group

comparison between the groups at baseline and post intervention with the 95% confidence interval for the median difference is also demonstrated.

**Table 4.15: Handgrip continuous data at baseline and post intervention**

Summary of baseline measurements			Summary of post intervention measurements		
Variable	Category	Median (range)	Variable	Category	Median (range)
Handgrip (kg)	Milk	20.0 (11.0 - 33.0)	Handgrip (kg)	Milk	25.0 (12.0 - 40.0)
	Both	22.0 (4.0 - 38.0)		Both	22.0 (14.0 - 43.0)
	Control	21.0 (11.0 - 51.0)		Control	20.5 (11.0 - 53.0)
Baseline And Post Intervention 95%CI For Median Difference					
Variable	(Milk - both)		Milk - control	(Both - control)	
Baseline handgrip	[-4.2 ; 2]		[-4.2 ; 2]	[-4 ; 3]	
Post handgrip	[-1 ; 5]		[1 ; 8]*	[-1 ; 6]	

\*p<0.05

As indicated in Table 4.15 above, the median for the handgrip improved in the milk only group from baseline (20.0 kg) to post intervention (25.0 kg) while the both group's median (22.0 kg) remained the same from baseline to post intervention. The control group is the only group to record a decrease in the median from baseline (21.0 kg) to post intervention (20.5 kg). The inter-group comparison for the median difference showed a statistically significant difference ( $p \leq 0.05$ ) post intervention in the milk group when compared to the control group; the possibility being that when compared to having no intervention at all, the milk intervention was significantly more beneficial.

Table 4.16 below indicates the categorical data for the handgrip at baseline and post intervention. To determine improvement, focus was placed on the participants who were classified as 'very poor' according to the norms (cf. 3.4.3.1) at baseline (males <40 kg and females <20 kg). The percentage of participants who improved describes participants who were 'below average' at baseline represented in the table and the percentage of participants who improved to the 'poor – very good' category: range of (males 40 – 43 kg to 56 – 64 kg and females 20 – 22 kg to 34 – 38 kg). An inter-group comparison from baseline to post intervention and the 95% confidence interval for the percentage improvement is also presented in the table below.



**Table 4.16: Handgrip categorical data at baseline and post intervention**

Baseline handgrip		Po5t intervention handgrip		Post intervention 95% CI for percentage difference	
Group	% Of participants in very poor category	Group	% of participants who improved	Group	95% CI For Percentage Improvement
Milk	61.1%	Milk	50.0%	Milk – both	[-15.8% ; 30.6%]
Both	66.3%	Both	41.9%	Milk – control	[8.0% ; 51.3%]*
Control	62.9%	Control	17.9%	Both - control	[0.5% ; 44.0%]*
Baseline 95% CI for percentage difference					
Group	95% CI for percentage difference				
Both - control	[-26.2% ; 15.5%]				
Both - milk	[23.2% ; 20.0%]				
Control - milk	[-17.2% ; 24.6%]				

\*p&lt;0.05

As indicated in Table 4.16 above, over 60% of all the participants (milk 61.1%, both 66.3% and control 62.9%) were categorised as very poor at baseline. The inter-group comparison for the percentage difference at baseline found no statistically significant difference, indicating the groups were similar at baseline. Post intervention, the greatest percentage of improved participants occurred in the milk group (50% of participants improved in a range from very poor to very good). The both group recorded the second highest percentage of improved participants at 41.9% and the control group only recorded 17.9% improved participants. Although the control group is not expected to improve, it recorded the smallest percentage of improved participants, so the interventions (milk and both groups) were possibly more effective in improving upper body strength.

The inter-group comparison for percentage difference in the improvement from baseline to post intervention, revealed a statistically significant difference ( $p \leq 0.05$ ) when comparing the milk group to the control group as well as in the both group compared to the control group. The significant improvement in the intervention groups (milk and both groups) compared to the control group means a combination of the interventions (milk only and both milk and physical activity) is possibly more likely to improve the performance of the handgrip test and therefore upper body strength, than no intervention at all or the respective interventions in isolation. The fact that the exercise programme of the both group (milk and physical activity)

intervention group) included exercises of upper body strength, was a possible contributing factor to the significant result in the physical activity intervention group.

Kim *et al.* (2015:16), however, found no statistically significant difference in the handgrip strength of the participants in their study. Their study investigated the effects of exercise and milk fat globule membrane supplementation (MFGM) on body composition, physical function and haematological parameters in community dwelling Japanese women. The study included women over 75 years of age who were randomly assigned into one of four groups: exercise and MFGM supplementation, exercise and placebo, MFGM supplementation only and a placebo only group. Their study, however, focused on lower body strength exercises and did not include any for the upper body; this can possibly explain why their participants did not show any improvement. The review of exercise interventions on frailty by Theou *et al.* (2011:12), generally found that interventions had a positive impact on the improvement of muscle strength. This study recorded a statistically significant difference ( $p \leq 0.05$ ) in the handgrip performance in both the intervention groups (both and milk group) compared to the control group. This suggests an intervention is more effective in improving hand grip strength than no intervention at all. Both upper body tests (arm curl and handgrip) had statistically significant results, this adds to the recommendation to include upper body exercises in interventions in order to improve upper body strength.

The exercise interventions reviewed in the study of Theou *et al.* (2011:12), followed a whole-body programme design to target the major muscle groups, which included upper body exercises to specifically improve upper body strength as well. Makizako *et al.* (2015:6), found a strong correlation between low handgrip strength and increased incidence of disability. Moreover, in their systematic review, De Labra *et al.* (2015:12), noted that an improvement in handgrip strength resulting from implemented muscle strength interventions, specifically those that targeted upper body muscle strength. The tendency of most interventions to focus on lower body muscle strength due to its importance to ambulation, has limited research into upper body strength.

Kim *et al.* (2015:16), referenced the fact that handgrip strength has clinical applications in the assessment of sarcopenia. Their study did not produce statistically significant changes in the grip strength of the intervention participants, but they ascribed that outcome to the composition of the exercise program. Since grip strength is a measure of upper body strength, an exercise intervention programme that lacks focus in upper body exercises may fail to promote any improvements in hand grip strength. They advise that any future studies that wish to measure grip strength as an outcome of their intervention, must place emphasis

on including upper body exercises within the exercise programme; such as done in this study.

#### 4.3.5 Modified sit and reach

The modified sit and reach was used to measure flexibility. Stathokostas and Vandervoort (2016:169), stated that flexibility decreases with age but that older adults can regain lost range of motion. Stretching is the recommended method of maintaining and improving ROM. The ACSM (2018:168), makes the following recommendation for the FITT- (frequency, intensity, time and type) principle applicable for flexibility: Each major muscle group should undergo static stretching 2-3 days a week at 60%-70% of a one repetition maximum (1 RM) and held for 10-30seconds. The type of stretching involved will depend on the activity being pursued.

Table 4.17 below contains the continuous data for the modified sit and reach (cm). The median is reported along with the range at baseline and at post intervention. An inter-group comparison between the groups at baseline and at post intervention with the 95% confidence interval for the median difference is also demonstrated.

**Table 4.17: Modified sit and reach continuous data at baseline and post intervention**

Summary of baseline measurements			Summary of post intervention measurements		
Variable	Category	Median (range)	Variable	Category	Median (range)
Modified sit (cm)	Milk	0 (0 - 30.7)	Modified sit (cm)	Milk	0 (0 - 16.3)
	Both	0 (0 - 31.2)		Both	0 (0 - 0)
	Control	0 (0 - 29.3)		Control	0 (0 - 29.3)
<b>Baseline and post intervention 95% CI for median difference</b>					
	<b>Variable</b>	<b>(Milk - both)</b>	<b>Milk - control</b>	<b>(Both - control)</b>	
	Baseline modified sit	[0 ; 0]	[0 ; 0]	[0 ; 0]	
	Post modified sit	[0 ; 0]	[0 ; 0]	[0 ; 0]	

Executing the modified sit and reach test correctly (being able to touch one's toes with one's fingers is recorded as zero (0 cm), which is a perfect score. Inability to touch one's toes is recorded by the amount of centimetres difference measured between the reaching hand and the foot. A decrease in this value is recorded as an improvement. It indicates improved flexibility, as the individual is now able to reach closer towards their foot. As indicated in Table 4.17 above, the median across all three groups at baseline was 0 cm. Post intervention, the median was still 0 cm but some improvements are recorded in the median

range which decreased from baseline to post intervention in the intervention groups (milk 30.7cm – 16.3 cm and both 31.2 – 0 cm). The both group recorded a median range of (0;0) post intervention, showing the greatest improvement in flexibility of the three groups. An inter-group comparison at baseline to post intervention showed no statistically significant difference indicating that the groups were similar.

Table 4.18 below contains the categorical data for the modified sit and reach at baseline and post intervention. To determine improvement, focus was placed on the participants who were classified as 'average' according to the norms (cf. 3.4.6.1) at baseline: range from ( $\geq 65$  years: males - 8cm to 8cm and females -1cm to 11cm) to ( $\geq 90$  years: males -17cm to 17cm and females -11cm to 11cm). The percentage of improved participants describes participants who were 'average' at baseline and represented in the table and the percentage of participants who improved to the 'above average' category: range from ( $\geq 65$  years: males  $>8$ cm and females  $>11$ cm) to ( $\geq 90$  years: males 1cm and females 3cm). An inter-group comparison from baseline to post intervention and the 95% confidence interval for the percentage difference (improvement) is also presented in the table below.

**Table 4.18: Modified sit and reach categorical data at baseline and post intervention**

Baseline modified sit		Post intervention modified sit		Post intervention 95% CI for percentage difference	
Group	% of participants in average category	Group	% of participants who improved	Group	95% CI for percentage improvement
Milk	88.9%	Milk	0.0%	Milk – both	[-11.4% ; 10.7%]
Both	79.5%	Both	0.0%	Milk - control	[-12.1 ; 10.7%]
Control	91.4%	Control	0.0%	Both - control	[-12.1% ; 11.4%]
Baseline 95% CI for percentage difference					
Group	95% CI for percentage difference				
Both - control	[-7.8% ; 25.9%]				
Both – milk	[-17.8% ; 12.8%]				
Control – milk	[-28.0% ; 5.0%]				

As indicated in Table 4.18 above, the control group had the highest percentage of improved participants (91.4%) classified as average at baseline. The milk group came in second with 88.9% of the participants classified as average and the both group contained 79.5% of participants classified as average. The inter-group comparison for percentage difference at baseline found no statistically significant differences, indicating that all three the groups

were similar at baseline. Post intervention, none of the participants in any of the groups improved from average to above average. The inter-group comparison for percentage difference from baseline to post intervention also found no statistically significant differences between the groups. In their reviews of the literature, Aguirre and Villareal (2015:86) and Theou *et al.* (2011:12), found that exercise generally improves flexibility, which in turn leads to improvement in physical performance. Conversely, Roberts *et al.* (2017:30), found that flexibility did not improve in their intervention. Their intervention ran over six months, containing six progressive exercise sessions with two sets of 11-12 multicomponent exercises. Although the participants had telephone support during the intervention, supervision can possibly have been a disadvantage in this set up. They further argued that strength and balance may in fact be more important for physical functionality than flexibility. Their intervention was delivered through a DVD in the intervention group while the control group received a DVD on successful ageing. It is the opinion of the researcher of this study, that one of the disadvantages of the programme being delivered through DVD is the lack of professional supervision. This meant that the participants could have executed some of the exercises incorrectly and some of the participants may not have completed the exercises at all. Home programmes are difficult to monitor and the results are subjective, based on the truthfulness of the participants. These are some of the reasons according to the researcher of this study, why the participants in the study of Roberts *et al.* (2017:30), did not show any improvements in flexibility.

Brown *et al.* (2000:964), stated that there is a correlation between decreased flexibility and decreased functionality. They alluded to the fact that any improvement in flexibility can lead to improved functionality in the frail elderly. Furthermore, they state that flexibility-only programmes are ineffective in addressing flexibility and range of motion (ROM) deficits in the frail elderly; their inclusion and integration within a multicomponent exercise programme is far more beneficial. The impact of flexibility exercises is also precluded by any pre-existing injuries or surgeries e.g. hip/knee replacement. Congruently, Aguirre & Villareal (2015:85), also stipulated to the fact that the response to resistance exercise training may be attenuated by mobility restrictions and other comorbidities. In their review, Theou *et al.* (2011:12), observed that exercise improved flexibility in the exercise groups where it was measured as an outcome.

#### **4.3.6 8-Foot up and go**

The 8-foot up and go test [also known as the timed up and go test TUG]) was used as a measurement of balance, speed and agility. Speed and agility are beneficial in respect of

the fact that they help improve efficiency of movement, decrease risk of injury, improve the ability to perform ADLs and as such improve the quality of life. According to Rubenstein (2006:ii37), the loss of balance leading to falls is among the highest causes of injuries in the elderly and fifth cause of death after CVD, cancer, stroke and pulmonary diseases. The resulting falls are the cause of both morbidity and mortality in this population, serious falls leading to death constitute more than two-thirds of unintentional injuries and the rest can result in serious disability. Improvements in muscle strength can also lead to improvements in speed and agility.

Table 4.19 below indicates the continuous data for the variable 8-foot up and go (seconds). The median is reported along with the range at baseline and at post intervention. An inter-group comparison between the groups at baseline and post intervention with the 95% confidence interval for the median difference is also demonstrated.

**Table 4.19: 8-foot up and go continuous data at baseline and post intervention**

Summary of baseline measurements			Summary of post intervention measurements		
Variable	Category	Median (range)	Variable	Category	Median (range)
8-foot up & go (seconds)	Milk	14.0 (6.5 - 40.5)	8-foot up & go (seconds)	Milk	12.0 (5.0 - 28.5)
	Both	12.0 (7.5 - 37.5)		Both	10.0 (6.0 - 23.0)
	Control	13.0 (5.0 - 99.0)		Control	11.5 (5.5 - 62.0)
<b>Baseline and post intervention 95% CI for median difference</b>					
	<b>Variable</b>	<b>(Milk - both)</b>	<b>Milk – control</b>	<b>(Both - control)</b>	
	Baseline 8- foot	[-0.5 ; 3.0]	[-1 ; 4]	[-2.5 ; 2.0]	
	Post 8- foot	[0 ; 4.5]	[-2 ; 3]	[-3.5 ; 0.5]	

An improvement in the 8-foot up and go is recorded as a decrease in the amount of time it took to complete the test. As indicated in Table 4.19 above, there was an improvement in the medians of all three groups from baseline to post intervention (milk 14 – 12sec; both 12 – 10sec and control 13 – 11.5sec). An inter-group comparison for the median difference from baseline to post intervention found no statistically significant difference between the groups, indicating that the groups were similar.

