NUTRITIONAL AND FALL RISK AMONG OLDER WOMEN LIVING IN LONG-TERM CARE FACILITIES OF INDIA

A Thesis

Submitted to the Faculty of Graduate Studies and Research

In partial fulfillment of the requirements

For the Degree of

Doctor of Philosophy

in

Kinesiology and Health Studies

University of Regina

By

Swati Madan

Regina, Saskatchewan

June, 2017

Copyright 2017: S. Madan
Swati Madan, candidate for the degree of Doctor of Philosophy in Kinesiology and Health Studies, has presented a thesis titled, *Nutritional and Fall Risk Among Older Women Living in Long-Term Care Facilities of India*, in an oral examination held on June 5, 2017. The following committee members have found the thesis acceptable in form and content, and that the candidate demonstrated satisfactory knowledge of the subject material.

External Examiner: *Dr. Jamuna Duvvuru, Sri Venkateswara University*

Supervisor: Dr. Shanthi Johnson, Faculty of Kinesiology and Health Studies

Committee Member: Dr. Rebecca Genoe, Faculty of Kinesiology and Health Studies

Committee Member: Dr. Patrick Neary, Faculty of Kinesiology and Health Studies

Committee Member: Dr. Richard MacLennan, Department of Psychology

Chair of Defense: Dr. Andrei Volodin, Department of Mathematics and Statistics

*Via Skype*
ABSTRACT

The objectives of the study were to assess the nature of nutritional and fall risk in older adults living in LTC facilities in New Delhi, evaluate the inter-relationship of nutritional and fall risk, and assess whether depression, fear of falling, and physical function predict fall risk, and to test the reliability of nutrition and fall risk measures. Eighty five women aged 60 years and over living in six LTC facilities in New Delhi were recruited. Measures included the Mini Nutritional Assessment (MNA), Falls Efficacy Scale International (FES-I), Downton Index, SF-36 Health Survey, Geriatric Depression Scale (GDS), Mini Mental State Exam (MMSE), and a background profile and physical activity questionnaire. Mobility was assessed using Timed up and go test (TUG), and handgrip strength was assessed using Jamar hydraulic hand dynamometer. Using SPSS software (version 22.0), descriptive statistics, correlation between different variables, predictors of fall risk, and reliability measures were analysed.

The mean age of participants was 74.21(5.52) years. A majority were widowed with poor educational and income level. Findings revealed that 54% of the older women were at a high level of nutritional risk. The factors that accounted for a large proportion of variance in the nutritional risk level were mobility status, intake of psychotropic medications, low dietary intake, and poor self-perception of health status. MNA scores had significant negative correlation with Downton Index scores (R=-.419, p<.001) which implies that higher MNA scores (lower nutritional risk) were associated with lower scores on Downton Index (lower fall risk). Multiple regression analysis revealed that fear
of falling, fall history, body pain, functional mobility, gait condition, and depression were predictors of fall risk. Analysis of the psychometric properties of the main constructs showed that the reliability of MNA was low (Cronbach’s alpha= 0.3) while the reliability of Downton Index was fair but acceptable (Cronbach’s alpha=0.7). The study highlights the burden of nutritional and fall risk among older adults living in LTC in India, the need to establish the psychometric properties of tools for various cultural contexts, and plan intervention studies to address this significant co-existing health issue.
ACKNOWLEDGMENT

First and foremost, I would like to thank my advisor and mentor, Dr. Shanthi Johnson, for her continuous and sincere support throughout my doctoral research program. Her kindness, patience, and positive attitude towards every situation have been a remarkable source of inspiration for me, and have given me motivation, strength and ambition, and have sharpened my skills as a researcher. I would like to express my heartfelt gratitude towards Dr. Richard MacLennan who helped me immensely with the statistical analysis of my data, and for his brilliant advice throughout my research program. I would like to sincerely thank him for his expert guidance and unconditional support throughout my PHD program. I am very grateful to my committee members Dr. Patrick Neary and Dr. Rebecca Genoe for their valuable feedback, and suggestions, and for their support and cooperation throughout my research study. I would like to thank them for their time, advice, and research inputs.

My sincere thanks to the Research Ethics Board (REB) at the University of Regina, and the Directors and Managers of long-term care facilities in New Delhi for giving me ethics approval to carry out research, and for giving me permission to meet older women living in the facilities. I am grateful to all the women who participated in my research study, the nursing staff, and the caregivers for their help and cooperation.
DEDICATION

I would like to dedicate this dissertation to my parents since they have played a very important role in providing me with motivation, guidance, encouragement, emotional, and financial support throughout my research program. My parents have been my pillars of strength while I faced many challenges at different phases of my research project. I am thankful to them for having faith in me, loving me unconditionally, and always being there whenever I needed their support and guidance. I also dedicate my dissertation to Tejas, my loving sister, for her encouragement and for being my source of inspiration and guidance. I would like to thank my grandparents for their love and blessings. Without the support provided by my family, this dissertation would not have been possible.
# TABLE OF CONTENTS

ABSTRACT.........................................................................................................................I

ACKNOWLEDGMENT..........................................................................................................III

DEDICATION...................................................................................................................IV

TABLE OF CONTENTS.......................................................................................................V

LIST OF TABLES...............................................................................................................IX

LIST OF APPENDICES..................................................................................................XIV

LIST OF ABBREVIATIONS............................................................................................XV

CHAPTER 1 INTRODUCTION............................................................................................1

CHAPTER 2 LITERATURE REVIEW..................................................................................7

  2.1 Long-term care...........................................................................................................8

  2.2 Prevalence of malnutrition in older adults..............................................................9

  2.3 Consequences of malnutrition in older adults......................................................12

  2.4 Factors contributing to malnutrition in LTC.........................................................14

    2.4.1 Medical Risk Factors.......................................................................................15

    2.4.2 Social Risk Factors........................................................................................23

    2.4.3 Psychological Risk Factors..........................................................................26

  2.5 Measurement of malnutrition in older adults.......................................................29

  2.6 Frailty and falls in LTC Facilities...........................................................................34

  2.7 Public Health Importance of Falls.........................................................................35

  2.8 Costs associated with falls and fall-related injuries.............................................39

V
2.9 Risk factors for falls

2.9.1 Lower extremity weakness due to sarcopenia

2.9.2 Low functional capacity

2.9.3 Psychotropic medications

2.9.4 Vitamin D deficiency

2.10 Measurement of Fall Risk

2.10.1 Downton Index

2.10.2 Falls Efficacy Scale International (FES-I)

2.10.3 Timed-up-and-go test

2.11 Association between Nutritional and Fall Risk

CHAPTER 3 METHODS

3.1 Selection of facilities and recruitment of participants

3.2 Sample size

3.3 Measures of Nutritional and Fall Risk

3.3.1 Background Profile Questionnaire

3.3.2 Mini-Nutritional Assessment (MNA)

3.3.3 Fall Efficacy Scale International

3.3.4 Downton Index

3.3.5 Geriatric Depression Scale

3.3.6 SF-36 Health Survey

3.4 Measure of Cognitive Status

3.5 Measure of Balance and Mobility

3.6 Measure of Functional Status

3.7 Data Analysis

3.7.1 Multiple Regression Analysis
CHAPTER 4 RESULTS

3.7.2 Factor Analysis

3.7.3 Reliability Analysis

CHAPTER 5 DISCUSSION

5.1 Study Purpose

5.2 Background characteristics

5.3 Health Profile

5.4 Psychological issues

5.5 Nutritional Risk Level

5.6 Fall Risk Level

5.7 Fear of falling

5.8 Cognitive Status

5.9 Association between nutritional status and falls

5.10 Multiple Regression

5.11 Factor Analysis
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.12 Reliability Analysis</td>
<td>133</td>
</tr>
<tr>
<td>5.13 Future Directions and Research</td>
<td>134</td>
</tr>
<tr>
<td>5.14 Strengths and Limitations of the Study</td>
<td>136</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>138</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1 Risk factors for falls..........................................................42
Table 2 Background characteristics of participants.................................69
Table 3 Health profile of participants..................................................73
Table 4 General health status of participants.........................................76-77
Table 5 Nutritional profile of participants..............................................79-80
Table 6 Fall risk profile of participants...............................................83-84
Table 7 Level of depression assessed using Geriatric Depression Scale in participants.........................................................86-87
Table 8 Severity of memory problems and cognitive decline assessment using MMSE..............................................................89
Table 9 Correlation analysis of age, TUG test and HGS with MNA, FES-I, GDS, Downton Index, and MMSE scores.................................90
Table 10 Correlation analysis of MNA with FES-I, Downton Index, GDS, and MMSE scores..............................................................91
Table 11 Regression analysis with FES-I score as predictor of fall risk.........................................................................................93
Table 12 Model summary for regression analysis with Downton Index score as DV and MNA and FES-I score as IVs.........................93
Table 13 Multiple regression analysis with fall history as predictor
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Model summary for regression involving Downton index score as DV and MNA score and fall history as IVs.</td>
</tr>
<tr>
<td>15</td>
<td>Multiple regression analysis showing a decreased ability to perform moderate activities acting as a predictor of future fall risk.</td>
</tr>
<tr>
<td>16</td>
<td>Model summary for multiple regression analysis involving Downton Index score as outcome variable or DV and MNA score and difficulty performing moderate level of activity as predictor variables or IVs.</td>
</tr>
<tr>
<td>17</td>
<td>Multiple regression analysis showing visual impairment as a predictor of fall risk.</td>
</tr>
<tr>
<td>18</td>
<td>Model summary for regression analysis involving Downton Index score as DV and MNA Score and visual impairment as predictor variables or IVs.</td>
</tr>
<tr>
<td>19</td>
<td>Multiple regression analysis showing limb impairment as a predictor of future fall risk.</td>
</tr>
<tr>
<td>20</td>
<td>Model summary for regression analysis involving Downton Index score as outcome variable or DV and MNA score and limb impairment as predictors or IVs.</td>
</tr>
<tr>
<td>21</td>
<td>Multiple regression analysis showing recently experienced body pain as a predictor of future fall risk.</td>
</tr>
<tr>
<td>22</td>
<td>Model summary for regression analysis involving Downton</td>
</tr>
</tbody>
</table>
score as outcome variable or DV and MNA score and
pain as predictors or IVs.

Table 23
Multiple regression analysis with Downton Index score
as outcome variable or DV and MNA score and time taken to
perform TUG test as predictors or IVs.

Table 24
Model summary for multiple regression analysis carried out
between Downton Index as DV or outcome variable and MNA
score and time taken to complete TUG test as predictors or
IVs.

Table 25
Multiple regression analysis showing GDS scores as a predictor of
fall risk.

Table 26
Model summary for regression analysis involving Downton Index
score as DV or outcome variable and MNA score and GDS score
as IVs or predictor variables.

Table 27
Multiple regression analysis showing gait condition acting as a
predictor of fall risk.

Table 28
Model summary for regression analysis involving Downton Index
score as DV and MNA score and gait condition as IVs
or predictors of fall risk.

Table 29
Multiple regression analysis showing lower social interaction with
friends and family acting as a predictor of fall risk.
Table 30  Model summary showing regression analysis between Downton Index score (DV) and MNA score and lower social interaction with friends and family as predictors (IVs).................................................107
Table 31  Factor Analysis of MNA items..............................................................108
Table 32  Total variance explained using factor analysis for determination of nutritional risk by including MNA items.........................................................108
Table 33  Rotated Component Matrix of items MNA.............................................109
Table 34  KMO and Barlett's test for FES-I ..........................................................110
Table 35  Total variance explained using factor analysis for items of FES-I.........................................................................................................................111
Table 36  Rotated Component Matrix for FES-I using Varimax Rotation technique: factor analysis method.................................................................111
Table 37  KMO and Barlett's test for Geriatric Depression Scale.........................113
Table 38  Total variance explained for depression using factor analysis of GDS items.........................................................................................................113
Table 39  Rotated component Matrix for items of Geriatric Depression Scale (GDS)........................................................................................................114-115
Table 40  KMO and Barlett's test for SF-36 Health Survey..................................116
Table 41  Total Variance explained by various items of SF-36 Health Survey using Factor Analysis......................................................................................116
Table 42  Rotated Component Matrix of SF-36 Health Survey Items using Varimax Rotation technique.................................................................117
Table 43  KMO and Barlett's test for items of MMSE...........................................118
Table 44  Variance explained by different components extracted by factor analysis for MMSE..............................................................119

Table 45  Rotated Component Matrix of items of MMSE using Varimax Rotation procedure......................................................119

Table 46  Reliability analysis for MNA, FES-I, Downton Index, GDS, MMSE and SF-36 using Cronbach's alpha.................................120
### LIST OF APPENDICES

<table>
<thead>
<tr>
<th>APPENDIX</th>
<th>Description</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Letter of Invitation</td>
<td>195-196</td>
</tr>
<tr>
<td>B</td>
<td>Letter of Informed Consent</td>
<td>197-198</td>
</tr>
<tr>
<td>C</td>
<td>Background Profile and PAL Questionnaire</td>
<td>199-202</td>
</tr>
<tr>
<td>D</td>
<td>Mini Nutritional Assessment Questionnaire</td>
<td>203-206</td>
</tr>
<tr>
<td>E</td>
<td>Downton Index</td>
<td>207-208</td>
</tr>
<tr>
<td>F</td>
<td>Falls Efficacy Scale International</td>
<td>209-210</td>
</tr>
<tr>
<td>G</td>
<td>Geriatric Depression Scale</td>
<td>211-213</td>
</tr>
<tr>
<td>H</td>
<td>Mini Mental State Exam</td>
<td>214-217</td>
</tr>
<tr>
<td>I</td>
<td>RAND Version of SF-36 Health Survey</td>
<td>218-222</td>
</tr>
<tr>
<td>J</td>
<td>Ethics Approval Certificate provided by Research Ethics Board (REB)</td>
<td>223-225</td>
</tr>
</tbody>
</table>
### LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD</td>
<td>Alzheimer's disease</td>
</tr>
<tr>
<td>ADL</td>
<td>Activities of daily living</td>
</tr>
<tr>
<td>BMI</td>
<td>Body mass index</td>
</tr>
<tr>
<td>CC</td>
<td>Calf circumference</td>
</tr>
<tr>
<td>CDC</td>
<td>Center for Disease Control and Prevention</td>
</tr>
<tr>
<td>ESPEN</td>
<td>European Society for Clinical Nutrition and Metabolism</td>
</tr>
<tr>
<td>FCI</td>
<td>Functional Co-morbidity Index</td>
</tr>
<tr>
<td>FES-I</td>
<td>Falls Efficacy Scale- International</td>
</tr>
<tr>
<td>FFMI</td>
<td>Fat free mass index</td>
</tr>
<tr>
<td>GDS</td>
<td>Geriatric Depression Scale</td>
</tr>
<tr>
<td>GNRI</td>
<td>Geriatric Nutritional Risk Index</td>
</tr>
<tr>
<td>HGS</td>
<td>Hand grip strength</td>
</tr>
<tr>
<td>HIC</td>
<td>High income countries</td>
</tr>
<tr>
<td>HRQoL</td>
<td>Health related quality of life</td>
</tr>
<tr>
<td>IADL</td>
<td>Instrumental activities of daily living</td>
</tr>
<tr>
<td>INR</td>
<td>Indian Rupee</td>
</tr>
<tr>
<td>KMO</td>
<td>Kaiser Meyer Olkin statistic</td>
</tr>
<tr>
<td>LMIC</td>
<td>Low and middle income countries</td>
</tr>
<tr>
<td>LTC</td>
<td>Long term care</td>
</tr>
<tr>
<td>MAC</td>
<td>Mid arm circumference</td>
</tr>
<tr>
<td>MCS</td>
<td>Mental Component Summary</td>
</tr>
<tr>
<td>MDS</td>
<td>Minimum data set</td>
</tr>
<tr>
<td>MMSE</td>
<td>Mini Mental State Exam</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>MNA</td>
<td>Mini Nutritional Assessment</td>
</tr>
<tr>
<td>MST</td>
<td>Malnutrition Screening Tool</td>
</tr>
<tr>
<td>MUST</td>
<td>Malnutrition Universal Screening Tool</td>
</tr>
<tr>
<td>NRS</td>
<td>Nutritional Risk Screening</td>
</tr>
<tr>
<td>OAHs</td>
<td>Old Age homes</td>
</tr>
<tr>
<td>PAL</td>
<td>Physical Activity Level</td>
</tr>
<tr>
<td>PCS</td>
<td>Physical Component Summary</td>
</tr>
<tr>
<td>PD</td>
<td>Parkinson's disease</td>
</tr>
<tr>
<td>ProFANE</td>
<td>Prevention of Falls Network Europe</td>
</tr>
<tr>
<td>SNAQ</td>
<td>Short Nutritional Appetite Questionnaire</td>
</tr>
<tr>
<td>TUG</td>
<td>Timed-up-and-go test</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>UNPF</td>
<td>United Nations Population Fund</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
</tbody>
</table>
CHAPTER 1
Introduction

Population aging is taking place at a rapid pace all across the world. The term “population aging” refers to an increased proportion of older adults in a given population, and a smaller proportion of younger adults and children (United Nations, 2013).

According to the United Nations Report on World Population Prospects (2015), the total global population reached 7.3 billion by mid-2015, and the number of individuals aged 60 years and over is 901 million, comprising 12% of the total population. Of the global population of 7.3 billion people, 4.4 billion live in Asia (60%). It is projected that by the year 2030, the number of older adults will reach 1.4 billion and their number will continually grow as a result of population aging. Many Asian countries have seen rapid population aging. For example, India is undergoing a rapid and unprecedented population aging, characterized by demographic changes which have occurred as a result of declining fertility, and improved longevity, and have led to an increased proportion of individuals aged 60 years and over.

The fertility rate in India was reported to be 2.3 in 2013 and is projected to drop to 1.88 by 2050 which is considered to be below the replacement level. Life expectancy at age 60 has increased significantly and is projected to reach 81 years by 2050 (United Nations World Population Report, 2015). Interestingly, life expectancy at age 80 has also increased due to advances in the medical field and is expected to rise to 88.5 years by 2050 (United Nations, 2015). In spite of the growing number of older adults in Asia and countries such as India, most of the aging research continues to emerge from high income
countries such as the United States of America, Canada, several European countries, Japan, and Australia.

Along with population aging, alterations in demographic and family characteristics have major implications for older adults, who will have fewer individuals to care for their needs and well being (WHO Report on Global Health & Aging, 2011). With decreased social support from families, older adults will need to transfer to long-term care (LTC) facilities, to ensure that their care needs will be met adequately. LTC facilities are growing in number in low and middle income countries (LMICs) such as India due to the breakdown of the traditional joint family system and rise of nuclear family units. Care for older adults was never a major issue when joint families were functioning successfully in the Indian society (Kumar & Bhargava, 2014). Older adults who were once considered to be "head of the family" in a traditional Indian joint family are not given the same status anymore, and are often neglected by younger members of the family who do not have the time to provide them with the care support they need to lead healthy lives (Sebastian & Sekher, 2011).

According to the data published in the Directory of Old Age Homes by HelpAge India, there are 1260 registered care homes in India which provide housing, food, medical assistance and social support to older adults (HelpAge India, 2009). Care homes are commonly referred to as “old age homes” or “homes for the aged” in India and have been in existence since early eighteenth century (Nair, 1995). These institutions traditionally served destitute persons who had no family members to look after their care needs and no income. Most of these care homes were free for older adults and were operated by Christian organizations primarily in the southern part of India (Datta, 2017). Most of the
care homes are situated in the southern Indian states of Karnataka, Andhra Pradesh, Tamil Nadu, and Kerela (Rajan, Mishra, & Sarma, 1999). Some developments have taken place in the past three decades and have led to the rise of “pay and stay homes” which are similar to retirement homes in the United States.

These pay and stay homes have been growing in number due to increasing demands of lower and upper middle class families whose younger members are unable to provide care support to older adults (Brink, 1998; Datta, 2017). Due to economic prosperity, higher rates of migration, and growing job mobility within and outside India, multigenerational co-residence is being replaced by nuclear households and resulting in a consequential decline in provision of informal care support to older adults (Brink, 1998; Datta, 2017). In LTC facilities, individualized and coordinated services are provided to the residents, with the aim of maximizing the quality of life by following a holistic approach (Singh, 2010). Studies from the high income countries (HIC) show that older adults especially those residing in LTC facilities have complex clinical profile with high rates of falls and malnutrition (Daniels, 2002).

Nutritional risk is high in older adults living in LTC facilities (Thompson et al., 2006), as they most commonly experience age-related problems such as decreased appetite, and a decline in taste and smell acuity. Aging also contributes to a progressive deterioration in physiological functioning, changes in gastrointestinal motility, appetite changes, and modification in secretion of hormones that regulate appetite (Ortolani, Landi, Martone, Onder, & Bernabei, 2013). In addition, greater intake of medications, which is quite common in older adults, is strongly associated with a decline in nutritional status (Jyrkka et al., 2011). While there has been sufficient research related to nutrition
risk from the context of HICs, there is limited research related to low and middle income countries (LMICs) including India. In addition to being at a heightened nutritional risk, older adults are also at an increased risk of encountering falls.

Falls are one of the leading problems affecting older adults and it is reported that 50% of individuals especially over the age of 80 fall at least once annually (Galantino et al., 2012). Falls and fall-related injuries are a major clinical issue in geriatric populations, since they are responsible for hospitalization, chronic pain, reduction in quality of life, increased risk of fractures, particularly hip fractures, and increased risk of death in cases where fall-related injuries are serious, and cannot be treated adequately (Statistics Canada, 2014). Falls are the primary cause of both fatal and non-fatal injuries in older adults (Centers for Disease Control and Prevention, 2013). They are reported to be the most common contributory factors towards traumatic brain injuries (Sterling, O’Connor, & Bonadies, 2001).

It has been estimated that one third of older adults experience at least one fall in a year (Stevens, 2005). To reduce risk of subsequent falls, many individuals restrict their level of physical activity as they have an intense fear of falling (Allison et al., 2013). Leading sedentary lives may result in a greater risk of experiencing falls (Denkinger, Lukas, Nikolaus, & Hauer, 2015). Injuries caused by fall incidents, such as, hip fractures and head injury, contribute towards significant costs related to fall-related hospitalizations and treatment (CDC, 2014). Falls are detrimental to the quality of life of older adults as they increase risk of disability, and lead to loss of independence. Head injuries, including intracranial injuries, skull fracture, and hematoma are associated with considerable care costs including admission to emergency departments of hospitals,
surgery, multiple visits paid to the general physicians, need for physiotherapists, nurses and caregivers (CDC, 2014). Therefore, fall-prevention becomes inevitable, and programs that are designed to lower fall risk and reduce fear of falling in older adults need to be implemented (Hoang, Jullamate, Piphavatchanitcha, & Rosenberg, 2016).

It is noteworthy that falls and injuries related to them are preventable. Several fall prevention strategies are available including multi-factorial interventions, exercise-based programs, and environmental modification (Cameron et al., 2010; Gillespie et al., 2012). However, the implementation and adherence rates of these fall-prevention strategies are quite low (Simek, McPhate, & Haines, 2012; Yardley et al., 2008).

Studies show that nutritional risk and fall risk co-exist in older adults given the commonality of the contributing factors. Neyens et al. (2013) carried out a study to examine the association between falls and a lower nutritional status in older adults living in LTC facilities in the Netherlands. They found that undernourished older adults encountered a greater number of falls as compared to individuals with an optimum nutritional status. It was also noted that with nutritional intervention the percentage of fallers in the malnourished group was much lower than the group of older adults who did not receive any nutritional intervention. The researchers of this study established that there is a solid relationship between malnutrition and falls in older adults. A recent study conducted by Chien and Guo (2014) found that malnutrition in older adults is an independent predictor for falls based on a study carried out in Taiwan. The strong relationship between malnutrition and falls in frail older adults is supported by previous studies (Gill, Taylor, & Pengelly, 2005; Johnson, 2003). To date, no study has examined the association between nutritional and fall risk among Indian older adults residing in
LTC facilities of New Delhi, along with the determination of fall risk from predictors such as depression, cognitive status, functional status (including the measurement of handgrip strength and timed-up-and-go (TUG) test performance), and no study has carried out factor analysis and reliability analysis of nutritional and fall risk measures such as MNA, Downton Index, and FES-I.

The World Health Organization has predicted that health care systems will face numerous challenges with aging of populations across the world (WHO, 2008). The presence of multiple co-morbidities is very common in LMICs with lower health care resources, and it is essential that health policies and programs address the health needs of older adults in LMICs such as India (Joshi, Kumar, & Awasthi, 2003). Nutrition plays a critical role in the determination of health status of older adults, and therefore it is imperative to do greater research on understanding the nutritional status of older adults in India (Vedantam, Subramaniam, Rao, & John, 2010). Besides nutritional status, understanding and addressing fall risk is also important in low and middle income countries (LMICs), as falls are one of the primary causes of fatal and non-fatal injuries in older adults. The prevalence of falls in Indian older adults has been reported to be between 14% and 53% (D'Souza et al., 2014). Falls are an emerging public health problem in India and are considered to be a major barrier to active aging (D'Souza et al., 2014). There is an urgent need for collaboration of health care professionals, researchers, health care delivery systems, and policy makers to develop programs and policies to prevent falls and fall-related injuries in Indian older adults and provide a boost to active aging in India (D'souza et al., 2014).
CHAPTER 2
LITERATURE REVIEW

The proportion of older adults in India (aged 60 years and over) is expected to increase from 8% in 2010 to 19% by 2050 i.e. 323 million people (Population Reference Bureau, 2012). As discussed in the Introduction, population aging started occurring over several decades ago in the high income countries (HICs) around the world, and has occurred over a much shorter timeframe in many low and middle income countries (LMICs) including India (United Nations, 2009). Currently, two thirds of the world’s older adults reside in LMICs (United Nations, 2013). Of the projected growth in the geriatric population, there will be 417 million older adults in HICs of the world and the LMICs will be home to 1.6 billion older adults in 2050 (United Nations, 2013). This rapid growth has been attributed to the reduction in the rates of infectious diseases, better sanitation practices, improved food handling procedures, and advancements in the medical domain. This profound increase in the proportion of older adults, along with several changes in the traditional joint family systems, and limited old-age income support, has many social, economic, and health care policy challenges associated with it (Population Reference Bureau, 2012). Therefore, the implications of population aging are magnified in the context of LMICs, since these countries will have less time to respond to the increasing care needs of the geriatric populations due to limited resources available (UNFPA, 2012).
2.1 Long-term care

With rapid changes taking place in the demographic structure of populations, institutionalization of older adults in long-term care (LTC) facilities (also called nursing homes) is becoming common. There are 1,260 LTC facilities in India, as compared to only 90 facilities in 1950 (HelpAge India, 2009). LTC represents a spectrum of health, personal, and supportive services that cater to the requirements of individuals who are unable to look after themselves adequately, due to the presence of chronic disease, physical, or cognitive disabilities, and other health-related conditions (US Department of Health and Human Services, 2013). Specifically, LTC involves the provision of assistance with activities of daily living (ADLs), such as, bathing, dressing, using the toilet, transferring, and eating; and instrumental activities of daily living (IADLs), such as, grocery shopping, managing money and medications, preparing meals, using the telephone, and caring for pets. LTC facilities also provide extensive nursing care services and supervision over a 24-hour period (US Department of Health and Human Services, 2013). While older adults are the primary recipients of LTC, children and young adults requiring chronic care are also potential recipients of these care services (Evashwick, 2005). The goal of LTC is to improve the ability of the older individuals to function independently, and provide optimum care support to enable them to lead a higher quality of life (Evashwick, 2005).

In LMICs, such as India, the provision of LTC is a relatively new and emerging trend. This is primarily attributed to population aging, but also to the disintegration of
traditional family structure, increasing employment among women who are the traditional caregivers, and other societal factors (Mahajan and Ray, 2013). LTC residents are confronted with numerous challenges including presence of multiple chronic health problems, disability, dementia, depression, and malnutrition. Malnutrition is a very common challenge faced by older adults living in LTC all over the world. Although malnutrition present in older adults living in care homes in HICs has been well studied and recognized as a major research priority, is not given due importance in LMICs (Bell, 2015). It is important to identify potential risk factors, and work towards interventional strategies to reduce malnutrition, and enhance nutritional health of the LTC residents.

2.2 Prevalence of malnutrition in older adults

Malnutrition has been defined as “a sub-acute or chronic nutritional state in which the extent of over-nutrition or under-nutrition varies considerably, and leads to an alteration in body composition and decreased function, with the simultaneous presence of inflammatory processes” (Soeters et al., 2008, p. 708). Broadly, it is used to characterize any imbalance in the nutritional state of a person either due to deficiency, or excess of nutrients. Although there is no gold standard procedure for diagnosing malnutrition in older adults, it is generally accepted by most researchers that this condition is characterized by involuntary weight loss with a reduction of dietary intake resulting in loss of muscle and subcutaneous fat or a low BMI <18.5 kg/m² (National Center for Classification in Health, 2010). Malnutrition is frequently observed in the frailest population groups, particularly older adults having a low income and individuals who are institutionalized i.e. living in LTC facilities (Donini et al., 2013). There are numerous
challenges faced by clinicians, nurses, and dietitians in recognizing individuals at nutritional risk due to a lack of uniformity in defining malnutrition.

The European Society for Clinical Nutrition and Metabolism (ESPEN) has recently proposed a consensus definition of malnutrition with the objective of reaching conformity between different countries as well as previously carried out studies. This definition considers an individual to be malnourished if she/he has lost weight combined with a low BMI i.e. <18.5 kg/m² for individuals <65 years, <20 kg/m² for individuals aged 65-70 years, and <22 kg/m² for individuals aged >70 years, or low fat-free mass index (FFMI) i.e. <17 kg/m² for men and <15 kg/m² for women (Rondel, Langius, Schueren, & Kruizenga, 2016). Some definitions of malnutrition contain information on appetite, fatigue, or quality of life (Kruizenga et al., 2005; Lim et al., 2012). As mentioned earlier, most definitions of malnutrition are based on a low BMI or unintentional weight loss i.e. >5% in the past 3 months or >10% in the past year (Dutch Malnutrition Steering Group (DMG) and Dietitians of Malnutrition Netherlands, 2011; Kruizenga et al., 2005; Todorovic & Micklewright, 2011).

The prevalence rates of malnutrition among older adults vary widely depending on the setting, i.e., whether older adults live in the community independently, or live in a LTC facility. They also vary depending on the definitions of malnutrition used, how it is measured, and the population. Donini et al. (2013) used the Mini Nutritional Assessment (MNA) in nursing home residents and community dwelling older adults and found that malnutrition was present in both men (16.3%) and women (26%). The prevalence of nutritional risk was reported to be 35.6% in men and 39% in women. Malnutrition prevalence was significantly higher in nursing home residents with 31% men and 42.5%
women being malnourished. Women living in LTC were found to be at a greater nutritional risk level (43.4%) than men (34.6%) (Donini et al., 2013). In the community setting, the prevalence of malnutrition is estimated to range between 4 and 44% (Cuervo et al., 2009; Kaiser et al., 2010). Among those living in LTC facilities, some international studies have reported that 30 to 50% of older adults are malnourished (Kaiser et al., 2010; Pauly et al., 2007; Soini et al., 2006; Stratton et al., 2003). Some studies have found that the prevalence of malnutrition in LTC facilities of Canada and United States ranges between 40 and 80% (Furman, 2006; Keller, 2000; Shatenstein, Kergoat, & Nadon, 2001).

Bell, Tamura, Masaki, and Amella (2013) have reported that malnutrition prevalence in older adults living in long-term care (LTC) ranges from 4 to 71%, and nutritional risk ranges from 29 to 97%. The wide variation in prevalence rate of malnutrition and nutrition risk can be attributed to selection criteria used to define malnutrition, and research methodology used which varies considerably, depending on the setting. In most research carried out in LTC, the prevalence of malnutrition in older adults has been reported to be between 20 and 39%, and nutritional risk typically ranges from 47 to 62% (Bell, Tamura, Masaki, & Amella, 2013).

It has been reported that the prevalence of malnutrition in Indian older adults is often under-represented and under-estimated. A study carried out in the city of Ambala in the northern state of Haryana assessed the nutritional status of 300 community-dwelling rural people aged >60 years by using the Mini-Nutritional Assessment Questionnaire (MNA) and found that 26% individuals were undernourished and 64% were at a high nutritional risk (Bishnoi, Kumar, Mittal, Goel, Nazir, Preet, Jain, 2016). Another study was conducted on older adults living in the community setting of Dehradun in the state of...
Himachal Pradesh and found that greater than 50% of older adults are underweight and malnourished (Semwal, Vyas, Juyal, & Sati, 2014). Kalaiselvi et al (2016) assessed the prevalence of under-nutrition in the rural town of Puducherry and revealed that 25% of older adults were undernourished. Some studies have found that under-nutrition in Indian older adults ranges from 14% to 52% (Jamir et al., 2015; Lahiri, Biswas, Santra, & Lahiri, 2015; Vedantam, Subramanium, Rao, & John, 2010).

Malnutrition affects a considerable percentage of older adults living in Indian LTC facilities (Jamir et al., 2015; Pai, 2011; Saha, Basu, Ghosh, Saha, & Banerjee, 2014). Individuals living in LTC facilities are undernourished due to a decline in food intake and also have a lower BMI as compared to those living in the community. Several studies carried out across the globe have discussed the nutritional challenges faced by LTC residents (Bell, Tamura, Masaki, & Amella, 2013; Kaiser et al., 2010; Kayser-Jones, 2002; Pauly, Stehle, & Volkert, 2007; Serrano-Urrea, & Garcia-Meseguer, 2013). For many people residing in LTC, aging brings about a continuous and progressive decline in physiological functioning that increases the susceptibility to nutritional risk and leads to feeding dependency which compromises autonomy (Porter Starr, McDonald, & Bales, 2015).

2.3 Consequences of Malnutrition in Older Adults

Malnutrition is regarded as a true geriatric syndrome which has a multi-factorial origin, and leads to frailty and disability in older adults (Volkert, 2013). It is related to adverse health outcomes in these individuals (Baldwin & Parson, 2004; Locher et al.,
Specifically, malnutrition is correlated with a greater mortality rate and decline in functional capacity (Chan et al., 2010; Ferdous et al., 2009; Ferreira et al., 2011).

Studies have shown that malnutrition contributes to cellular, physical, and psychological degeneration by interfering with cellular defense mechanisms. Kubrak and Jensen (2007) studied malnutrition in acute care patients and observed that it leads to serious wound infections and pneumonia which lengthen hospital stay and increase health care costs. Fatigue and lethargy are frequently observed in affected individuals, leading to delayed recovery from illness, and worsening of anorexia in which an individual experiences lack of appetite (Kubrak & Jensen, 2007). Reduction in taste sensitivity and olfaction occurs frequently with advancing age and lowers the enjoyment experienced by older adults during mealtimes. Appetite is severely altered in individuals taking multiple medications (Morley, 2012). Anorexia which has been shown to predict mortality independent of other factors (Rolland et al., 2006), leads to a 30% decline in dietary intake in older men and 20% decline in dietary intake in older women (Morley, 2010). This decrease in food intake as a result of loss of appetite has been termed as the "physiological anorexia of aging" (Morley, 2012).

Malnutrition also leads to the formation of pressure ulcers in older adults who are institutionalized. Studies show that the vulnerability of a malnourished individual to develop pressure ulcers increases considerably (Neloska et al., 2016), and causes adverse thermoregulatory effects. A pressure ulcer is a skin and/or tissue injury which typically takes place over a bony prominence and leads to the progressive destruction of underlying tissues (European Pressure Ulcer Advisory Panel, 2009). The prevalence of pressure ulcers in LTC residents ranges between 11 and 29% (Donini et al., 2005;
Lahmann, Halfens, & Dassen, 2006). It has been reported in literature that there is a direct relationship between the severity of malnutrition and occurrence of pressure sores in LTC residents (Park, 2014). Older adults having pressure ulcers go through a continuous cycle of losing protein in the form of excess exudate and experience delayed wound healing (Neloska et al., 2016).

Naber et al. (1997) found that renal functioning is impaired and there is a lowered absorption of nutrients from the intestine in malnourished individuals. It has also been reported that malnutrition contributes towards sarcopenia (loss of muscle mass), retrogression of visceral organs, and an impairment of the respiratory and cardiac muscle functioning (Holmes, 2007; Kubrack & Jensen, 2007). Malnutrition has a considerable impact on the functional status, mood, and quality of life of older adults (Rasheed & Woods, 2013). It has been shown in many studies that the consequences of malnutrition vary widely. Also, the onset of malnutrition and manifestation of the consequences occur over an extended period of time influenced by a number of factors such as pre-existing co-morbidities, physical and psychological state, age, and so on. Given the debilitating consequences of malnutrition, it is important to identify and address the risk factors that contribute to its development.

2.4 Factors contributing to malnutrition in LTC

Several research studies have been conducted in developed countries of the western part of the world which have examined the contributory factors to malnutrition in older adults. A recent systematic review carried out by Favaro-Moreira et al. (2016) evaluated the risk factors that make older adults more vulnerable to malnutrition. They
included six longitudinal studies in their analysis and identified age, frailty especially in institutionalized individuals, excessive intake of medications, reduction of physical function, Parkinson's disease, constipation, poor or moderate self-reported health status, cognitive deficits, dementia, mealtime dependency, poor appetite, swallowing difficulties (dysphagia), loss of interest in life and institutionalization as important factors that lead to malnutrition in older adults. A few studies in India have also examined risk factors associated with malnutrition in older adults. Kalaiselvi et al. (2016) carried out a study to assess the determinants of malnutrition in Indian older adults and found that the factors making older adults more vulnerable to under-nutrition were reported to be age, a lower socio-economic status, and male gender.

As indicated earlier, there are many factors that make older adults more susceptible to malnutrition. Hickson (2006) has identified three major categories that lead to an increased risk of malnutrition- medical, psychological, and social. According to Hickson (2006), the most important medical factors that contribute to malnutrition are oral health problems, loss of appetite, changes in taste and smell acuity, gastrointestinal disorders, and neurological health conditions. Anxiety, depression, and bereavement are the psychological factors that may increase an individual’s nutrition risk. In addition, there are certain social factors such as lack of knowledge, loneliness, socio-economic status, and poverty that lead to malnutrition.

2.4.1 Medical Risk Factors

2.4.1.1 Poor Appetite
A decline in appetite in older adults is one of the cardinal causes of malnutrition. Food intake decreases with the increasing age of an individual (Amarya, Singh, & Sabharwal, 2016). Various changes take place in the digestive system with increasing age, including a decrease in gastric acid secretion, lower saliva production, consequently leading to slow peristalsis and frequent constipation. This contributes towards appetite loss and alteration of eating patterns which lead to nutritional deficits in older adults (Amarya, Singh, & Sabharwal, 2016).

Roberts et al. (1994) have also reported that aging leads to impairment in the mechanisms governing food intake. They carried out a study which found that younger men are able to regain the weight lost in the ad libitum period, as compared to older men who failed to gain weight during the same period. Other studies have shown that cholecystokinin (CCK) levels increase with age and lead to sluggish gastric emptying and early satiety (Clarkston et al., 1997). In addition, cytokines are involved in the regulation of food intake in the older individuals and may adversely affect appetite in older adults (Morley, 2001).

2.4.1.2 Oral health problems, Poor dentition and Dysphagia

The World Health Organization defines “oral health” as the absence of pain in the mouth and facial tissues, the lack of birth defects such as cleft lip and palate, sores, and periodontal disease, and no evidence of oral and throat cancer, tooth decay, or disorder affecting the oral cavity (Petersen, 2003). Unfortunately, older adults in the LTC setting are at a heightened risk of having oral health problems (Dion, Cotart, & Rabilloud, 2007; Savikko et al., 2013; Soini et al., 2011). Rauen et al. (2006) have shown that there is a significant association between poor oral health and compromised nutritional status in
older adults residing in institutions. Food intake and choices are restricted due to oral health problems in older adults residing in LTC facilities. Specifically, tooth decay or loss, periodontal disease, incompatible dentures, and a reduction in chewing capacity are associated with an insufficient intake of energy, protein, carbohydrates, fat, fiber, calcium, and antioxidants. Additionally, the enjoyment that accompanies mealtimes is decreased (Sahyoun, 2004). Improvement in oral health can take place by using preventive dentistry, replacement of lost or broken teeth, artificial saliva preparations, well-fitted dentures, and texture modifications of food (Sahyoun, 2004).

Oral health issues also extend to swallowing difficulty often described as dysphagia. This condition refers to the discomfort experienced by an individual while bolus passes from the mouth to the stomach, and may be caused by oropharyngeal or esophageal dysfunction (Clave, Verdaguer, & Arreola, 2005; Clave, Terre, de Kraa, & Serra, 2004). Dysphagia is common among older adults and is often caused by dementia, weakness, stroke, low salivary secretions, inflammatory disorders, infection, Parkinson’s disease, and obstruction. Most cases of dysphagia are chiefly related to the oropharyngeal and/or the esophageal phases of swallowing.

The first subgroup involves oropharyngeal issues, including chewing problems, poor neuromuscular coordination needed for normal food passage into the esophagus, and could be preceded by difficulty in initiating the swallowing process. This may result in choking, coughing, food getting stuck in the mouth, persistent pneumonia, alterations in speech or voice, and regurgitation of food or fluids. Studies have reported the prevalence of oropharyngeal dysphagia to be over 51% in the older individuals who live in LTC facilities (Lin et al., 2002; Turley & Cohen, 2009).
The second subgroup involves esophageal issues where the patients may suffer from problems related to passage of food from the back of the throat to the esophagus. There could be a feeling of food being stuck in the throat or chest, pain in the chest region due to difficulty in swallowing, or regurgitation of food after swallowing. Involuntary loss of weight, changes in dietary patterns, or loss of appetite could be due to any of the two above mentioned phases of dysphagia, or due to other problems (Kayser-Jones & Pengilly, 1999; Palmer, Drennan, & Baba, 2000). Individuals having oropharyngeal dysphagia are particularly at high risk of developing lower respiratory tract infections (Serra-Prat et al., 2012). Oropharyngeal dysphagia is associated with tracheobronchial aspiration (inhalation of gastric contents into the respiratory tract) which leads to pneumonia in about 50% of cases and also leads to increased mortality in affected individuals (Clave et al., 2005). Therefore, dysphagia needs to be managed effectively in these individuals to prevent the onset of respiratory problems and also to prevent the onset of malnutrition.

2.4.1.3 Loss of taste and smell acuity

Loss of taste in older adults is commonly observed and results primarily from a physiological decline in the number of taste buds and papillae. Loss of taste is also governed by dryness of mouth and throat, diseases commonly associated with the process of aging, prescription drugs, environmental factors, and surgical treatments (Donini et al., 2003; Lang et al., 2006). Impairment of taste and smell in older adults is associated with a reduced appetite, and thus a lower intake of food (Pilgrim, Robinson, Sayer, & Roberts, 2015).
Taste is mainly attributed to non-volatile substances present in food including sugars, salts, acid, and limonin which primarily determine basic flavours—sweet, salty, acidic, and bitter (Douglas, 2011). Individuals who have a diminished perception of these flavours are unable to experience the enjoyment associated with meal consumption and consequently have a reduced dietary intake (Boyce & Shone, 2006). Taste comprises a prominent part of the cephalic phase response needed for the process of digestion. It helps in the determination of food choices and meal consumption by raising satiety and increasing pleasure during mealtimes (Schiffman, 1997). Loss of taste and smell sensitivity is not uncommon in older adults and may be worsened due to the presence of disease, or drug intake (Schiffman, 1997). Evidence indicates that persons having one or more health problems, and consuming a minimum of three medications need approximately 11 times more salt and three times sugar to recognize the presence of these substances in food as compared to young adults (Schiffman & Gatlin, 1993). Studies carried out in community dwelling older women in the age group 65 to 93 years suggest that decreased flavour perception leads to a loss of interest in activities related to meal preparation, and result in a higher consumption of sweets and fats (Duffy et al., 1995).

Some studies have demonstrated that making food flavourful can increase palatability, and promote food intake in not only hospitalized older adults and LTC residents, but also in healthy older adults (Mathey, Siebelink, de Graaf, Van Staveren, 2001; Schiffman & Graham, 2000). A decline in gustatory function has to be managed effectively in older adults by using flavour enhancers in food to encourage eating in persons who are experiencing multiple co-morbidities, and consume many medications daily which adversely affect their sense of taste and reduce dietary intake (Toffanello et
A recent study carried out by Neumann, Schauren, and Adami (2016) examined the taste sensitivity of older adults living in LTC institutions and found that institutionalized older adults have a lower perception of sweet and sour flavour than younger adults. They suggested that medications, smoking, alcohol consumption, and gender were not significantly associated with taste perception and sensitivity.

2.4.1.4 Gastrointestinal problems

Decreased peristaltic contractions (Huang et al., 1995), delayed liquid emptying (Kao et al., 1994) and reductions in solid emptying (Brogna et al., 1999) are the changes normally associated with the aging process. In addition, a slower transit of fecal contents through the colon is commonly observed in older adults over the age of 80. This delay in passage is due to a decline in the number of neurons in the myenteric plexus (major nerve supply to GI tract which contributes to GI tract motility) (Madsen & Graff, 2004). Some studies have found a greater prevalence of atrophic gastritis in older adults that ranges from 50 to 70% (Pilotto & Salles, 2002). Atrophic gastritis associated with the infection of Helicobacter Pylori, lowers the production of ghrelin, and increases leptin activity. Both these conditions increase the risk of developing anorexia and undernutrition in older adults (Azuma et al., 2001; Nwokolo et al., 2003). Frequently occurring problems in older adults include gastroesophageal reflux disease (GERD), dyspepsia, irritable bowel syndrome (IBS), and chronic primary constipation (Grassi et al., 2011).

2.4.1.5 Neurological disorders

Neurological disorders refer to the disorders involving malfunctioning of the nervous system. They involve a range of physical and psychological impairments which require a multifaceted management (Murray & Lopez, 2002). Neurological disorders are
frequently observed in individuals aged 55 years and over and their prevalence ranges from 5 to 55% in these individuals (Hofman et al., 2013). The most commonly observed neurological conditions are dementia, Parkinson’s disease, poly-neuropathy, stroke and essential tremor (Callixte et al., 2015). Dementia and Parkinson’s disease will be discussed in the following section.

2.4.1.6 Dementia and Parkinson's disease

Dementia is not a normal part of the aging process and reflects multiple impairments in cognitive functioning. It is an irreversible and progressive syndrome that involves cognitive deterioration and can considerably lead to a decreased social and occupational functioning (Health Quality Ontario, 2008). Alzheimer’s disease (AD) is the most common cause of dementia and its prevalence ranges from 60% to 80% in older adults (Alzheimer’s Association, 2015). Initially, there is a decline in episodic memory. In advanced stages, there are marked changes in other aspects of memory and cognition (Beydoun et al., 2014). Neuropathological studies have demonstrated that dementia in older adults is representative of more than one pathological state (Kovacs et al., 2008). Hypertension and hyperlipidemia are also associated with an increased risk of acquiring dementia (Lautenschlager, Almeida, & Flicker, 2003). Research studies have found essential links between nutritional status and cognitive functioning (Morris, 2012; Solfrizzi et al., 2011).

Dietary factors including vitamins, antioxidants such as polyphenols, and fish have been found to have a protective role against AD, whereas high intake of calories, saturated fatty acids, and excessive alcohol intake have been shown to promote AD in older adults (Ramassamy & Belkacemi, 2011). Individuals with a compromised cognitive
function are more vulnerable to malnutrition. In addition, depression and poly-pharmacy are important contributing factors in the development of dementia (LoGiudice & Watson, 2014). Since residents of LTC facilities frequently consume multiple medications on a daily basis, and often experience episodes of depression, they are at an escalated risk of developing dementia which can reduce their food intake and place them at a higher risk of malnutrition.

Alzheimer’s disease (AD) is characterized by decline in memory and cognitive skills, and gradually leads to the inability to perform simple tasks of daily living. It is a progressive and irreversible brain disorder, in which symptoms usually start appearing after the age of 65, and is the most common cause of dementia in older adults (National Institute of Aging, 2015). Increased pro-inflammatory cytokine levels are linked with a higher susceptibility to develop Alzheimer’s disease in old age (Kang et al., 2014).

In Parkinson’s disease (PD), there is slow movement, tremor, and postural instability. People with PD have stiff and aching limbs, along with the presence of gait impairment (Nutt & Wooten, 2005) which prevent them from engaging in grocery shopping, meal preparation, or independent feeding (Lorefalt et al., 2006; Miller &Daniels, 2000). Additionally, individuals with PD have dysphagia, constipation, and poor appetite leading to early satiety (Verbaan et al., 2007). Therefore, individuals having these problems are at an elevated risk of malnutrition.

2.4.1.7 Cancer

Cancer is commonly associated with under-nutrition, especially, in advanced stages. Individuals having cancer often undergo cachexia which is characterized by a
gradual weight loss, abnormal metabolic activity, and compromised immunity (Esper & Harb, 2005; Van Cutsem & Arends, 2005). Cancer treatment involving chemotherapy leads to modifications in dietary intake, nausea, swallowing difficulties, and depression. Cancer has the potential to induce anorexia (decreased appetite), asthenia (lack of strength and energy), and severe reduction in body mass index of affected individuals (Fearon, Voss, & Hustead, 2006; van Halteren, Bongaerts, & Wagener, 2003).

Diagnosis of cancer is directly associated with anorexia (lack of appetite) and the severity of anorexia depends on the location of the tumour, mood alterations, and toxicity related to treatment being provided to patients. It is noteworthy that cancer is the second most important risk factor for weight loss in older adults and cancer contributes manifold in the severity of anorexia. Anorexia is a leading cause of weight loss in older adults with and without cancer (Broughman et al., 2015; Nishino et al., 2015). Besides the medical risk factors, there are some social risk factors that contribute towards nutritional risk in older adults. These factors have been discussed in the following section.

2.4.2. Social Risk Factors

2.4.2.1 Inadequate nutrition knowledge and poverty

Individuals who have a low education level are often unaware of the nutritional benefits of different foods and lack knowledge of health maintenance and well being. Lower education status has been shown to strongly affect the nutritional risk profile of community dwelling older adults aged 65 and over (Chor, Leung, Griffiths, & Leung, 2013). It has been reported in the literature that social factors, including poverty and low level of education, play a role in influencing the nutritional status of older individuals. Poverty is a strong determinant of health status of an individual (Benzeval & Ken, 2001)
and malnutrition is frequently observed in individuals having a low income (Chen, Schilling, & Lyder, 2001). A dearth of economic resources restricts the availability of food (Donini, Savina, & Cannella, 2003). The socio-economic status of an individual determines the food choices that he or she would make and also has an impact on food availability (Joseph & Carriquiry, 2010; Torheim, Ferguson, Penrose, & Arimond, 2010).

2.4.2.2 Loneliness and social isolation

Loneliness and social isolation are commonly observed in geriatric populations and their impact on nutritional status of older adults is complex but well established. Loss of a spouse through divorce or death may lead to grief, loneliness, lack of social support, and lower social participation, which may have an impact on the nutritional status of older adults (Quandt et al., 2000). A Finnish study was carried out to determine the relationship between loneliness and malnutrition in older adults aged 75 years and over in the city of Kuopio. The researchers assessed nutritional risk using the Mini Nutritional Assessment (MNA) questionnaire, cognitive status using Mini Mental State Exam (MMSE) and subjective loneliness was assessed by asking the participants how often they felt lonely (3-step scale: 1= “often”, 2= “sometimes”, 3= “never”). Findings of this study revealed that there was a strong association between nutritional risk and feelings of subjective loneliness. Individuals who were found to be at a higher nutritional risk were more prone to loneliness and were mostly women, had a lower body mass index (BMI), lower MMSE scores and higher co-morbidity scores assessed using the Functional Co-morbidity Index (FCI) (Eskelinen, Hartikainen, & Nykanen, 2016).

In another study involving 1200 older adults (>65 years) in rural areas of Lebanon, social isolation and loneliness were found to be independently associated with
undernutrition. Data was collected using face-to-face interviews along with administration of Mini Nutritional Assessment (MNA), the Lubben Social Network Scale, and Jong-Gierveld Loneliness Scale. The Lubben Social Network Scale 6 (LSNS 6) includes three questions regarding the family networking of older adults.

The LSNS 6 determines the closeness of older adults with their relatives and evaluates whether they have some close relatives whom they can approach for help or for discussing private matters. The Jong-Gierveld Loneliness Scale is a 5 item scale that includes questions on feeling empty, missing having people around, feeling a lack of friends, feeling abandoned, and feeling the absence or lack of a really good friend. Social isolation was found to be more frequent in the older individuals having physical and mental status impairment. Individuals who were divorced, from a lower socio-economic status, and had a lower level of education were at the highest risk of being socially isolated (Boulos, Salameh, & Barberger-Gateau, 2016).

Studies have shown that the dietary intake of older adults who experience loneliness and social isolation is severely reduced. For example, in a longitudinal study carried out in the United States involving 1000 older individuals, social isolation and a lower income were found to be important factors contributing towards a higher nutritional risk (Locher et al., 2005). The nutritional status of older adults affected by loneliness leads to poor food availability (Joseph & Carriquiry, 2010). This could be due to geographical isolation and distant location of grocery stores. Absence of help with grocery shopping and food preparation may lead to a compromised nutritional status. Inadequate social support networks and social isolation have been found to adversely affect the nutritional health of older adults (Locher et al., 2005; Pirlich et al., 2005).
2.4.3 Psychological Risk Factors

2.4.3.1 Depression

Depression is a very common problem faced by individuals staying in LTC facilities (Diegelmann et al., 2017) and it is considered to be a major psychiatric disorder in this population group (Nazemi et al., 2013). Studies have shown that prevalence rates of depression could reach as high as 45% in institutionalized older adults (Jongenelis et al., 2004; Webber et al., 2005). Untreated depression is a very serious public health problem (Health Council of Canada, 2012; Cole & Dendukuri, 2003) and has been associated with decreased health-related quality of life, higher morbidity and loss of independence, decline in functional capacity, nursing home admissions (Harris & Cooper, 2006), increased use of healthcare services (Gallegos-Carrillo et al., 2009), and elevated risk of premature death from suicide and other medical health conditions (Schoevers et al., 2009). There is a strong link between depression and malnutrition in older adults (Evers & Marin, 2002; Feldblum et al., 2007; Kvamme et al., 2011; Visvanathan, 2003). Vafaei et al. (2013) examined the relationship between malnutrition and depression in rural older adults (≥60 years) and found that malnourished individuals were 15.5 times more prone to suffer from severe depression. They concluded that both under-nutrition and depression have deleterious effects on the health and well-being of older adults.
Many studies have reported depression to be an important contributory factor to weight loss observed in older adults (Morley & Kraenzle, 1994; Blaum, Fries, & Fiatarone, 1995). Bales, Fischer, and Orenduff (2004) showed that 36% of residents in nursing homes having involuntary weight loss suffered from depression. A study has shown that low levels of vitamin B$_{12}$ and disturbance in the ratio of omega 6 fatty acids to omega 3 fatty acids is associated with late-life depression, even after controlling for other risk factors (Tiemeier, 2003).

The presence of depression predisposes older adults to develop anorexia and this could further increase their nutritional problems (Morley & Silver, 1995). A close interrelationship exists between depression and malnutrition even after adjusting for the level of education, smoking, and socioeconomic status (Morley & Kraenzle, 1994; Cabrera, Mesas, Garcia, & de Andrade, 2007). Some evidence indicates that although depression remains an under-recognized and under-treated problem in older adults, its prevalence is high both in HIC and LMICs. Goyal and Kajal (2014) have reported that the prevalence of depression in older adults living in India is high. They recruited 100 individuals aged 60 years and above from different socio-economic backgrounds. It was found that 17% of the participants were suffering from severe depression and 60% were suffering from moderate depression.