Table 4.20 below indicates the categorical data for the 8-foot up and go. To determine improvement, focus was placed on participants who were classified as 'below average' (cf. 3.4.7.1) at baseline: range from (age  $\geq 65$  years: males  $> 5.7$ sec and females  $> 6.4$ sec) to (age  $\geq 90$  years: males  $> 10$ sec and females  $> 11.5$ sec). The percentage of participants who improved describes participants who were 'below average' at baseline and progressed to 'average' post intervention: range from (age  $\geq 65$  years: males 5.7 to 4.3sec and females

6.4 to 4.8sec) to (age  $\geq 90$  years: males 10.0 to 6.2sec and females 11.5 to 7.3sec). An inter-group comparison from baseline to post intervention and the 95% confidence interval for the percentage difference (improvement) is also presented in the table below.

**Table 4.20: 8-foot up and go categorical data at baseline and post intervention**

Baseline 8-foot up and go test		Post intervention 8-foot up and go test		Post intervention 95% CI for percentage difference	
Group	% of participants in below average category	Group	% of participants who improved	Group	95% CI for percentage improvement
Milk	100.0%	Milk	9.7%	Milk - both	[-21.2% ; 13.6%]
Both	97.3%	Both	13.3%	Milk - control	[-10.5% ; 21.4%]
Control	87.9%	Control	3.8%	Both - control	[-7.6% ; 26.1%]
Baseline 95% CI for percentage difference					
Group	95% CI for percentage difference				
Both – control	[-7.4% ; 13.8%]				
Both – milk	[-0.2% ; 27.3%]				
Control – milk	[-3.9% ; 24.8%]				

As indicated in Table 4.20 above, all the participants in the milk group (100%) were classified as below average according to the norms at baseline. The both group had (97.3%) participants who were below average and 87.9% of the control were classified as below average. An inter-group comparison for percentage difference at baseline between the three groups showed no statistically significant difference, indicating that the groups were similar at baseline. Post intervention, the greatest percentage of improved participants (from below average to average) was found in the both group 13.3%. The milk group (9.7%) came in second and the control group (3.8%) also recorded improved participants (even though it was the lowest percentage of improved participants recorded). The improvement of the control group can possibly be explained by the fact that they were now au fait with the movement, having previously been exposed to it during the baseline testing and knew what to expect. The 'Hawthorne effect' can also have played a role, psychologically, knowing that the post intervention testing was testing for improvements, could have motivated the control group to try harder. An inter-group comparison from baseline to post intervention for percentage difference found no statistically significant difference between all the groups, indicating that they were similar.

Paw *et al.* (2008:790), in their review of the literature of the functional effects of physical exercise training in frail older people, found that physical activity interventions generally

improved the time required to perform the 'timed up and go test' or TUG. This post intervention improvement is congruent with the functional outcomes in the reviews of Cadore *et al.* (2013:105-114) and Theou *et al.* (2011:13). Post intervention, the intervention groups spent a significantly less amount of time on the TUG compared to the control groups, therefore indicating improvement. In contrast, in their reviews, Ginè-Garriga *et al.* (2014:760) and Chou *et al.* (2012:239), observed that scores of the TUG showed heterogeneity and there were no differences observed. This could be due to the heterogeneity of the exercise programmes used in the interventions. In a single blind controlled trial conducted in Brazil, Pollock *et al.* (2012:918), using whole body vibration (WBV) as intervention, also found a significant improvement in the TUG in the WBV group and the exercise group. The study was only comprised of women over 65 years of age who were then randomised into an experimental group (that participated in exercises) or control group (that simply continued with their ADLs).

In their reviews, Cadore *et al.* (2013:108) and Chou *et al.* (2012:241), found that resistance training produced improvement in muscle strength, but not in the speed of the performance of the TUG test. Pollock *et al.* (2012:921) also observed increases in the TUG using WBV. They made the assertion that because the TUG is a speed and agility test, the improved time was probably due to improvement in the gait speed, which improved the speed component of the test. Progressively increasing the resistance in strength programmes seems to be the difference between a successful intervention and no improvement. Effective training programmes should use body weight and be as functional as possible, mimicking the ADLs of the participants. This results in the greatest cross-over in gains from an intervention to daily life. Chou *et al.* (2012:241), concluded that the heterogeneity in the TUG results may stem from the varied status of the participants in the different studies at baseline as well as the varied exercise training conditions and programmes implemented in the interventions.

#### 4.3.7 Frailty status

Singh *et al.* (2014:1727), recognised frailty as 'a complex clinical syndrome of increased vulnerability to stressors which results from multiple impairments across different systems and accounts, at least in part, for the heterogeneity between chronological and biological age'. Rockwood *et al.* (1999:205-206), also proposed a definition of frailty which does not need sophisticated clinical measurements. According to this scale, persons are classified as **fit** (walks without help; performs basic ADLs e.g. eating, dressing, bathing & bed transfer; continent of bowel and bladder; not cognitively impaired); **fit but bladder incontinent**



(walks without help; performs basic ADLs e.g. eating, dressing, bathing & bed transfer; continent of bowel but not of bladder; not cognitively impaired), **pre-frail** (one or more of the following, two if incontinent: needs assistance with ADLs or mobility; bowel or bladder incontinent; cognitive impairment without dementia); **frail** (two of the following, three if incontinent: totally dependent for transfers; totally dependent with one or more ADLs; bowel or bladder incontinent; demented). In their study, Rockwood and colleagues (1999:205-206) aimed to develop a more accepted and easy-to-use clinical frailty scale (cf. Appendix E) which had the ability to predict death or need for institutional care, and correlated the results with those obtained from other established tools.

Table 4.21 below indicates the categorical data of the frailty status at baseline and post intervention. To determine improvement, focus was placed on the participants classified as frail at baseline (cf. Appendix E). The percentage of improved participants post intervention describes the percentage of participants who were still categorised as frail. An inter-group comparison from baseline to post intervention and the 95% confidence interval for the percent difference (improvement) is also presented in the table below.

**Table 4.21: Frailty status categorical data at baseline and post intervention**

Baseline frailty status		Post intervention frailty status		Post intervention 95% CI for percentage difference	
Group	% of participants in frail category	Group	% of participants in frail category	Group	95% CI for percentage difference
Milk	17.8%	Milk	0.0%	Both-control	[-11.9% ; 23.9%]
Both	5.0%	Both	16.13%	Both-milk	[2.5% ; 32.6%]*
Control	17.0%	Control	10.0%	Control-milk	[-2.1% ; 25.6%]
Baseline 95% CI for percentage difference					
Group	95% CI for percentage difference				
Both - control	[-25.6% ; 2.1%]				
Both - milk	[26.8% ; 1.5%]*				
Control - milk	[-16.6% ; 14.9%]				

\*p≤0.05

As indicated in Table 4.21 above, the highest percentage of participants who were classified as frail at baseline were in the milk group (17.78%). The control group came in second at 17.0% and the both group had the least number of frail participants at 5.00%. There was a tendency for the both group to have less frail participants at baseline. The inter-group comparison for percentage difference at baseline showed no statistically significant difference, indicating that the groups were similar at baseline. Post intervention, the highest percentage frail participants was now in the both group (16.13%) while the control group

now recorded a lower percentage of frail participants (10.0%) and the milk group had none (0.0%). Furthermore, the inter-group comparison for percentage difference from baseline to post intervention found a statistically significant difference in the both group when compared to the milk group. Since both the milk and both group had no statistically significant difference when compared to the control group, there is a possibility of a tendency for participants in the both group to be frailer post intervention. This result is unexpected. Possible reasons for this occurrence are the following:

- Worsening health. Considering the frailty scale that was used, it is possible that the participants in the frail group could have developed incontinence during the course of the intervention or developed dementia. Those are the only two criteria not specifically addressed by the physical activity intervention. Due to the exercises performed, loss of independence would not be expected or depending on others for transfers.
- Contributing factors to frailty status. Frailty that possibly results from malnutrition and not from physical inactivity will more likely benefit from a nutrition intervention than a physical activity intervention. Since the both group received both interventions and 'worsened', the group demographics might be a factor. If the both group was older than the milk group, that can possibly explain their worsening status.

#### **4.4 SUMMARY OF THE FINDINGS OF THE IMPACT OF PHYSICAL ACTIVITY (BOTH GROUP VIZ MILK AND PHYSICAL ACTIVITY INTERVENTION) ON THE VARIOUS VARIABLES**

In all of the variables, in both the continuous and categorical analysis, all three groups (milk, both and control) did not exhibit any statistically significant differences at baseline, indicating that the sample was homogenous. This is important, because if the groups were similar at baseline, any recorded changes post intervention are likely to be from the intervention. The impact of the physical activity intervention (the both group) on the variables is summarised in Table 4.22 below and will be briefly discussed thereafter.

**Table 4.22: Summary of the findings (categorical) of the both group (milk and physical activity)**

Summary of the findings of the 'both' group			
Variable	Change	Beneficial/Not beneficial/ Constant/Inconclusive	Statistically significant * $p \leq 0.05$
<b>BMI</b>	↑	Inconclusive	Yes (Both vs Milk)
<b>6-min walk</b>	↑	Beneficial	No
<b>Chair stand</b>	↑	Beneficial	Yes (Both vs Control)
<b>Arm curl</b>	↑	Beneficial	Yes (Both vs Milk & Control)
<b>Handgrip</b>	↑	Beneficial	Yes (Both vs Control)
<b>Modified sit and reach</b>	0	Constant	No
<b>8-foot up and go</b>	↓	Beneficial	No
<b>Frailty status</b>	↑	Not beneficial	Yes (Both vs Milk)

A summary of the findings presented in Table 4.22 above will be presented next. The both group was singled out because it was the group that contained the milk and physical activity intervention. To assess the impact of the physical activity intervention, special attention was paid to the both group's performance in the variables investigated.

#### 4.4.1 BMI

There was an improvement (although not statistically significant) in the median of the BMI from baseline to post intervention in the both group (26.1 kg.m<sup>-2</sup> to 28.4 kg.m<sup>-2</sup>). A statistically significant difference was found in the BMI of the both group when compared to the milk only group post intervention (95% confidence interval for median difference). The result is described as 'inconclusive' since BMI does not distinguish body composition. As a result, the increase in BMI cannot specifically be attributed to increase in fat mass due to the full cream sour milk ingested or if it was due to an increase in muscle/lean body mass due to the resistance exercises engaged in the intervention.

The BMI also increased in the milk and control group (although not statistically significant). The result is expected in the milk group due to the full cream sour milk ingested during the intervention and in the control group whose diet or physical activity was not monitored nor restricted during the intervention.

#### 4.4.2 6-minute walk

Three-point two percent (3.2%) of the participants in the both group (milk and physical activity) improved in the 6-minute walk post intervention. The 6-minute walk was used to measure cardiovascular endurance. Walking was used in the intervention programme as a

warm-up exercise. The both group (milk and physical activity) was in a rural area of Maseru and as such walking was their primary mode of transport. In terms of cardiovascular endurance, the result also means that the participants who improved could walk further, for longer. This improvement can go a long way towards improving their quality of life.

The cardiovascular endurance of participants in the milk and the control group also improved as measured in the performance of the 6-minute walk. This result was expected in the milk group as they were also rural community dwelling citizens whose main mode of transport is walking. Although more urbanised, the result was also expected in the control group as they also walk in town to complete their errands.

#### **4.4.3 Chair stand**

Fifty-four-point-eight percent (54.8%) of the participants in the both group (milk and physical activity) improved in the chair stand. The chair stand was used to measure lower extremity strength. The exercises in the intervention that focused on lower leg strength (e.g. mini squats, sit to stand and standing march for hip flexors) appear to have contributed towards improving the lower body strength in the both group. It is also worth noting that it is only in this variable (chair stand) that the improvement in the both group (milk and physical activity) was significant when compared to the milk and the control group. It can be concluded that physical activity was a significant contributor to improvement in strength.

Participants in the milk and the control group also improved in their lower body strength. The result was unexpected in the milk and control group as they did not receive the physical activity intervention. The milk group, however, could have improved as a result of improved nutrition from the nutrition intervention.

#### **4.4.4 Arm curl**

Thirty-five-point-four-eight percent (35.48%) of the participants in the both group (milk and physical activity) improved in the arm curl and upper body strength. When compared to the control group (which received no intervention) there was a statistically significant improvement. One of the notable elements of this intervention programme was the holistic approach to the exercise programme. The inclusion of various exercises (e.g. bicep curls,

lateral raises, wood chops and triceps extensions). paid special attention to the development of upper body strength.

Participants in the milk and the control group also improved their upper body strength as measured in the arm curl test. The result was unexpected in the control group as they did not receive the physical activity intervention. The milk group, however, could have improved as a result of improved nutrition from the nutrition intervention.

#### **4.4.5 Handgrip**

Forty-one-point-nine percent (41.9%) of the participants in the both group improved post intervention. Handgrip (along with the arm curl) was used to assess upper body strength. When compared to the control group, the both group (milk and physical activity) had a statistically significant improvement. One can therefore argue that an intervention is better for improvement than no intervention at all. Once again, the focus of the intervention programme on upper body strength could have contributed to the improvement in the handgrip strength as well. This improvement is essential to the performance of various ADLs.

Participants in the milk and the control group also improved their upper body strength as measured in the handgrip test. The result was unexpected in the control group as they did not receive the physical activity intervention. The milk group, however, could have improved as a result of improved nutrition from the nutrition intervention.

#### **4.4.6 Modified sit and reach**

The modified sit and reach is the only variable where no improvement was seen in the both group (milk and physical activity) post intervention. It is worth noting that 88.9% of the participants were already able to perform the movement at baseline and were classified as average. The modified sit and reach was used to measure flexibility. Stretches were implemented in the exercise program for all the major muscle groups (before and after the

exercise sessions), quadriceps, hamstrings, gastrocnemius and rotator cuff. Participants were encouraged to continue with the stretches after the intervention concluded.

Participants in the milk and the control group also did not improve in their flexibility as measured in the modified sit and reach test. The result was expected in the milk and control group as they did not receive the physical activity intervention.

#### **4.4.7 8-foot up and go**

Thirteen-point-three percent (13.3%) of the participants in the both group (milk and physical activity) improved post intervention. The 8-foot up and go measured balance, speed and agility. The fear of falling is a major deterrent for the elderly participating in physical activity. Even in the pursuit of functional performance of ADLs, the fear of falling can eat away at the confidence of the elderly to perform those activities - leading to a loss of independence. Improvement in balance can contribute significantly to relieving these symptoms (fear of falling and poor balance). As rural community dwelling citizens, the ability to walk on uneven surfaces and navigate obstacles can be beneficial to improving a simple activity such as walking for these participants.

Participants in the milk and the control group also improved their balance, speed and agility as measured in the 8-foot up and go test. The result was unexpected in the milk and control group as they did not receive the physical activity intervention.

#### **4.4.8 Frailty status**

The outcome of the frailty status was unexpected. Five percent (5%) of the participants were classified as frail at baseline in the both group and 16.13% of the participants were classified as frail post intervention. When compared to the milk group (whose percentage of frail participants dropped from 17.78% at baseline to 0.0% post intervention), the both group has a statistically significant improvement in frailty status. This is a negative outcome. The explanation for the rise in frail participants in the both group is difficult to ascribe. It is possible that the Frailty scale used was not sensitive enough to measure the gains made the physical activity intervention and was perhaps more sensitive to changes in nutritional status. This is one of the disadvantages of a combined study that shares variables and

instruments. Fried's Phenotype Scale may have been a better instrument for the physical activity intervention as it observes physical deficits.

Physical activity interventions are more effective in addressing the sedentary lifestyle factor - which is a contributor towards frailty. Once initiated, they can help target sarcopenia, slow gait speed and diminished endurance. Nutrition can also contribute to improvement in sarcopenia; it is conceivable that if frailty was due to malnutrition more than sedentary lifestyle, a nutritional intervention can make a more notable contribution to frailty status than physical activity.

## **CHAPTER 5**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH**

---

#### **5.1 INTRODUCTION**

The global population of the elderly is expected to increase dramatically over the next decade with the UN reporting the number of people aged over 60 years to increase from 524 million in 2010 to 1.5 billion in the year 2050. Fried *et al.* (2004:255), already noted the increasing pressure on health professionals and the medical community to prepare adequate infrastructure and policies to be able to care for this population. The majority of these elderly people will be found in developing countries. This, coupled with the ailing health of most elderly persons, immediately creates potential strain on the health sector that must care for these individuals. With frailty only recently being studied in developing nations, the need for further studies is apparent.

As a result, an in-depth study was undertaken with the view to investigate the impact of a physical activity intervention programme on frailty syndrome in elderly citizens in Maseru district, Lesotho.

#### **5.2 OVERVIEW OF THE STUDY**

Having already noted that research on frailty in developing nations is lacking when compared to developed nations, the task of investigating frailty and instituting a possible intervention on frailty got underway. Does the picture of frailty look the same in developing nations as in developed nations? Will the interventions currently supported by literature have the same impact in developing nations as in developed nations? In light of these questions, one research question was formulated and investigated: "What is the impact of a physical activity intervention programme on frailty syndrome in elderly citizens of Maseru district, Lesotho? The research was driven by the objectives investigating the impact of physical activity intervention on the various components of physical fitness (e.g. cardiovascular endurance, upper and lower body strength, flexibility, balance, speed and agility). The results of this research will possibly add to the foundation of existing research on frailty in developing nations and hopefully motivate for further research. It is also the hope of the researcher of this study to provide the results to Lesotho's ministry of Health to motivate for further projects the government can undertake to address the elderly population - especially with regards to frailty.



Chapter 1 outlined the background of the research problem and presented the research question: “What is the impact of a physical activity intervention programme on frailty syndrome in elderly citizens of Maseru district, Lesotho?” The objectives that were derived to investigate the research question were also outlined.

Chapter 2 outlined the ageing process and health-related diseases associated with ageing. A special focus was given to the geriatric disease frailty and the impact of physical activity on frailty. Other chronic diseases associated with ageing (e.g. CVDs, chronic respiratory diseases) presenting as comorbidities or multimorbidities and musculoskeletal-related chronic diseases such as osteoporosis were also discussed as well as the effect of physical activity on these diseases.

Chapter 3 discussed the methodology of the study. The equipment used in the testing and intervention were explained. The structure of the intervention and testing was thoroughly detailed.

Chapter 4 presented the results of the study and the discussion thereof. The statistical analysis was demonstrated in tables and figures, followed by a discussion of the findings. The chapter was concluded by a summary of the findings, with special focus on the impact of the physical activity intervention.

### 5.3 CONCLUSIONS

From the results of the investigation, the following conclusions can be drawn:

**Research question:** What is the impact of a physical activity intervention programme, on frailty syndrome in elderly citizens in Maseru district, Lesotho?

**Outcome:** The frailty status of the elderly citizens of Maseru district, Lesotho did not improve.

The percentage of participants classified as frail increased post intervention. This outcome was unexpected and not beneficial to the participants. The results reflect that the exercise intervention was possibly not adequate (in terms of the FITT principles) to prevent decline into frailty status or improve frailty status. The Rockwood frailty scale used, was possibly not sensitive enough to measure the impact of the physical activity intervention and was perhaps more sensitive to the changes brought about by the nutritional intervention.

### **Research objectives:**

- To investigate the impact of physical activity intervention programme on cardiovascular fitness i.e. the 6-minute walk test in elderly citizens in the Maseru district, Lesotho.

The intervention programme brought about an improvement (although no statistically significant) in the cardiovascular endurance as tested by the 6-minute walk in all the groups (milk, both and control). The control group improved the most. Participants who improved were able to walk further and longer. This outcome was expected and beneficial for all participants who improved.

- To explore the impact of the physical activity intervention programme on upper and lower body strength i.e. chair stand, the arm curl test and handgrip test in elderly citizens in Maseru district, Lesotho.

The improvement in the both group (milk and physical activity) participants was statistically significant when compared to the milk only and the control for the chair stand. It is the only variable where the both group performed significantly better than the milk only group and the control group. These results argue strongly for the impact of physical activity, in improving lower body strength. The improvement in the both group was also statistically significant when compared to the control group in the arm curl and handgrip. The evidence suggests that the physical activity intervention was instrumental in the improvement of upper body strength, which was addressed in the exercise program.

- To investigate the impact of physical activity intervention programme on flexibility i.e. modified sit and reach test in elderly citizens in Maseru district, Lesotho.

There was no improvement in the flexibility of any of the participants. The majority of participants already scored well for the sit and reach test, when compared with normal values at baseline - which indicated good flexibility. The possible advantage was that flexibility was maintained throughout the exercise intervention programme and no declines were seen post intervention. It can therefore be concluded that where flexibility is already sufficient, the intervention programme contributed to the maintenance of that flexibility.

- To explore the impact of physical activity intervention programme on balance, speed and agility i.e. 8-foot up and go test on elderly citizens in Maseru district, Lesotho.

Improvement (although not statistically significant) was seen in the balance, speed and agility in all the groups (milk, both and control) post intervention. The both group improved the most. The time taken to perform the test decreased post intervention, indicative of an improvement in the performance of the exercise. The improvement of balance, speed and agility also contributes to improved gait. This outcome was expected and is beneficial to the participants.

Improvement was seen in the functional outcomes investigated, which contribute to the ADL performance and quality of life in the elderly. It is notable that of all the fitness components investigated, only muscle strength showed a statistically significant improvement. This is of particular importance as sarcopenia has been identified as a major problem in frailty and muscle strength is crucial in the fight against sarcopenia. Physical activity interventions are more effective in addressing the sedentary lifestyle factor - which is a contributor towards frailty.

#### **5.4 LIMITATIONS OF THE STUDY AND RECOMMENDATIONS FOR FUTURE RESEARCH**

##### Study duration

This study did not run for the full 12 weeks. Due to the logistical challenges experienced by the researcher in initiating the study. The full details are explained in the researcher's note at the end of this chapter. Three (3) month interventions are common, but the shorter duration of this study, may have impacted on the results of the study. A follow-up period is also recommended as other studies have shown the immediate decline upon cessation of activity. A better understanding of the retainability of the gains made during the intervention is important in creating future sustainable programs for the elderly.

##### Frailty status

Although the participants in our study were frail according to the Frailty Index, due to their rural setting, most were still living independently. Interventions on frailty do well for the pre-frail and those with severe frailty who have much room for gains. The frailty status should be investigated in context of the living environment of the participants, to determine if they will benefit from an intervention or not and what kind of intervention would be most beneficial to them. Appropriate frailty scales should be selected for the intervention being

implemented. The frailty scale used in this study was perhaps more sensitive to the nutritional intervention than to the physical activity intervention.

#### Gender representation

Studies have shown females to be at more risk of developing frailty, but an over representation of females in the study can skew the results. A bigger study sample that can also allow for the differentiation of gender within the results, is recommended. Each test scores differently for males and females and a clear presentation of those statistics can better describe the participants instead of painting them as a homogenous sample, gender wise.

#### Outcomes of the study

This study measured frailty as the outcome of the study, but it did not include the functional outcomes tested in the study as well. Including the functional outcomes could also have demonstrated the wider impact of interventions beyond their specific impact on frailty status. In this study, frailty status did not improve but there was improvement in the fitness components tested and trained in the intervention

#### Exercise programme variability

The problem identified by most reviews into exercise interventions, is the variability of the programmes. The varying FITT principles in every study make it difficult to study the effect and impact of the exercise and/or physical activity interventions. The components being tested can also vary and create problems in reviewing their impact. One researcher, for example, defines sit to stand as a lower body strength exercise, another researcher defines it a lower body muscle endurance exercise and yet another researcher defines it a strength and balance exercise. An effort to streamline the exercise outcomes and FITT principles can go a long way in determining the overall effect.

### **5.5 RESEARCHER'S NOTE AND IMPACT OF THE STUDY**

This study spanned a period of three years, full of delays and many challenges. For one thing, the working environment for the field testing was extremely difficult and much of the credit goes to the field assistants for lightening the working load. The political situation in Lesotho at the time also lent to a few complications that we encountered from the outset of

the study. Initial contact by Rose Turkson (PhD student) to recruit participants, to obtain sociodemographic and frailty status data, was done in the beginning of 2015. This physical activity study is a sub-study of the PhD study of the nutritional intervention on frailty. We had to wait a few months after making the initial contact with communities, due to the elections and subsequent political fallout that took time to stabilize. We returned in September 2015 for the intervention. That meant when we returned to implement the intervention, we had to go back to all the community leaders and remind them and the participants who we were and what our study was about. This was time consuming and not all the participants that had made the inclusion criteria were still living in the same areas or available to participate in the study. The intervention period would have run until December but, in anticipation of the fact that getting hold of participants during the festive period (when many of them travel to be with their families) meant that the study needed to conclude sooner. The intervention concluded in the beginning of December to allow time for post intervention testing, which was concluded by 18 December 2015. This time erosion is the reason the intervention period was not a full 12 weeks. Once baseline testing got underway, the communities were sometimes kilometers away from each other and in rural mountainous areas that were not easy to navigate. In the political climate of Lesotho at the time, we had to constantly distinguish ourselves from government officials and government projects. Association with the government either lent support from the community or caused outright animosity, depending on which area you were in.

On the positive side, the Basotho people were a very warm and generous people. Every group had the odd cantankerous old man, but overall the groups were very pleasant to work with. Once the protocols had been established, we received assistance from many chiefs and community leaders within the communities we were involved in. The elderly participants were so excited to have a project meant just for them. They bemoaned being forgotten by a government that, in their opinion, was heavily focused on the youth. They felt noticed. We noticed changes in their attitude from when we began to when we finished. Though some were reluctant in the beginning, and participated merely for the milk that they were receiving from the intervention, by the conclusion of the study they had formed a sense of community that they were sad to see end. We encouraged them to continue even in the absence of the formal interventions, as the physical activity intervention did not use any specialized equipment.

It was encouraging to see many elderly persons who had resigned themselves to be being old, find renewed strength and vigor. The '*aha! Moment*' when they discovered that they could in fact still sit and rise from a chair without holding on but had merely grown

accustomed to holding on for support, or for those with walking aids to discover they were in fact still capable of walking some distances without them. Perhaps the greatest testimony in this regard, was watching participants who came with walking aids, carrying the walking aids home after the intervention. This gave credence to the concept of 'successful ageing' and why it matters.

The overall sense of awareness that they were still capable, was the greatest product of this intervention. Although there were not many statistically significant improvements, there was improvement in every variable overall (except flexibility). While further research is obviously warranted, it is our hope to present the outcome of this study back to the study population and hopefully to the Lesotho Government Ministry of Health. It is our goal to encourage the Lesotho Government to invest in programmes to promote 'successful ageing', health and wellness in the elderly. Many people will 'age before their time' simply from inactivity and a lack of education of how to maintain their physical fitness. Educational programs that can help dispel myths around ageing and intervention programmes that can stimulate the elderly to move and be healthy will be important for Lesotho to realize its vision 2020, which states: "By the year 2020 Basotho shall be a healthy nation with a well-developed human resource base. The country will have a good quality health system with facilities and infrastructure accessible and affordable to all Basotho, irrespective of income, disabilities, geographical location and wealth. Health personnel will provide quality health service and patient care. All Basotho will be conscious of healthy lifestyles and will engage in sporting and recreational activities".

## REFERENCES

---

Abad-Diez, J.M., Calderon-Larranaga, A., Poncel-Falco, A., Poblador-Plou, B., Calderon-Meza, J.M., Sicras-Mainar, A., Clerencia-Sierra, M. & Prados-Torres, A. 2014. Age and gender differences in the prevalence and patterns of multi-morbidity in the older population. *BMC Geriatrics*, 75 (14): 1 – 8.

Abizanda, L., Romero, P.L., Sanchez-Jurado, P.M., Martinez-Reig, M., Alfonso-Silguero, S.A & Rodriguez-Manas, L. 2014. Age, frailty, disability, institutionalisation, multi-morbidity or comorbidity, which are the main targets in older adults? *The Journal of Nutrition, Health and Aging*, 18 (6): 622 – 627.

ACSM, 2018. Riebe, D., Ehrman, J.K., Liguori, G. & Magal, M. 2018. ACSM's Guidelines for Exercise Testing and Prescription. 10th Edition. Wolters Kluwer.

ACSM, 2016. Moore, G.E., Durstine, J.L. & Painter, P.L. 2016. ACSM's Exercise Management for Person's With Chronic Diseases and Disabilities. 4th Edition. Human Kinetics.

ACSM, 2009. Durstine, J.L., Moore, G.E., Painter, P.L. & Roberts, S.O. 2009. ACSM's Exercise Management for Person's With Chronic Diseases and Disabilities. 3rd Edition. Human Kinetics.

Aguirre, L.E. & Villareal, D.T. 2015. Physical Exercise as Therapy for Frailty. *Nestlé Nutr Inst workshop Ser*, 83: 83 – 92.

AHA, 2017. What is cardiovascular disease?

Retrieved from ([http://www.heart.org/HEARTORG/Support/What-is-Cardiovascular-Disease\\_UCM\\_301852\\_Article.jsp#mainContent](http://www.heart.org/HEARTORG/Support/What-is-Cardiovascular-Disease_UCM_301852_Article.jsp#mainContent))

Date of access: 20 November 2017.

Ahmed, H.M., Blaha, M.J., Nasir, K., Rivera, J.J Blumenthal, R.S. 2012. Effects of Physical Activity on Cardiovascular Disease. *American Journal of Cardiology*, 109: 288 – 295.