2.4.3.2 Bereavement

Losing a loved one is very stressful and has a serious impact on an individual's life (Tseng, Petrie, & Leon-Gonzalez, 2017). Many studies have been carried out to assess the effect of bereavement on health status of older adults. Most studies have focused their attention on the relationship of bereavement with a lower health care
utilization, depression, and mortality (van den Berg et al., 2011; Guldin et al., 2012; Simeonova, 2013; Koslow, Ruiz, & Nemeroff, 2014). Bereavement also has a considerable impact on an individual’s nutritional behaviour (Stahl & Schulz, 2014). Stahl and Schulz (2014) have reported alterations in dietary intake of individuals who are bereaved as compared to those who are not, and have found that meal skipping is very common in bereaved individuals. In addition, they observed that bereaved persons consume fewer servings of fruits and vegetables and have higher fat intake.

During the period of acute grief, men are considered to be at a greater risk of encountering health problems as compared to females (Stroebe et al., 2001) and widowers have a greater likelihood of being at high nutritional risk due to problems with cooking which lead to an insufficient calorie intake (Koehn, 2001; van den Berg et al., 2011). Women who lose their spouse may suffer from poverty due to financial dependency on their partner and may be at a greater risk of morbidity and mortality (McGarry and Schoeni, 2005). This also puts them at an elevated level of nutritional risk. Depression resulting from loss of spouse leads to sleep disorders, lower immune function, and increased susceptibility to multiple co-morbidities (Buckley et al., 2010; Hirschfeld, 2011).

Johnson (2002) studied nutritional risk level among bereaved individuals and compared the results with individuals living in relationships i.e couples. NSI DETERMINE Checklist was used to assess the nutritional risk profile of participants. The findings revealed that bereaved individuals were at moderate nutritional risk regardless of whether they had received grief counselling or not. The level of nutritional risk in individuals coping with bereavement and those in coupled relationships was
significantly different. The study emphasized on the need to address food issues in interventions targeting grief resolution.

Given the knowledge and understanding of the diverse set of factors contributing to malnutrition, it is essential to screen older adults for identifying those at risk for malnutrition or those with varying levels of malnutrition. Nutrition risk screening is considered to be valuable as it helps in early identification of malnutrition, frailty, falls, hospitalization, and delays institutionalization and death in older adults (Cederholm et al., 2011; Bauer & Sieber, 2008).

2.5 Measurement of Malnutrition in Older Adults

Rather than relying on laboratory parameters such as serum albumin, researchers consider nutrition screening tools to be more suitable for identifying undernourished older adults and to screen for other nutritional problems including weight loss and lack of appetite (Agarwal, Marshall, Miller, & Isenring, 2016). Nutritional screening is considered to be the first step in the prevention and management of under-nutrition in older adults and therefore several international nutrition organizations recommend routine nutritional screening of high risk frail individuals in order to prevent complications of under-nutrition (Gustafsson et al., 2013; Malone & Hamilton, 2013; Mueller et al., 2011; White et al., 2012). Ideally, the responsibility of nutritional assessment of older adults belongs to the dietitians, but they are always not available to carry out assessment in care homes, particularly in LMICs. Clinical nurses are present in most care facilities and have the ability to carry out routine nutritional assessment and screening of older adults (Juntao et al., 2017).
There are several nutrition screening tools that have been used in identifying older adults at a greater level of nutritional risk. Van Bokhorst et al. (2014) have reported that 20 nutrition screening tools have been used for assessment of nutritional risk in older adults living in different settings i.e. community, acute-care, and long-term care. These tools include the Chinese Nutrition Screen (CNS), Minimum Data Set (MDS), Simplified Nutrition Appetite Questionnaire (SNAQ), Short Nutritional Assessment Questionnaire for Residential Care (SNAQ-RC), DETERMINE, Geriatric Nutrition Risk Index (GNRI), Mini Nutritional Assessment- Long Form (MNA), Mini Nutritional Assessment-Short Form (MNA-SF), Revised MNA-SF, Malnutrition Universal Screening Tool (MUST), Nutrition Risk Index (NRI), Nutrition Form For The Elderly (NUFFE), Rapid Screen, Simple Screening Tool#1, Simple Screening Tool#2, Malnutrition Screening Tool (MST), Nutrition Risk Screening (NRS), NRS-2002, and Subjective Global Assessment (SGA). It was noted by the researchers who carried out a systematic review of these 20 screening tools that none of the tools performed consistently well in nutritional status assessment of older adults. The Mini Nutritional Assessment (MNA) which is the most commonly used nutrition assessment tool yielded modest psychometric properties. It was concluded by the researchers that existing screening tools for the LTC setting are fairly able to predict nutrition-related outcomes. The ideal screening tool for the LTC environment should contain more items specific to the risk factors that contribute to under-nutrition in older adults living in this setting (Van Bokhorst et al., 2014). Since MNA is the most commonly used nutritional assessment and screening tool in older adults, most emphasis has been placed on a detailed study of this measurement scale.

Mini-Nutritional Assessment (MNA)
The Mini-Nutritional Assessment (MNA) is the most widely used tool in care home settings and has been studied extensively in the older adults (Salva, Corman, Andrieu, et al., 2004). The complete MNA consists of 18 items (score ranging from 0 to 30) which covers anthropometric assessment (weight, height, mid-arm circumference, calf circumference, and weight loss in the last 3 months), general assessment (mobility, level of independence, prescription medications, pressure sores or skin ulcers), dietary intake assessment (number of meals consumed, food and fluid intake, and self-feeding capacity), and subjective assessment (an individual’s self-perception of health and well being, comparison of one’s own nutritional status with that of others). This questionnaire is divided into two parts for classifying individuals on the basis of their nutrition risk score obtained by completing the questionnaire (Guigoz, Lauque, & Vellas, 2002).

The first part consists of items A to F, and if an individual scores 11 and above, the person is considered to be well nourished. The second part of the MNA has items G to R and is administered to participants with a score of lower than 11. Individuals getting a total score >24 are considered as “well nourished,” those getting a score lying between 17 and 23.5 are “at risk of malnutrition,” and those scoring <17 are potentially “malnourished” (Guigoz, Vellas, & Garry, 1996). The MNA has been found to be useful and effective in assessing the nutritional status of the geriatric populations in various settings (Griep et al., 2000; Kaiser et al., 2010; Kaiser et al., 2011).

The development and validation of the MNA was carried out for timely identification of protein-energy malnutrition in older adults (Guigoz, Vellas, & Garry, 1994; Guigoz, Vellas, & Garry, 1996). With the diagnostic criteria of MNA, this tool has a sensitivity of 96% and specificity of 98% and predictive value of 97% (Vellas et al.,
In addition, it possesses the predictive validity for negative health outcomes, mortality, number of visits to general practitioner, length of hospitalization, and transition to a nursing home (Berner, 2003; Kondrup et al., 2003). This makes it the most appropriate tool for nutrition risk screening in older adults (Volkert et al., 2010).

As the commonly used nutrition screening tool, MNA has been used with more than 35,000 older adults living in a variety of settings such as home care, hospitals, institutional care, outpatient care and the community and the rates of malnutrition and risk for malnutrition have ranged widely depending on the population. When separated on the basis of their accommodation facilities, 21% older adults staying in service flats, 33% living in homes for elderly, 39% cognitively impaired individuals, and 71% older adults residing in LTC institutions were in a malnourished state (Guigoz, Lauque, & Vellas, 2002). Individuals obtaining low MNA scores have a higher likelihood of suffering from disease (Beck & Ovesen, 1998) and being admitted to nursing homes (Van Nes et al., 2001).

The reliability of the MNA has been evaluated in institutionalized older adults. When tested in Spanish older individuals, the internal consistency estimated by Cronbach’s alpha was found to be 0.83 and 0.74 for the first and second assessment respectively. The inter-rater reliability was reported to be 0.89 for total MNA score and higher than 0.89 for the continuous items. The value of Kappa index (inter-rater agreement) was 0.78 and the researchers observed that the test-retest reliability for the total MNA was good. In addition, the test-retest reliability of 12 items out of 18 was found to be “almost perfect” using the Kappa index (Bleda, Bolibar, Pares, & Salva, 2002). This screening instrument is easily administered by professionals working in the
healthcare sector in geriatric clinics and also used in hospitals and nursing homes for identification of patients requiring timely nutrition intervention. It was originally designed and validated using data from Western countries involving primarily Caucasian populations (Guigoz, Vellas, & Garry, 1994). It has been used without modification in some non-white populations such as the Japanese (Kuzuya et al., 2005; Izawa et al., 2006). However, it is recommended that for obtaining better results in certain populations, some modifications are desirable in the original version of the MNA. The MNA must be modified taking into consideration the cultural and anthropometric characteristics of the population of interest (Chumlea, 1999; Chumlea, 2006).

Diekmann et al (2013) carried out a comparative analysis of three screening tools among nursing home residents. They used the Mini Nutritional Assessment (MNA), the Nutritional Risk Screening (NRS 2002), and the Malnutrition Universal Screening Tool (MUST). They evaluated the applicability, classification of nutritional status, and predictive value in the nursing home environment. The study was conducted on 200 residents living in two nursing homes of Nuremberg in Germany. The prevalence of malnutrition using the MNA was 15.4% and it was observed that 8.6% the older individuals were at nutrition risk using NRS 2002 and MUST. The one-year mortality rate was highest in individuals categorised as “malnourished” using the MNA. MNA showed the best predictive value for survival as compared to NRS 2002 and MUST in LTC residents. The researchers of the study could not establish the superiority of any tool over the others, but concluded that MNA items reflect specific conditions relevant in older adults and are based on anthropometric thresholds that are suitable for geriatric
populations. It was suggested by the researchers of this study that MNA appears to be suitable for use in the LTC setting for malnutrition assessment of older adults.

While several nutritional risk screening tools exist, no tool is considered to be superior as compared to the others. As reported earlier, some of these are more commonly used in LTC settings with better psychometric properties. Specifically, MNA, and MNA-SF are more commonly used in LTC settings. After being developed by Vellas and Guigoz in 1989, the MNA has become the most widely preferred nutritional assessment tool (Guigoz, Lauque, & Vellas, 2002). It is the most appropriate tool for assessing the nutritional status of individuals living in LTC facilities, since it offers a multidimensional approach by including components that correspond well with characteristic problems faced by LTC residents, such as dementia, pressure sores, feeding problems, and mobility issues (Kaiser et al., 2010).

Research also suggests that any individual identified to be at nutrition risk should have a complete nutrition assessment, and if indicated by the health care professional, implementation of a nutrition intervention must be carried out (Joint Commission International, 2011). As indicated earlier, nutritional risk predisposes individuals to not only malnutrition, but also other adverse health consequences including an increased morbidity and mortality. Nutritional risk and malnutrition have been associated with compromised immunity (Bohl, Shen, Kayupov, & Della Valle, 2016), reduced functional capacity (Kruizenga et al., 2016; Ahmed & Haboubi, 2010), and frailty which leads to an increased propensity for falls (Kamo et al., 2017). The following section will summarize the literature on falls in LTC context and creating a rationale for examining the relationship between nutritional risk and fall risk in older adults.
2.6 Frailty and Falls in LTC Facilities

Older adults who live in LTC facilities are considered to be at high risk of frailty (Kojima, 2015; Matusik et al., 2012). Frailty is a syndrome involving a decline in physiological functioning and a heightened risk of adverse health outcomes resulting from substantial deficits of multiple systems of an individual (Fried et al., 2001). The likelihood of developing frailty increases as a result of dementia, sensory deficits (e.g. visual impairment), poly-pharmacy and presence of multiple health problems (Kamo et al., 2017). Frailty is an important contributor to falls, disability, institutionalization, and even death (Lally & Crome, 2007). Prevalence of frailty in LTC residents ranges between 19% and 75.6% (Khater & Mousa, 2012). Since falls are the most common negative health outcome associated with frail LTC population, the following section focuses on falls in older adults living in LTC facilities.

2.7 Public Health Importance of Falls

Falls are considered to be a geriatric syndrome since they involve a deterioration of multiple functions which is commonly observed in individuals who develop age-related frailty (Montero-Odasso, 2016). Falls and their consequences have far-reaching outcomes not only for the older adults who have experienced fall events, but also for caregivers and health care providers. Screening for fall risk and timely identification of the older individuals at risk of falling is critical for appropriate referral to fall-prevention interventions. Research has demonstrated that falls have a multi-factorial etiology and there is no definitive single diagnostic tool available for fall risk assessment (Frith, 2015). It has not been established by past research studies that a particular performance-based measure, self-reported measure, fall history information, or a combination of several
measures is best at prediction of future fall incidents (Lucardi et al., 2017).

Falls are caused by an interaction of several factors, including a reduction in efficiency of postural responses, sensory deficits, musculo-skeletal impairment, deconditioning related to physical inactivity, excessive polypharmacy, depression, reduction in balance self-efficacy, and neuromuscular dysfunction (Lucardi et al., 2017). Falls encountered by older adults pose a serious public health problem with an increased economic burden not only for the affected person, but also for the society. In individuals aged 65 years and over, falls result in frequent emergency department admissions and long hospital stays lasting at least three weeks. There is sufficient data available on falls and fall-related injuries in HICs such as Canada. In 2010/2011, the fall-related hospitalizations reported in Canadian seniors were 78,330 and hospital stays were nine days higher in individuals who had experienced falls as compared to individuals who had been admitted for other reasons. Fall-related hospitalizations in Canadian older adults were reported to have increased by 19% between 2006 and 2010 and estimated to be 12,884 in number (Public Health Agency of Canada, 2014). Fall-related hospitalizations in individuals living in LTC were associated with higher rates of hip fracture (59%) and mortality as compared to fall-related hospitalization rates in community dwelling older adults. Individuals living in LTC are a vulnerable population considered to be at a high fall risk due to the complex health challenges faced by them including advanced dementia, multiple chronic diseases, and limited mobility (Public Health Agency of Canada, 2014).

Globally, an estimated 424,000 deaths occur per year as a result of falls and greater than 50% of these fall-related deaths take place in older adults (aged 60 and over).
More than 70% of these deaths occur in developing countries (WHO, 2008). Compared to older adults in the community setting, those in LTC have higher rates of falls. Specifically, studies done in LTC institutions have computed that the annual average fall rate per person is 1.7 which ranges between 0.6 and 3.6, and is higher than that observed in community dwelling older adults, who have a mean fall rate of 0.65 ranging between 0.3 and 1.6 (Rubenstein, 2006). It has been estimated that a fall occurs every second day in a LTC institution consisting of about 100 beds. Studies have shown that the rate of hospitalization varies from 1.6 to 3.0 per 10,000 population in older adults living in Canada, UK, and Australia (WHO, 2007).

Falls have numerous implications for older adults. Multiple health outcomes are associated with the occurrence of falls, including, fear of loss of independence, social isolation, poor mobility, depression, and episodes of confusion. Fallers aged 75 years and over, are approximately four to five times more likely to be admitted to a LTC facility for a year or more, as compared to fallers aged 65 to 74 years (Scott, 1990). Research has shown that falls contribute to 95% of all hip fractures suffered by older adults and have caused death in 20% of the cases (Wolinsky et al., 2009; Ioannidis et al., 2009; Jiang et al., 2005). Falls can also contribute to premature transition to LTC facilities. Studies have shown that one-third of older adults who are hospitalized following a fall are institutionalized soon after being discharged from the hospital (Scott, Wagar, & Eliott, 2010). Besides having a tremendous impact on the society, falls also affect the quality of life of older adults (Hartholt et al., 2011b).

Adequate research focusing on fall risk factors, burden, and prevention strategies has been carried out in developed countries (Lord et al., 2007). However, there has been
insufficient research in the field of fall prevention and estimation of true burden, imposed by the high incidence of falls in middle and low income countries. The high mortality rates associated with falls in developing countries reflect the severity of morbidity, disability, and treatment costs that follow in fall-related cases (Jagnoor et al., 2011; Dandona et al., 2010). The prevalence of falls in Indian older adults has been reported to be between 14% and 53% (D'souza, Shringapure, & Karol, 2008; Johnson, 2006; Joshi, Kumar, & Avasthi, 2003).

Few studies have attempted to evaluate risk factors for falls that increase older adults’ susceptibility to hospital admissions. Ravindram and Kutty (2016) have examined the risk factors for fall-related injuries in community-dwelling older adults that result in hospitalization in the city of Thiruvananthapuram in the state of Kerela in India. They included 251 older adults who were admitted in hospitals following injuries suffered as a result of falls. Patients admitted in the General Surgery, Orthopaedics, and Neurosurgery departments were included in the research study. The mean age of the participants was 71.6 (9.1) years and out of a total cases of 251, most of the cases were females (n=165). It was noted that hip fractures were the most common injury following a fall incident. Visual impairment was present in 42% cases and 10% of total cases (n=251) had suffered previous falls. The monthly income of 80% of cases was <INR 5,000 (=CAD$100). A majority of cases (84%) did not use walking aids for going out of their room. The causes of falls were mainly intrinsic including syncope (27%). Extrinsic causes included slipping and tripping (66%) and some falls were a combination of both intrinsic and extrinsic factors (7%).
Joshi, Kumar, and Awasthi (2003) have estimated that 1 in every 5 falls results in a hip fracture in older adults. Johnson (2006) examined the frequency and nature of falls in community dwelling and institutionalized older Indian women living in Kerala. A field survey was used to collect demographic data and falls profile. The study reported a lower prevalence of falls (45%) in community dwelling women, as compared to that observed in LTC facilities (64%). Findings revealed that 70% of LTC residents, who encountered falls, required medical treatment for injuries related to falls. The researcher recommended the development and implementation of falls prevention strategies within the Indian context. D'Souza et al. (2008) studied falls history, injuries, and hospitalization rates in Indian older adults living in cities of Manipal and Udupi. This study found that 59% of fall cases led to injuries, 16% resulted in fractures, 47% involved physician consultation, and 19% required hospitalization. Kaushik and D'Souza (2008) reported a lower balance and confidence level observed in 40% of individuals who had a history of previous falls. Cardona et al. (2008) studied the burden of injuries in rural areas of Andhra Pradesh and found that falls were more common in females as compared to males. The study revealed that 86% of fatal falls occurred in individuals aged 60 and over.

2.8 Costs associated with falls and fall-related injuries

Falls in older adults put an immense burden on the health care system. The high occurrence of falls has led to a high demand for healthcare services which include emergency department visits, hospitalization (Hartholt et al., 2011a, 2011b; Stevens et al., 2006), and LTC admissions (Hartholt et al., 2011b). Costs of treating injuries related to falls are substantial, and have numerous implications for the family, society, and
community. Fall-related costs are increasing at a rapid pace all over the world (WHO, 2007).

In the United States, the direct medical costs of falls in older adults living in the community were approximately $34 billion (Stevens, Corso, Finkelstein, & Miller, 2006). Few studies have investigated the costs of experiencing falls in nursing home residents. It has been estimated that a fall encountered in a nursing home by an older adult costs $1,456 (Carroll et al., 2008). Two surveys were carried out which revealed that the average cost of a fall was $1,892 and it ranged between $700 and $13,000. This cost was reported without envisioning the period beyond one year of follow-up, and it also did not consider the amount spent in case of a second or third fall. In addition, it did not include the amount needed for nursing care after a typical fall. Some research has been done to estimate the cost of falls in Canada. For example, the direct expenses associated with falls in Canadian older adults were estimated to be greater than $2 billion in the year 2004. The total cost of falls for Canadian older adults (aged 65 and over) was reported to be $26.8 billion which included direct care costs of approximately $15.9 billion (Parachute, 2015). The economic cost of injury in Canada has risen by 35% since 2004 and it is projected that by the year 2035 the cost of injuries will increase by 180% and would be $75 billion annually (Parachute, 2015). This suggests that the costs of treating injuries associated with falls are very high in individuals aged 65 years and over and hence may exert an enormous burden on health care resources. It is therefore, essential to screen older adults for falls to implement timely fall-prevention interventions and save hospitalization and follow-up costs.
As mentioned earlier, falls are common with serious health related consequences, and are a public health concern all around the world. As such, studies have focussed on understanding the factors contributing to falls, and ways to address them through appropriate interventions. In the following section, the risk factors associated with falls will be discussed.

2.9 Risk Factors for Falls

Researchers have come to understand and agree that falls are caused by a complex array of factors. Falls in older adults are the result of an interaction of long-term or short-term risk factors; and short term triggers, including a trip, acute disease condition, or an adverse reaction to medications (Tinetti, 2003). Factors contributing to falls can be categorized into four major domains: biological, behavioural, environmental, and socio-economic (WHO, 2007). Biological risk factors include age, gender, and ethnicity and may play a role in influencing the “postural control system” of an individual. Behavioural risk factors include alcohol intake, poly-pharmacy, wearing inappropriate footwear, and lack of physical activity. These risk factors are potentially modifiable and are in a person’s control. Environmental factors include uneven surfaces, architectural obstacles, and transportation problems and socio-economic risk factors include poverty.

Falling risk becomes four times higher in older adults discharged from the hospital and these individuals are at the greatest risk during the first two weeks following discharge (Mahoney, Sager, Dunham, & Johnson, 1994). Hospitalization puts individuals at a heightened risk of encountering falls, and approximately 29% of individuals who have fallen during their hospital stay, would fall at home, 35% are likely to be
hospitalized again due to a fall, and 5% have a high likelihood of dying within 30 days (Davenport et al., 2009). This is mainly due to the compromised nutritional status of these individuals which makes them more prone to fall. Fall risk factors can also be categorized as modifiable (e.g., gait, balance) and non-modifiable, as in the case of age and gender. According to the American Geriatrics Society/British Geriatrics Society Guidelines (2010), fall risk factors are mainly classified as extrinsic and intrinsic. Important extrinsic risk factors are intake of multiple medications (polypharmacy), particularly psychotropic medications, environmental hazards, such as poor lighting, lack of safety equipment e.g. grab bars in bathrooms, and ill-fitted carpets. Major intrinsic risk factors for falls include lower extremity weakness, history of falls, female gender, gait and balance impairment, functional and cognitive decline, dizziness, lower body mass index (BMI), urinary incontinence, age over 80, visual deficits, and depression. There is a complex interaction and synergism between both intrinsic and extrinsic risk factors and falls result from a combination of multiple factors reported above (AGS/BGS Clinical Practice Guidelines, 2010). Scott, Dukeshire, Gallagher, and Scanlan (2001) have proposed a model for risk factors that make older adults more vulnerable to encounter falls. It is shown below.

Table 1. Risk factors for falls (Scott, Dukeshire, Gallagher, & Scanlan, 2001)

<table>
<thead>
<tr>
<th>Biological/Intrinsic</th>
<th>Behavioural</th>
<th>Social and Economic</th>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor mobility</td>
<td>Fear of falling</td>
<td>Low income</td>
<td>Poor building design</td>
</tr>
<tr>
<td>Gait/balance</td>
<td>History of falls</td>
<td>Low education</td>
<td>Stairs</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------</td>
<td>--------------</td>
<td>-------</td>
</tr>
<tr>
<td>deficits</td>
<td></td>
<td>level</td>
<td></td>
</tr>
<tr>
<td>Muscle</td>
<td>Polypharmacy</td>
<td>Language</td>
<td>Lack of hand</td>
</tr>
<tr>
<td>weakness</td>
<td></td>
<td>barriers</td>
<td>rails or grab bars</td>
</tr>
<tr>
<td>Chronic illness</td>
<td>Antipsychotics</td>
<td>Improper living</td>
<td>Poor lighting</td>
</tr>
<tr>
<td></td>
<td>Antidepressants</td>
<td>conditions</td>
<td></td>
</tr>
<tr>
<td>Cognitive</td>
<td>Alcohol</td>
<td>Living alone</td>
<td>Slippery or</td>
</tr>
<tr>
<td>decline</td>
<td></td>
<td>consumption</td>
<td>uneven surfaces</td>
</tr>
<tr>
<td>Stroke</td>
<td>Lack of regular</td>
<td>Lack of social</td>
<td>Obstacles</td>
</tr>
<tr>
<td></td>
<td>exercise</td>
<td>support/networks</td>
<td></td>
</tr>
<tr>
<td>Parkinson’s disease</td>
<td>Inappropriate</td>
<td>Cultural factors</td>
<td>Tripping hazards</td>
</tr>
<tr>
<td>Arthritis</td>
<td>Improper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>assistive devices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>Poor nutrition</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A meta-analysis showed that the strongest risk factors for encountering a fall are having a history of falls, gait impairment, inappropriate use of walking aids, Parkinson’s disease, vertigo, and consumption of anti-epileptic drugs (Deandrea et al., 2010). A study carried out recently found that there is an increase in risk of encountering falls with a sharp rise in musculoskeletal pain, number of joints affected, and the degree of hindrance in an individual’s daily activities (Leveille et al., 2009). Also, studies have shown that there is an increase in the risk of falling with the rise in number of risk factors. The one-
year falling risk almost doubles with every additional risk factor. When no additional risk factor is present, the one-year risk of falling is approximately 8% but it rises to 78% in the presence of four risk factors (Tinetti & Kumar, 2010). Some of the common risk factors that lead to falls have been discussed in the following section.

2.9.1 Lower extremity weakness due to sarcopenia

Sarcopenia can be defined as the age-related progressive loss of skeletal muscle mass and function (Fielding et al., 2011). Risk factors for sarcopenia have been identified as age, female gender, a low body mass index (BMI), a decline in physical activity level, and poor scores obtained on the six-minute walking test (Tramontano et al., 2017). The process of sarcopenia involves either a gradual loss of muscle mass alone, or a combination of an increased fat mass and a lower muscle mass. There are multiple factors that contribute towards the development of sarcopenia including physical inactivity, endocrine changes, chronic diseases, inflammation, and nutritional deficits (Tramontano et al., 2017). The International Sarcopenia Initiative (ISI) has reported the prevalence of sarcopenia among older adults to range from 1 to 33% (Cruz-Jentoft et al., 2014), but all the studies on the estimation of sarcopenia prevalence have been conducted on older adults residing in developed countries (Tramontano et al., 2017).

Sarcopenia is associated with a lower handgrip strength (Woo, Leung, Sham, & Kwok, 2009), mobility impairment (Reid et al., 2008), poor balance and a higher risk of falls in older adults (Szulc, Beck, Marchand, & Delmas, 2005). In addition, it increases the risk of disability (Kim et al., 2015) and can prolong length of hospital stay in these individuals (Gariballa & Alessa, 2013). Interestingly, sarcopenia is reversible to some extent, and some studies have been carried out which have demonstrated that exercise can
play an essential role in prevention of sarcopenia and change the rate and pattern of muscle mass decline in older adults (Hassan et al., 2015; Iolascon et al., 2014). Although sarcopenia is considered to be an important risk factor for falls in older adults (Landi et al., 2012), it can be managed and prevented with exercise interventions involving physiotherapists and exercise trainers.

2.9.2 Lower Functional capacity

Individuals with a decreased functional capacity are more susceptible to experience falls. Functional capacity is the ability to carry out activities of daily living (ADL) in a normal or accepted way and it has been reported in literature that there is a decline in functional capacity of older adults as they continue to experience the aging process (Millan-Calenti et al., 2010). The inability to carry out ADL efficiently is a growing concern among individuals aged 60 years and over since it may adversely affect their quality of life and increase their level of dependency on others (Aijanseppa et al., 2005). The prevalence of functional disability among older adults in rural India has been reported to be 34.7% (Sharma, Parashar, & Mazta, 2014). In general, data on functional disability among older adults populations of India is scanty (Agrawal, 2016). A recent study carried out to predict factors contributing towards functional decline in Indian older adults revealed that squatting, climbing stairs, and walking was limited in community dwelling persons. A majority of the participants (67.1%) reported problems with performing ADL. Factors contributing to a lower functional status were found to be
female gender, previous hospitalization, having two or more chronic diseases, memory loss, and loneliness (Nagarkar & Kashikar, 2017).

With advancing age of an individual, the ability to maintain balance diminishes (Lajoie & Gallagher, 2004) and studies have shown that balance and gait deficits are crucial predictors of falls (Bergland, Pettersen, & Laake, 2000). Cognitive decline and lower affective functioning may adversely affect the functional status of an individual (Kaminska, Brodowski, & Karakiewicz, 2015).