Avila-Funes, J.A., Helmer, C., Amieva, H., Barberger-Gateau, P., Le Goff, M., Ritchie, K., Portet, F., Carriere, I., Tavernier, B., Gutierrez-Robledo, L.M. & Dartigues, J.F. 2008. Frailty

among Community-Dwelling Elderly People in France: The Three-City Study. *Journal of Gerontology: Medical Sciences*, 63: 1089 – 1096.

Bales, C.W. & Ritchie, C.S. 2002. Sarcopenia, weight loss, and nutritional frailty in the elderly. *Annual Review of Nutrition*, 22: 309 – 323.

Bandeem-Roche, K., Seplaki, C.L., Huang, J., Buta, B., Kalyani, R.R., Varadhan, R., Xue, Q-L., Walston, J.D. & Kasper, J.D. 2015. Frailty in Older Adults: A Nationally Representative Profile in the United States. *The Gerontological Society of American*, 70 (11): 1427 – 1434.

Barnett, K., Mercer, S.W., Norbury, M., Watt, G., Wyke, S. & Guthrie, B. 2012. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *The Lancet*, 380: 37 – 43.

Beam, W.C. & Adams, G.M. 2010. *Exercise Physiology Laboratory Manual*. 6<sup>th</sup> Edition. McGraw-Hill Publication.

Bean, J.F., Vora, A. & Frontera, W.R. 2004. Benefits of exercise for Community-Dwelling Older Adults. *Archives of Physical Medicine and Rehabilitation*, 85 (3): S31 – S42.

Bergman, H., Ferrucci, L., Guralnik, J., Hogan, D.B., Hummel, S., Karunanathan, S. & WOLFSON, C. 2007. Frailty: An emerging Research and Clinical Paradigm – Issues and Controversies. *Journal of Gerontology*, 62A (7): 731 – 737.

Binder, E.F., Schechtman, K.B., Ehsani, A.A., Steger-May, K., Brown, M., Sinacore, D.R., Yarasheski, K.E. & Holloszy, J.O. 2002. Effects of Exercise Training on Frailty in Community-Dwelling Older Adults: Results of a Randomized, Controlled Trial. *American Geriatrics Society*, 50: 1921 – 1928.

Binder, E.F., Yarasheski, K.E., Steger-May, K., Sinacore, D.R., Brown, M., Schechtman, K.B. & Holloszy, J.O. 2005. Effects of Progressive Resistance Training on Body Composition in Frail Older Adults: Results of a Randomised, Controlled Trial. *Journal of Gerontology*, 60: 1425 – 1431.

Boeckxstaens, P., Vaes, B., Legrane, D., Dalleur, O., De Sutter, A. & Degryse, J.M. 2015. The relationship of multi-morbidity with disability and frailty in the oldest patients: A cross-



sectional analysis of three measures of multi-morbidity in the Belfrail cohort. *European Journal of General Practice*, 21: 39 – 44.

BoS (Bureau of Statistics). 2006. (Retrieved from [www.bos.gov.ls](http://www.bos.gov.ls))

BoS (Bureau of Statistics). 2009. (Retrieved from [www.bos.gov.ls](http://www.bos.gov.ls))

Botz Ij, W.M. 2002. A Conceptual Framework of Frailty: A Review. *Journal of Gerontology*, 57A (5): M283 – M288.

Bouillon, K., Kivimaki, M., Hamer, M., Sabia, S., Fransson, E.I., Singh-Manoux, A., Gale, C.R. & Batty, G.D. 2013. Measures of frailty in population-based studies: an overview. *BMC Geriatrics*, 13 (64): 1 – 11.

Boulos, C., Salameh, P. & Barberger-Gateau, P. 2016. Malnutrition and Frailty in community dwelling older adults living in a rural setting. *Clinical Nutrition*, 35: 198 – 143.

Brown, M., Sinacore, D.R., Ehsani, A.A., Binder, E.F., Holloszy, J.O. & Kohort, W.M. 2000. Low-Intensity Exercise as a Modifier of Physical Frailty in Older Adults. *Archives of Physical Medicine and Rehabilitation*, 81: 960 – 965.

Buchner, D.M. & Wagner, E.H. 1992. Preventing Frail Health. *Clinics in Geriatric Medicine*, 8: 1 – 17.

Buchner, D.M. 2003. Physical Activity to Prevent or Reverse Disability in Sedentary Older Adults. *American Journal of Preventative Medicine*, 25 (3Sii): 214 – 215.

Bürkler, A., Moreno-villanueva, A., Bernhard, J., Blasco, M., Zondag, G., Hoeijmakers, J.H.J., Touissant, O., Grubeck-loebenstein, B., Mocchegiani, E., Collino, S., Gonos, E.S., Sikora, E., Gradinaru, D., Dolle, M., Salmon, M., Kristensen, P., Griffiths, H.R., Libert, C., Grune, T., Breusing, N., Simm, A., Franceschi, C., Capri, M., Talbot, D., Caiafa, P., Friguet, B., Sagboom, P.E., Hervonen, A., Hurme, M & Aspinall, R. 2015. Mark-age biomarkers of ageing. *Mechanisms of Ageing and Development*, 151: 2 -12.

Buttery, A.K., Busch, M.A., Gaertner, B., Scheidt-Nave, C. & Fuchs, J. 2015. Prevalence and correlates of frailty among older adults: findings from the German health interview and examination survey. *BMC Geriatrics*, 15: 22 (1-9).

Cadore, E.L., Casas-Herrero, A., Zambom-Ferraresi, F., Idoate, F., Millor, N., Gomez, M., Rodriguez-Manas, L. & Izquierdo, M. 2013 (a). Multicomponent exercises including muscle power training enhance muscle mass, power output, and functions outcomes in institutionalized frail nonagenarians. *American Aging Association*, 36: 773 – 783.

Cadore, E.L., Rodriguez-Manas, L., Sinclair, A. & Izquierdo, M. 2013 (b). Effects of different Exercise Interventions on Risk of Falls, Gait Ability, and Balance in Physically Frail Older Adults: A Systematic Review. *Rejuvenation Research*, 16 (2): 105 -114.

Cameron, I.D., Fairhall, N., Gill, L., Lockwood, K., Langron, C., AGGAR, C., Monaghan, N. & Kurrle, S. 2015. Developing Interventions for Frailty. *Advances in Geriatrics*, 10.115.845356 (1-7).

Cartee, G.D., Hepple, R.T., Bamman, M.A. & Zierath, J.R. 2016. exercise promotes healthy aging of skeletal muscle. *cell metabolism*, 23: 1034 – 1047.

Cesari, M., Landi, F., Vellas, Bernabei, R. & Marzetti, E. 2014. Sarcopenia and physical activity: two sides of the same coin. *Frontiers in Aging Neuroscience*, 6 (192): 1 – 4.

Cesari, M., Vellas, B., HSU, FC., Newmana.B., Doss, H., King, A.C., Manini, T.M., Church, T., Gill, T.M., Miller, M.E. & Pahor, M. 2015. A Physical Activity Intervention to treat the Frailty Syndrome in Older Persons – Results From the LIFE-P Study. *Journal of Gerontology: Medical Sciences*, 70 (2): 216 – 222.

Chen, C.Y., WU, S.C., Chen, L.J & Lue, B.H. 2010. The prevalence of subjective frailty and factors associated with frailty in Taiwan. *Archives of Gerontology and Geriatrics*, 50 (1): S43 – S47.

Chen, X., Mao, G. & Leng, S.X. 2014. Frailty syndrome: an overview. *Clinicals Interventions in Aging*, 9: 433 – 441.

Cho, S.I. & AN, D.H. 2014. Effects of a Fall Prevention Exercise Program on Muscle Strength and Balance of the Old-old elderly. *Journal of Physical Therapy Science*, 26: 1771 – 1774.

- Chou, C.H., Hwang, C.L. & Wu, Y.T. 2012. Effect of Exercise on Physical function, Daily Living Activities, and Quality of Life in the Frail Older Adults: A Meta-Analysis. *Archives of Physical Medicine and Rehabilitation*, 93: 237 – 244.
- Clegg, A., Young, J., Liffle, S., Rikkert, M.O. & Rockwood, K. 2013. Frailty in elderly people. *The Lancet*, 381: 752 – 762.
- Collard, R.M., Boter, H., Schoevers, R.A. & Oude Voshaar, R.C. 2012. Prevalence of Frailty in community-Dwelling Older Persons: A Systematic Review. *Journal of the American Geriatric Society*, 60: 1487 – 1492.
- Cosco, T.E., Prina, A.M., Perales, J., Stephan, B.C.M. & Brayne, C. 2014. Operational definitions of successful aging: a systematic review. *International Psychogeriatrics*, 26 (3): 373 – 381.
- Daniels, R., Van Rossum, E., De Witte, L., Kempen, G.I.J.M. & Van Den Heuvel, W. 2008. Interventions to prevent disability in frail community-dwelling elderly: a systematic review. *BioMed Central*, 278 (8): 1 – 8.
- Dankel, S.J., Loenneke, J.P. & Loprinzi, P.D. 2015. Participation in muscle-strengthening activities as an alternative method for the prevention of multimorbidity. *Preventative Medicine*, 81: 54 – 57.
- De Labra, C., Guimares-Pinheiro, C., Maseda, A., Lorenzo, T. & Millan-Calenti, J.C. 2015. Effects of physical exercise interventions in frail older adults: a systematic review of randomized controlled trials. *BMC Geriatrics*, 15:154 (1-16).
- Dekker, J., De Rooij, M. & Van Der Leeden, M. 2015. Exercise and comorbidity: the i3-S strategy for developing comorbidity-related adaptations to exercise therapy. *Disability and Rehabilitation*, 38: 905 – 909.
- Dent, E., Kowal, P., Hoogendijk, E.O. 2016. Frailty measurement in research and clinical practice: A review. *European Journal of Internal Medicine*, 31: 3 – 10.
- Drewnoski, A. & Evans, W.J. 2001. Nutrition, Physical Activity, And Quality of Life in Older Adults: Summary. *Journals of Gerontology*, 56A (11): 89 – 94.

Durstine, J.L., Gordon, B., Wang, Z. & LUO, X. 2013. Chronic disease and the link to physical activity. 2: 3 – 11.

Etman, A., Burdof, A., Van Der Cammen, T.J., Mackenbach, J.P. & Van Lenthe, F.J. 2012. Socio-demographic determinants of worsening in frailty among community-dwelling older people in 11 European countries. *Journal of Epidemiology and Community Health*, 66: 1116 – 1121.

Fiatarone, M.A., O' Neill, E.F., Ryan, N.D., Clements, K.M., Solares, G.R., Nelson, M.E., Roberts, S.B., Kehayias, J.J., Lipsitz, L.A. & Evans, W.J. 1994. Exercise training and nutritional supplementation for physical frailty in very elderly people. *The New England Journal of Medicine*, 330 (25): 1769 – 1775.

Fillenbaum, G.G., Pieper, C.F., Cohen, H.J., Comoni-Huntley, J.C. & Guralnik, J.M. 2000. Comorbidity of Five Chronic Health Conditions in Elderly Community Residents: Determinants and Impact on Mortality. *Journal of Gerontology*, 56A (2): M84 – M89.

Fransen, M., Mcconnell, S., Harmer, A.R., Van Der Esch, M., Simic, M. & Bennell, K.L. 2015. Exercise for osteoarthritis of the knee: a Cochrane systematic review. *British Journal of Sports Medicine*, 49: 1554 – 1557.

Fried, L.P., Ferrucci, L., Darer, J., Williamson, J.D. & Anderson, G. 2004. Untangling the Concepts of Disability, Frailty, and comorbidity: Implications for Improved targeting and Care. *Journal of Gerontology*, 59 (3): 255 – 263.

Fried, L.P., Tangen, C.M., Walston, J., Newman, A.B., Hirsch, C., Gottdiener, J., Seeman, T., Tracy, R., Kop, W.J., Burkle, G. & Mcburnie, M.A. 2001. Frailty in Older adults: Evidence for a Phenotype. *Journal of Gerontology*, 56A (3): M146 – M156.

Fulop, T., Larbi, A., Witnowski, J.M., Mcelhaney, J., Loeb, M., Mitniski, A. & Pawelec, G. 2010. Aging, frailty and age-related diseases. *Biogerontology*, 11: 547 – 563.

Gale, C.R., Cooper, C. & Sayer, A.A. 2015. Prevalence of frailty and disability: findings from the Longitudinal Study of Ageing. *Age and Ageing*, 44: 162 – 165.

Garcia-Garcia, F.J., Avila, G.G., Alfaro-Acha, A., Andres, M.S.A., De Los Angeles De La Torre Lanza, M., Aparicio, M.V.E., Aparicio, S.H., Zugasti, J.L.Z., Reus, M.G.S., Rodriguez-

Artalejo, F. & Rodriguez-Manas, L. 2001. The prevalence of frailty syndrome in an older population from Spain. The Toledo study for healthy aging. *The Journal of Nutrition, Health and Aging*, 15 (10): 852 – 856.

Garcia-Gonzalez, J.J., Garcia-Pena, C., Franco-Marina, F. & Gutierrez-Robledo, L.M. 2009. A Frailty index to predict the mortality risk in a population of senior Mexican adults. *BMC Geriatrics*, 9 (47): 1 – 8.

Gine-Garriga, M., Roque-Figuls, M., Coll-Planas, L., Sitja-Rabert, M. & Salva, A. 2014. Physical Exercise Interventions for Improving Performance-Based Measures of Physical Function in Community-Dwelling, frail Older Adults: A Systematic Review and Meta-Analysis. *Archives of Physical Medicine and Rehabilitation*, 95: 753 – 769.

Gobbens, R.J.J., Luijckx, K.G., Wijnen-Sponselee, M.T. & Schols, J.M.G.A. 2010. Towards an integral conceptual model of frailty. *The Journal of Nutrition, Health and Aging*, 14: 175 – 181.

GoL (Government of Lesotho). 2012. *National Strategic Development Plan*.

GoL (Government of Lesotho). 2012. *National Vision 2020*.

Gonzalez-Vaca, J., De La Rica-Escuin, M., Silva-Iglesias, M., Arjonilla-Garcia, M.D., Varela-Perez, R., Oliver-Carbonell, J.L & Abizanda, P. 2014. Frailty in Institutionalized older adults from Albacete. The FINAL Study: Rationale, design, methodology, prevalence and attributes. *Maturitas*, 77: 78 – 84.

Grden, C.R.B., De Sousa, J.A.V., Lenardt, M.H., Kusomota, L., Dellaroza, M.S.G. & Betiulli, S.E. 2017. Associations between frailty syndrome and sociodemographic characteristics in long-lived individuals of a community. *Revista Latino-Americana de Enfermagem*, 25: e2886 (1-8).

Groll, D.L., TO, T., Bombardier, C. & Wright, J.G. 2005. *Journal of Clinical Epidemiology*, 58: 595 – 602.

Hamer, M., Lavole, K.L. & Bacon, S.L. 2014. Taking up physical activity in later life and healthy ageing: the English longitudinal study of ageing. *British Journal of Sports Medicine*, 48: 239 – 243.

Hamilton, A., Balnave, R. & Adams, R. 1994. Grip strength testing reliability. *Journal of Hand Therapy*, 7 (3): 163 – 170.

Heyward, V.H. & Gibson, A.L. 2014. *Advanced Fitness Assessment and Exercise Prescription*. 7<sup>th</sup> Edition.

Hunter, G.R., McCarthy, J.P. & Bamman, M.M. 2004. Effects of Resistance Training on older Adults. *Sports Medicine*, 34 (5): 329 – 348.

Jakovljević, M. & Ostojić, L. 2013. Comorbidity and multi-morbidity in medicine today: challenges and opportunities for bringing separated branches of medicine closer to each other. *Medicina Academica Mostariensia*, 1 (1): 18 – 28.

Jenkins, S., Cecins, N., Camarri, B., William, C., Thompson, P. & Eastwood, P. 2009. Regression equations to predict 6-minute walk distance in middle aged & elderly adults. *Physiotherapy Theory and Practice*, 25 (7): 516 – 522.

Jones, C.J., Rikli, R.E. & Noffal, G. 1998. The reality and validity of a chair sit-and-reach test as a measure of hamstring flexibility in older adults. *Research Quarterly for Exercise and Sport Journals*, 69 (4): 338:343.

Kahana, E., Kahana, B. & Lee, J.E. 2014. Proactive Approaches to Successful Aging: One clear Path through the Forest. *Gerontology*, 60: 466 – 474.

Kannus, P., Sievanen, H., Palvanen, M., Jarvinen, T. & Parkkari, J. 2005. Prevention of falls and consequent injuries in elderly people. *The Lancet*, 366: 1885 – 1893.

Keysor, J.J. & Jette, A.M. 2001. Have We Oversold the Benefit of Late-Life Exercise? *Journal of Gerontology*, 56A (7): M412 – M423.

Keysor, J.J. 2003. Does Late-Life Physical Activity or Exercise Prevent or Minimize Disablement? *American Journal of Preventative Medicine*, 25 (3Sii): 129 – 136.

Kim, H., Suzuki, T., Kim, M., Kojima, N., Ota, N., Shimotoyodome, A., Hase, T., Hosol, E. & Yoshida, H. 2015. Effects of Exercise and Milk Fat Globule Membrane (MFGM) supplementation on Body composition, Physical Function, and Haematological Parameters

in Community Dwelling Frail Japanese Women: A Randomised Double Blind, Placebo-Controlled, post intervention Trial. *Public Library of Science One*, 10.1371.0116526 (1-20)

Lahousse, L., Maes, B., Ziere, G., Loth, D.W., Verlinden, V.J.A., Zilikenns, M.C., Uitterlinden, A.G., Rivadeneira, F., Tiemeier, H., Franco, O.H., Ikram, M.A., Hofman, A., Brusselle, G.G. & Stricker, B.H. 2014. Adverse outcomes of frailty in the elderly: the Rotterdam Study. 29: 419 – 427.

Lally, F. & Crome, P. 2007. Understanding Frailty. *Post Grad Medical Journal*, 83: 16 -20.  
Landi, F., Abbatecola, A.M., Provinciali, M., Corsonello, A., Bustacchini, S., Manigrasso, L., Cherubini, A., Bernabei, R. & Lattanzio, F. 2010. Moving against frailty: does physical activity matter? *Biogerontology*, 11: 537 – 545.

Landi, F., Marzetti, E., Martone, A.M Bernabei, R. & Onder, G. 2013. Exercise as a remedy for sarcopenia. *Current Opinion in Clinical Nutrition and Metabolic Care* 16: 1363 – 1950.

Lang, P.O, Michel, J.P. & Zekry, D. 2009. Frailty syndrome: A transitional state in a dynamic Process. *Gerontology*, 55: 539 – 549.

Lee, I.M. Shiroma, E.J., Lobelo, F., Puska, P., Blair, S.N. & Katzmarzyk, P.T. 2012. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *The Lancet*, 380: 219 – 229.

Lekan, D. 2009. Frailty and Other emerging concepts in Care of the Aged. *Southern Online Journal of Nursing Research*, 9:3.

Lenardt, M.H., Carneiro, N.H.K., Binotto, M.A., Setoguchi, L.S. & Cechinel, C. 2015. The relationship between physical frailty and sociodemographic and clinical characteristics of elderly. *Escola Anna Nery*, 19 (4): 585 – 592.

Lenardt, M.H., Carneiro, N.H.K., Binotto, M.A., Setoguchi, L.S. & Cechinel, C. 2015. The relationship between physical frailty and sociodemographic and clinical characteristics of elderly. *Escola Anna Nery*, 19 (4): 585 – 592.

Lesotho Demographics Profile, 2017.

(Retrieved from [http://www.indexmundi.com/lesotho/demographics\\_profile.html](http://www.indexmundi.com/lesotho/demographics_profile.html)).

Date of access: 23 November 2017.

Leveille, S.G., Guralnik, J.M., Ferucci, L. & Langlois, J.A. 1999. Aging Successfully until Death in Old Age: Opportunities for Increasing Active Life Expectancy. *American Journal of Epidemiology*, 149 (7): 654 – 664.

Liu, C.K. & Fielding, R.A. 2011. Exercise as an intervention for Frailty. *Clinics of Geriatric Medicine*, 27 (1): 101 – 110.

Loprinzi, P.D. 2015. Sedentary behaviour and medical multi-morbidity. *Physiology and Behaviour*, 151: 395 – 397.

Lord, S.R., Castell, S., Corcoran, J., Dayhew, J., Matters, B. & Williams, P. 2003. The effect of Group Exercise on Physical Functioning and Falls in Frail Older People Living in Retirement Villages: A Randomised, controlled Trial. *American Geriatrics Society*, 51: 1685 – 1692.

Lustosa, L.P., Silva, J.P., Coelho, F.M., Pereira, D.S., Parentoni, A.N. & Pereira, L.S.M. 2011. Impact of resistance exercise program on functional capacity and muscular strength of knee extensor in pre-frail community-dwelling older women: a randomised crossover trial. *Revista Brasileira de Fisioterapia*, 15:318 – 324.

LVAC (Lesotho Vulnerability Committee). 2016. *Market Assessment Report*.

Makizako, H., Shimada, H., Doi, T., Tsutsumimoto, K. & Suzuki, T. 2015. Impact of physical frailty on disability in community-dwelling older adults: a prospective cohort study. *British Medical Journal Open*, 5:e008462 (1-9)

Malmstrom, T.K., Miller, D.K. & Morley, J.E. 2014. A comparison of four frailty models. *Journal of American Geriatrics Society*, 62: 721 – 726.

Markle-Reid, M. & Browne, G. 2003. Conceptualizations of Frailty in relation to older adults. *Journal of Advanced Nursing*, 44 (1): 58 – 68.

Marventano, S., Ayala, A., Gonzalez, N., Rodriguez-Blazquez, C., Garcia-Gutierrez, S. & Forjaz, M.J. 2014. Multi-morbidity and functional status in community-dwelling older adults. *European Journal of Internal Medicine*, 25: 610 – 616.



Mathers, C.D., Stevens, G., Boerna, T., White, R.A & Tobias, M.I. 2015. Causes of international increases in older age life expectancy. *The Lancet*, 380: 540 – 548.

Miller, J.M., Hilbert, S.C. & Brown, L.E. 2001. Speed, Quickness, and Agility Training for Senior Tennis Players. *National Strength & Conditioning Association*, 23 (5): 62 -66.

Miller, M.E., Rejeski, W.J., Reboussin, B.A., Ten Have, T.R. & Ettinger, W.H. 2000. Physical Activity, Functional Limitations, and Disability in Older Adults. *American Geriatrics Society*, 48: 1264 – 1272.

Moreira, V.G. & Lourenco, R.A. 2013. Prevalence and factors associated with frailty in an older population from the city of Rio de Janeiro, Brazil: the FIBRA-RJ Study. *CLINICS* (68)7: 979 – 985.

Nelson, A.E., Allen, K.D., Golightly, Y.M., Goode, A.P. & Jordan, J.M. 2014. A systematic review of recommendations and guidelines for the management of osteoarthritis: The Chronic Osteoarthritis Management Initiative of the U.S. Bone and Joint Initiative. *Seminars in Arthritis and Rheumatism*, 43: 701 – 712.

NG, T.P., Feng, L., Nyunt, M.S.Z., Feng, L., Niti, M., Tan, B.Y., Chan, G., Khoo, S.A., Yap, P. & Yap, K.B. 2015. Nutritional, Physical, Cognitive, and Combination Interventions and Frailty reversal among Older Adults: A Randomised Controlled Trial. *The American Journal of Medicine*, 128: 1225 – 1236.

Nguyen, T.N., Cumming, R.G. & Hilmer, S.N. 2015. *Journal of Nutrition, health and Aging*, 19 (9): 941 – 946.

Pahor, M., Guralnik, J.M., Ambrosius, W.T., Blair, S., Bonds, D.E., Church, T.S., Espeland, M.A., Fielding, R.A., Gill, T.M., Groessl, E.J., King, A.C., Kritchevsky, S.B., MANINI, T.D., Mcdermott, M.M., Miller, M.E., Newman, A.B., Rejeski, W.J., Sink, K.M. & Williamson, J.D. 2014. Effect of Structured Physical Activity on Prevention of Major Mobility Disability in older Adults. *Journal of the American Medicine Association*, 311 (23): 2387 – 2396.

Paterson, D.H. & Warburton, E.R. 2010. Physical activity and functional limitations in older adults: a systematic review related to Canada's Physical Activity Guidelines. *Journal of Behavioural Nutrition and Physical Activity*, 7 (38): 1 – 22.

Paw, M.J.C., Van Uffelen, G.Z., Riphagen, I. & Van Mechelen, W. 2008. The Functional Effects of Physical Exercise Training in Frail Older People. *Sports Medicine*, 38: 781 – 793.

Paw, M.J.C., Van Uffelen, G.Z., Riphagen, I. & Van Mechelen, W. 2008. The Functional Effects of Physical Exercise Training in Frail Older People. *Sports Medicine*, 38: 781 – 793.

Peterson, M.J., Guiliani, C., Morey, M.C., Pieper, C.F., Evenson, K.R., Mercer, V., Cohen, H.J., Visser, M., Brach, J.S., Kritchevsky, S.B., Goodpaster, B.H., Rubin, S., Satterfield, S., Newman, A.B. & Simonsick, E.M. 2009. Physical Activity as a Preventive Factor for Frailty: The Health, Aging, And Body Composition Study *Journal of Gerontology*, 64A (1): 61-68.

Pollock, R.D., Martin, F.C. & Newham, D.J. 2012. Whole-body vibration in addition to strength and balance exercise for falls-related functional mobility of frail older adults: a single-blind randomized controlled trial. *Clinical Rehabilitation*, 26:915 – 923.

Prentice, W.E. 2014. *Principles of athletic Training*. 15<sup>th</sup> Edition. McGraw Hill Publishing.

Prince, M.J., WU, F., GUO, Y., Robledo, L.M.G.R., O' Donnel, M., Sullivan, R. & Yusuf, S. 2015. The burden of disease in older people and implications for health policy and practice. *The Lancet*, 385: 549 – 562.

Reed-Jones, R.J., Dorgo, S., Hitchings, M.J. & Bader, J.O. 2012. Vision and agility training in community dwelling older adults: Incorporating visual training into programs for fall prevention. *Gait & Posture*, 35 (4): 585 – 589.

Rejeski, W.J., Marsh, A.P., Chmelo, E., Prescott, A.J., Donrosielski, M., Walkup, MP., Espeland, M., Miller, M.E. & Kritchevsky, S. 2009. The Lifestyle Interventions for Elders Pilot (LIFE-P): 2 years follow up. *Journal of Gerontology: Medical Sciences*, 64: 462 – 467.

Rikli, R.E & Jones, C.J. 2002. Measuring functional fitness in older adults. *Journal on Active Aging*, 27 – 29.

Rikli, R.E. & Jones, C.J. 1998. The reliability and validity of a 6-minute Walk Test as a measure of physical endurance in older adults. *Journal of Aging and Physical Activity*, 6: 363 – 375.

Roberts, S.A., Awick, E.A., Fanning, J., Ehlers, D., Motl, R.W. & Mcauley, E. 2017. Long-term Maintenance of Physical Function in Older Adults Following a DVD-Delivered Exercise Intervention. *Journal of Ageing and Physical Activity*, 25 (1):27 – 31.

Rockwood, K. & Mitnitski, A. 2007. Frailty in Relation to the Accumulation of Deficits. *Journal of Gerontology*, 62A (7): 722 – 727.

Rockwood, K. & Mitnitski, A. 2011. Frailty defined by deficit accumulation and geriatric medicine defined by frailty. *Clinics of Geriatric Medicine*, 27: 17 – 26.

Rockwood, K., Song, X., Macknight, C., Berman, H., Hogan, D.B., McDowell, I. & Mitnitski, A. 2005. A global clinical measure of fitness and frailty in elderly people. *Canadian Medical Association Journal*, 173: 489 – 495.

Rockwood, K., Standyk, k., MacKnight, C., McDowell, I., Hèrbert, R & Hogan, D.B. 1999. A brief clinical instrument to classify frailty in elderly people. *The Lancet*, 353 (9148): 205 – 206.

Rolfson, D.B., Majumdar, S.R., Tsuyuki, R.T., Tahir, A. & Rockwood, K. 2006. Validity and reliability of the Edmonton frail Scale. *Age and ageing*, 35: 526 – 529.

Rubenstein, L.Z. 2006. Falls in older people: epidemiology, risk factors and strategies for prevention. *Age and Aging*, 35-S2: ii37 – ii41.

Runzer-Colmenares, F.M., Samper-Ternent, R., AL Snih, S., Ottenbacher, K.J., Parodi, J.F. & Wong, R. 2014. Prevalence and factors associated with frailty among Peruvian older adults. *Archives of Gerontology and Geriatrics*, 58: 69 – 73.

Rydwik, E., Frandin, K. & Akner, R. 2010. Effects of a physical training and nutritional intervention program in frail elderly people regarding habitual physical activity level and activities of daily living – A randomized controlled pilot study. *Archives of Gerontology and Geriatrics*, 51: 283 – 289.

Salive, M.E. 2012. Multi-morbidity in Older Adults. *Epidemiologic Reviews*, 35: 75 – 83.