2.9.3 Psychotropic medications

Psychotropic medications are commonly consumed by older adults living in the community as well in LTC facilities (Cox et al., 2016). The intake of some psychotropic medications is strongly associated with falls in older adults living in care homes (Cox et al., 2016). Anxiolytic medications are used in the management of anxiety disorders, and are consumed on a daily basis by 50 to 80% of residents of long-term care (Conn & Madan, 2006). Meta-analyses on this topic have shown that the use of anxiolytics such as benzodiazepines is associated with a heightened risk of falls in older adults (Ensrud et al., 2002; Leipzig, Cumming, & Tinetti, 1999; Woolcott et al., 2009). Ray et al. (2000) have reported that consumption of benzodiazepines in care home residents is significantly associated with falls. Anti-depressants such as selective serotonin reuptake inhibitors (SSRIs) have been also recognized as a risk factor for falls (Kerse et al., 2008). SSRIs have been linked with a lower bone mineral density (Diem et al., 2007) and a higher risk of fractures in older adults (Richards et al., 2007) and hence are believed to have a high potential of increasing fall risk in older adults consuming these medications. Sterke et al.
(2012) have reported a significant increase in fall risk with low dosage use of anxiolytics, hypnotics, sedatives, anti-depressants and anti-psychotics in older adults living in nursing homes particularly those having cognitive impairment (e.g. dementia).

2.9.4 Vitamin D deficiency

Vitamin D is essential for maintenance of bone health and prevention of fractures. It also plays a role in the prevention of certain chronic diseases such as diabetes and cancer. In addition, it helps in developing a strong immunity against infections and disease (Schwalfenberg, 2007). Vitamin D is obtained mainly through sunlight and food sources of this vitamin are few, most important of which are egg yolk and fatty fish. Fortified non-dairy drinks and fortified cow’s milk are major sources of vitamin D in the diet (Vatanparast, Calvo, Green, & Whiting, 2010). Research indicates that fortification is not adequate to prevent vitamin D deficiency (Vieth, 2012). Vitamin D is not adequately synthesized during winter months and older adults are at an elevated risk of deficiency (Whiting, Langlois, Vatanparast, & Green-Finestone, 2011) and therefore it is important to take vitamin D supplements to meet daily requirements.

The prevalence of vitamin D deficiency in institutionalized older adults is high. Low concentrations of serum 25(OH)D in older adults are associated with risk of institutionalization and a high risk of mortality (Visser, Deeg, Puts, Seidell, & Lips, 2006). Older adults have a greater likelihood of having vitamin D deficiency due to lower
exposure to sunlight and the decreased formation of vitamin D3 under the influence of UV light (Holick, Matsuoka, & Wortsman, 1989). Studies have shown that low concentrations of 25-hydroxyvitamin D [25(OH)D] and 1,25-hydroxyvitamin D [1,25(OH)D] lead to an elevated bone loss and increase the risk of falling (Bischoff-Ferrari et al., 2004). Multiple cross-sectional studies have reported the association between low 25(OH) D concentrations and decreased muscle strength in older adults (Gerdhem, Ringsberg, Obrant, & Akesson, 2005). Randomized clinical trials have shown that vitamin D supplementation has the potential to reduce 23 to 53% of falls in older adults living in nursing homes (Bischoff et al., 2003; Flicker et al., 2005). In addition, a meta-analysis of vitamin D supplementation and falls found a 22% decline in the number of falls suffered by residents of nursing homes (Bischoff-Ferrari et al., 2004). Another meta-analysis conducted by Murad et al. (2011) concluded that vitamin D plays a cardinal role in improvement of functional capacity and prevention of falls which lead to significant morbidity in older adults. Most of the evidence was derived from trials comprising of older women (Murad et al., 2011). A meta-analysis carried out by Kalyani et al. (2010) has shown the efficacy of vitamin D in falls prevention in older adults living in the community and in nursing homes. The effect of vitamin D on decreasing the number of falls was significant in certain subgroups of individuals, such as community dwelling older adults aged 80 years and below, those having adequate calcium intake, no previous history of fall or fracture, taking a dose of 800 IU and above.

The combined effects of vitamin D and calcium in fall risk reduction and decreasing the severity of injurious falls have been studied. A study found that vitamin D supplementation in combination with calcium reduced the severity of fractures,
particularly hip fractures in older adults and reduces the risk of injurious falls (Nowson, 2010). A meta-analysis was carried out by Weaver et al. (2016) to assess the combined role of calcium and vitamin D in fracture reduction and found that there was a 15% reduction in fractures in older adults taking these supplements. Vitamin D and calcium when used in combination have the potential to reduce fall-related injuries such as fractures and can prevent treatment costs of hospitalizations and surgeries.

Within the LTC environment, the presence of risk factors is further magnified given the complex health and medical conditions often present in LTC residents. Older adults living in long-term care institutions often suffer from depression and social isolation. Their social networks get restricted, and they are unable to maintain close ties with old friends and family members. A recent study done in Caucasian women aged 70 years and over has shown that stronger family networks lead to lower rates of falls (Faulkner, Cauley, Zmuda, Griffin, & Nevitt, 2003). Changes associated with increasing age such as, decreased balance, poor gait, and loss of vision (Tinetti, 1987; van Doorn et al., 2003) contribute towards the increased proneness of nursing home residents to falls (Spector et al., 2007).

2.10 Measurement of Fall Risk

Given the severe and debilitating consequences of falls and related injuries, and the awareness of the risk factors that predispose older adults to falls, various assessment tools have been developed. The tools vary widely in the extent to which various risk factors are taken into account. For example, some consider multiple risk factors whereas others focus only on risk factors related to physical function of individuals, or
psychosocial aspects such as the fear of falling. The tool used for assessing risk of falls in older adults should be simple, reliable, and must have sufficient discriminative ability (Kelly & Dowling, 2004).

2.10.1 Downton Index

The Downton index has been validated for use in the nursing home setting (Rosendahl et al., 2003). It is a simple falls risk assessment tool and can be easily administered by nurses. Studies have reported its predictive value to be similar to that of other tools (Perell et al., 2001; Scott, Votova, Scanlan, & Close, 2007). It includes information related to history of falls within the past 12 months, use of tranquilizers and sedatives, diuretics, antidepressants, and anti-parkinsonian medications. In addition, it assesses sensory deficits possessed by an individual. Visual and hearing impairment are assessed by nurses, which is subsequently followed by evaluation of limb dysfunction. Nurses are also required to examine the patients’ cognitive functioning status. The gait of individuals being tested is also studied by examining their ambulatory potential and need for assistive devices (Meyer, Kopke, Haastert, & Muhlhauser, 2009).

Rosendahl and colleagues (2003) observed that the sensitivity of the Downton index ranged from 81 to 95% and the specificity ranged from 35 to 40%. These researchers confirmed that relatively few individuals are falsely predicted by the Downton index as being at low risk of falling. They concluded that low specificity of this instrument is more acceptable than low sensitivity, as long as the fall intervention does not cause any injury to the individual through the use of physical restraints, or obstacles. This tool has been studied in nursing homes in Hamburg (Germany) but has not been
tested in developing countries. A recent study examined the characteristics of Spanish older adults admitted in acute care who are prone to suffer falls. The Downton index was used to assess the risk of falls in these individuals. Using this index, 56.5% of the older patients were classified to be “at risk” of suffering a fall and females were found to be at lower risk of falling as compared to males (Aranda-Gallardo et al., 2014).

2.10.2 Falls Efficacy Scale International (FES-I)

The Falls Efficacy Scale International (FES-I) was developed and validated by the Prevention of Falls Network Europe (ProFaNE) (Yardley et al., 2005; Delbaere et al., 2010). It is used extensively for evaluating fear of falling in older adults. There is a shorter version of FES-I which has been developed and tested as well (Kempen et al., 2008). Initially, the FES-I was validated in English which was followed by its validation in several other languages (Kwan, Tsang, Close, & Lord, 2013; Ulus et al., 2012; Billis et al., 2011; Camargos, Dias, Dias, & Freire, 2010). The FES-I questionnaire can be completed within three to four minutes. The participant can complete the questionnaire or the information can be collected using an interview process (Visschedijk et al., 2015). The FES-I measures response of participants while performing 16 ADLs and assesses their fear of falling. The response to each question of the questionnaire consists of four levels ranging from “not at all concerned” to “very concerned.” The score obtained on the FES-I ranges from 16 to 64 (Kempen et al., 2007).
The FES-I has shown good measurement properties in older adults living in the community. In a group of 94 German older adults, the Cronbach’s alpha was 0.90 and the intra-class correlation was reported to be 0.79. Another study carried out in a sample of 193 older adults living in the Netherlands, aged 70 years and above, revealed that the Cronbach’s alpha was 0.96 and intra-class correlation was 0.82 (Kempen et al., 2007). Visschedijk and colleagues (2015) assessed the reliability and validity of FES-I in older adults (aged >65 years) living in Netherlands. They reported that the reliability and construct validity of the FES-I are good. The Cronbach’s alpha was 0.94 which suggests that the internal consistency of FES-I is desirable and highly acceptable. The ICC for all raters was found to be 0.72. The researchers of this study concluded that the FES-I has the desired internal consistency and reliability to measure fear of falling in older adults.

Mane, Sanjana, Patil, and Sriniwas (2014) assessed the prevalence and correlates of fear of falling (FOF) in older adults living in the southern state of Karnataka in India using the short version of FES-I and found that 33.2% older adults were struggling with FOF. The researchers found that gender and socio-economic status were not significantly associated with FOF among the subjects but a fall history, depression, restriction of physical activity, education level, family type and presence of multiple health problems was significantly correlated with FOF in this population group. The FES-I has been translated into Hindi which is the national language of India and is spoken by most Indians. Arora (2014) used the Hindi version of FES-I to assess the confidence of Indian older adults (>60 years) in performing activities of daily living (ADL) and found that the internal consistency (Cronbach’s alpha=0.831) and test-retest reliability (ICC=0.894) were significant (p<0.001). Occupational status was found to cause variation between
mean FES-I scores of the study participants. The researcher concluded that FES-I is a valid measure of fear of falling among Hindi speaking Indian older adults.

2.10.3 Timed-up-and-go (TUG) test

One of the commonly used tests is timed up and go (TUG) which was developed by Mathias et al. (1986) for screening older adults having difficulties in the maintenance of balance. TUG was taken to another level of sophistication by Podsialdo and Richardson (1991) and Shumway-Cook, Brauer, and Woollacott (2000) by the addition of elements such as time, and cognitive loading. TUG has been recommended by the American Geriatrics Society, the British Geriatric Society, and Nordic Geriatricians as a screening tool for identifying individuals at risk of falling (American Geriatrics Society, British Geriatrics Society, American Academy of Orthopedic Surgeons Panel On Falls Prevention, 2001). Specifically, it is used to detect individuals requiring an elaborate gait and balance assessment (American Geriatrics Society/British Geriatrics Society, 2011). This test involves computation of time taken by an individual to rise from a chair having armrests, walk for a distance of 3 metres using some devices, turn at a predetermined point, return to the chair, and get seated (Podsialdo & Richardson, 1991).

Cut-off values for TUG have been set between 10 and 25 seconds and are reported to differentiate between fallers and non-fallers (Chiu, Au-Yeung, & Lo, 2003; Dite & Temple, 2002). The commonly used version of the TUG involves completion of the task at a convenient walking speed (Podsialdo & Richardson, 1991). However, some modifications have been made to the original version such as, walking at the fastest possible pace (Rikli & Jones, 1999), addition of tasks related to cognitive and motor
functioning (Shumway-Cook, Brauer, & Woollacott, 2000), time measurement of different constituent tasks (Wall et al., 2000), use of a chair that is without arms (Smith, Segal, & Wolf, 1996), and arranging another chair at the 3 metre path (O’Brien, Culham, & Pickles, 1997). Timed-up and go (TUG) test has been used in a few Indian studies (Anuradha et al., 2012; Krishnamurthy & Telles, 2007; Rege & Joshi, 2005) but is not very commonly used in older adults in India.

2.11 Association between nutritional risk and fall risk

The literature review suggests that both nutritional risk and fall risk are common among older adults. Malnutrition and falls are debilitating with negative consequences for individual and health systems perspectives. With aging, muscle weakness and gait/balance deficits increase the risk of falling by approximately three to fourfold (AGS, BGS, & American Academy of Orthopedic Surgeons Panel on Falls Prevention, 2001). Decline in muscle mass and functioning with age is commonly referred to as sarcopenia. Multiple factors contribute to sarcopenia including imbalance in protein metabolism, lack of adequate nutritional intake, (Kinney, 2004), presence of chronic diseases and intake of several medications (Tinetti, 2003). Although literature indicates that there is an association between malnutrition and an elevated fall risk (Vellas et al., 1990; Vellas, Baumgartner, & Wayne, 1992), very few studies have been carried out to study this association in geriatric populations.

Johnson (2003) examined the association between nutritional and falls risk in frail older adults and found that fallers were at increased nutritional risk and had lower
physical and psychological well being as compared to non-fallers. The study found a significant association between nutritional risk and balance and leg strength which are important predictors of falls in the older adults. A study conducted by Daniels (2002) revealed that older adults at high risk of falling in long-term care facilities are also at risk of being undernourished. A recent study carried out to determine the association between nutritional status and risk of falling in Taiwanese community dwelling older adults, revealed that nutritional status is an independent predictor of falls in this population irrespective of gender, age, falls history, hospital stay within past 12 months, and difficulties experienced while performing ADLs and IADLs (Chien & Guo, 2014). Given the prevalence of falls and nutrition risk as well as the adverse consequences, further research is needed in this area especially from the context of LMICs.

Objectives

The primary objective of the study was to assess the nutritional and fall risk in older women living in LTC facilities in India. The researcher also wanted to examine the correlation between nutritional risk and fall risk of female LTC residents living in New Delhi, India. In addition, the role of variables such as the depression, cognitive status, general health status, and physical function in predicting fall risk was also examined.

Only women were included in the study. The other criteria were as follows:

Inclusion criteria

- Individuals >60 years of age
- Living in LTC institutions for at least 6 months
- Residents of LTC who can walk independently or are using walking aids

Exclusion criteria
- Individuals aged <60 years
- Community dwelling older adults
- Older adults that have been newly admitted in LTC facilities
- Having serious health problems such as end-stage renal disease, cirrhosis, cancer, or severe dementia

**Hypotheses**

It was expected that Indian older adults living in LTC facilities would have a high nutritional risk and fall risk level. Also, it was expected that there will be a strong association between nutritional and fall risk. Based on existing research within the HIC context, it was further hypothesized that the high rates of depression, poor physical function and fear of falling will be significant predictors of fall risk.
CHAPTER 3
METHODS

3.1 Selection of Facilities and Recruitment of Participants

Six “homes for the aged” (also referred to as old age homes) in New Delhi, were selected to recruit participants for the study. To recruit the facilities and participants, the researcher carried out a survey of old age homes in New Delhi registered with HelpAge India foundation. Old age homes with a sizeable proportion i.e more than 50% of women irrespective of whether they were Government affiliated care homes or private homes were contacted. Invitation letters were distributed amongst the residents of each care facility, and the researcher went to the care homes after a week to meet the residents who had received the invitation letters. Residents who were willing to participate in the research study were provided with letters of informed consent and after completing these letters, interested residents completed the questionnaires administered to them by the researcher. The data collection took place over a four month period (January to April
after ethics approval had been granted by the Research Ethics Board (REB) at the University of Regina and by the directors of the six care homes visited in New Delhi. A sample of the letter of invitation and the letter of informed consent can be found in Appendices A and B. The following section includes details of sample size estimation, the inclusion and exclusion criteria, information on nutritional and fall risk screening as well as other questionnaires, and statistical procedures used in the study.

3.2 Sample Size

A priori sample size N was calculated using recommended level of power (1-β or 80%), significance level α (0.01), and the expected effect size (Aberson, 2010; Cohen, 1988). Cohen classified effect size as small (d=0.2), medium (d=0.5), and large (d >0.8) and stated that a medium effect size of 0.5 is visible to a careful observer and a small effect size of 0.2 is although noticeably small but not trivial that it should be neglected. In addition, a large effect size of 0.8 is considered to be the same distance above the medium effect size as small effect size is below it (Coe, 2002). It is noteworthy that these designations of effect size do not take into consideration other variables such as the accuracy of the assessment tool or measure used and also do not account for the diversity of the study population. However, these effect size designations provide a general guide for researchers and must be informed by context (Sullivan & Feinn, 2012). G*Power 3 software was used to compute the sample size N (Faul, Erdfelder, Lang, & Buchner, 2007).
The G*Power was developed as a stand-alone power analysis program for conducting statistical analysis in social and behavioural research. It involves the provision of options for carrying out power analysis for a range of commonly used t, F, z, $\chi^2$, and exact tests. G*Power 3 is a very flexible method of power computation of any statistical test that involves t, F, z, $\chi^2$ (Faul, Erdfelder, Lang, & Buchner, 2007). Using G*Power 3 software, it was determined a sample size of 85 was needed for the study. The sample size was calculated by using values of $\alpha= .01$, power=.80 and effect size $d=0.5$ (medium effect size according to Cohen). Based on sample size estimation, the researcher recruited a total of 85 older adults from six nursing homes (homes for the aged) in New Delhi.

3.3 Measures of Nutritional Risk and Fall Risk

3.3.1 Background Profile questionnaire

A background profile questionnaire was used to obtain information about the participants’ family background, education status, annual income, marital status, and length of stay in LTC. In addition, information on medication intake and chronic illness was obtained from the participants of the study. Participants were asked to mention their self-perceived level of physical activity, and social support availability.

3.3.2 Mini-Nutritional Assessment (MNA)

The Mini-Nutritional Assessment (MNA), which is a non-invasive simple tool with good psychometric properties, was used to screen individuals for nutritional risk (Guigos, Vellas, & Garry, 1994). It includes 18 items covering anthropometric indicators, dietary intake, global and self-viewed nutritional aspects. The score of MNA ranges from 0 to 30. A score of <17 is indicative of malnutrition, a score lying between 17.5 and 23.5
indicates moderate nutritional risk, and a score of >24 implies that an individual is at no nutritional risk (Vellas et al., 1999).

3.3.3 Falls Efficacy Scale- International (FES-I)

The FES-I (Yardley et al. 2005) was used for evaluating the fear of falling which is a strong risk factor for predicting future falls. The FES-I can be used to assess fear of falling in older adults with or without a history of falls and fear of falling. The FES-I was developed to include more challenging activities which older adults might fear performing in order to prevent falls. The FES-I has been used to measure level of concern about falling while performing physical and social activities inside and outside the house. The FES-I was developed jointly by the members of Prevention of Falls Network Europe (ProFANE), European Committee focused on fall prevention, and the psychology of falling (Greenberg, 2011). This group assessed fear of falling in older adults living in different countries and also translated FES-I into several languages such as Chinese, Spanish, German, Dutch, English, French, Greek, Hindi, Swedish, Norwegian, and Danish.

In FES-I, the participants were asked for their perceived level of concerns regarding the likelihood of falling in relation to performance of 16 activities. These activities included cleaning the house, getting dressed/undressed, preparing meals, taking a shower, shopping, getting in and out of a chair, going upstairs and downstairs, walking around inside the house, reaching up or bending down, using the telephone, walking on a slippery surface, visiting a friend, going to a crowded place, walking on an uneven surface, going to an event, and walking up and down a slope. The scoring of perceived concern is done using a four point scale (“not at all,” “somewhat,” “fairly,” and “very
concerned”). The score of FES-I varies from 16 to 64 and a higher score (i.e. >23) (Delbaere et al., 2010) means that the respondent has a strong fear of falling and a greater fall risk. When Falls Efficacy Scale International (FES-I) was first developed and validated it was found to have excellent internal consistency (Cronbach's alpha=0.96) and also had impressive test-retest reliability (ICC=0.96) (Yardley et al., 2005). The FES-I has shown very good internal consistency in most studies with a Cronbach's alpha value of at least 0.79 (Delbaere et al., 2010). This questionnaire was developed using factor analysis and has better psychometric characteristics as compared to the original version of FES (Greenberg, 2011).

3.3.4 Downton Index

The Downton index (Rosendahl, Lundin-Olsson, Kallin, Jensen, Gustafson, & Nyberg, 2003) was used for assessing risk of falls. This tool includes well established risk factors that lead to falls, such as sensory deficits (visual impairment and hearing impairment), medications (sedatives, diuretics, anti-parkinsonian drugs, antidepressants), history of falls, gait (with/without use of walking aids), and cognitive status (oriented/confused). The score ranges from 0 to 11 and obtaining a score of >3 is indicative of a high risk of falling. This index has a very high sensitivity which suggests that only few individuals are falsely predicted to be at risk of falling.

3.3.5 Geriatric Depression Scale

The Geriatric Depression Scale (GDS) was developed to detect depressive disorders in older adults. In the present study, the long form of GDS was used. The GDS consists of 30 items or questions which concern an individual’s feelings and behaviours during the past week. It has a simple yes/no format and with no gradation or frequency
choices. Participants scoring 0 to 9 are normal or have mild depression; scores between 10 and 19 are indicative of moderate depression; and individuals who obtain scores between 20 and 30 are suffering from severe depression. Responses to items 1, 5, 7, 9, 15, 19, 21, 27, 29, and 30 must be "No" in order to get a score of 1 for each of the responses to these questions (Yesavage et al., 1983). It was developed to be a self-administered questionnaire, but can be administered with the help of another person who may not be a professional (Roman & Callen, 2008). The GDS has been shown to have a sensitivity of 84% and specificity of 95% with a cut-off score greater than 11 in a sample that consisted of normal controls and depressed individuals (Yesavage et al., 1983). The reliability and validity of the GDS have been supported through clinical practice and research. The Long form of GDS has been widely used by researchers and clinicians in the field of geriatric psychiatry and has been recommended by the Institute of Medicine. The original Long form is a powerful tool in identification of depression in nursing home residents, including patients who are suffering from mild dementia (Jongenelis et al., 2005). The short form GDS is not as robust as the long form GDS in the identification of minor depressive symptoms. It has a slightly lower specificity and sensitivity when compared to the long form GDS (Cwikel & Ritchie, 1988), but a large-scale study has found that it has acceptable internal reliability and construct validity in identification of depression in cognitively intact older adults (Friedman, Heisel, & Delavan, 2005).

3.3.6 SF-36 Health Survey

The SF-36 (Ware, Gandek, and IQOLA Project, 1994), which is a multi-purpose health survey consisting of 36 questions or items related to functional status, physical and mental health, and self-evaluation of general health status, was used in this study. Items
are grouped into various categories or scales. These scales represent physical functioning, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health. The first four scales represent physical health status and the last four scales represent mental health status. It only takes 5 to 10 minutes to complete this health questionnaire. Lowest score obtained is 0 and highest is 100. Higher scores are suggestive of better health status. The RAND version of the SF-36 form (Nicholas, Laucis, Hays, & Bhattacharyya, 2015) was used in the study. The RAND scoring instructions were followed for grading responses to items of SF-36 questionnaire and items are scored in a way such that a higher score defines a more desirable health state (Nicholas, Laucis, Hays, & Bhattacharyya, 2015).

The reliability of the eight scales and summary measures has been estimated using internal consistency and test-retest methods. Reliability statistics have exceeded 0.7 which is the minimum accepted standard in group comparisons in more than 25 studies (Tsai, Bayliss, & Ware, 1997). Reliability estimates for physical and mental summary scores have usually been greater than 0.90 in most studies (Ware et al., 1994). There is evidence of adequate content, criterion, construct, and predictive validity. The SF-36 questionnaire is suitable for self-administration, computerized administration, or administration by a trained interviewer in person or by telephone to individuals aged 14 years and older.

Pro-rating of item scores of SF-36 was carried out by the researcher to compensate for items which were not included in the questionnaire due to their emotional risk level. Items 16, 17, 18, and 19 were associated with adversely affecting the
emotional health of older adults and were thus not a part of the SF-36 form administered to the participants in care homes.

Pro-rated score= Raw Score/Current number of items * original number of items

3.4 Measure of Cognitive Status

Mini-Mental State Examination (MMSE)

The Mini-Mental State Examination (MMSE) (Folstein, 1975) is a questionnaire designed to assess the cognitive status of individuals and this was used to test for the presence or absence of cognitive deficits in this study. This questionnaire is quick and easy to administer and its use requires minimal training. It is useful in identification of seniors having dementia but it must be noted that its specificity decreases when cognitively healthy individuals and patients with mild cognitive impairment have to be discriminated.

The score of MMSE ranges from 0 to 30 and includes an assessment of orientation, concentration, attention, verbal learning, naming, and visual-construction. Scores lower than 9 are indicative of severe dementia, scores ranging from 10 to 19 indicate moderate cognitive deficits, scores ranging from 20 to 25 are suggestive of mild cognitive impairment, and scores higher than 26 indicate a normal cognitive status. The scores on MMSE are dependent on demographic variables such as age, and education, where younger and more educated individuals are likely to score higher. Cultural differences, head trauma, and severe depression may adversely affect MMSE scores. False-positives may be reported especially among seniors having a lower education status and lower socio-economic status. Despite some of its weaknesses, it has been used extensively by clinicians to monitor cognitive functioning in older adults.
3.5 Measure of Balance and Mobility

Timed-up-and-go (TUG) test

The Timed-up-and-go (TUG) test (Podsialdo & Richardson, 1991) which measures functional mobility is a commonly used screening tool for assessing falls risk in older adults. In this test, the person is required to rise from a seated position in an arm chair, walk a distance of 3 meters, turn and walk back to the chair, and sit down. The time taken to complete this test and any difficulties encountered during the test are noted. A cut-off score of >13.5 seconds is used for determination of falling risk (Rose, Jones, & Lucchese, 2002).

3.6 Measure of Functional Status

Handgrip strength

Handgrip strength (HGS) is considered to be a good measure of physical fitness and frailty among older adults (Lam et al., 2016). HGS assessment of older adults is essential to evaluate the degree of frailty and risk of future disability, and enables researchers to identify functional limitations in early stages. HGS is also used to predict negative health outcomes such as mortality and hospital discharge outcome (Sasaki, Kasagi, Yamada, & Fujita, 2007). Measurement of HGS is simple, non-invasive and inexpensive but most data available on HGS is from Western populations and scanty data is available on Asian older adults who have a smaller stature, different genetics, lifestyle, and occupations (Lam et al., 2016).

The standard procedure for measuring HGS using Jamar hydraulic hand dynamometer (Patterson Medical, Warrenville, IL, USA) was followed which includes asking participants to be seated on a standard height chair without armrests and
positioned as per the American Society of Hand Therapists' recommendation (Fess & Moran, 1981). The grip bar or handle of the dynamometer was adjusted based on the participant's hand size in order to get an optimal grip position and the test was performed by participants after the researcher provided them with clear verbal instructions. HGS was measured by asking participants to hold the device in their left hand and then right hand and press as hard as they can. Participants pressed the dynamometer three times for each hand and the highest value was recorded to get a measure of left hand strength and right hand strength. Both the readings were added to get the total handgrip strength of each participant.

3.7 Data Analysis

The data were entered and analysed using SPSS version 22.0. Data analysis included descriptive and correlational analysis, multiple regression, factor analysis, and reliability analysis for the key measures. Descriptive analysis was carried out to determine means, frequencies, percentages, and standard deviations for the demographic profile, physical activity profile, dietary intake, fall risk factors, depression risk factors, general health status, and cognitive condition of the participants of the study. Correlation analyses were carried out to examine the relationship between nutritional risk (MNA scores) and fear of falling (FES scores), nutritional risk (MNA scores) and fall risk (Downton Index scores) and to evaluate the relationship of nutritional status and depression.

3.7.1 Multiple Regression Analysis

Multiple regression analysis involves fitting a model to a data which is then used to predict values of the dependent variable (DV) from two or more independent variables.
(IVs). In other words regression analysis is a method of predicting an outcome variable from two or more predictor variables. The multiple regression equation involving two predictor variables can be expressed as follows:

\[ Y = b_0 + b_1 X_1 + b_2 X_2 \]

where \( X_1 \) and \( X_2 \) represent the predictors or independent variables, \( b_1 \), and \( b_2 \) represent regression coefficients and \( b_0 \) is the intercept of the regression line. A straight line can be defined by a slope (or gradient) which is denoted by \( b_1 \) and the point at which the line crosses the vertical axis of the graph i.e. \( b_0 \) which is the intercept of the line. It is noteworthy that a particular line has a specific intercept and gradient. We used the Enter method which is also known as forced entry method where the predictor variables are entered into the model simultaneously and the researcher can make no decision about the order in which variables are entered into the analysis (Field, 2009). This ensures that there is no bias involved and it gives replicable results if the model is tested repeatedly. It is considered to be the only appropriate procedure for theory testing and is preferred over hierarchical (block-wise method) and stepwise method where investigators can control which predictor variables to enter first in the analysis (Studenmund & Cassidy, 1987).