Sanchez-Garcia, S., Sanchez-Arenas, R., Garcia-Pena, C., Rosas- Carrasco, O., Avila-Funes, J.A., Ruiz-Arregui, L. & Juarez-Cedillo, T. 2014. Frailty among community-dwelling

elderly Mexican people: Prevalence and association with sociodemographic characteristics, health state and the use of health services. *Geriatrics Gerontology International*, 14: 395 – 402.

Savela S.L., Koistinen, P., Tilvis, R.S., Strandberg, A.Y., Pitkala, K.H., Salomaa, V.V., Miettinen, T.A. & Strandberg, P.E. 2010. Physical activity at midlife and health-related quality of life in older men. *Archives of Internal Medicine*. 170 (13):1171–1172.

Seguin, R. & Nelson, M.E. 2003. The Benefits of Strength Training for Older Adults. *American Journal of Preventative Medicine*, 25 (3Sii): 141 – 149.

Shimada, H., Uchiyama, Y. & Kakurai, S. 2003. Specific effects of balance and gait exercises on physical function among the frail elderly. *Clinical Rehabilitation*, 17 (5): 472 – 479.

Sibley, K.M., Voth, J., Munce, S.E., Straus, S.E. & Jaglal, S.B. 2014. Chronic disease and falls in community-dwelling Canadians over 65 years old: a population-based study exploring associations with number and pattern of chronic conditions. *BMC Geriatrics*, 14 (22): 1 – 11.

Simonsick, E.M., Lafferty, M.E., Phillips, C.L., Mendes De Leon, C.F., Kasl, S.V., Seeman, T.E., Fillenbaum, G., Herbet, P. & Lemke, J.H. 1993. Risk Due to Inactivity in Physically Capable Older Adults. *American Journal of Public Health*, 83 (10): 1443 – 1450.

Singh, M., Stewart, R. & White, H. 2014. Importance of frailty in patients with cardiovascular disease. *European Heart Journal*, 35: 1727 – 1731.

Singh, M.A.F. 2002. Exercise Comes of Age: Rationale and Recommendations for a Geriatric Exercise Prescription. *Journal of Gerontology*, 57A (5): M262 – M282.

Son, J.H., KIM, S.Y., WON, C.W., Choi, H.R., Kim, B.S. & Park, M.S. 2015. Physical frailty predicts medical expenses in community-dwelling, elderly patients: Three-year prospective findings from living profiles of older people surveys in Korea. *European Geriatric Medicine*, 6: 412 – 416.

Sparling, P.B., Howard, B.J., Dunstan, D.W. & Owen, N. 2015. Recommendations for physical activity in older adults. *British Medical Journal*, 350: 1 – 5.

Stathokostas, L. & Vandervoort, A.A. 2016. Flexibility training and functional ability in older adults: a systematic review. *Annual Review of Gerontology & Geriatrics*, 36: 169.

Stuck, A.E., Walthert, J.M., Nikolaus, T., Bula, C.J., Hohmann, C. & Beck, J.C. 1999. Risk factors for functional status decline in community-living elderly people: a systematic review. *Social Science and Medicine*, 48: 445 – 469.

Sun, Q., Hu, F.B. & Grodstein, F. 2010. Physical activity at midlife and health-related quality of life in older men. *Archives of Internal Medicine*, 170: 1172 – 1173.

Taaffe, D.R., Duret, C., Wheeler, S. & Marcus, R. 1999. Once-weekly resistance exercise improves muscle strength and neuromuscular performance in older adults. *Journal of the American Geriatrics Society*, 47:1208 – 1214.

Tarazona-Santabalbina, F.J., Gomez-Cabrera, M.C., Perez-Ros, P., Martinez-Arnau, F.M., Cabo, H., Tsaparas, K., Slavador-Pascual, A., Rodriguez-Manas, L. & Vina, J. 2016. A Multicomponent Exercise Intervention that Reverses Frailty and Improves Cognition, Emotion, and Social Networking in the Community-Dwelling Frail elderly: A Randomised Clinical Trial. *Journal of American Medical Directors Association*, 17: 426 – 433.

Taylor, D. 2014. Physical activity is medicine for older adults. *Postgrad Medical Journal*, 90: 26 – 32.

Theou, O., Stathokostas, L., Poland, K.P., Jakobi, J.M., Patterson, O., Vandervoort, A.A. & Jones, G.R. 2011. The effectiveness of exercise Interventions for the Management of Frailty: A Systematic Review. *Journal of Aging Research*, 10.4061.569194. 1-19.

Thomas, J.R., Nelson, J.K. & Silverman, S.J. 2011. *Research Methods in Physical Activity*. 6<sup>th</sup> Edition. Human Kinetics.

Topinkova, E. 2008. Aging, Disability and Frailty. *Annals of Nutrition & Metabolism*, 52 (1): 6 – 11.

Tousignant, M., Corriveau, H., Roy, P.M., Desroiers, J., Dubuc, N. & Hebert, R. 2013. Efficacy of supervised Tai chi exercises versus conventional therapy exercises in fall

prevention for frail older adults: A Randomised controlled trial. *Disability and Rehabilitation*, 35: 1429 – 1435.

Troosters, T., Van Der Molen, T., Polkey, M., Rabinovich, R.A., Vogiatzis, I., Weisman, I. & Kulich, K. 2013. Improving physical activity in COPD: towards a new paradigm. *Respiratory Research*, 115 (14): 1 – 8.

UNDP (United Nations Development Project). 2014. *Human Development Report, Lesotho*.

Van Der Bij, A.K., Laurant, M.G.H. & Wensing, M. 2002. Effectiveness of Physical Activity Interventions for Older Adults. *American Journal of Preventative Medicine*, 22 (2): 120 – 133.

Van Der Bij, A.K., Laurant, M.G.H. & Wensing, M. 2002. American Journal of Preventative Medicine, 22: 120 – 133.

Van Der Walt, E. 2006. *Quoting sources*. North-West University, Potchefstroom Campus: Potchefstroom. 83 p.

Van Der Wiel, A.B., Gussekloo, J., De Crean, A.J.M., Van Exel, E., Bloem, B.R. & Westendorp, R.G.J. 2002. Common chronic Diseases and General Impairments as Determinants of Walking Disability in the Oldest-Old population. *Journal of the American Geriatrics Society*, 50: 1405 – 1410.

Verbrugge, L.M. & Jette, A.M. 1994. The disablement process. *Social Science and Medicine*, 38 (1): 1 – 14.

Vermeulen, J., Neyens, J.C.L., Van Rossum, E., Spreeuwenberg, M.D. & DE Witte, L.P. 2011. Predicting ADL disability in community-dwelling elderly people using physical frailty indicators: a systematic review. *BMC Geriatrics*, 11 (33): 1 – 11.

Vigorito, C. & Giallauria, F. 2014. Effects of exercise on cardiovascular performance in the elderly. *Frontiers in Physiology*, 5 (51):1 – 8.

Villareal, D.T., Chode, S., Parimi, N., Sinacore, D.R., Hilton, T., Armamento-Villareal, R., Napoli, N., Qualls, C. & Shah, K. 2011. Weight Loss, exercise, or Both and Physical function in Obese Older Adults. *New England Journal of Medicine*, 364: 1218 – 1289.

Viola, C., Foguet-Boreu, Q., Flores-Mateo, G., Salisbury, Blom, J., Freitag, M., Glynn, L., Muth, C. & Valderas, J.M. 2014. Prevalence, Determinants and Patterns of Multimorbidity in Primary Care: A systematic review of Observational Studies. *Public Library Of Science One*, 9 (7): 1 – 9.

Vita, A.J., Terry, R.B., Hubert, H.B. & Fries, J.F. 1998. Aging, health risks and cumulative disability. *The New England Journal of Medicine*, 338 (15): 1035 – 1041.

Vogel, T., Brechat, P.H., Leprete, P.M., Kaltenbach, G., Berthel, M. & Lonsdorfer, J. 2009. Health benefits of physical activity in older patients: a review. *The International Journal of Clinical Practice*, 63 (2): 303 – 320.

Wang, J., Jen, C.J. & Chen, H. 1995. Effects of Exercise Training and Deconditioning on Platelet Function in Men. *Arteriosclerosis, Thrombosis, and Vascular Biology*, 15: 1668 - 1674.

Warburton, D.E.R., Nicol, C.W. & Bredin, S.S.D. 2006. Health benefits of physical activity: the evidence. *Canadian Medical Association Journal*, 146 (6): 801 – 809.

Watz, H., Pitta, F., Rochester, C.L., Garcia-Aymeich, J., Zuwallack, R., Troosters, T., Vaes, A.W., Puhan, M.A., Jehn, M., Polkey, M.I., Vogiatziz, I., Clini, E., Toth, M., Gimeno-Santos, E., Waschki, B., Esteban, C., Hayot, M., Casaburi, R., Porszasz, J., Mcauley, E., Singh, S.J., Langer, D., Wouters, E.F.M., Magnussen, H. & Spruit, M.A. 2014. An official European Respiratory Society statement on physical activity in COPD. *European Respiratory Journal*, 44: 1521 – 1537.

Wen, C.P., Wai, J.P.M., Tsai, M.K., Yang, Y.C., Cheng, T.Y.D., Lee, M.C., Chan, H.C. & Tsao, C.K. 2011. Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. *The Lancet*, 378: 1244 – 1253.

WHO (World Health Organization). 2011. *Global health and ageing*. NIH Publication: 11: 2.

WHO, 2017. Cardiovascular Disease, Retrieved from:  
([http://who.int/cardiovascular\\_diseases/en/](http://who.int/cardiovascular_diseases/en/)) Date of access: 20 November 2017.

WHO, 2017. Chronic Respiratory Diseases, Retrieved from: [www.who.int/respiratory/en/](http://www.who.int/respiratory/en/)  
Date of access: 20 November 2017.

Wolf, S.L., Sattin, R.W., O'grady, M., Freret, N., Ricci, L., Greenspan, A.I., XU, T. & Kutner, M. 2001. A Study to Investigate the Effect of Intense Tai Chi in reducing Falls among Older Adults Transitioning to Frailty. *Controlled Clinical trials*, 22: 689 – 704.

Wood, R. J. (2008). Handgrip strength test. [online]. Available at: <http://www.topendsports.com/tests/handgrip.htm> [Accessed 25 January 2018].

Wood, R. J. (2008). Sit and reach flexibility test. [online]. Available at: <http://www.topendsports.com/tests/sit-and-reach.htm> [Accessed 25 January 2018].

Yu, H.W., Chen, D.R., Chiang, T.L., Tu, Y.K. & Chen, Y.M. 2015. Disability trajectories and associated disablement process factors among older adults in Taiwan. *Archives of Gerontology and Geriatrics*, 60: 272 – 280.

6-minute walk test image. <https://sites.google.com/site/umbresp/test-adecuados-a-la-tercera-edad/senior-fitness-test-sft> [Accessed 25 January 2018].

Handgrip test image.

[http://urcc-ccop.com/ccop/index.php?id=22&option=com\\_seyret&task=videodirectlink](http://urcc-ccop.com/ccop/index.php?id=22&option=com_seyret&task=videodirectlink)

[Accessed 25 January 2018].

Arm curl test image. <https://www.sarthaks.in/14772/discuss-arm-curl-test> [Accessed 25 January 2018].

Chair stand test image. <https://www.sarthaks.in/14770/discuss-chair-stand-test> [Accessed 25 January 2018].

Modified sit and reach test image. <https://sites.google.com/site/umbresp/test-adecuados-a-la-tercera-edad/senior-fitness-test-sft> [Accessed 25 January 2018].

8-foot up and go test image.

<https://www.phenxtoolkit.org/index.php?pageLink=browse.protocoldetails&id=150202>

[Accessed 25 January 2018].



## **LIST OF APPENDICES**

---

**Appendix A – Ethics approval letter**

**Appendix B – sociodemographic data collection form**

**Appendix C – Miniature Nutritional Assessment form (MNA)**

**Appendix D – Frailty Scale**

**Appendix E – Study information (English)**

**Appendix F – Study information (Sesotho)**

**Appendix G – Consent form (English)**

**Appendix H – Consent form (Sesotho)**

**Appendix I – Physical activity data collection form**

**Appendix J – Plagiarism report**

**Appendix K – Gallery**

# APPENDIX A

## ETHICS APPROVAL LETTER



IRB nr 00006240  
REC Reference nr 230408-011  
IORG0005187  
FWA00012784

29 August 2016

MS KM MPEKO  
DEPT EXERCISE & SPORT SCIENCE  
FACULTY OF HEALTH SCIENCES  
UFS

Dear Ms KM Mpeko

**ECUFS NR 217/2014B**

**SUPERVISOR(S): DR MC OPPERMAN, PROF CM WALSH**

**DEPARTMENT EXERCISE & SPORT SCIENCE**

**PROJECT TITLE: THE IMPACT OF A PHYSICAL ACTIVITY INTERVENTION PROGRAMME ON FRAILTY SYNDROME IN ELDERLY CITIZENS IN MASERU, LESOTHO**

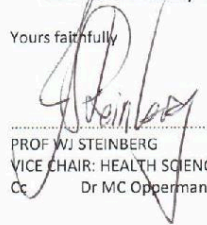
1. You are hereby kindly informed that, at the meeting held on 23 August 2016, the Health Sciences Research Ethics Committee (HSREC) approved the above project.

1.1 *Dept Exercise & Sport Science was transferred from a non-health faculty to the Faculty of Health Sciences. The HSREC grants retrospective ethical approval for this project based on the ruling of the UFS Senate Research Ethics Committee regarding retrospective approval of non-health research and the resulting grace period of one year for all non-Health Faculties.*

*\*Prof Walsh did not recuse herself from the meeting at the Committee's request for elucidation. She did, however, not take part in the decision.*

2. The Committee must be informed of any serious adverse event and/or termination of the study.
3. Any amendment, extension or other modifications to the protocol must be submitted to the HSREC for approval.
4. A progress report should be submitted within one year of approval and annually for long term studies.
5. A final report should be submitted at the completion of the study.
6. Kindly use the **HSREC NR** as reference in correspondence to the HSREC Secretariat.
7. The HSREC functions in compliance with, but not limited to, the following documents and guidelines: The SA National Health Act. No. 61 of 2003; Ethics in Health Research: Principles, Structures and Processes (2015); SA GCP(2006); Declaration of Helsinki; The Belmont Report; The US Office of Human Research Protections 45 CFR 461 (for non-exempt research with human participants conducted or supported by the US Department of Health and Human Services- (HHS), 21 CFR 50, 21 CFR 56; CIOMS; ICH-GCP-E6 Sections 1-4; The International Conference on Harmonization and Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH Tripartite), Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines, Constitution of the HSREC of the Faculty of Health Sciences.