3.7.2 Factor Analysis

Factor analysis was carried out to summarize data and interpret relationships between variables. It is commonly regarded as a data reduction technique and is used to regroup variables into a smaller set based on shared variance. Factor analysis is based on the premise that measurable variables can be reduced to a few latent variables that have a common variance and are unobservable. These factors that are unobservable are not directly measured but are hypothetical constructs that are used to represent variables. In
simplest terms, exploratory factor analysis is used to discover a number of factors that influence variables and to examine which variables "fit together." This procedure is very valuable in understanding concepts and identifying constructs. It helps in the simplification of inter-related measures and helps the researcher in determining patterns by examining a set of variables.

3.7.3 Reliability Analysis

Reliability of a scale or test is a measure of the extent to which it is a consistent measure of a concept or construct. Cronbach's alpha is the measure used to evaluate reliability, or internal consistency, of a set of test items. Cronbach's alpha is usually computed by correlating the individual score for each scale item with the total score for each observation and then comparing it to the variance for all item scores. The value of Cronbach's alpha ranges from 0 to 1 and a value closer to 1 is considered to be desirable. Cronbach's alpha lower than 0.5 is unacceptable and values ranging from 0.6 to 0.8 are generally considered to be acceptable. Reliability analysis was carried out for MNA, FES-I, Downton Index, MMSE, GDS, and SF-36 Health Survey.
4.1 Background profile of participants

The background characteristics of participants of the study have been summarized in Table 2. All participants were of Indian origin and lived in either government-affiliated or profit-oriented private care homes in New Delhi. Women (n=85) aged 60 years and over, were recruited for the study from a total of six LTC facilities. The mean age of the LTC residents was 74.21(5.52) years and age range was 62 to 89 years. Most were widowed (81.8%) and some were never married (5.9%).

Table 2
Background characteristics of Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Never married</td>
<td>5 (5.9%)</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>11 (12.9%)</td>
</tr>
<tr>
<td>Widow</td>
<td>69 (81.2%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Educational background</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10&lt;sup&gt;th&lt;/sup&gt; grade or below</td>
<td>43 (50.6%)</td>
</tr>
<tr>
<td>12&lt;sup&gt;th&lt;/sup&gt; grade</td>
<td>17 (20.0%)</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>25 (29.4%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of children</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>10 (11.7%)</td>
</tr>
<tr>
<td>One</td>
<td>17 (20.0%)</td>
</tr>
<tr>
<td>Two</td>
<td>40 (47.1%)</td>
</tr>
<tr>
<td>&gt;Three</td>
<td>18 (21.2%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annual income</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>INR &lt;50,000</td>
<td>26 (30.5%)</td>
</tr>
<tr>
<td>INR 50,000 to 100,000</td>
<td>23 (27.3%)</td>
</tr>
<tr>
<td>INR 100,000 to 500,000</td>
<td>8 (9.4%)</td>
</tr>
<tr>
<td>INR &gt;500,000</td>
<td>2 (2.3%)</td>
</tr>
<tr>
<td>No income</td>
<td>26 (30.5%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency of visits by children</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Once in 2 weeks</td>
<td>11 (12.9%)</td>
</tr>
<tr>
<td>Once a month</td>
<td>30 (35.4%)</td>
</tr>
<tr>
<td>Once in six months</td>
<td>19 (22.3%)</td>
</tr>
</tbody>
</table>
A majority of participants (90.6%) had stayed in the residential care facility for a period greater than two years. Most of them (68%) had two or more children and some participants (11.8%) had no children. It was reported by 35.3% of participants that their children visited them only once every month and provided them with some fruits, letters and greeting cards sent by their grandchildren. Many residents did not have any source of income (30.6%) and were supported by their care homes for their daily necessities, such as food, medications, clothing, and others. Some residents living in these care homes were getting monthly financial assistance in the form of pension from the government and/or the former employer (11.8%). These individuals either had annual incomes ranging between INR 100,000 to 500,000 or above INR 500,000.

4.2 Health and activity profile of participants

The health and physical activity profile information of the participants is shown in Table 3. The mean body weight of the participants was found to be 59.14 (7.15) kg
The mean Body Mass Index (BMI) of the residents of care homes was 23.29 (2.65). The WHO guidelines for BMI cut-offs classify persons having a BMI of 18.5 to 24.9 kg/m\(^2\) as having a normal weight but optimum BMI cut-offs for Indians proposed by Misra et al. (2009) classify individuals as normal weight if their BMI is between 18.0 and 22.9 kg/m\(^2\), underweight if their BMI is <18.0 kg/m\(^2\), overweight if their BMI is 23 to 24.9 kg/m\(^2\) and obese if BMI is >25 kg/m\(^2\). Using Misra et al. (2009) BMI classification for Indians, 42.4% of participants had normal weight, 28.2% were overweight, 28.2% were obese, and 1.2% were underweight. Misra et al. (2003) has proposed that WHO guidelines for BMI classification are based on morbidity data of Caucasian populations and are not applicable to Indian populations which have a greater percentage of body fat and abdominal adiposity at lower level of BMI compared to Caucasians. Therefore, BMI cut-offs for Indians have been lowered and the optimal cut-off in identification of overweight individuals has been proposed as 23 kg/m\(^2\). This has been confirmed in another study carried out by Mohan et al. (2007) which recommends the ideal BMI cut-off for Indian men and women to be 23kg/m\(^2\).

The study participants spent most of their time in sedentary activities such as reading books and newspapers, listening to music, talking to friends, and watching television. The mean sitting time was computed as 8 hours and mean time spent doing exercise was 16 minutes. Participants were aware of the benefits of doing regular exercise (99%) and knew that exercise keeps an individual in good health and is useful in prevention of chronic disease (45%). Only one participant was not aware of the benefits of engaging in exercise regularly. A majority of participants (84.5%) were willing to
participate in an exercise program in their care home, if the director or manager of the
care home was prepared to take some initiatives in organizing such programs on a daily or
weekly basis. Many individuals (48%) preferred individually designed exercise programs
in the presence of an exercise trainer or instructor. The researcher collected information
on the physical activity level (PAL) of the participants throughout their lives as younger
adults, and found that most of them (71.7%) led fairly active lives in the past and
performed exercise regularly. Some participants did not perform exercise at all (23.5%) when
they were younger or middle-aged adults while others (20%) performed
"pranayama," a form of yoga which originated in India and includes deep breathing
exercises comprising inhalation, retention, and exhalation practised at different rates of
respiration. A few participants preferred walking (26.6%) in the facility compound. Only 2.2% women reported doing 30 minutes of moderate-intensity exercise daily. The
researcher gathered information on knowledge of benefits of balance and strength
training in fall prevention. It was observed that only 18.8% of women were aware of the
importance of balance and strength training exercises in prevention of falls and fall-
related injuries.

Table 3

Health profile of participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n (%) or M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>59.14 (7.9)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>159.62 (3.7)</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>23.29 (2.6)</td>
</tr>
<tr>
<td>Mid arm circumference (MAC)</td>
<td>25.77 (1.9)</td>
</tr>
</tbody>
</table>
Calf circumference (CC) 33.34 (2.2)

Physical Activity profile

Time spent sitting (hours) 7.94 (2.4)
Time spent doing exercise (mins) 15.56 (4.9)

Preference for doing exercise

Individual exercise 40 (48.2%)
Group exercise 29 (34.9%)
Both individual and group exercise 4 (4.8%)
Neither individual nor group exercise 10 (12.1%)

Physical activity level (PAL) throughout life n (%)

Very active (% yes) 4 (4.7%)
Active (% yes) 61 (71.8%)
Not active at all (% yes) 20 (23.5%)

The daily mean medication intake was 4.79 (2.34) and 60.6% of participants consumed 3 to 6 medications in a day. A few women reported that they were healthy and did not take any medications (8.2%). Some residents (23%) consumed 7 to 10 medications daily. Study participants had several chronic health conditions including diabetes, hypertension, heart disease, asthma, osteoarthritis, gastrointestinal disorders (including acidity, gastroesophageal reflux, and constipation), back problems, and rheumatoid arthritis. It was reported that 94.4% of care home residents had chronic health problems. The most common chronic health conditions found in the participants were
osteoarthritis (44.7%), back problems (39.7%), hypertension (38.8%), and gastrointestinal disorders (37.6%).

The SF-36 scale was used to evaluate health-related quality of life (HRQoL) and is comprised of 36 questions or items which assess eight domains including, physical functioning, limitations due to physical health problems (role-physical, RP), body pain (BP), general health (GH), vitality (VT), social functioning (SF), limitations resulting from emotional health problems (role-emotional, RE), and mental health (MH). Four items on the survey were found irrelevant to the context of LTC and were removed leaving only 32 items. These items included: difficulty in performing work or other activities (e.g. requiring extra effort (item 16)), during past 4 weeks emotional problems (e.g. anxiety, depression) resulted in cutting down time spent on work or other activities (item 17), accomplishing less due to these problems (item 18), and did not do work as carefully as usual due to emotional reasons (item 19). The multiple items on the eight subscales represent physical component summary (PCS) and mental component summary (MCS). Higher scores represent a greater level of health-related quality of life (HRQoL), and are suggestive of a better physical and mental health status. The general health characteristics as assessed using SF-36 Health Survey have been described in Table 4.

Some study participants described their health status as being good (34%) and a few individuals felt that their health status was rather poor (14%). Several participants (45%) reported that their health was almost the same when compared to their health one year ago. Almost half the study participants (48%) had limited performing moderate activities to some extent, and vigorous activities were not at all performed by 93% of participants. Doing grocery shopping was limited a lot by most individuals (62%), as they
were mostly satisfied with the meals they were being provided at the care home facilities, and also did not have adequate financial resources to spend on purchasing groceries. Climbing several stairs was also considered to be a difficult task and was limited a lot by 82% participants. A major proportion of participants (85%) described their inability to accomplish tasks as per their preference due to physical health problems, and 51% of women revealed that they were experiencing moderate body pain which restricted their work productivity and social interaction. About 52% participants reported that they mostly expected their health to become worse in the following years and a good bit of the residents often felt blue, down hearted (31%) and were suffering from low energy levels and fatigue most of the time (31%).
Table 4

General health status of study participants

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Characteristic</th>
<th>M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Self-perception of general health</td>
<td>35.8 (18.7)</td>
</tr>
<tr>
<td>2</td>
<td>Present health condition compared to health one year ago</td>
<td>41.1 (23.3)</td>
</tr>
<tr>
<td>3</td>
<td>Difficulty performing vigorous activity</td>
<td>3.9 (12.9)</td>
</tr>
<tr>
<td>4</td>
<td>Performing moderate level of activity</td>
<td>28.5 (26.3)</td>
</tr>
<tr>
<td>5</td>
<td>Problems with lifting or carrying groceries</td>
<td>21.8 (25.7)</td>
</tr>
<tr>
<td>6</td>
<td>Difficulty climbing several stairs</td>
<td>9.9 (19.2)</td>
</tr>
<tr>
<td>7</td>
<td>Difficulty climbing one flight of stairs</td>
<td>47.6 (34.9)</td>
</tr>
<tr>
<td>8</td>
<td>Bending to find something on the floor</td>
<td>54.9 (40.1)</td>
</tr>
<tr>
<td>9</td>
<td>Walking more than a mile</td>
<td>58.8 (40.0)</td>
</tr>
<tr>
<td>10</td>
<td>Walking several blocks</td>
<td>12.6 (23.6)</td>
</tr>
<tr>
<td>11</td>
<td>Walking one block</td>
<td>50.8 (35.9)</td>
</tr>
<tr>
<td>12</td>
<td>Bathing or dressing up regularly</td>
<td>68.2 (39.4)</td>
</tr>
<tr>
<td>13</td>
<td>Cutting down time spent on work / activities as a result of physical health problems</td>
<td>17.2 (36.2)</td>
</tr>
<tr>
<td>14</td>
<td>Accomplishing less than one’s preference due to physical problems</td>
<td>17.2 (36.2)</td>
</tr>
<tr>
<td>15</td>
<td>Limited in the kind of work or activity due to physical problems</td>
<td>37.0 (47.3)</td>
</tr>
<tr>
<td></td>
<td>Question</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>20</td>
<td>Interference of physical problems in social activities e.g. meeting friends/relatives</td>
<td>53.2 (22.8)</td>
</tr>
<tr>
<td>21</td>
<td>Presence of body pain</td>
<td>39.5 (17.7)</td>
</tr>
<tr>
<td>22</td>
<td>Interference of body pain with work</td>
<td>42.6 (25.2)</td>
</tr>
<tr>
<td>23</td>
<td>Feeling full of pep in the past 4 weeks</td>
<td>37.8 (19.8)</td>
</tr>
<tr>
<td>24</td>
<td>Been a nervous person in the last 4 weeks</td>
<td>45.2 (22.7)</td>
</tr>
<tr>
<td>25</td>
<td>Feeling low such that nothing could cheer you</td>
<td>56.9 (26.5)</td>
</tr>
<tr>
<td>26</td>
<td>Felt calm and peaceful</td>
<td>44.4 (20.9)</td>
</tr>
<tr>
<td>27</td>
<td>Had lots of energy</td>
<td>39.5 (19.7)</td>
</tr>
<tr>
<td>28</td>
<td>Feeling downhearted and blue</td>
<td>57.7 (22.3)</td>
</tr>
<tr>
<td>29</td>
<td>Felt worn out</td>
<td>45 (19.27)</td>
</tr>
<tr>
<td>30</td>
<td>Been a happy person</td>
<td>44.4 (22.8)</td>
</tr>
<tr>
<td>31</td>
<td>Feeling tired</td>
<td>45 (19.27)</td>
</tr>
<tr>
<td>32</td>
<td>How frequently in the past four weeks have your physical problems prevented you from social interaction e.g. meeting friends</td>
<td>46.9 (18.6)</td>
</tr>
<tr>
<td>33</td>
<td>Getting sick easily as compared to other people</td>
<td>50.9 (24.5)</td>
</tr>
<tr>
<td>34</td>
<td>Are you as healthy as others</td>
<td>52.9 (27.6)</td>
</tr>
<tr>
<td>35</td>
<td>Expecting health to get worse</td>
<td>33.4 (17.5)</td>
</tr>
<tr>
<td>36</td>
<td>Feeling your health is excellent</td>
<td>22.5 (20.7)</td>
</tr>
</tbody>
</table>
Items 16, 17, 18, and 19 were omitted due to their emotional risk level with participants living in care homes. These items concern difficulty performing work or activities as a result of emotional problems e.g anxiety, depression. Pro-rating was carried out to compensate for missing items on emotional health of older adults.

4.3 Nutritional characteristics of participants

The Mini-Nutritional Assessment (MNA) Long-form was used to assess the nutritional risk profile of older women who participated in the study. The MNA includes questions on weight loss, number of medications taken daily, dietary intake, neuropsychological problems and self-perception of health status. The nutritional status characteristics of the study participants are shown in Table 5. Weight loss between 1 and 3 kg was reported by 24.7% women and weight loss greater than 3 kg was reported by 32.9% women. Some women reported that they did not know if they had lost weight (20%) in the past few months and 22.3% women had maintained the same weight status as they did not lose any weight in the past several months.
Table 5
Nutritional profile of study participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Meal intake</strong></td>
<td></td>
</tr>
<tr>
<td>Three meals</td>
<td>56 (65.9%)</td>
</tr>
<tr>
<td>Two meals</td>
<td>28 (32.9%)</td>
</tr>
<tr>
<td>One meal</td>
<td>1 (1.2%)</td>
</tr>
<tr>
<td><strong>Decline in food intake</strong></td>
<td></td>
</tr>
<tr>
<td>No decrease in food intake</td>
<td>27 (31.7%)</td>
</tr>
<tr>
<td>Moderate decrease in food intake</td>
<td>45 (52.9%)</td>
</tr>
<tr>
<td>Severe decrease in food intake</td>
<td>13 (15.4%)</td>
</tr>
<tr>
<td><strong>Weight loss during past 3 months</strong></td>
<td></td>
</tr>
<tr>
<td>Between 1 and 3 kg</td>
<td>21 (24.7%)</td>
</tr>
<tr>
<td>Greater than 3 kg</td>
<td>28 (32.9%)</td>
</tr>
<tr>
<td>No weight change</td>
<td>19 (22.4%)</td>
</tr>
<tr>
<td>Does not know</td>
<td>17 (20.0%)</td>
</tr>
<tr>
<td><strong>At least one serving of dairy products/day</strong></td>
<td>84 (98.8%)</td>
</tr>
<tr>
<td><strong>Two or more servings of legumes per week</strong></td>
<td>79 (92.9%)</td>
</tr>
<tr>
<td><strong>Two or more servings of fruits and/or vegetables daily</strong></td>
<td>62 (72.8%)</td>
</tr>
<tr>
<td><strong>Fluid consumed per day</strong></td>
<td></td>
</tr>
<tr>
<td>3-5 cups</td>
<td>6 (7.1%)</td>
</tr>
<tr>
<td>&gt;5 cups</td>
<td>79 (92.9%)</td>
</tr>
</tbody>
</table>
Mode of feeding

Unable to eat without assistance  4 (4.8%)
Self-feed with some difficulty  8 (9.4%)
Self-feed without any difficulty  73 (85.8%)

Self-perception of nutritional state

Considers self as malnourished  15 (17.6%)
Views self as having no problem  37 (43.5%)
Uncertain of nutritional status  33 (38.9%)

Self-perception of health condition

Not as good  21 (24.7%)
As good  31 (36.4%)
Not sure  27 (31.8%)
Better  6 (7.1%)

MNA Score  18.44 (4.71)

Nutritional risk classification

≤17 Malnourished  27 (31.7%)
17.5 to 23.5 At nutritional risk  46 (54.1%)
>23.5 Normal nutritional status  12 (14.2%)

Three complete meals were consumed by 65.8% of participants and 32.9% preferred only two meals a day (breakfast and dinner). Milk, cheese, and/or yoghurt were consumed daily by a majority of women (98.8%). At least two servings of fruits and vegetables were included in the daily dietary intake of 72.9% of women. Most participants were able to eat independently (85.8%) without assistance provided by caregivers. A few persons were totally dependent on caregivers (4.7%) during mealtimes. Many of them considered themselves to be healthy and without any nutritional problem.
Some women viewed themselves as malnourished and at a high nutritional risk (17.6%). The mean MNA Score of the participants was 18.44 (4.71) and they were classified as “malnourished”, “at nutritional risk” and having a “normal nutritional status” depending on the score obtained by adding their responses to MNA questions. It was found that 54.1% of study participants were at nutritional risk based on the computed MNA scores. Individuals who obtained MNA Score <17 were classified as malnourished or undernourished and those who scored between 17 and 23.5 were considered to be “at nutritional risk”. Moreover, individuals who scored greater than 24 on the MNA were classified as having a normal nutritional status.

4.4 Fall risk profile of participants

The fall risk of participants was assessed using Downton Index, which is used to determine presence of factors that lead to a heightened risk of falling, and the Fall Efficacy Scale International (FES-I), which evaluates fear of falling. The Downton Index measures fall risk and is based on information related to falls history, intake of sedatives, diuretics, anti-depressants, gait status, and cognitive status. Individuals getting high scores on Downton Index (>3) questionnaire are at a greater fall risk. Fall risk profile of the participants has been listed in Table 6. The mean Downton index score was computed as 3.38 (2.18). Using the Downton index classification, more than half of the total participants (58%) were found to be at a high risk of falling. Many women faced balance and mobility problems and an unsteady gait (45.9%). Only 32% were safe while using assistive devices and had an adequate gait status. Some women were not comfortable with using walking devices (14%) and were classified as “unsafe while using assistive devices” such as cane sticks and walkers. These individuals had gait instability and
balance deficits and had lower confidence in using walking aids. More than half of the participants had experienced previous falls (54%) and a majority of them had visual impairment (71%) while some had hearing impairment (21%) and limb impairment (33%).

The FES-I questionnaire examines the confidence of older adults in performing 16 activities of daily living and determines their concern about falling. The activities include cleaning, meal preparation, dressing, bathing, going to answer the phone, grocery shopping, moving out of chair/bed, climbing stairs, walking in the neighbourhood, walking up or getting down a slope, walking on an uneven surface, walking on a slippery surface, visiting friends, going to a crowded area and going to a social event. A higher score obtained on FES-I is indicative of higher risk of falling. Scores obtained on the FES typically range between 16 and 64 with higher scores indicating higher levels of fear of falling. The mean FES-I score was 34.04 (13.8) and 60% of older adults had an intense fear of falling as evident from their FES-I scores ranging from 28 to 64. Some residents were very concerned about walking on a slippery surface (20%), walking on an uneven surface (33%), walking in a crowded area (18%), and going to a social/religious event (21%). Study participants had a greater confidence level (lower fear of falling) while cleaning, dressing up, going to attend a phone call, and moving in or out of their chair and bed, but had a low confidence level (higher fear of falling) while climbing or descending stairs, walking on a slippery or uneven surface, bathing, visiting friends and neighbourhood, going to a social or religious event and walking in a crowded place or on a slope.
**Table 6**

Fall risk profile of participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n (%) or M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of falls</td>
<td>46 (54.1%)</td>
</tr>
<tr>
<td>Use of tranquillizers</td>
<td>36 (42.3%)</td>
</tr>
<tr>
<td>Use of anti-depressants</td>
<td>20 (23.5%)</td>
</tr>
<tr>
<td>Use of diuretics</td>
<td>33 (38.8%)</td>
</tr>
<tr>
<td>Use of anti-hypertensives</td>
<td>33 (38.8%)</td>
</tr>
<tr>
<td>Visual impairment</td>
<td>60 (70.6%)</td>
</tr>
<tr>
<td>Hearing impairment</td>
<td>18 (21.2%)</td>
</tr>
<tr>
<td>Limb impairment</td>
<td>28 (32.9%)</td>
</tr>
</tbody>
</table>

**Gait status**

- **Need for assistive devices**
  - Normal (safe without walking aids) 45 (52.9%)
  - Safe with walking aids 12 (14.1%)
  - Unsafe without walking aids 1 (1.2%)
  - Unable

**Falls Efficacy Scale (FES-I)**

- Fear of falling while performing the following activity
  - Cleaning 1.69 (0.8)
<table>
<thead>
<tr>
<th>Daily Activity</th>
<th>M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparing meals</td>
<td>1.68 (0.8)</td>
</tr>
<tr>
<td>Dressing or undressing oneself</td>
<td>1.67 (0.8)</td>
</tr>
<tr>
<td>Bathing</td>
<td>2.02 (0.9)</td>
</tr>
<tr>
<td>Grocery shopping</td>
<td>1.92 (1.0)</td>
</tr>
<tr>
<td>Moving in/or out of a chair</td>
<td>1.71 (0.9)</td>
</tr>
<tr>
<td>Climbing stairs</td>
<td>2.32 (0.9)</td>
</tr>
<tr>
<td>Walking in neighbourhood</td>
<td>1.99 (1.0)</td>
</tr>
<tr>
<td>Reaching for things above (in cabinets)</td>
<td>1.87 (0.9)</td>
</tr>
<tr>
<td>Going to answer the phone</td>
<td>1.76 (0.9)</td>
</tr>
<tr>
<td>Walking on a slippery surface</td>
<td>2.75 (0.8)</td>
</tr>
<tr>
<td>Going to visit friends</td>
<td>2.02 (1.1)</td>
</tr>
<tr>
<td>Walking in a crowded place</td>
<td>2.24 (1.1)</td>
</tr>
<tr>
<td>Walking on an uneven surface</td>
<td>2.89 (0.9)</td>
</tr>
<tr>
<td>Going up/down a slope</td>
<td>3.13 (0.9)</td>
</tr>
<tr>
<td>Attending a social event</td>
<td>2.35 (1.1)</td>
</tr>
<tr>
<td>FES Score (0 to 64)</td>
<td>34.04 (13.8)</td>
</tr>
<tr>
<td>Fear of Falling Classification</td>
<td>n (%)</td>
</tr>
<tr>
<td>Low risk (score 16-19)</td>
<td>9 (10.6)</td>
</tr>
<tr>
<td>Moderate risk (score 20-27)</td>
<td>25 (29.4)</td>
</tr>
<tr>
<td>Severe risk (score 28-64)</td>
<td>51 (60.0)</td>
</tr>
</tbody>
</table>

Most individuals who participated in the study (70%) had some form of visual impairment. Some women recently had cataract surgeries (20%), while some others had myopia or short-sightedness (35%); a few had retinopathy (10%), while the remaining women had some unknown visual impairment (5%). Hearing impairment was also present in some persons (21%) and only 7% of these women had been using hearing aids. Others who did not have access to hearing aids felt helpless and experienced
communication problems. Limb impairment was present in 33% of women and resulted in balance and mobility problems in these individuals and increased their susceptibility to encounter falls.

The depression level was assessed using Geriatric Depression Scale-Long Form which consists of 30 items with Yes or No response. The depression items included in GDS are shown in Table 7. Individuals scoring higher than 20 on this questionnaire were considered to be having severe depression while individuals scoring between 0 and 9 were considered to be having mild depression. Participants who scored between 10 and 19 were moderately depressed. A majority of them faced a drop in interest in daily activities (80%) and some were dissatisfied with life (24.7%). Boredom was experienced by 71.7% women and emptiness was present in the lives of 45.8% women. Several participants felt that unpleasant things would occur in future (60%) and would constantly worry about an uncertain future (67%).

More than half (53%) participants believed that other individuals are better off than them 51.7% residents preferred avoiding social events and activities and most individuals wanted to stay in the care facility (73%) as they found it to be safe and comfortable as compared to going out. Using the GDS Classification scale, it was found that severe depression was experienced by 47% women, and it was also observed that 42.4% women were moderately depressed.
Table 7

Level of depression as assessed using Geriatric Depression Scale (GDS)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n (% Yes or No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfaction with life (% No)</td>
<td>21 (24.7%)</td>
</tr>
<tr>
<td>Drop of interest in activities (% Yes)</td>
<td>68 (80.0%)</td>
</tr>
<tr>
<td>Feeling of emptiness (% Yes)</td>
<td>39 (45.8%)</td>
</tr>
<tr>
<td>Getting bored often (% Yes)</td>
<td>61 (71.7%)</td>
</tr>
<tr>
<td>Hopeful about future (% No)</td>
<td>49 (57.6%)</td>
</tr>
<tr>
<td>Bothered by repetitive thoughts (% Yes)</td>
<td>56 (65.8%)</td>
</tr>
<tr>
<td>In good spirits most of the time (% No)</td>
<td>43 (50.6%)</td>
</tr>
<tr>
<td>Afraid of something bad occurring in future (% Yes)</td>
<td>51 (60.0%)</td>
</tr>
<tr>
<td>Feeling happy most of the time (% No)</td>
<td>54 (63.5%)</td>
</tr>
<tr>
<td>Feeling helpless (% Yes)</td>
<td>52 (61.2%)</td>
</tr>
<tr>
<td>Getting restless and fidgety often (% Yes)</td>
<td>57 (67.1%)</td>
</tr>
<tr>
<td>Prefer staying at home rather than going out (% Yes)</td>
<td>62 (72.9%)</td>
</tr>
<tr>
<td>Often worrying about future ( % Yes)</td>
<td>57 (67.1%)</td>
</tr>
<tr>
<td>Having memory problems greater than others (% Yes)</td>
<td>33 (38.8%)</td>
</tr>
<tr>
<td>Enjoy being alive (% No)</td>
<td>31 (36.4%)</td>
</tr>
<tr>
<td>Question</td>
<td>Yes</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Feel blue or downhearted (%) Yes</td>
<td>53</td>
</tr>
<tr>
<td>Feeling worthless often (% Yes)</td>
<td>25</td>
</tr>
<tr>
<td>Thinking of past frequently (% Yes)</td>
<td>58</td>
</tr>
<tr>
<td>Find life exciting (% No)</td>
<td>63</td>
</tr>
<tr>
<td>Trouble concentrating (% Yes)</td>
<td>56</td>
</tr>
<tr>
<td>Enjoy getting up in the morning (% No)</td>
<td>39</td>
</tr>
<tr>
<td>Prefer avoiding social gatherings (% Yes)</td>
<td>44</td>
</tr>
<tr>
<td>Ease of making decisions (% No)</td>
<td>21</td>
</tr>
<tr>
<td>Clarity of mind (% No)</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mean   GDS Score (0 to 30 points)</th>
<th>16.6 (9.7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Depression using GDS</td>
<td></td>
</tr>
<tr>
<td>Normal to mild (score 0-9)</td>
<td>9 (10.6%)</td>
</tr>
<tr>
<td>Moderate (score 10-19)</td>
<td>36 (42.4%)</td>
</tr>
<tr>
<td>Severe (score 20-30)</td>
<td>40 (47.1%)</td>
</tr>
</tbody>
</table>

Cognitive deficits present in participants were assessed using the Mini-Mental State Exam (MMSE) questionnaire which evaluates an individual's ability to remember, recall, read, write, perform an act after reading the instructions, copy a diagram shown on a piece of paper, and identify familiar objects. The degree or extent of memory loss can be determined by this questionnaire. Higher scores obtained on MMSE are suggestive of a better cognitive status and is indicative of acceptable level of memory, orientation,
registration, judgment, identification, attention, and recall. MMSE is a screening test that is used commonly in geriatric populations to identify presence of cognitive deficits and determine if dementia is present.