Yours faithfully

  
.....  
PROF WJ STEINBERG  
VICE CHAIR: HEALTH SCIENCES RESEARCH ETHICS COMMITTEE  
Cc: Dr MC Opperman, Prof CM Walsh

Health Sciences Research Ethics Committee  
Office of the Dean: Health Sciences

T: +27 (0)51 401 7795/7794 | F: +27 (0)51 444 4359 | E: ethicsfhs@ufs.ac.za  
Block D, Dean's Division, Room D104 | P.O. Box/Posbus 339 (Internal Post Box G40) | Bloemfontein 9300 | South Africa  
www.ufs.ac.za



**APPENDIX B**

**SOCIODEMOGRAPHIC DATA COLLECTION FORM**

Department of Nutrition and Dietetics

University of the Free States

**THE IMPACT OF NUTRITION AND PHYSICAL ACTIVITY INTERVENTION PROGRAMME FOR FRAILTY SYNDROME IN ELDERLY BASOTHO CITIZENS**

**SOCIO-DEMOGRAPHIC AND HOUSEHOLD QUESTIONNAIRE**

(All information in this questionnaire is confidential)

Area	_____									(1-2)
Respondents number :										(3-5)
Interviewer:	_____									(6-8)
Interview Date:										(9-16)
		D	D	M	M	Y	Y	Y	Y	

**INSTRUCTIONS: FILL IN THE BOX WITH THE APPROPRIATE ANSWERS**

1. How many years have you been living in an urban area? \_\_\_\_\_    (17-19)

2. What is your First language?

i. Sesotho

ii. English

iii. Other, specify \_\_\_\_\_

20

3 What is your marital status:

i. Never married

ii. Currently married/ Traditional marriage

iii. Living with partner

iv. Widowed

v. Separated

vi. Divorced

vii. Other, specify \_\_\_\_\_

21

4. What is your occupation?

- i. Housewife by choice
- ii. Unemployed
- iii. Self Employed
- iv. Full time wage earner (receive a salary)
- v. Pension
- vi. Other, specify (part-time, piece job etc.)\_\_

 22

5. Type of dwelling (main):

- i. Brick, Concrete
- ii. Traditional mud
- iii. Tin
- iv. Plank, wood
- v. Other, specify\_\_\_\_\_

 23

6. Do you have electricity in the house? Yes =1 No=2

 24

7. Where do you get drinking water most of the time?

- i. Own tap
- ii. Communal tap
- iii. River, dam
- iv. Borehole, well
- v. Other, specify \_\_\_\_\_

 25

8. What type of toilet does this household have?

- i. Flush
- ii. Pit
- iii. Bucket, pot
- iv. VIP
- v. Other, specify \_\_\_\_\_

 26

9. What type of fuel is used for cooking most of the time?

- i. Electric
- ii. Gas
- iii. Parafin
- iv. Wood, Coal
- v. Sun
- vi. Open fire

 27

10. Does the home have a working:

- i. Television 1=Yes 2=No
- ii. Radio 1=Yes 2=No
- iii. Refrigerator and/or freezer 1=Yes 2=No
- iv. Stove (Gas, Coal or electric) or Hot Plate

	28
	29
	30

- 1 = Yes 2= No
- v. Primus or Paraffin Stove. 1= Yes 2=No
- vi. Microwave 1=Yes 2 = No
- 31
- 32
- 33
11. How many people contribute to the total income? \_\_\_\_\_
- 34-35
12. Household income per month (including wages, rent, sales of vegs, etc. State grants).
- i. None
- ii. M100-M500
- iii. M501- M1000
- iv. M1001-M3000
- v. M3001-M5000
- vi. Over M5000
- vii. Don't know
- 36
13. Is this more or less the income that you had over the past six months?
- i. More
- ii. Less
- iii. The same
- 37
14. What is your level of education?
- i. None
- ii. Primary School
- iii. Secondary
- iv. Tertiary Education
- v. Don't Know
- 38

## APPENDIX C

### MINIATURE NUTRITIONAL ASSESSMENT FORM (MNA)

Appendix C: Mini Nutritional Assessment (MNA)

Questionnaire	For office use only:
<i>Mark the appropriate option with a X or write your answer in the space provided:</i>	
1 Today's date:    d   d   m   m   y   y <div style="display: flex; justify-content: space-around; width: 100%;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div>	<div style="display: flex; justify-content: space-around; width: 100%;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> <div style="text-align: right;">1 - 4</div>
2 Gender: <div style="display: flex; margin-left: 20px;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px;"></div> 1 Male  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px; margin-top: 5px;"></div> 2 Female         </div>	<div style="display: flex; justify-content: space-around; width: 100%;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> <div style="text-align: right;">5 -10</div>
3 Age: _____ years	<div style="display: flex; justify-content: space-around; width: 100%;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> <div style="text-align: right;">12 - 13</div>
4 Ethnicity <div style="margin-left: 20px;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px;"></div> 1 Black  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px; margin-top: 5px;"></div> 2 White  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px; margin-top: 5px;"></div> 3 Coloured  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px; margin-top: 5px;"></div> 4 Indian  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px; margin-top: 5px;"></div> 5 Other    Specify _____         </div>	<div style="display: flex; justify-content: space-around; width: 100%;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> <div style="text-align: right;">14</div>
5 Weight: _____ Kg	<div style="display: flex; justify-content: space-around; width: 100%;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; text-align: center;">●</div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> <div style="text-align: right;">15 - 19</div>
6 Height: _____ cm	<div style="display: flex; justify-content: space-around; width: 100%;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> <div style="text-align: right;">20 - 22</div>
7 Knee height: _____ cm	<div style="display: flex; justify-content: space-around; width: 100%;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> <div style="text-align: right;">23 - 24</div>
<b>THE MNA (MINI NUTRITIONAL ASSESSMENT): UPDATE</b> MINI NUTRITIONAL ASSESSMENT © 1994 Nestec Ltd (Nestlé Research Centre)/Nestlé Clinical Nutrition	
<b>i. ANTHROPOMETRIC ASSESSMENT</b>	
8 B.M.I (weight / height <sup>2</sup> in Kg/m <sup>2</sup> ) <div style="margin-left: 20px;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px;"></div> 0 BMI &lt;19  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px; margin-top: 5px;"></div> 1 19 ≤ BMI &lt;21  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px; margin-top: 5px;"></div> 2 21 ≤ BMI &lt;23  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px; margin-top: 5px;"></div> 3 BMI ≥23         </div>	<div style="display: flex; justify-content: space-around; width: 100%;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> <div style="text-align: right;">25</div>
9 Mid Arm Circumference _____ cm <div style="margin-left: 20px;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px;"></div> 0.0 MAC &lt; 21  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px; margin-top: 5px;"></div> 0.5 21 ≤ MAC ≤ 22  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px; margin-top: 5px;"></div> 1.0 MAC &gt; 22         </div>	<div style="display: flex; justify-content: space-around; width: 100%;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; text-align: center;">●</div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> <div style="text-align: right;">26 - 28</div>
10 Calf Circumference _____ cm <div style="margin-left: 20px;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px;"></div> 0 CC &lt;31  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block; margin-right: 5px; margin-top: 5px;"></div> 1 CC ≥31         </div>	<div style="display: flex; justify-content: space-around; width: 100%;"> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> <div style="text-align: right;">29</div>

11	Weight loss during last 3 months	<input type="checkbox"/>	30
	0 weight loss > 3Kg		
	1 does not know		
	2 weight loss between 1 and 3 Kg		
	3 no weight loss		
<b>ii. GLOBAL EVALUATION</b>			
12	Does the participant live independently in contrast to a nursing home?	<input type="checkbox"/>	31
	0 no		
	1 yes		
13	Does the participant take more than 3 prescription drugs (per day)?	<input type="checkbox"/>	32
	0 no		
	1 yes		
14	In the past few months, has the participant suffered from psychological stress or acute disease?	<input type="checkbox"/>	33
	0 no		
	1 yes		
15	Mobility	<input type="checkbox"/>	34
	0 bed or chair bound		
	1 able to get out of bed / chair, but does not go out		
	2 goes out		
16	Neuropsychological problems	<input type="checkbox"/>	35
	0 severe dementia or depression		
	1 mild dementia		
	2 no psychological problems		
17	Pressure sore or skin ulcers	<input type="checkbox"/>	36
	0 yes		
	1 no		
<b>iii. DIETARY ASSESSMENT</b>			
18	How many full meals does the participant eat daily?	<input type="checkbox"/>	37
	0 1 meal		
	1 2 meals		
	2 3 meals		
19	Does he/she consume:	<input type="checkbox"/>	38 - 40
	At least one serving of dairy products (milk, cheese, yogurt) per day?	<input checked="" type="checkbox"/>	
	Two or more servings of beans or eggs per week?	<input type="checkbox"/>	
	Meat, fish or poultry every day?	<input type="checkbox"/>	
	0.0 if 0 or 1 yes		
	0.5 if 2 yes		
	1.0 if 3 yes		

20	Does he/she consume two or more servings of fruits or vegetables per day?	<input type="checkbox"/>	41
	<input type="checkbox"/> 0 no		
	<input type="checkbox"/> 1 yes		
21	Has the participant food intake declined over the past 3 months due to a loss of appetite, digestive problems, chewing or swallowing difficulties?	<input type="checkbox"/>	42
	<input type="checkbox"/> 0 severe loss of appetite		
	<input type="checkbox"/> 1 moderate loss of appetite		
	<input type="checkbox"/> 2 no loss of appetite		
22	How many cups / glasses of beverages (water, juice, coffee, tea, milk, wine, beer,...) does the participant consume per day?	<input type="checkbox"/>	<input checked="" type="radio"/> 43 - 45
	<input type="checkbox"/> 0.0 less than 3 glasses		
	<input type="checkbox"/> 0.5 3 to 5 glasses		
	<input type="checkbox"/> 1.0 more than 5 glasses		
23	Mode of feeding	<input type="checkbox"/>	46
	<input type="checkbox"/> 0 fed requires assistance		
	<input type="checkbox"/> 1 self-fed with some difficulties		
	<input type="checkbox"/> 2 self-fed without any problem		

**iv. SUBJECTIVE ASSESSMENT**

24	Does the participant consider to have any nutritional problems?	<input type="checkbox"/>	47
	<input type="checkbox"/> 0 major malnutrition		
	<input type="checkbox"/> 1 does not know or moderate malnutrition		
	<input type="checkbox"/> 2 no nutritional problems		
25	In comparison with other people of the same age, how would the participant consider his/her health status?	<input type="checkbox"/>	<input checked="" type="radio"/> 48 - 50
	<input type="checkbox"/> 0.0 not as good		
	<input type="checkbox"/> 0.5 does not know		
	<input type="checkbox"/> 1.0 as good		
	<input type="checkbox"/> 2.0 better		

<b>TOTAL (maxi 30 points): (question 8-25)</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--	--	--------------------------	--------------------------	--------------------------

Ref: Guigoz Y, Vellas B and Gary P.J. 1994. Mini Nutritional Assessment: A practical assessment tool for grading the nutritional state of elderly patients. Facts and Research in Gerontology. Supplement #2: 15-59



Questionnaire translated to Sesotho

Questionnaire		For office use only:	
		<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	1 - 4
<i>Mark the appropriate option with a X or write your answer in the space provided:</i>			
1 Lersatsi:	d d m m y y <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	d d m m y y <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	5 - 10
2 Botono/botshehaeli	<input type="checkbox"/> 1 Botono <input type="checkbox"/> 2 Botshehaeli	<input type="checkbox"/>	11
3 Dilema:		<input type="text"/> <input type="text"/>	12 - 13
4 Ethnicity	<input type="checkbox"/> 1 Black <input type="checkbox"/> 2 White <input type="checkbox"/> 3 Coloured <input type="checkbox"/> 4 Indian <input type="checkbox"/> 5 Other Specify _____	<input type="checkbox"/>	14
5 Boima Bammele: _____ Kg		<input type="text"/> <input type="text"/> <input checked="" type="radio"/> <input type="text"/>	15 - 19
6 Bolelele: _____ cm		<input type="text"/> <input type="text"/> <input type="text"/>	20 - 22
7 Bolelele ba lengwete: _____ cm		<input type="text"/> <input type="text"/>	23 - 24
<b>THE MNA (MINI NUTRITIONAL ASSESSMENT): UPDATE</b> MINI NUTRITIONAL ASSESSMENT © 1994 Nestec Ltd (Nestlé Research Centre)/Nestlé Clinical Nutrition			
<b>i. Ho lekolwa ha Antropometry</b>			
8 Boima ba mmele	<input type="checkbox"/> 0 BMI <19 <input type="checkbox"/> 1 19 ≤ BMI <21 <input type="checkbox"/> 2 21 ≤ BMI <23 <input type="checkbox"/> 3 BMI ≥23	<input type="checkbox"/>	25
9 Bobphara ba sephaka _____ cm	<input type="checkbox"/> 0.0 MAC < 21 <input type="checkbox"/> 0.5 21 ≤ MAC ≤ 22 <input type="checkbox"/> 1.0 MAC > 22	<input type="checkbox"/> <input checked="" type="radio"/> <input type="text"/>	26 - 28
10 Bophara ba thafu _____ cm	<input type="checkbox"/> 0 CC <31 <input type="checkbox"/> 1 CC ≥31	<input type="checkbox"/>	29

11	Ho fokola ha mmele kgeding tse thaso (3) tse fetileng	<input type="checkbox"/>	30	
	0 ha fokolo hi feta > 3 kg			
	1 ha o sa tsebe			
	2 ha fofoka ha immele pakeng tsa lle 3 kg			
	3 ha no pwokolo ya mmele/boima			
<b>ii. Holekolwa ha mmele ka ka kaoretso</b>				
12	Na mokuueli o dula a lemong lehaeng la thlokomelo?	<input type="checkbox"/>	31	
	0 che			
	1 eye			
13	Na mokuueli o nwa meriaria e fetang boraro (3) ka letsatsi?	<input type="checkbox"/>	32	
	0 che			
	1 eye			
14	Dikgweding tse tharo (3) tse fetleng na mokuueli o kile a kula ena le kgakekko ya meukutlo kappa mahloko emmang?	<input type="checkbox"/>	33	
	0 che			
	1 eye			
15	Ho tsamaye/ Ho itsamaise	<input type="checkbox"/>	34	
	0 o dula a le betueng/ setulong			
	1 nokgona ho tueolabetueng / setulong			
	2 o kisa kantle			
16	.) Matualta a kelello	<input type="checkbox"/>	35	
	0 ho lebala halulo / kgalello ya neilcutlo			
	1 ho lebala ho makereng			
	2 ho ana metata a kellello			
17	Mageba dikarolong tse ilseng tsa mmele?	<input type="checkbox"/>	36	
	0 che			
	1 eye			
<b>iii. Holekolwa ha dijo</b>				
18	Mokuloli o ja dijo tse felleseng ha kae ka letsatsi ?	<input type="checkbox"/>	37	
	0 hangwe (1)			
	1 thatbedi (2)			
	2 hatraro (3)			
19	Na o nwa/ no ja: Bonyane e lengwe ya tse lateleng tse nang le	<input type="checkbox"/>	38 - 40	
	lebese(lebese, cheese le yogurt) ka letsatsi ?	<input type="checkbox"/>		che / eye
	Tse pedi kappa ho feta pakey tsa dina kappa mabe ka beke?	<input type="checkbox"/>		che / eye
	Nama, thapi kappa kgowo ka mehla?	<input type="checkbox"/>		che / eye
	0.0 = if 0 or 1 eya			
	0.5 = haeba tse 2 eya			
	1.0 = haeba 3 eya			