A considerable proportion of participants (41.2%) were aware of the date and only 2% of them were unable to recall the date (Table 8). Almost half participants (47.1%) were able to obtain full 5 marks and 34.1% participants obtained 4 marks on recalling the exact location of self, including details of the care home address, floor number where their apartment was located, name of care home, and name of the city where it was located. Most individuals had sufficient object-identification skills (92.9%) and were able to name three unrelated objects shown by the researcher. A majority of individuals faced difficulty in spelling "world" backwards and only 7.1% of the participants were able to spell "world" backwards without making any mistake. A majority of women had the ability to follow instructions after reading (96.5%), and could easily perform an act such as, repeating a given phrase (58.8%), and copy a diagram shown on a piece of paper (85.9%). The mean MMSE score was found to be 21.7 (5.3). It was observed that on the basis of MMSE cognitive status classification, 4.7% seniors had severe cognitive deficits (score ranging between 0 and 9), 16.5% seniors had moderate cognitive impairment (score ranging between 10 and 19), 49.4% seniors had mild cognitive impairment (scores ranging between 20 and 24), and 29.4% seniors had no cognitive deficits (scores ranging between 25 and 30) (Table 8).
Table 8

Severity of memory problems and cognitive decline assessed by Mini Mental State Exam (MMSE)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Item Score (scored out of 5) M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness of date, day, month, year, season</td>
<td>4.0 (1.1)</td>
</tr>
<tr>
<td>Awareness of location of self</td>
<td>4.2 (1.0)</td>
</tr>
<tr>
<td>Ability to name three unrelated objects</td>
<td>2.8 (0.4)</td>
</tr>
<tr>
<td>Recalling names of three objects mentioned before</td>
<td>2.4 (0.8)</td>
</tr>
<tr>
<td>Spelling the word &quot;world&quot; backwards</td>
<td>1.5 (1.4)</td>
</tr>
<tr>
<td>Identifying two simple objects</td>
<td>1.8 (0.4)</td>
</tr>
<tr>
<td>Repeating a given phrase</td>
<td>0.6 (0.5)</td>
</tr>
<tr>
<td>Folding a sheet of paper as instructed</td>
<td>2.3 (1.2)</td>
</tr>
<tr>
<td>Reading and performing</td>
<td>0.9 (0.2)</td>
</tr>
<tr>
<td>Writing a sentence with both noun and verb</td>
<td>0.2 (0.4)</td>
</tr>
<tr>
<td>Copying a given picture/diagram</td>
<td>0.8 (0.3)</td>
</tr>
</tbody>
</table>

4.5 Correlation Analysis

Correlation analysis was carried out to determine the relationship of variables such as age, TUG score and total handgrip strength with each of the following test scores-MNA, FES-I, GDS, Downton Index and MMSE. Results of this analysis have been
presented in Table 9 shown below. A higher age was found to be associated with lower MNA scores ($r=-.497$) and indicates that advancing age was associated with a greater nutritional risk. It was also observed that advancing age was associated with increased fear of falling among study participants ($r=.563$). Older individuals were more concerned about performing activities of daily living and feared that they might fall and injure themselves. Individuals who had a higher fear of falling took longer to complete the timed-up-and-go (TUG) test ($r=.611$). Women who scored well on MMSE questionnaire had a higher functional status as their handgrip strength was greater. Depression severity was shown to be associated with advanced age ($r=.398$) and scores obtained on Mini Mental State Exam dropped with higher age ($r=-.387$).

Table 9
Correlation analysis of age, TUG time and total handgrip strength with MNA, FES-I, GDS, Downton Index and MMSE scores

<table>
<thead>
<tr>
<th>Scale</th>
<th>Age</th>
<th>TUG time</th>
<th>HGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MNA</td>
<td>-0.497</td>
<td>-0.353</td>
<td>0.472</td>
</tr>
<tr>
<td></td>
<td>(p&lt;0.001)</td>
<td>(p=0.001)</td>
<td>(p&lt;0.001)</td>
</tr>
<tr>
<td>FES-I</td>
<td>0.563</td>
<td>0.611</td>
<td>-0.483</td>
</tr>
<tr>
<td></td>
<td>(p&lt;0.001)</td>
<td>(p&lt;0.001)</td>
<td>(p&lt;0.001)</td>
</tr>
<tr>
<td>GDS</td>
<td>0.398</td>
<td>0.353</td>
<td>-0.504</td>
</tr>
<tr>
<td></td>
<td>(p&lt;0.001)</td>
<td>(p=0.001)</td>
<td>(p&lt;0.001)</td>
</tr>
<tr>
<td>Downton Index</td>
<td>0.329</td>
<td>0.480</td>
<td>-0.421</td>
</tr>
<tr>
<td></td>
<td>(p&lt;0.002)</td>
<td>(p&lt;0.001)</td>
<td>(p&lt;0.001)</td>
</tr>
<tr>
<td>MMSE</td>
<td>-0.387</td>
<td>-0.318</td>
<td>0.524</td>
</tr>
</tbody>
</table>
Correlation analysis of Mini Nutritional Assessment (MNA) scores was conducted with FES-I, Downton Index, Geriatric Depression Scale-Long form and Mini-Mental State Exam scores and it is shown in Table 10 below. It was found that individuals having higher fear of falling had a lower nutritional status and the older adults who were severely depressed according to GDS classification criteria had a lower nutritional status. Individuals who scored high on Mini-Mental State Exam had a higher nutritional status and consequently a lower nutritional risk.

Table 10

Correlation analysis of MNA with FES-I, Downton Index, GDS and MMSE scores

<table>
<thead>
<tr>
<th>MNA</th>
<th>FES-I</th>
<th>Downton Index</th>
<th>GDS</th>
<th>MMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-.644</td>
<td>-.419</td>
<td>-.616</td>
<td>.528</td>
</tr>
<tr>
<td></td>
<td>(p&lt;0.001)</td>
<td>(p&lt;0.001)</td>
<td>(p&lt;0.001)</td>
<td>(p&lt;0.001)</td>
</tr>
</tbody>
</table>

4.6 Multiple Regression Analysis

Multiple regression analysis was carried out with Downton Index as the outcome variable or dependent variable (DV) and the MNA score as predictor variable or independent variable (IV) along with other variables of interest, such as, fear of falling (measured by FES-I score), fall history, depression (measured by GDS score), cognitive status (measured by MMSE scores), body pain, gait condition, time taken to perform...
TUG test and ability to carry out moderate intensity activities. Significant b values (p<.001 or p<.05) indicated that the predictor variables (IVs) are strong determinants of fall risk. The b values give us information about the relation between fall risk and predictor variables. The sign of b-values indicates the direction of relationship between the predictor and outcome variable. The summary tables contain valuable information about unstandardized and standardized regression coefficients. Standardized regression co-efficients are considered to be useful as researchers find them easier to interpret since they are measured in standard deviation units, and thus are directly comparable and hence provide a greater insight into the importance of a predictor variable.

Multiple regression analysis was carried out to test whether FES-I (measure of fear of falling) score acts as a predictor of Downton Index Score i.e. fall risk (Table 11). It was found that fear of falling represented by FES-I score is a strong predictor variable and can determine future fall risk. FES-I is indicative of the confidence possessed by seniors in performing 16 activities of daily living. The unstandardized regression coefficients associated with MNA score and FES-I score were -.007 and .099 respectively. The standardized regression coefficients associated with MNA score and FES-I score were -.015 and .627 respectively. As shown in Table 12, the F value was 28.05 and degrees of freedom for regression and residual were 2 and 82. Also, both MNA score and FES-I score together account for 40.6% variability in fall risk.
Table 11

Multiple regression analysis involving FES-I Score as a predictor of fall risk (Downton Index Score)

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized coefficients</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td>Constant</td>
<td>.132</td>
</tr>
<tr>
<td>MNA Score</td>
<td>-.007</td>
</tr>
<tr>
<td>FES-I Score</td>
<td>.099</td>
</tr>
</tbody>
</table>

Table 12

Model summary for regression analysis involving Downton Index score (DV) and MNA score and FES-I score as IVs

<table>
<thead>
<tr>
<th>DV</th>
<th>IVs</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downton index</td>
<td>MNA score, FES-I</td>
<td>.637</td>
<td>.406</td>
<td>28.05</td>
<td>82</td>
<td>.000</td>
</tr>
</tbody>
</table>

The researcher also attempted to determine if previous falls encountered by study participants act as a predictor of fall risk. Both MNA score and fall history were entered into the regression analysis as independent variables and Downton Index score was
entered as the dependent variable or outcome variable. From Table 13, it can be noted that the unstandardized and standardized regression coefficients for MNA score were -1.1 and -0.227 respectively. For fall history, the value of unstandardized and standardized regression coefficients was 2.2 and 0.509. As included in the model summary in Table 14, F value is 27.16 and degrees of freedom are 2 and 82. $R^2$ is 0.399 which implies that both MNA score and fall history together account for 39.9% variability in fall risk.

Table 13

Multiple regression analysis showing fall history as a predictor of fall risk

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients**</th>
<th>t-test</th>
<th>Sig. level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized coefficients</td>
<td>Standardized coefficients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Standard error</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant</td>
<td>4.1</td>
<td>.914</td>
<td>4.5</td>
</tr>
<tr>
<td>MNA Score</td>
<td>-1.1</td>
<td>.043</td>
<td>-2.4</td>
</tr>
<tr>
<td>Falls history</td>
<td>2.2</td>
<td>.403</td>
<td>5.5</td>
</tr>
</tbody>
</table>

Table 14

Model summary for regression involving Downton Index as DV and MNA and fall history as IVs

<table>
<thead>
<tr>
<th>DV</th>
<th>IVs</th>
<th>R</th>
<th>$R^2$</th>
<th>F</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downton Index</td>
<td>MNA, Score, Fall history</td>
<td>.631</td>
<td>.399</td>
<td>27.16</td>
<td>2</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>82</td>
<td></td>
</tr>
</tbody>
</table>
The researcher found that difficulty in carrying out moderate intensity activities was a predictor of fall risk. The unstandardized and standardized regression coefficients for MNA score and moderate intensity activity have been shown in Table 15. The negative sign of b-values suggests that there is an inverse relationship between difficulty in performing moderate intensity activity and Downton Index score. From Table 16, it can be noted that the F value was 22.28 and degrees of freedom for the regression and residual were 2 and 82. Both MNA score and difficulty in doing activities of moderate intensity accounted for 35.2% variability in Downton Index scores or fall risk. Difficulty encountered by participants in doing activities of moderate intensity indicates that they had low functional status and were vulnerable to develop dependence on caregivers for performing activities of daily living (ADL).

Table 15

Multiple regression showing a decreased ability to perform moderate activities acting as a predictor of fall risk

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients**</th>
<th>t-test</th>
<th>Sig. level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized coefficients</td>
<td>Standardized coefficients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Standard error</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant</td>
<td>5.930</td>
<td>.813</td>
<td>7.29</td>
</tr>
<tr>
<td>MNA Score</td>
<td>-.083</td>
<td>.047</td>
<td>-.180</td>
</tr>
<tr>
<td>Difficulty with moderate intensity activity</td>
<td>-.040</td>
<td>.008</td>
<td>-.483</td>
</tr>
</tbody>
</table>

Dependent variable: Downton index score
Predictor variable: MNA Score, difficulty with moderate level of activity

Table 16
Model summary for regression analysis involving Downton Index score as outcome variable or DV and MNA score and difficulty performing moderate level of activity as predictor variables or IVs

<table>
<thead>
<tr>
<th>DV</th>
<th>IVs</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downton</td>
<td>MNA Score, Difficulty performing moderate level of activity</td>
<td>.593</td>
<td>.352</td>
<td>22.28</td>
<td>2</td>
<td>.000</td>
</tr>
</tbody>
</table>

Multiple regression analysis was conducted to determine whether visual and limb impairment act as predictors of fall risk. Both visual and limb impairments were found to be strong predictor variables as their effect on Downton Index score was found to be significant. From Table 17, it is clear that the unstandardized and standardized regression coefficients for visual impairment are 1.995 and .419, respectively. It implies that older adults living in care homes who suffer from visual impairment are at a greater fall risk. Visual impairment makes it difficult for older adults to notice obstacles in their path while walking or descending stairs.
Table 17

Multiple regression analysis showing visual impairment as a predictor of future fall risk

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients**</th>
<th>t-test</th>
<th>Sig. level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>coefficients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>4.525</td>
<td>4.705</td>
<td>.000</td>
</tr>
<tr>
<td>MNA Score</td>
<td>-.139</td>
<td>-3.189</td>
<td>.002</td>
</tr>
<tr>
<td>Visual</td>
<td>1.995</td>
<td>4.465</td>
<td>.000</td>
</tr>
<tr>
<td>impairment</td>
<td>.962</td>
<td>.043</td>
<td>-.229</td>
</tr>
<tr>
<td></td>
<td>.447</td>
<td>.419</td>
<td></td>
</tr>
</tbody>
</table>

It can be noted from Table 18 that both MNA score and visual impairment account for 33.7% variability in fall risk. The F value was 20.85 and degrees of freedom for regression and residual were 2 and 82. Obtaining lower scores on MNA questionnaire is associated with a higher level of nutritional risk and as discussed earlier, loss of visual acuity makes it difficult to notice impediments, uneven surfaces, and increases the susceptibility to encounter falls in care home residents. From Table 19, it can be observed that limb impairment is also a significant predictor of fall risk.
Table 18

Model summary for regression analysis involving Downton Index score as DV and MNA Score and visual impairment as predictor variables or IVs

<table>
<thead>
<tr>
<th>DV</th>
<th>IVs</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downton Index</td>
<td>MNA Score, Visual impairment</td>
<td>.581</td>
<td>.337</td>
<td>20.85</td>
<td>2</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 19

Multiple regression analysis showing limb impairment as a predictor of future fall risk

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients**</th>
<th>t-test</th>
<th>Sig. level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized coefficients</td>
<td>Standardized coefficients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Standard error</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant</td>
<td>3.874</td>
<td>.834</td>
<td>4.646</td>
</tr>
<tr>
<td>MNA Score</td>
<td>-.077</td>
<td>.041</td>
<td>-.166</td>
</tr>
<tr>
<td>Limb</td>
<td>2.793</td>
<td>.406</td>
<td>.605</td>
</tr>
</tbody>
</table>

Limb impairment was found to have a role in predicting fall risk in care home residents. Foot problems adversely affect balance and mobility and this has the potential to result in a fall event. From Table 19, it can be seen that the unstandardized and
standardized coefficients for limb impairment are 2.793 and .605, respectively. It can be noted from Table 20 that the F value was 37.51 and degrees of freedom were 2 and 82. MNA score and limb impairment together account for 47.8% variability in fall risk. This implies that both nutritional risk and lower extremity problems can contribute towards an increased fall risk in older adults living in LTC facilities.

Table 20
Model summary for regression analysis involving Downton Index score as outcome variable or DV and MNA score and limb impairment as predictors or IVs

<table>
<thead>
<tr>
<th>DV</th>
<th>IVs</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downton Index score</td>
<td>MNA score, limb</td>
<td>.691</td>
<td>.478</td>
<td>37.51</td>
<td>2</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>limb impairment</td>
<td></td>
<td></td>
<td></td>
<td>82</td>
<td></td>
</tr>
</tbody>
</table>

As shown in Table 21, the unstandardized and standardized regression coefficients for body pain were found to be -.053 and -.428, respectively. Body pain experienced by participants in the past four weeks significantly predicted fall risk.
Table 21

Multiple regression analysis showing recently experienced body pain as a predictor of future fall risk

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients**</th>
<th>t-test</th>
<th>Sig. level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized coefficients</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standardized coefficients</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Standard error</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant</td>
<td>6.911</td>
<td>.809</td>
<td>8.548</td>
</tr>
<tr>
<td>MNA score</td>
<td>-.091</td>
<td>.050</td>
<td>-.197</td>
</tr>
<tr>
<td>Body pain experienced in the past 4 weeks</td>
<td>-.053</td>
<td>.013</td>
<td>-.428</td>
</tr>
</tbody>
</table>

It can be noted from Table 22 that the F value was 18.42 and the degrees of freedom were 2 and 82. Both MNA scores and body pain accounted for 31% variability in fall risk (Table 22). Body pain was responsible for the low physical activity level in some seniors. The presence of chronic pain in older women restricted their mobility and affected their functional status. Decreased mobility is a major challenge faced by many older adults living in LTC facilities and it decreases their ability to move independently within the LTC environment.
Table 22

Model summary for regression analysis involving Downton Index score as outcome variable or DV and MNA score and body pain as predictors or IVs

<table>
<thead>
<tr>
<th>DV</th>
<th>IVs</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downton Index score</td>
<td>MNA score, body pain in past 4 weeks</td>
<td>.557</td>
<td>.310</td>
<td>18.42</td>
<td></td>
<td>.000</td>
</tr>
</tbody>
</table>

The researcher was interested in determining whether time taken to perform timed-up-and-go test acts as a predictor of future fall risk. Table 23 highlights the summary of the regression analysis with Downton score as outcome variable and MNA and TUG test performance as the predictor variables. The unstandardized and standardized regression coefficients for the TUG test performance are .421 and .400 respectively. As presented in Table 24, the F value is 14.38 and degrees of freedom are 2 and 76, respectively. Both MNA score and TUG test performance together account for 27.5% variability in fall risk. This implies that a low nutritional status and mobility status can both increase risk of encountering falls. TUG test is a simple test which normally takes less than 13.5 seconds to complete and older adults who take longer to complete this test have problems with balance, gait, and mobility. These individuals are at a higher risk of encountering falls. It was observed that the time taken to perform TUG test can effectively predict Downton Index scores in care home residents.
Table 23

Multiple regression analysis with Downton index score (fall risk) as outcome variable or DV and MNA score and time taken to complete timed-up-and-go (TUG) test as predictors or IVs

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients**</th>
<th>t-test</th>
<th>Sig. level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized coefficients</td>
<td>Standardized coefficients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Standard error</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant</td>
<td>.090</td>
<td>1.974</td>
<td>.046 .964</td>
</tr>
<tr>
<td>MNA score</td>
<td>-.113</td>
<td>.052</td>
<td>-2.164 .034</td>
</tr>
<tr>
<td>Time taken</td>
<td>.421</td>
<td>.110</td>
<td>3.827 .000</td>
</tr>
<tr>
<td>to perform TUG test</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 24

Model summary for regression carried out between Downton Index as DV or outcome variable and MNA score and time taken to complete TUG test as predictors or IVs

<table>
<thead>
<tr>
<th>DV</th>
<th>IVs</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downton Index score</td>
<td>MNA score, TUG test performance</td>
<td>.524</td>
<td>.275</td>
<td>14.38</td>
<td>2</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 25 contains the information on regression analysis carried out between Downton Index score as outcome variable and MNA score and GDS score as independent variables. GDS scores, which are indicative of the level of depression found
in older adults, were found to act as a predictor of fall risk. As shown in Table 25, the
unstandardized and standardized regression coefficients for GDS score are .091 and .406,
respectively. From Table 26, it is clear that both MNA score and GDS scores together
account for 27.8% variability in fall risk. In other words, both nutritional status and
depression can cause variance in the risk of encountering falls.

Table 25
Multiple regression analysis involving GDS scores as a predictor of fall risk

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients**</th>
<th>t-test</th>
<th>Sig. level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized coefficients</td>
<td>Standardized coefficients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Standard</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant</td>
<td>3.313</td>
<td>1.351</td>
<td>2.453</td>
</tr>
<tr>
<td>MNA score</td>
<td>-.078</td>
<td>.055</td>
<td>-.169</td>
</tr>
<tr>
<td>GDS scores</td>
<td>.091</td>
<td>.027</td>
<td>.406</td>
</tr>
</tbody>
</table>

Table 26
Model summary for regression analysis involving Downton Index score as DV or
outcome variable and MNA score and GDS score as IVs or predictor variables

<table>
<thead>
<tr>
<th>DV</th>
<th>IVs</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downton Index score</td>
<td>MNA score, GDS score</td>
<td>.528</td>
<td>.278</td>
<td>15.81</td>
<td>2</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Table 27

Multiple regression analysis showing gait condition acting as a predictor of future fall risk

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients</th>
<th>t-test</th>
<th>Sig. level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized coefficients</td>
<td>Standardized coefficients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Standard error</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant</td>
<td>.462</td>
<td>1.279</td>
<td>3.488</td>
</tr>
<tr>
<td>MNA score</td>
<td>-.092</td>
<td>.059</td>
<td>-.198</td>
</tr>
<tr>
<td>Gait condition</td>
<td>.950</td>
<td>.364</td>
<td>.335</td>
</tr>
</tbody>
</table>

***p<.05

From Table 27, it can be noted that the unstandardized and standardized regression coefficients for gait condition are .950 and .335, respectively. Gait condition significantly predicts Downton Index scores. It can be noted from Table 28 that the F value obtained was 12.87 and degrees of freedom were 2 and 82, respectively. Both MNA score and gait condition together account for 23.9% variability in fall risk. Older adults living in LTC often experience difficulties with maintaining an optimum gait status and frequently need assistive devices such as cane sticks and walkers to prevent fall incidents. Gait disturbances are commonly observed in older adults and are mostly multi-
factorial in origin. Sensory impairment, including visual deficits, hearing problems, and vestibular deficits, along with neurodegenerative processes and medication intake adversely affects gait status of older adults. Individuals having gait impairment often complain of joint stiffness, pain, numbness, lower extremity weakness, and an altered gait pattern. Gait disorders make older adults highly vulnerable to encounter falls since individuals with gait problems engage in sedentary behaviours and avoid being physically active which further increases their fall risk. MNA scores and gait condition of older adults accounted for 23.9% variability in fall risk.

Table 28

Model summary for regression analysis involving Downton Index score as DV and MNA score and gait condition as IVs or predictors

<table>
<thead>
<tr>
<th>DV</th>
<th>IVs</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downton Index score</td>
<td>MNA score, gait condition</td>
<td>.489</td>
<td>.239</td>
<td>12.87</td>
<td>2</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 29 contains information on regression analysis between Downton Index score as outcome variable and MNA score and social interaction as predictor variables. The unstandardized and standardized regression coefficients for social interaction with friends are -.059 and -.509, respectively. It can be noted from Table 30 that the F value was 21.87 and the degrees of freedom were 2 and 82. Both MNA scores and lower social
interaction with friends and family together accounted for 35% variability in fall risk (Table 30). Study participants reported that their social interaction with friends and family was restricted after being transferred to LTC facilities, and thus their social support networks were limited to the individuals living in the care homes including their neighbours and caregivers looking after their care needs. A reduction in social activity was found to act as a predictor of fall risk. Social support networks play an important role in determining the satisfaction with life and lack of social interaction adversely affects the health status of institutionalized older adults. It contributes towards loneliness and social isolation and diminishes quality of life. Negative b-values represent an inverse association between social interaction and fall risk. The lower the social networks of older adults, the higher would be the fall risk and vice versa.

Table 29

Multiple regression analysis showing lower social interaction with friends and family acting as a predictor of fall risk

<table>
<thead>
<tr>
<th>Model</th>
<th>Coefficients</th>
<th>t-test</th>
<th>Sig. level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardized coefficients</td>
<td>Standardized coefficients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Standard error</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant</td>
<td>6.930</td>
<td>.786</td>
<td>8.817</td>
</tr>
<tr>
<td>MNA score</td>
<td>-.058</td>
<td>.051</td>
<td>-.125</td>
</tr>
<tr>
<td>Lower social interaction</td>
<td>-.059</td>
<td>.013</td>
<td>-.509</td>
</tr>
</tbody>
</table>
Table 30

Model summary showing regression analysis between Downton index score (DV) and MNA score and lower social interaction with friends and family as predictors (IVs)

<table>
<thead>
<tr>
<th>DV</th>
<th>IVs</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downton Index score</td>
<td>MNA score, reduced social interaction</td>
<td>.590</td>
<td>.348</td>
<td>21.87</td>
<td>2</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.7 Factor Analysis

Factor analysis was conducted by including items of the Mini-Nutritional Assessment (MNA) questionnaire as seen in Table 31. It was found that the value of KMO test of sampling adequacy was .615 and the chi-square value of Barlett's test of sphericity was 360 (p<.001). The computed KMO value was significant for the MNA. From Table 32, it is clear that Factor 1 (mobility status) accounted for a large proportion of variance (23.7%), while other factors accounted for a much smaller proportion of variance including factor 2 (intake of psychotropic medications) (10.6%), factor 3 (lower dietary intake) (9.7%), and factor 4 (self-perception of health status) (8.4%). Table 33 contains the factor loadings for the various items of MNA and the interpretations are based on these factor loadings. The factor structure of MNA is not desirable within the context of use among the LTC residents in this study as seen in Table 33. There are only two loadings under each factor that have been taken into consideration. Factor loadings with value below 0.300 have been excluded from the Table.
Table 31
Factor analysis of MNA items

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser- Meyer- Olkin (KMO)* test of sampling adequacy</td>
<td>0.615</td>
</tr>
<tr>
<td>Barlett's test of sphericity (chi-square)</td>
<td>360</td>
</tr>
</tbody>
</table>

* KMO test is significant (p<.001)

Table 32
Total variance explained using factor analysis for determination of nutritional risk by including MNA items

<table>
<thead>
<tr>
<th>Factor/Component</th>
<th>Eigen value</th>
<th>% variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1</td>
<td>3.8</td>
<td>23.7</td>
</tr>
<tr>
<td>Factor 2</td>
<td>1.7</td>
<td>10.6</td>
</tr>
<tr>
<td>Factor 3</td>
<td>1.6</td>
<td>9.7</td>
</tr>
<tr>
<td>Factor 4</td>
<td>1.3</td>
<td>8.4</td>
</tr>
<tr>
<td>Factor 5</td>
<td>1.3</td>
<td>8.0</td>
</tr>
<tr>
<td>Factor 6</td>
<td>1.1</td>
<td>6.7</td>
</tr>
</tbody>
</table>
Table 33

Rotated Component Matrix of items of Mini Nutritional Assessment (MNA)

<table>
<thead>
<tr>
<th>Item</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
<th>Component 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving out of bed/chair</td>
<td>.795</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeding assistance required</td>
<td>.796</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid consumption</td>
<td>.681</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological stress present in past 4 weeks</td>
<td></td>
<td>.716</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake of &gt;3 medications daily</td>
<td></td>
<td>.786</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased food intake</td>
<td></td>
<td></td>
<td>.831</td>
<td></td>
</tr>
<tr>
<td>Weight loss in</td>
<td></td>
<td></td>
<td></td>
<td>.810</td>
</tr>
<tr>
<td>Two or more servings of legumes per week</td>
<td></td>
<td></td>
<td></td>
<td>.793</td>
</tr>
<tr>
<td>Comparison of self health status with that of others</td>
<td></td>
<td></td>
<td></td>
<td>.740</td>
</tr>
</tbody>
</table>
Factor analysis was done using items of Falls Efficacy Scale-International (FES-I) as seen in Table 34. Fear of falling concerning 16 activities is presented in the FES-I questionnaire in the form of 16 items, including cleaning, meal preparation, bathing, reaching above to get something, moving in or out of a chair or bed, dressing, grocery shopping, climbing stairs, going up or descending a slope, going to answer the telephone, walking in a crowded area, walking in the neighbourhood, walking on a slippery surface, walking on an uneven surface, visiting a friend or relative, and attending a social or religious event. The KMO test of sampling adequacy and Barlett's test of sphericity were computed and found to be .955 and 2090 respectively which were significant (p<.001).