20	Na o ja ditholoana tsapa meroho e mmedi kappa ho feta ka letsatsi? 0 che 1 eye	<input type="checkbox"/>	41	
21	Na takatso ya hoja dijo ya mokudi e tueule dikyweding tse tharo (3) tse fefileng ka tlasa mataka a ho hloka takatso, botuata bei tsulo ya dij, ho hlafuna kappa ho kwenya? 0 Bothata to mahareng be ho hloka taka ya dijo 1 Bothata ko mahareng ba ho hloka takatso ya diljo 2 Ho se hloke thakatso ya dijo	<input type="checkbox"/>	42	
22	O nwa mabekere kaya kgalase tse kae tsa dino tse tapaneng tse o mokudi a dinwang ka letatsi?(metsi, senomafwe, kofi, teue, lenese, wine kappa biri ) 0.0 ka tlase ho makere a bhasaro (3) 0.5 makere a 3 woisa ho a ihlasio (5) 1.0 ho feta inabere as a 5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	43 - 45
23	O ja wang ? 0 O wa Jeswa 1 O wa itjesa a ntse a sokola ka botuata 2 O itjesa keintle ho botuata	<input type="checkbox"/>	46	
<b>iv. SUBJECTIVE ASSESSMENT</b>				
24	Na mokudi o na le boluata ba hoja dijo tse ohepo e ntle 0 matheta a mauslo 1 ha a tsebe kappa a mahareng 2 ha ana mahete a phepo entle	<input type="checkbox"/>	47	
25	Uo bapiswa le batho bang ba dilemong tse tshwanang, na mokueli a ka bona Dopahelo bo battle ba hae 60 le jwang ? 0.0 bo se botle 0.5 ha a tsebe 1.0 bo le botle 2.0 bo le betese	<input type="checkbox"/>	<input checked="" type="checkbox"/>	48 - 50
<b>TOTAL (maxi 30 points): (question 8-25)</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Ref: Guigoz Y, Vellas B and Gary P.J. 1994. Mini Nutritional Assessment:

A practical assessment tool for grading the nutritional state of elderly patients.

Facts and Research in Gerontology . Supplement #2: 15-59

## APPENDIX D FRAILITY SCALE

### Frailty Scale

Overview: A frailty scale based on the geriatric status scale can be used to rapidly assess an elderly patient for functional status. This can help identify those patients requiring specialized intervention.

Performance	Level	Status
1 • walks without help	0	fit
2 • performs basic activities of daily living (eating dressing bathing bed transfer)		
3 • continent of bowel and bladder		
4 • not cognitively impaired		
2 • walks without help  • performs basic activities of daily living (eating dressing bathing bed transfer)  • continent of bowel but not of bladder  • not cognitively impaired	1	fit, but bladder incontinent
3 one or more of following (2 if incontinent)  • needs assistance with activities of daily living or mobility  • bowel or bladder incontinent  3 • cognitive impairment without dementia	2	pre-frail
4 two of following (3 if incontinent)  • totally dependent for transfers  • totally dependent with one or more activities of daily living  • bowel and bladder incontinent  • demented	3	frail
<b>Level</b>	<b>Percent Not Institutionalized in 3 Months</b>	<b>Percent Surviving at 5 Years</b>
0	95%	82%
1	90%	78%
2	80%	66%
3	50%	50%

References: Rockwood K, Stadnyk K et al. A brief clinical instrument to classify frailty in elderly people. Lancet. 1999; 353: 205-206.

**APPENDIX E**  
**STUDY INFORMATION (ENGLISH)**

---

**THE IMPACT OF A NUTRITION AND PHYSICAL ACTIVITY INTERVENTION PROGRAMME ON FRAILITY SYNDROME IN ELDERLY CITIZENS IN LESOTHO**

We are from the University of the Free State, Faculty of Health Sciences. We are carrying out a study to determine the impact of a nutrition and physical activity intervention program for frailty syndrome in elderly Basotho citizens. It is very important that we gather quality data and knowledge on the elderly because they need to live long to take care of themselves, sick relatives and orphans we have in our society. Research is just the process to learn the answer to a question.

**Invitation to participate:** We are asking/inviting you to participate in this research study.

**What is involved in the study:** The aim of the study is to determine the nutritional status and indicators of frailty in the elderly in Maseru and district. In this study we will be collecting baseline information on socio-demography, reported health, nutritional status, physical activity and frailty. The questionnaires will be completed at the homes of the participants by the researcher and trained field workers.

We will also take measurements such as weight, height, knee height, calf circumference, mid upper arm circumference. It will take approximately one hour to complete these questionnaires and to take the measurements. You will not be paid to participate in the baseline survey and it will cost you nothing.

Researchers will endeavour to provide information about the outcome of the research. Your information will not be released for use by anyone else without consent, unless required by law.

**Benefits and risks of being in the study:** By participating in the study you will help us to collect nutrition and frailty information on the elderly that will benefit the senior citizens of our land. There are no risks involved.

**Participation is voluntary**, and refusal to participate will involve no penalty or loss of benefits to which you are entitled; you may discontinue participation at any time.

**Confidentiality:** Efforts will be made to keep personal information confidential. Absolute confidentiality cannot be guaranteed. Personal information may be disclosed if required by law. Organizations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the Ethics Committee of the Faculty of Health Sciences, UFS and the Ministry of Health Lesotho. If results are published, this may lead to individual/cohort identification. The results of the research may be presented at a conference or published in scientific journals.

Kind regards

-----  
Prof. Corinna Walsh

(Promoter)

+27514013818

-----  
Rose Dufe Turkson

(Researcher)

+266 59501023

**APPENDIX F**  
**STUDY INFORMATION (SESOTHO)**

---

**SEO PHEPO E NEPAHETSENG LE BOIKOETLISO LI SE ETSANG ELE HO KENA LIPAKENG FOR FRAILTY SYNDROME MAQHEKUNG LE MAQHEKOANENG A SECHABA SA LESOTHO**

Hlaha junifesiting ea foreisetata, lekaleng la mahlele a bophelo. Re etsa boithuto bo shebaneng le ts'usumetso ea phepo e nepahetseng le boikoetliso khahlanong le frailty syndrome ho maqheku a Lesotho.

Ho bohlokoa hore re fumane likarabo le tsebo hitsoa ho maqheku hobane ba hloka ho phela halelele ba ithokomela, ba lelapa ba kulang le likhutsana sechabeng sa rona.

Lipatlisiso ke mokhoa oa ho ithuta likarabo ka lipotso kapa hotsoa lipotsong.

**Memo ea ho nka karolo:** re u kopa/mema ho nka karolo boithutong bona.

**Se kenyeletsang boithuto:** moikemisetso ea boithuto ke ho ela hloko ts'usumetso ea phepo e nepahetseng le boikoetliso ho a phepo le litlamorao tsa frailty maqhekung a seterekeng sa Maseru. U khethiloe ho ba karolong e senang ho angoa ke ho kena lipakeng ha phepo e nepahetseng ho fihlela boithuto bo felile. Ha boithuto bo felile, u tla fumana monyetla oa ho nka karolo hona boithutong moo mme u amohela melemo ea phepo e nepahetseng le boikoetliso ha u batla.

Likhoeli tse tharo, tse tseletseng le selemo kamora lipatlisiso tsa mantlha, moithuti le sehlopha sa hae batla le etela malapeng a lona ho bokella lintlha

Re tla thabela le ho nka limetho tsa boima, bolelele, bolelele ba lengole, calf circumference, le selika likoe sa sephaka.

Ho bohlokoa ho bokella molaetsa o nepahetseng le hoba le tsebo ka maqheku hobane ba lokela ho phela ha lelele le ho ithokomela, le ho hlokomela bang ka bona ba kulang le likhutsana tse phelang kahare ho sebaka sa bona.

Moithuti aka fana ka molaetsa o hlakisang bohlokoa bokamosong ba bophelo ba motho ea khethuoeng ho nka karolo.

Moithuti o tla leka ka matla ho fana ka molaetsa ha boithuto bo fihletsoe. Lisebelisoa tsa lona le melaetsa e keke ea lokolla seabakeng sa mabaka a mang ntle le tumello, ntle le haeba molao o tlama joalo.

**Melemo** oa ho ba karolo ea boithuto: ho nka karolo boithutong bona ho tla re thusa ho holisa phepo e nepahetseng le ho fetisa molaetsa ka frailty ho maqheku molemong oa sechaba sa rona.

**Ho nka karolo ke boithaopo**, ho hana ho nka karolo ho keke ha eba le likotlo kapo tahlehelo ea melemo e u lokelang; u ka tlohela ka lehare 'me ha hona likotlo kapo tahlehelo ea melemo e u lokelang.

**Lekunutu:** boikhatso bo matla bo tla etsoa e le ho boloka melaetsa ea motho ka bo mong ele lekunutu. Le ha ho le joalo, ha ho bonnete ba lekunutu le tsoeleletseng. Litaba tseo eleng lekunutu ho monga tsona li ka hlaella ha fela molao o tlamo joalo. Mekhatlo e tla hlahloba/kapo ho qopitsa lipoloko tsa boithuto ba hau molemong oa netefatso ea boleng bo holimo li kenyeletsa lihlopha tse kang komiti ea ethics ea lekalana la mahlale ka bophelo, UFS le lekala la bophelo Lesotho. Ha liphetho li phatlelelitsoe

Rea leboha

-----  
Prof. Corinna Walsh

(Promoter)

+27514013818

-----  
Rose Dufe Turkson

(Researcher)

+266 59501023

**APPENDIX G**  
**CONSENT FORM (ENGLISH)**

---

**THE IMPACT OF A NUTRITION AND PHYSICAL ACTIVITY INTERVENTION PROGRAMME FOR FRAILTY  
SYNDROME IN ELDERLY CITIZENS IN LESOTHO**

**CONSENT TO PARTICIPATE IN RESEARCH- BASELINE**

You have been asked to participate in a research study.

You have been informed about the study by Rose Dufe Turkson.

You may contact Prof Corinna Walsh on +27514013818 or Rose Dufe Turkson on +266 59501023/63329275 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 Secretariat of the Ethics Committee of the Faculty of Health Sciences, UFS at telephone number +27(051)4052812 if you have questions about your rights as a research participant.

Your participation in this research is voluntary, and you will not be penalised or lose benefits if you refuse to participate or decide to terminate participation.

If you agree to participate, you will be given a participant information sheet, which is a written summary of the research.

The research study, including the above information has been verbally described to me. I understand what my involvement in the study means and I voluntarily agree to participate.

\_\_\_\_\_  
Signature or mark of Participant

\_\_\_\_\_  
Date

**APPENDIX H**  
**CONSENT FORM (SESOTHO)**

---

**SEO PHEPO E NEPAHETSENG LE BOIKOETLISO LI SE ETSANG ELE HO KENA LIPAKENG FOR FRAILTY  
SYNDROME MAQHEKUNG LE MAQHEKOANENG A SECHABA SA LESOTHO**

U kopuo e ho nka karolo phuputsoeng.

U joetsuo e boithuto ba phuputso ke Rose Dufe Turkson.

U ka ikopanya le Prof. Corinna Walsh nomorong tse latelang +2751413818 kapa Rose Dufe Turkson nomorong tsena 266 59501023 nako efe ha u na le lipotso ka liphuputso kapa ha u hlalile kotsi nakong ea liphuputso.

U ka ikopanya le ofisi ea komiti ea Ethics ea lekala la tsa mahlale le tsa bophelo, UFS nomorong tsena 27 (051) 4052812 ha u na le lipotso ka litolelo tso hau joaloka boithuto liphuputsoeng.

Ho nka karolo hoa hau liphuputsoeng ke boithaopo, ebile ha u na ho sekisetsoa kapa hona hose une molemo o itseng ha u khetha ho se nke karolo, kapa hona ho tlohela ho nka karolo ka lehare.

Ha u lumela ho nka karolo, u tla fua kopi ea tokomane e tekennoeng le pampiri e bontsang boithaopo e ngotsoeng kakaretso ea liphuputso.

Liphuputso, ho kkenyeletsa le litaba tsohle tse ka holimo, li ntlhake tse. Ke utluisisa bohlokoa ba ho nka karolo ho aka 'me ke lumela ho ithaopela ho nka karolo.

---

Tekeno ea a nkileng karolo

---

letsatsi



## PHYSICAL ACTIVITY DATA COLLECTION FORM

K. Mpeko DATA COLLECTION FORM 2015

Participant Name and Surname: \_\_\_\_\_

Participant number: \_\_\_\_\_

Date of Testing: \_\_\_\_\_

Sex (Arm Curl Test M: 3.6kg; F:2.3kg) \_\_\_\_\_

ASSESSMENT TESTS	Value 1	Value 2	Value 3	Average
1 Chair Stand (max. count in 30sec)				
2 Arm curl (max. count in 30sec)				
3 6-Minute Walk (max. distance)				
4 8-Foot Up and Go (duration)				
5 Modified Sit-and-Reach (cm)				
6 Handgrip test				

## PLAGIARISM REPORT

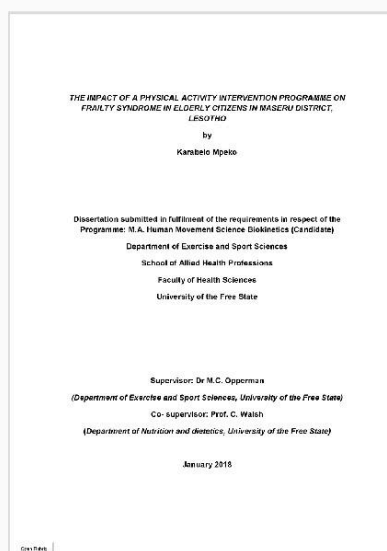


## Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author: Kb Mpeko  
Assignment title: Turnitin Submission  
Submission title: Masters  
File name: KB\_Mpeko\_FINAL\_25\_January\_plg...  
File size: 1.52M  
Page count: 133  
Word count: 45,335  
Character count: 251,405  
Submission date: 29-Jan-2018 12:21PM (UTC+0200)  
Submission ID: 908151649



GALLERY

---



















e