As shown in Tables 35 and 36, most of the variance was explained by factor 1 which indicated concern about moving out of bed or chair to perform activities inside the care facility (79.6%). The remaining variance was explained by factor 2 which represented concern about going out of the care facility (6.4%). From Table 36, it can be seen that the loadings on factor 1 are higher than the loadings on factor 2. The interpretations of factor structure of FES-I are based on the factor loadings shown in Table 36.

Table 34
KMO and Barlett's test for Falls Efficacy Scale International (FES-I)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin measure of sampling adequacy</td>
<td>.955</td>
</tr>
<tr>
<td>Barlett's test of sphericity (chi-square)</td>
<td>2090</td>
</tr>
</tbody>
</table>
Table 35
Total variance explained using factor analysis for items of FES-I

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigen value</th>
<th>% Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1</td>
<td>12.7</td>
<td>79.63</td>
</tr>
<tr>
<td>Factor 2</td>
<td>1.2</td>
<td>6.4</td>
</tr>
<tr>
<td>Factor 3</td>
<td>0.5</td>
<td>3.1</td>
</tr>
<tr>
<td>Factor 4</td>
<td>0.3</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Table 36
Rotated Component Matrix for FES-I using Varimax Rotation technique

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 1 loadings</th>
<th>Factor 2 loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fear of falling while cleaning</td>
<td>.874</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while preparing meals</td>
<td>.880</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while dressing</td>
<td>.899</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while bathing</td>
<td>.789</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while moving in or out of a chair</td>
<td>.860</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while climbing stairs</td>
<td>.679</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while walking in a neighbourhood</td>
<td>.781</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Factor Loading</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while reaching above for things</td>
<td>.801</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while going to answer the phone</td>
<td>.821</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while walking on a slippery surface</td>
<td>.664</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while visiting friends at their place</td>
<td>.558</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while walking on an uneven surface</td>
<td>.890</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while ascending or descending a slope</td>
<td>.904</td>
<td></td>
</tr>
<tr>
<td>Fear of falling while attending a social or religious event</td>
<td>.642</td>
<td></td>
</tr>
</tbody>
</table>

Factor analysis was also carried out using items of Geriatric Depression Scale (GDS) as seen in Table 37. The KMO and Barlett's chi-square test values were observed to be .878 and 1898 respectively and were significant (p<.001). From Tables 38 and 39, it can be noted that worrying about future (Factor 1) accounted for a major proportion of variance (48.4%) in depression. Remaining variance in depression was accounted by being unhappy with present condition (factor 2) (6.7%), lacking the energy levels and not being in good spirits most of the time (factor 3) (5.4%), and drop of interest in activities and experiencing boredom often (factor 4) (4.4%). Factor loadings shown in Table 39.
were used to make interpretations about constructs that were underlying the factors. GDS has a very good factor structure and it adequately represents the underlying construct i.e. depression.

Table 37
KMO and Barlett's test for Geriatric Depression Scale

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin test of sampling adequacy</td>
<td>.878</td>
</tr>
<tr>
<td>Barlett's test of sphericity (chi-square)</td>
<td>1898</td>
</tr>
</tbody>
</table>

Table 38
Total variance explained for depression using factor analysis of GDS items

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigen value</th>
<th>% Variance accounted by the item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1</td>
<td>14.0</td>
<td>48.4</td>
</tr>
<tr>
<td>Factor 2</td>
<td>1.9</td>
<td>6.7</td>
</tr>
<tr>
<td>Factor 3</td>
<td>1.5</td>
<td>5.4</td>
</tr>
<tr>
<td>Factor 4</td>
<td>1.2</td>
<td>4.4</td>
</tr>
<tr>
<td>Factor 5</td>
<td>1.1</td>
<td>3.9</td>
</tr>
</tbody>
</table>
Table 39

Rotated component Matrix for items of Geriatric Depression Scale (GDS)

<table>
<thead>
<tr>
<th>Variable/Item</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
<th>Component 4</th>
<th>Component 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worrying about future</td>
<td>.673</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling blue/downhearted</td>
<td>.769</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thinking about past events</td>
<td>.765</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afraid something bad will happen</td>
<td>.693</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helplessness</td>
<td>.659</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do not feel like getting up in the morning</td>
<td>.728</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoid social gatherings</td>
<td>.778</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequently feel like crying</td>
<td>.595</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not finding life exciting</td>
<td>.738</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not feeling energetic</td>
<td>.764</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not hopeful about future</td>
<td>.689</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Not being in 
good spirits most 
of the time 

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drop of interest in activities</td>
<td>.765</td>
</tr>
<tr>
<td>Avoid going out</td>
<td>.561</td>
</tr>
<tr>
<td>Worrying about future</td>
<td>.510</td>
</tr>
<tr>
<td>Getting bored often</td>
<td>.610</td>
</tr>
<tr>
<td>Difficult to take decisions</td>
<td>.659</td>
</tr>
<tr>
<td>Dissatisfied with life</td>
<td>.786</td>
</tr>
<tr>
<td>Feeling empty</td>
<td>.425</td>
</tr>
<tr>
<td>Feeling worthless</td>
<td>.622</td>
</tr>
</tbody>
</table>

Results of factor analysis using items of SF-36 Health Survey questionnaire revealed that KMO was .904 and Barlett's chi-square test value was 1753 (p<.001) (Table 40). Most variance was accounted by a lower functional status (factor 1) (50.9%), and the remaining proportion of variance was explained by psychological and emotional health (factor 2) (10.4%), body pain (factor 3) (4.7%), and self-view of health status (factor 4) (4.3%) (Table 41). Using varimax rotation procedure, it was observed that loadings on factor 1 are higher than loadings on factor 2, 3, and 4. Table 42 shows the factor loadings that were used to draw interpretations of the underlying constructs of the factor structure of SF-36 questionnaire.
Table 40
KMO and Barlett's test for SF-36 Health Survey

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin measure of sampling adequacy</td>
<td>.904</td>
</tr>
<tr>
<td>Barlett's test of sphericity (chi-square)</td>
<td>1753</td>
</tr>
</tbody>
</table>

Table 41
Total Variance explained by various items of SF-36 Health Survey using Factor Analysis

<table>
<thead>
<tr>
<th>Item</th>
<th>Eigen value</th>
<th>% Variance accounted by the factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1</td>
<td>12.7</td>
<td>50.9</td>
</tr>
<tr>
<td>Factor 2</td>
<td>2.6</td>
<td>10.4</td>
</tr>
<tr>
<td>Factor 3</td>
<td>1.2</td>
<td>4.7</td>
</tr>
<tr>
<td>Factor 4</td>
<td>1.1</td>
<td>4.3</td>
</tr>
</tbody>
</table>
Table 42
Rotated Component Matrix of SF-36 Health Survey Items using Varimax Rotation technique

<table>
<thead>
<tr>
<th>Item</th>
<th>Loadings on Component 1</th>
<th>Loadings on Component 2</th>
<th>Loadings on Component 3</th>
<th>Loadings on Component 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty doing moderate activity</td>
<td>.719</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems going for grocery shopping</td>
<td>.709</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty climbing one flight of stairs</td>
<td>.802</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems with walking one mile</td>
<td>.784</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty walking one block</td>
<td>.759</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General health status</td>
<td></td>
<td>.521</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staying happy often in the past 4 weeks</td>
<td></td>
<td>.800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling energetic in last 4 weeks</td>
<td></td>
<td>.776</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staying calm in the past 4 weeks</td>
<td></td>
<td>.798</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling full of pep</td>
<td></td>
<td>.614</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeling nervous</td>
<td></td>
<td>.690</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interference of body pain with work or activity</td>
<td></td>
<td></td>
<td></td>
<td>.737</td>
</tr>
</tbody>
</table>
Body pain experienced in last 4 weeks .789

Interference of physical problems with work or activity .527

Health condition a year ago .621

Thinking health will get worse in coming years .583

Felt sick in last 4 weeks .746

The KMO statistic for MMSE was computed as .794 and Barlett's test of sphericity was reported to be 324 (p<.001) (Table 43). Factor 1 which represented the construct recalling and memory condition accounted for most of the variance in test scores (39.1%) and the remaining variance was accounted by factor 2 which denoted the construct of the ability to follow instructions (11.2%) and factor 3 which denoted registration and orientation (9.4%) (Table 44). Table 45 contains factor loadings for various items of MMSE that were used to interpret the constructs underlying the factors.

Table 43
KMO and Barlett's test for items of Mini Mental State Exam (MMSE)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Test value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin*** measure of sampling adequacy</td>
<td>.794</td>
</tr>
</tbody>
</table>
Barlett's test of sphericity 324

Note: *** p<.001; KMO test is significant

Table 44
Variance explained by different components extracted by factor analysis for MMSE

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigenvalue</th>
<th>% Variance explained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.3</td>
<td>39.1</td>
</tr>
<tr>
<td>2</td>
<td>1.2</td>
<td>11.2</td>
</tr>
<tr>
<td>3</td>
<td>1.0</td>
<td>9.4</td>
</tr>
</tbody>
</table>

Table 45
Rotated Component Matrix of items of MMSE using Varimax Rotation procedure

<table>
<thead>
<tr>
<th>Item</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remembering date</td>
<td>.728</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remembering location</td>
<td>.858</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability to name 3 unrelated objects</td>
<td>.812</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recalling names of the 3 objects mentioned before</td>
<td>.803</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identifying 2 simple objects</td>
<td>.617</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Folding a sheet of paper in accordance with given instructions .569

Reading and performing the act .776

Copying a picture shown .691

Spelling WORLD backwards .850

Repeating a phrase shown on paper .543

4.8 Reliability Analysis

The researcher carried out reliability analysis (Table 46) to test whether the items of each of the questionnaires used in the study (i.e. MNA, FES-I, Downton Index, GDS, MMSE, and SF-36 Health Survey) measure the construct they denote.

Table 46

Reliability analysis for MNA, FES-I, Downton Index, GDS, MMSE and SF-36 using Cronbach's alpha

<table>
<thead>
<tr>
<th>Cronbach's alpha coefficient</th>
<th>MNA</th>
<th>FES-I</th>
<th>Downton Index</th>
<th>GDS</th>
<th>MMSE</th>
<th>SF-36</th>
</tr>
</thead>
<tbody>
<tr>
<td>A .300</td>
<td>.982</td>
<td>.663</td>
<td>.961</td>
<td>.787</td>
<td>.954</td>
<td></td>
</tr>
</tbody>
</table>
The internal consistency of items of Falls Efficacy Scale International (FES-I) 
($\alpha=.982$) was found to be the highest amongst all questionnaires tested using reliability 
analysis in SPSS. Geriatric depression scale (GDS) items also had a very high value of 
Cronbach's alpha ($\alpha=.961$) which indicates that the various items on this questionnaire 
have a good ability to measure a common construct (i.e. depression). Mini Mental State 
Exam and Downton Index items also had an acceptable level of internal consistency. The 
items of Mini Nutritional Assessment (MNA) showed a poor measure of internal 
consistency ($\alpha=.300$) in this study (Table 46). It must be noted here that items having 
zero variance were eliminated from the reliability analysis to prevent any occurrence of 
errors.
CHAPTER 5
DISCUSSION

5.1 Study Purpose

The present study was carried out to assess the level of and the association between nutritional and fall risk among older women living in long-term care (LTC) facilities in New Delhi (India). The role of variables such as depression, cognitive impairment, general health status, and physical function level in the prediction of fall risk was also explored. This is the first study that has attempted to determine the factors that contribute towards an elevated nutritional and fall risk in older adults living in LTC facilities of New Delhi, India.

5.2 Background characteristics of participants

The participants involved in the study were older women (average age of 74) and a majority were widowed (82%) with lower level of education and socioeconomic status. This is not surprising given that traditional long term care in India emerged as a system to support poor and destitute women as a charity provided by religions organizations (Datta, 2017; Rajan, Mishra, & Sarma, 1999). Also, studies in India have shown high rates of illiteracy (70-73%) among the older population (Ingle & Nath, 2008; HelpAge India, 2014). Although a majority of the participants (68%) had two or more children, only 35% reported having children visit them at least on a monthly basis. The residents also indicated that most of the visits were for financial reasons only and they did not have strong emotional ties with their mothers living in care homes. While these kinds of elder abuse are common, they are largely under-estimated and under-reported by older adults.
Although some initiatives have been taken by the government of India in the past three decades to provide assistance to its senior populations, most of the programs and welfare schemes have lacunae and are not implemented on a regular basis. A Health Insurance Plan is available to help older adults with treatment of health problems and surgery and is known as Rashtriya Swasthya Bima Yojana (RSBJ). This plan was launched in 2008 and by getting registered with the health authority, beneficiaries are entitled to hospitalization coverage of INR 30,000 (CAD $ 600) (Maroof, Ahmad, Khalique, & Ansari, 2016). Awareness of availability of welfare programs and benefits, including the existence of social security plans and health plans, supported by the government of India is low among Indian older adults, and this has a tremendous impact on utilization of health care services (Maroof, Ahmad, Khalique, & Ansari, 2016).

5.3 Health profile of participants

The participants in this study also had poor health with multiple chronic diseases (94%) with concomitant intake of multiple medications (average of 5 medications daily and 61% consumed 3 to 6 medications in a day) and experienced psychosocial issues such as high rates of depression and social isolation. India is undergoing a rapid demographic transition phase (Visaria, 2011) and is confronted with the twofold burden of diseases: under-nutrition and infectious diseases on one hand, and lifestyle-related diseases such as obesity, diabetes, hypertension, heart disease, and cancer on the other hand. In the present study, the most common chronic health conditions found in seniors were osteoarthritis, back problems, hypertension, and gastrointestinal disorders. These figures are very similar to the findings reported by Thakur, Banerjee, and Nikumb (2013) who have examined the chronic health problems present in rural older adults in India and
found that hypertension was present in 30.7% of persons with prevalence higher in women as compared to men. These researchers suggested that lower literacy levels among Indian older adults contribute towards a greater number of health problems since they found that literacy has a positive impact on overall health of older adults (Thakur et al., 2013).

5.4 Psychological issues

Besides chronic health problems and associated poly-pharmacy, many participants reported the presence of stress in their daily lives (82%). Inability to afford treatment for some health problems, lack of regular visits of friends and family members, and constant thoughts of unpleasant past events added to their stress levels. The long form of Geriatric Depression Scale was used to assess depression as it is a useful screening tool for identifying individuals with depressive disorders. The mean GDS score obtained in the present study was 16.6 (9.7). This score represents moderate level of depression if we consider the mean scores obtained in the GDS development study by Yesavage et al. (1982) which found mean GDS scores of 5.75 (4.3) in individuals who were not depressed at all, 15.1 (6.5) in individuals with mild to moderate level of depression and score of 22.85 (5.1) in severely depressed individuals.

The study participants were suffering from moderate (42.4%) to high (47%) levels of depression. Only 10.6% of participants had mild symptoms of depression. The burden of depression is 50% higher for women compared to men in India and the prevalence of depression in Indian adults has been estimated to be 9% with average age of onset being 32 years (Bohra, Srivastava, & Bhatia, 2015). In Indian older women, depression is
mainly caused by widowhood and loneliness after death of spouse (Sinha, Shrivastava, & Ramasamy, 2013). Poor nutritional status and a lower socio-economic status further add to the burden of depression in older adults (Mohandas, 2009). Most of the older women who participated in the study were widows (81.2%) and at high nutritional risk (54.1%). This could explain the moderate to severe level of depression observed in these women living in LTC facilities of India.

A study conducted in OAHs of West Bengal state in India, involving 200 older women by Saha et al. (2014) has shown that severe depression was present in 59% residents and 32% residents had mild depression. Interestingly, these researchers found that these women were also at high nutritional risk. Tiwari, Pandey, and Singh (2012) reported similar findings in their study carried out in Lucknow city in India and found depression to be very common (38%) in older adults living in LTC. Other studies have reported higher rates of anxiety and depression among the geriatric population in India (Ghosh, 2006). For many individuals, it is difficult to cope with the stress of being isolated from family members, and not easy to accept that the younger members of their families who once consulted them for taking important decisions, and treated them with utmost respect, no longer need them. Rao, Trivedi, and Yadav (2015) examined the reasons for relocation to LTC, quality of life and coping strategies of 50 residents (male=33, female=17) of five care homes in the city of Ahmedabad in the state of Gujarat. They found that most of the residents were very dissatisfied with the behaviour of their family members, particularly children and were unhappy to be deprived of love, respect, and affection they deserved from the younger members of their families. Studies have shown that social determinants of health (lower education, income) along with poor
physical and psychosocial health, such as, depression and social isolation, are well known contributors to poor nutrition (Lahiri, Biswas, Santra, & Lahiri, 2014).

5.5 Nutritional Risk Level

Not surprisingly, the level of nutritional risk assessed using the Mini Nutritional Assessment (MNA) tool was high in this population with 54.1% of residents at high nutritional risk. Similar findings were reported by Saha et al. (2014) who reported the prevalence of nutritional risk to be 57% in older adults living in OAHs in the state of West Bengal. Pai (2011) who conducted a comparative study of nutritional status of older adults (>60 years) living in care homes (n=108) and community setting (n=102) in the city of Mangalore in India using MNA questionnaire also found similar level of nutritional risk prevalence in India. Results of the study indicated that 57.4% of care home residents were at a high nutritional risk and only 15% of community dwelling older adults were at nutritional risk. Most studies on nutritional status assessment of older adults have been conducted on those who are community dwelling and very scanty research has been carried out to evaluate the nutritional status of older adults living in LTC facilities. Kalaiselvi et al. (2016) have reported nutritional problems in community dwelling older adults. They found that the prevalence of under-nutrition was 25% with 59% of the study participants viewing themselves as undernourished. Agarwalla, Saikia, and Baruah (2015) assessed the nutritional status of 360 older adults living in the community setting in the state of Assam using MNA and 24 hour dietary recall method and found that 55% older adults were at high nutritional risk. They found a significant association of nutritional status with age, female gender, low functional status, financial dependency on others, and poor calorie intake.
The mean MNA score was found to be 18.44 (4.71) in the present study participants. The findings of this study are similar to a recent study carried out in older adults living in the community setting in West Bengal, where mean MNA scores were found to be 18.41 (3.78) in women and 19.25 (3.51) in men (Lahiri et al., 2014). Another study was conducted a few years ago which assessed the nutritional risk in rural older adults living in the state of Tamil Nadu in South India. The mean MNA scores in rural older women were found to be 22.17 (3.57) (Vedantam, Subramanium, Rao, & John, 2009). These scores are higher than the MNA scores obtained in the current study as community dwelling older adults have better nutritional status as compared to individuals living in LTC facilities.

Under-nutrition is a major public health problem in India (Jamir et al., 2013) but most emphasis has been laid on examining the prevalence and consequences of this problem in children. Moreover, in India, nationwide surveys such as National Family Health Survey (NFHS) and United Nations Population Fund (UNPF) Survey conduct assessment of health status of older adults, but do not pay attention to nutritional risk assessment (Kalaiselvi, Arjumand, Jayalakshmy, Gomathi, Pruthu, & Palanivel, 2016). Although more than 50% of older adults in India are malnourished and greater than 90% have dietary intakes below the recommended level (Mathew, 2016), conducting research on assessment of nutritional risk is seldom considered to be a priority, and is often neglected.

Older adults living in long-term care (LTC) facilities, such as nursing homes or care homes, are a high risk population for developing nutritional problems (Kaiser et al., 2010; Kojima, 2015; Matusik et al., 2012; Sloane et al., 2008). The level of nutritional
risk in individuals residing in LTC is high due to a decline in food intake, and an increased likelihood of weight loss, resulting from appetite changes, swallowing problems, reduced gastrointestinal tract motility, and hormonal changes that lead to early satiety or feeling full too soon (Hickson, 2006). Reduction in metabolic rate, presence of several co-morbidities, oral health problems including tooth decay, and social neglect, contribute enormously towards under-nutrition in older adults (Kikafunda & Lukwago, 2005). Economic insecurity coupled with the rise of nuclear families, and breakdown of traditional joint families leads to inadequate care support available to older adults, and also puts them at a higher nutritional risk (Ramage-Morin & Garriguet, 2013). Undernourished older adults are at an elevated risk of being unable to perform activities of daily living, have feeding difficulty, mobility impairment, and may develop incontinence (Kikafunda & Lukwago, 2005). It has been reported in the literature that undernourished older adults often need to be hospitalized, and have a high risk of mortality (Bose, Bisai, Das, Dikshit, & Pradhan, 2007; Pednekar, Hakama, Hebert, & Gupta, 2008).

5.6 Fall risk level

Besides under-nutrition, falls are also a prominent public health problem in older adults leading to disability, loss of independence, and premature death (Sibley, Voth, Munce, Straus, & Jaglal, 2014). The findings of the present study revealed that fall risk was high in women living in care homes of New Delhi. Using the Downton index classification (Rosendahl et al., 2003), more than half of the total residents (58%) were found to be at a high risk of falling. Many seniors faced balance and mobility problems and an unsteady gait (46%). More than half of the participants had experienced previous
falls (54%) in the previous year and a majority of them had visual (71%) and mobility impairment (33%), which are well known risk factors of falls. The findings of the study are consistent with the literature that suggests that balance and gait impairment (Al-Momani et al., 2016; Salzman, 2010), fall history (Lee, Lee, & Khang, 2013), and sensory deficits in older adults living in care homes such as visual impairment are strongly related to falls (Rubenstein, 2006).

5.7 Fear of falling in participants

Fear of falling in the present study was found to be high and the mean FES-I score of the participants was 34.04 (13.8). This is higher than the mean FES-I score reported in other studies carried out in older adults living in the community. Fear of falling was assessed in a study carried out on community dwelling older adults of Canada, Columbia, Albania, and Brazil using FES-I and the mean FES-I score was found to be 23.3 (8.8) in individuals having a mean age of 69.0 (2.8). The researchers of this study concluded that fear of falling has a strong association with the spatial area where a person moves through in daily life and fear of falling is site specific i.e. it varies depending on the location of the person (Auais et al., 2017).

Although falls are considered to be a major public health problem in HICs as they are the leading cause of injury and death in geriatric populations, they are not given the status of an important public health issue in LMICs and resource-poor countries (United Nations, 2013; Takanishi, Yu, & Morita, 2008). Even though a substantial proportion of older adults are affected by falls and fall-related injuries in LMICs, there is a paucity of research carried out in India regarding the risk factors for falls and fall-related injuries in
India along with effective strategies to reduce them. Some researchers have examined the falls prevalence in India including Joshi et al. (2003), Johnson (2006), and D’souza (2008). More research needs to be directed towards evaluation of fall risk factors and fall prevention in LMICs such as India.

5.8 Cognitive status of participants

The cognitive status was assessed using the Mini-Mental State Exam in the participants of the study. The MMSE is a widely used screening tool for identifying older adults at risk of developing severe cognitive deficits and dementia. The mean MMSE score was found to be 21.7 (5.3) in the participants and it was observed that 4.7% women obtained very low scores (0 to 9) on MMSE and were likely to have severe cognitive impairment. Normal cognitive functioning was observed in 29.4% of participants as they obtained desirable scores on MMSE (25-30) while moderate cognitive deficits were observed in 49.4% participants who scored between 20 and 24 on MMSE. Similar findings were reported by Gambhir et al (2014) who studied cognitive functioning of older adults with mean age 65.8 (5.8) and obtained mean MMSE score of 22.9 (4.9) in individuals with a low level of education i.e. mean primary school training of 5 (3) years and MMSE mean score of 26.1 (3.9) in individuals who had at least completed higher secondary school education (12th grade). This study found some interesting results and reported that regardless of poor cognitive function scores obtained on MMSE, the level of dementia found in older adults was low. Only 1.5% males and 1.5% females had Alzheimer's disease and only 1.2% males and 0.6% females had vascular dementia. The researchers concluded that a low level of education negatively affects performance on
MMSE but does not imply that older adults have cognitive deficits or dementia (Gambhir et al., 2014).

5.9 Association between nutritional and fall risk

The current study also showed a strong association between nutritional and fall risk. Nutritional risk and fall risk were found to be highly correlated. It is to be noted that as the nutritional risk level decreases, nutritional status improves leading to higher MNA scores and fall risk decreases with a consequent reduction in Downton Index scores. Scores obtained on MNA questionnaire are inversely correlated with Downton Index scores. This is the reason we found a negative correlation coefficient while carrying out correlation analysis using Downton Index scores as the outcome variable (dependent variable) and MNA scores as the predictor variable (independent variable).

5.10 Multiple Regression Analysis

In this study, several predictors of fall risk level were identified. These variables include fear of falling, fall history, depression, visual impairment, limb impairment, presence of body pain, difficulty performing moderate intensity exercise, gait impairment, and greater time taken to complete the timed-up-and-go (TUG) test. Falls have a multi-factorial etiology and several factors contribute towards falls. It must be noted that as the number of risk factors increases, fall risk increases correspondingly. Older adults who have a high fear of falling are more likely to stay indoors and avoid being physically active. They do not want to encounter any fall incident and are fearful of fall-related injuries such as fractures which require hospitalization and nursing care support. Having previous falls further escalates fall risk and older adults limit their mobility and prefer having their meals inside their room.
Depression is an important factor that predicts falls and is common in widows, older adults with a lower socio-economic status and lack of social networks. Depression is commonly found in residents of LTC facilities as they are away from family and friends and their children do not come to meet them frequently in the care facilities. Literature has shown a higher prevalence of depression ranging from 8 to 40% in care home residents. Depression is widely prevalent in Indian women across all age groups. Depression is under-reported in Indian older adults due to the social stigma associated with expressing the symptoms present in depressed individuals. In India, the prevalence of depression increases with age (Barua et al., 2007). It is particularly common in widows (Poongothai et al., 2009) and older adults with a lower socio-economic status and poor nutritional intake (Mohandas, 2009).

Visual deficits are frequently observed in LTC residents and vision problems limit their ability to see any obstacle or hindrance in their path while walking around the LTC facility. Limb impairment is also common in LTC residents and negatively affects balance, gait, and mobility. Foot problems are a strong predictor of fall risk and are often observed in older adults who have neuropathy which is a complication of diabetes. Presence of severe body pain in back and legs also restricts mobility and intensifies fall risk. It also adversely affects the ability to perform moderate intensity activities and leads to poor performance on balance and mobility tests such as timed-up-and-go test. Multiple regression analysis was therefore very useful in identifying predictors of fall risk in older women who participated in this study.
5.11 Factor Analysis

Factor analysis was helpful in identifying the main constructs represented by the items on various assessment tools. The researcher studied the factor structure of tools such as, the Mini Nutritional Assessment, Downton Index, Falls Efficacy Scale International, Geriatric Depression Scale, Mini Mental State Exam and SF-36 Health Survey. The factor structure of Downton Index was remarkably poor and since KMO was not very high, the factor analysis for Downton Index has been excluded from the results. Mini Nutritional Assessment also did not have a desirable factor structure. The factor structure of Falls Efficacy Scale International was found to be the best amongst all tools and the factor structure of SF-36 was also very good. Mini Mental State Exam had an acceptable factor structure and Geriatric Depression Scale had a highly desirable factor structure with the value of KMO >0.8 which is very high. Since the factor structures of FES-I and GDS are clearly of high quality, it can be said that Falls Efficacy Scale-International and Geriatric Depression Scale both measure fear of falling and depression very well and are very useful tools for assessment of confidence in performing ADL and for assessing the presence of depressive symptoms in older adults living in LTC facilities.

5.12 Reliability Analysis

The present study also made contribution to understanding the psychometric properties of tools commonly used in HIC context. Specifically, modest reliability was observed for the Downton Index (α=0.7) whereas the level of reliability for MNA was very poor (α=0.3). Some items had to be excluded from the reliability analysis of the MNA screening tool since the participants' responses to some items had zero variance.
For example most participants consumed milk products on a daily basis and none of the participants consumed meat, fish or poultry within the care home. Most participants had some level of psychological stress present in their daily lives in the care facility. Since these items were removed from the analysis, the researcher was able to use a limited number of items for carrying out the reliability test. This might explain why the researcher found a modest value of Cronbach's alpha ($\alpha= 0.3$) for MNA in the study. No previous study has been carried out in India which has attempted to assess the reliability of nutrition and fall risk screening tools.

5.13 Future directions and research

An important finding of the present study is that researchers should use caution in using MNA and Dowton Index as stand alone measures of nutritional and fall risk as they had low reliability and poor factor structures in the Indian LTC context. It would be recommended that a comprehensive nutritional and fall risk assessment must be carried out in LTC residents in India and other LMICs as there is no gold standard tool available to identify the presence of nutritional or fall risk in older adults. For example, a comprehensive nutritional assessment can include a detailed diet history, 3 day 24 hour-dietary recalls, use of MNA, serum albumin level test, determination of quantities of food consumed by older adults by carrying out plate waste measurements, and monitoring weight to check for involuntary weight loss on a monthly basis. A comprehensive fall risk assessment can include assessing fall history, number of risk factors for falls, evaluation of presence of limb impairment and foot problems, assessing fear of falling by using FES-I and carrying out TUG test and functional reach test to assess physical function.
The Government of India (GoI) has made some efforts recently to work towards the improvement of health care services provided to older adults, particularly, individuals living in rural areas (Verma & Khanna, 2013). For example, the GoI launched the National Program for the Health Care of the Elderly (NPHCE) which has the following objectives: to provide accessible, affordable, and high quality long-term and comprehensive health care services to older adults in India; to build a framework to promote the concept of healthy and active aging; to provide promotional, preventive, curative, and rehabilitative services through primary health-care approach which is community based; to build the capacity of medical and paramedical health care professionals as well as caregivers within the family system to provide care support to seniors; and identification of health problems of older adults and provision of health interventions in the community along with referral services through district hospital regional medical institutions (Verma & Khanna, 2013). Although some health care support is provided to community dwelling older adults in India, the needs of older adults requiring LTC services are largely neglected. The GoI urgently needs to develop strategies to provide comprehensive and affordable long-term care services to Indian older adults who are growing in number as a result of population aging and other demographic changes taking place in India. Given the burden associated with treatment of under-nutrition and fall-related injuries, efforts should be directed towards prevention and treatment of under-nutrition in older adults and in formulation and sincere implementation of fall prevention strategies and intervention programs to help older adults lead healthy, productive, and fulfilling lives.
5.14 Strengths and Limitations of the Present study

The present study had the primary objective of examining the level nutritional and fall risk and their association among women residing in LTC facilities of New Delhi, India. Since it is the first research study of its kind, it is of great value and significance. Older adults living in "homes for the aged" are frequently neglected, and not much importance is placed on examining their health status, particularly nutritional condition and susceptibility to encounter falls in the LTC environment. Due to a wide variety of nutritional and fall risk factors studied and analyzed, the study contributed to a more in-depth understanding of the factors contributing towards poor nutritional health and increased risk of falls in older adults. This study will be a valuable addition to the existing data on nutritional and fall risk profile of older adults living in India and will inform future programs and policies directed towards health status improvement of older adults living in OAHs in India.

The study had a few limitations as it included only women staying in OAHs. Men were not included in the study as they were not willing to participate. The results obtained by including women are not generalizable to the total population of older adults living in OAHs in India. Only six LTC facilities were included in the study after obtaining ethics approval from their directors and managers. Most LTC facilities have very complex procedures for gaining ethical permission as they take many months to process the ethics applications and even after waiting for several months, the directors of OAHs are often unwilling to allow research projects to be implemented due to fears of older adults being harmed, injured, or revelation of LTC lacunae and gaps in health care.
systems. An important limitation is that there is no gold standard tool which can singularly assess nutrition risk and fall risk accurately in older adults living in LTC facilities in India. Both MNA and Downton Index have poor factor structures and low levels of reliability as is exhibited by low values of Cronbach's alpha (i.e. <.80). Further research must be carried out to develop tools for nutritional and fall risk assessment which have high levels of reliability to identify older adults at an elevated risk of being undernourished and having a high risk of encountering falls in the LTC environment.
References


http://doi.org/10.2147/CIA.S112282


http://doi.org/10.4103/0019-5545.161485


Canadian Institute for Health Information. 2010. “Seniors and falls.” *Series on seniors*. Ottawa.


Guideline Screening and Treatment of Malnutrition (2011). Dutch Malnutrition Steering Group (DMG) and Dietitians Malnutrition Netherlands (DON).

http://www.fightmalnutrition.eu/.


following the health promoting RCT-Elderly persons in Risk Zone, *Gerontologist*, 53 (4), 654-663.


HelpAge India (2009). Directory of Old Age Homes in India. Policy Research and Development Department, HelpAge India.


position paper of the Italian Society of Orthopaedics and Medicine (OrtoMed).

_Clinical Cases in Mineral and Bone Metabolism, 11_(3), 215–221.


http://doi.org/10.4103/0970-0218.43225


Mini Nutritional Assessment Short-Forms in the Community, Nursing Home and 

Kalaiselvi, S., Arjumand, Y., Jayalakshmy, R., Gomathi, R., Pruthu, T., Palanivel, C. 
(2016). Prevalence of undernutrition, associated factors and perceived nutritional 
status among elderly in a rural area of Puducherry, South India. Archives of 
Gerontology and Geriatrics, 65 (July-August 2016), 156-160.

Vitamin D Treatment for the Prevention of Falls in Older Adults: Systematic 
Review and Meta-Analysis. Journal of the American Geriatrics Society, 58(7), 
1299–1310.

Kaminska, M.S., Brodowski, J., and Karakiewicz, B. (2015). Fall risk factors in 
community dwelling elderly depending on their physical function, cognitive 
status, and symptoms of depression. International Journal of Environmental 

Coexisting severe frailty and malnutrition predict mortality among the oldest old 
in nursing homes: A 1-Year Prospective Study. Archives of Gerontology and 
Geriatrics, 70, 99-104.

Associations of cytokine genes with Alzheimer’s disease and depression in an 
elderly Korean population Journal of Neurology, Neurosurgery, & 


Morris, M. S. (2012). The role of B vitamins in preventing and treating cognitive impairment and decline. *Advances in Nutrition, 3*, 801–812. 10.3945/an.112.002535


National Centre for Classification in Health. (2010). The international statistical classification of diseases and related health problems, 10th revision, Australian modification (ICD-10-AM): New South Wales, Australia: National Centre for Classification in Health, Faculty of Health Sciences, The University of Sydney.


http://doi.org/10.7748/nop.27.5.29.e697


http://doi.org/10.7860/JCDR/2014/8321.4024


Statistics Canada (2013). Nutritional Risk among older Canadians (Cat. No. 82-003-x). Ottawa, ON.


nutritional management of malnutrition in adult patients across the continuum of care. *Nutrition & Dietetics*, 66, S1-S34.


www.who.int/ageing/publications/global_health.pdf


APPENDIX A

Faculty of Kinesiology and Health Studies
Centre for Kinesiology, Health & Sport
University of Regina, Regina, SK S4S 0A2

LETTER OF INVITATION

Dear resident,

We invite you to participate in the research study, “Nutritional and fall risk assessment in older women living in long-term care facilities of New Delhi.” We are working with 85 care home residents in New Delhi (India) to learn what causes these older adults to have high nutritional and fall risk. We will ask you some questions to learn about your background, physical activity and general health, but you are only required to answer those questions you are comfortable with. We will also measure your balance and mobility, along with hand grip strength. This will take 45 minutes to complete and give us valuable information about the health of elders in old age homes. There is no risk in doing these simple tests, but you also can choose not to do these. Your participation is voluntary and that non-participation will not impact the services received from the care home. Permission for this study has been obtained from the director of this care home and the Research Ethics Board at the University of Regina.

By participating, you will help us and other health professionals better
understand nutritional and fall risk in seniors like you. This will then help to plan better strategies, programs, and services to help prevent falls and nutrition problems among seniors. If you are interested in participating in this research study, kindly contact the researcher at the following address, by phone or mail or when she is back to the care facility in a week’s time.

Swati Madan
1024, Kisik Towers
3737 Wascana Parkway, University of Regina, Regina, Saskatchewan, S4S0A2
Phone: 306-790-7221
E-mail: swati.madan@uregina.ca

Dr. Shanthi Johnson
CK 115, 3737 Wascana Parkway
University of Regina, Regina, SK. S4S0A2
Phone: 306-337-2436
Email: Shanthi.johnson@uregina.ca
APPENDIX B

LETTER OF INFORMED CONSENT

Dear Participant,

Thank you for your interest in our study, “Nutritional and fall risk assessment in older adults living in long-term care facilities: A cross cultural comparison.” Your participation is valuable and appreciated. We want to make sure you understand that:

Your participation in this study is voluntary (you don’t have to participate) and non-participation will not impact the services received.

You are not obligated to answer anything you are uncomfortable with, and may stop answering questions anytime for any reason. It is your choice to perform the TUG test (balance and mobility impairment test), and handgrip strength test, and if you do not wish to take part, you can inform the researcher. You can withdraw from the study at anytime, until three months from the time of survey. After that, the data would be analyzed and it will not be possible to remove your information.

There are minimal risks associated with your participation to your health or the service you get in the care home.

Your name, address, and personal information will be kept confidential. We will keep all the files in a secure location in a locked cabinet. Your answers to questionnaires will be used for data analysis using a statistical analysis software program. The results of the study will help us understand what causes heightened nutritional and fall risk in older adults living in care homes.

This project has been approved on ethical grounds by the University of Regina Research Ethics Board. Any questions regarding your rights as a participant may be addressed to the committee at 1-306-585-4775 or research.ethics@uregina.ca. Out of town participants may call collect.”

Are you willing to participate in this study? Yes_____ No _____

I have received a copy of this letter of consent. Yes _____ No _____
If you have any other questions or concerns, please feel free to contact:

Swati Madan
1024, Kisik Towers
3737 Wascana Parkway,
University of Regina, Regina,
Saskatchewan, S4S0A2
Phone : 306-790-7221
E-mail : swati.madan@uregina.ca

Dr. Shanthi Johnson
CK 115, 3737 Wascana Parkway
University of Regina, Regina,
SK. S4S0A2
Phone: 306-337-2436
Email: Shanthi.johnson@uregina.ca
APPENDIX C

Background Profile and Physical Activity Questionnaire

Please answer the following questions as they describe you. Choose one of the following options.

1. How long have you lived in this facility?
   a. Six months
   b. Six months to a year
   c. One to two years
   d. More than two years

2. Marital status
   a. Never married
   b. Married
   c. Divorced
   d. Widowed

3. Indicate the number of children you have
   a. None
   b. One
   c. Two
   d. Three
   e. >three
4. Educational status
   a. 10th Grade or below
   b. 12th Grade
   c. Bachelors degree
   d. Masters degree and above

5. Annual income
   a. INR 50,000
   b. INR 50,000 -100,000
   c. INR 100,000- 500,000
   d. INR > 500,000

6. Level of social support
   Do your children or friends frequently visit this nursing home to meet you (Yes/No). If yes, how often?
   a. Once a week
   b. Once every two weeks
   c. Once a month
   d. Once every six months
   e. Once every year

7. Physical activity level in the past
   a. Very active
   b. Active
   c. Fairly active
   d. Rarely active
8. Do you take medications? If yes, how many medications per day? Also mention which ones.

9. Presence of chronic conditions

Do you have any chronic health condition? If yes, mention it below.

10. In a typical week, how many days do you perform moderate intensity exercises that cause small increases in breathing and heart rate?

11. Do you perform activities involving stair climbing and walking on a daily basis?

12. How much time do you spend sitting or reclining on a typical day?

13. Are you aware of the benefits of regular physical exercise in the maintenance of good health (e.g. strong bones and muscles)?

14. Are you willing to participate in an exercise program designed to improve your health and well being?
15. Will you perform exercises that are recommended by a physiotherapist or exercise trainer?

16. Does your LTC facility have any ongoing exercise programs that you would like to join?

17. If your LTC facility does not have any exercise training or group activity sessions, would you like the facility to incorporate training sessions involving group exercises?

18. Would you prefer doing group exercise or individually tailored exercise?
APPENDIX D
Mini-Nutritional Assessment (MNA)

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

Screening:

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

B. Weight loss during the last three months
   
   0= weight loss greater than 3 kg
   1= does not know
   2= weight loss between 1 and 3 kg
   3= no weight loss

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

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

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

F. Body Mass Index (BMI) (weight in kg)/(height in m²)

0= BMI less than 19
1= BMI 19 to less than 21
2= BMI 21 to less than 23
3= BMI 23 or greater

Screening score (subtotal max. 14 points)
12-14 points: Normal nutritional status
8-11 points: at risk of malnutrition
0-7 points: malnourished

For a more in-depth assessment, continue with questions G-R

Assessment

G. Lives independently (not in nursing home or hospital)

1= yes
0= no

H. Takes more than three prescription medications daily

0= yes
1= no

I. Pressure sores or skin ulcers

0= yes
1= no

J. How many full meals does the patient eat daily

0= 1 meal
1= 2 meals
2= 3 meals

K. Selected consumption markers for protein intake

- At least one serving of dairy products (milk, cheese, yoghurt) per day  yes
  no

- Two or more servings of legumes or eggs per week  yes
  no

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

L. Consumes two or more servings of fruits or vegetables per day?

0 = no
1 = yes

M. How much fluid (water, juice, coffee, tea, milk) is consumed per day?

0.0 = less than 3 cups
0.5 = 3 to 5 cups
1.0 = more than 5 cups

N. Mode of feeding

0 = unable to eat without assistance
1 = self-fed with some difficulty
2 = self-fed without any problem

O. Self-view of nutritional status

0 = views self as being malnourished
1 = uncertain of nutritional state
2 = views self as having no nutritional problem

P. In comparison with other people of the same age, how does the patient consider his/her health status?

0.0 = not as good
0.5 = does not know
1.0 = as good
2.0 = better

Q. Mid-arm circumference (MAC) in cm

0.0 = MAC less than 21
0.5 = MAC 21 to 22
1.0= MAC greater than 22

R. Calf-circumference (CC) in cm

0= CC less than 31

1= CC 31 or greater

Assessment (max. 16 points) score

Screening score

Total assessment score (max. 30 points)

Malnutrition Indicator Score

24 to 30 points Normal nutritional status

17 to 23.5 points At risk of malnutrition

Less than 17 points Malnourished
APPENDIX E

Downton Index

<table>
<thead>
<tr>
<th>Item</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Known previous falls</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>Medications</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>Tranquillizers/sedatives</td>
<td>1</td>
</tr>
<tr>
<td>Diuretics</td>
<td>1</td>
</tr>
<tr>
<td>Antihypertensives</td>
<td>1</td>
</tr>
<tr>
<td>Antiparkinsonian drugs</td>
<td>1</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>1</td>
</tr>
<tr>
<td>Other medications</td>
<td>0</td>
</tr>
<tr>
<td>Sensory deficits</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>Visual impairment</td>
<td>1</td>
</tr>
<tr>
<td>Hearing impairment</td>
<td>1</td>
</tr>
<tr>
<td>Limb impairment</td>
<td>1</td>
</tr>
</tbody>
</table>
Mental state

Oriented 0
Confused (cognitively impaired) 1

Gait

Normal (safe without walking aids) 0
Safe with walking aids 0
Unsafe (with/without walking aids) 1
Unable 0

Item scores are added together to obtain an index total which ranges from 0 to 11, where a score of 3 or greater is indicative of a high risk of falls

(Adapted from Downton, 1993).
APPENDIX F

Falls Efficacy Scale International (FES-I)

For each of the following activities, please tick the box which is closest to your own opinion to show how concerned you are that you might fall if you did this activity.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Not at all concerned</th>
<th>Somewhat concerned</th>
<th>Fairly concerned</th>
<th>Very concerned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cleaning the house (sweep, vacuum, dust)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Getting dressed/undressed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Preparing meals</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Taking a bath or shower</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Going to the shop</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. Getting in and out of a chair</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. Going up or down the stairs</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. Walking around in the neighbourhood</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. Reaching for something above your head or on the ground</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Going to answer the telephone before it</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
stops ringing

<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Walking on a slippery surface (wet or icy)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Visiting a friend or relative</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Walking in a place with crowds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Walking on an uneven surface (rocky ground, poorly maintained pavement)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Walking up or down the slope</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Going to a social event (religious service, family gathering or a club meeting)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX G
Geriatric Depression Scale Long Form

1. Are you basically satisfied with your life?  
   yes  no

2. Have you dropped many of your activities and interests?  
   yes  no

3. Do you feel that your life is empty?  
   yes  no

4. Do you often get bored?  
   yes  no

5. Are you hopeful about the future?  
   yes  no

6. Are you bothered by thoughts you can’t get out of your head?  
   yes  no

7. Are you in good spirits most of the time?  
   yes  no

8. Are you afraid that something bad is going to happen to you?  
   yes  no

9. Do you feel happy most of the time?  
   yes  no

10. Do you often feel helpless?  
    yes  no

11. Do you often get restless and fidgety?  
    yes  no

12. Do you prefer to stay at home, rather than going out and doing  
    new things?  
    yes  no
13. Do you frequently worry about the future?  yes  no
14. Do you feel you have more problems with memory than most?  yes  no
15. Do you think it is wonderful to be alive now?  yes  no
16. Do you often feel downhearted and blue?  yes  no
17. Do you feel pretty worthless the way you are now?  yes  no
18. Do you worry a lot about the past?  yes  no
19. Do you find life very exciting?  yes  no
20. Is it hard for you to get started on new projects?  yes  no
21. Do you feel full of energy?  yes  no
22. Do you feel that your situation is hopeless?  yes  no
23. Do you think that most people are better off than you are?  yes  no
24. Do you frequently get upset over little things?  yes  no
25. Do you frequently feel like crying?  yes  no
26. Do you have trouble concentrating?  yes  no
27. Do you enjoy getting up in the morning?  yes  no
28. Do you prefer to avoid social gatherings?  yes  no
29. Is it easy for you to make decisions?  yes  no

30. Is your mind as clear as it used to be?  yes  no

This is the original scoring for the scale: One point for each of these answers. Cutoff: normal-0 to 9; mild depression-10 to 19; severe depression-20 to 30
APPENDIX H

Mini Mental State Exam

Date: __________________

Instructions: Score one point for each correct response within each question or activity.

<table>
<thead>
<tr>
<th>Total score</th>
<th>Score</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td>“What is the year? Season? Date? Day? Month?”</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>“Where are we now? State? County? Town/city? Hospital? Floor?”</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>The examiner names three unrelated objects clearly and slowly, then the instructor asks the patient to name all three of them. The patient’s response is used for scoring.</td>
</tr>
</tbody>
</table>
| 5           |       | “I would like you to count backward from 100 by sevens.”(93,86,79, 72, 65,…)
Alternative: “Spell WORLD backwards.”(D-L-R-O-W) |
<p>| 3           |       | “Earlier I told you the names of three things. Can you tell me what those were?” |
| 2           |       | Show the patient two simple objects, such as a wrist-watch and a pencil, and ask the patient to name them. |
| 1           |       | “Repeat the phrase: ‘No ifs, ands, or buts.’” |
| 3           |       | “Take the paper in your right hand, fold it in half, and put it on the floor.” |
| 1           |       | “Please read this and do what it says.”(Written instruction is “Close your eyes.”) |
| 1           |       | “Make up and write a sentence about anything.”(This sentence must contain a noun and a verb.) |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“Please copy this picture.” (The examiner gives the patient a blank piece of paper and asks him/her to draw the symbol below. All 10 angles must be present and two must intersect.)</td>
</tr>
<tr>
<td>30</td>
<td>TOTAL</td>
</tr>
</tbody>
</table>
Interpretation of the MMSE:

<table>
<thead>
<tr>
<th>Method</th>
<th>Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutoff</td>
<td>&lt;24</td>
<td>Abnormal</td>
</tr>
<tr>
<td>Range</td>
<td>&lt;21</td>
<td>Increased</td>
</tr>
<tr>
<td></td>
<td>&gt;25</td>
<td>risk of</td>
</tr>
<tr>
<td>Education</td>
<td>21</td>
<td>Abnormal for 8th grade education</td>
</tr>
<tr>
<td></td>
<td>&lt;23</td>
<td>Abnormal for high school education</td>
</tr>
<tr>
<td></td>
<td>&lt;24</td>
<td>Abnormal for college education</td>
</tr>
<tr>
<td>Severity</td>
<td>24-30</td>
<td>No cognitive impairment</td>
</tr>
<tr>
<td></td>
<td>18-23</td>
<td>Mild cognitive impairment</td>
</tr>
<tr>
<td></td>
<td>0-17</td>
<td>Severe cognitive impairment</td>
</tr>
</tbody>
</table>

Interpretation of MMSEScores:

<table>
<thead>
<tr>
<th>Score</th>
<th>Degree of Impairment</th>
<th>Formal Psychometric Assessment</th>
<th>Day-to-Day Functioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-30</td>
<td>Questionably significant</td>
<td>If clinical signs of cognitive impairment are present, formal assessment of cognition may be valuable.</td>
<td>May have clinically significant but mild deficits. Likely to affect only most demanding activities of daily living.</td>
</tr>
<tr>
<td>20-24</td>
<td>Mild</td>
<td>Formal assessment may be helpful to better determine pattern and extent of deficits.</td>
<td>Significant effect. May require some supervision, support and assistance.</td>
</tr>
<tr>
<td>Score</td>
<td>Severity</td>
<td>Description</td>
<td>Source</td>
</tr>
<tr>
<td>-------</td>
<td>----------</td>
<td>------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>10-19</td>
<td>Moderate</td>
<td>Formal assessment may be helpful if there are specific clinical indications.</td>
<td>Clear impairment. May require 24-hour supervision.</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>Clear impairment. May require 24-hour supervision.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX I

RAND VERSION OF SF-36 HEALTH SURVEY

Choose one option for each questionnaire item.

1. In general, would you say your health is:
   - 1 - Excellent
   - 2 - Very good
   - 3 - Good
   - 4 - Fair
   - 5 - Poor

2. Compared to one year ago, how would you rate your health in general now?
   - 1 - Much better now than one year ago
   - 2 - Somewhat better now than one year ago
   - 3 - About the same
   - 4 - Somewhat worse now than one year ago
   - 5 - Much worse now than one year ago
The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

3. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports
4. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf
5. Lifting or carrying groceries
6. Climbing several flights of stairs
7. Climbing one flight of stairs
8. Bending, kneeling, or stooping
9. Walking more than a mile
10. Walking several blocks
11. Walking one block
12. Bathing or dressing yourself

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

13. Cut down the amount of time you spent on work or other activities
14. Accomplished less than you would like
15. Were limited in the kind of work or other activities
16. Had difficulty performing the work or other activities (for example, it took extra effort)
During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

17. Cut down the amount of time you spent on work or other activities
   - Yes
   - No

18. Accomplished less than you would like
   - Yes
   - No

19. Didn't do work or other activities as carefully as usual
   - Yes
   - No

20. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?
   - 1 - Not at all
   - 2 - Slightly
   - 3 - Moderately
   - 4 - Quite a bit
   - 5 - Extremely

21. How much bodily pain have you had during the past 4 weeks?
   - 1 - None
   - 2 - Very mild
   - 3 - Mild
   - 4 - Moderate
   - 5 - Severe
   - 6 - Very severe
22. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

- 1 - Not at all
- 2 - A little bit
- 3 - Moderately
- 4 - Quite a bit
- 5 - Extremely

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

How much of the time during the past 4 weeks...

23. Did you feel full of pep?

- 1 - All of the time
- 2 - Most of the time
- 3 - A good bit of the time
- 4 - Some of the time
- 5 - A little of the time
- 6 - None of the time

24. Have you been a very nervous person?

- 1 - All of the time
- 2 - Most of the time
- 3 - A good bit of the time
- 4 - Some of the time
- 5 - A little of the time
- 6 - None of the time

25. Have you felt so down in the dumps that nothing could cheer you up?

- 1 - All of the time
- 2 - Most of the time
- 3 - A good bit of the time
- 4 - Some of the time
- 5 - A little of the time
- 6 - None of the time

26. Have you felt calm and peaceful?

- 1 - All of the time
- 2 - Most of the time
- 3 - A good bit of the time
- 4 - Some of the time
- 5 - A little of the time
- 6 - None of the time

27. Did you have a lot of energy?

- 1 - All of the time
- 2 - Most of the time
- 3 - A good bit of the time
- 4 - Some of the time
- 5 - A little of the time
- 6 - None of the time

28. Have you felt downhearted and blue?

- 1 - All of the time
- 2 - Most of the time
- 3 - A good bit of the time
- 4 - Some of the time
- 5 - A little of the time
- 6 - None of the time

29. Did you feel worn out?

- 1 - All of the time
- 2 - Most of the time
- 3 - A good bit of the time
- 4 - Some of the time
- 5 - A little of the time
- 6 - None of the time

30. Have you been a happy person?

- 1 - All of the time
- 2 - Most of the time
- 3 - A good bit of the time
- 4 - Some of the time
- 5 - A little of the time
- 6 - None of the time
31. Did you feel tired?

☐ 1 - All of the time
☐ 2 - Most of the time
☐ 3 - Some of the time
☐ 4 - A little of the time
☐ 5 - None of the time

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

☐ 1 - All of the time
☐ 2 - Most of the time
☐ 3 - Some of the time
☐ 4 - A little of the time
☐ 5 - None of the time

How TRUE or FALSE is each of the following statements for you.

33. I seem to get sick a little easier than other people

☐ 1 - Definitely true
☐ 2 - Mostly true
☐ 3 - Don't know
☐ 4 - Mostly false
☐ 5 - Definitely false

34. I am as healthy as anybody I know

☐ 1 - Definitely true
☐ 2 - Mostly true
☐ 3 - Don't know
☐ 4 - Mostly false
☐ 5 - Definitely false

35. I expect my health to get worse

☐ 1 - Definitely true
☐ 2 - Mostly true
☐ 3 - Don't know
☐ 4 - Mostly false
☐ 5 - Definitely false

36. My health is excellent

☐ 1 - Definitely true
☐ 2 - Mostly true
☐ 3 - Don't know
☐ 4 - Mostly false
☐ 5 - Definitely false
Investigator(s)  Swati Madan
Department     Kinesiology & Health Studies
Funder:         Unfunded
Supervisor:     Dr. Shanthi Johnson
Title:          Nutritional and fall risk assessment in older adults living in Long-term care facilities

APPROVED ON: January 1, 2016

APPROVAL OF:
Application  For
Behavioural  Research  Ethics Review
Background Profile and Physical Activity Questionnaire
Falls Efficacy Scale
International Downton Index
Geriatric Depression
Scale Long Form
SF-36 Health Survey
Letter of Invitation
Letter of Informed Consent
FULL BOARD MEETING DELEGATED REVIEW

The University of Regina Research Ethics Board has reviewed the above-named research project. The proposal was found to be acceptable on ethical grounds. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to this research project, and for ensuring that the authorized research is carried out according to the conditions outlined in the original protocol submitted for ethics review. This Certificate of Approval is valid for the above time period provided there is no change in experimental protocol, consent process or documents.

Any significant changes to your proposed method, or your consent and recruitment procedures should be reported to the Chair for Research Ethics Board consideration in advance of its implementation.

ONGOING REVIEW REQUIREMENTS

In order to receive annual renewal, a status report must be submitted to the REB Chair for Board consideration within one month of the current expiry date each year the study remains open, and upon study completion. Please refer to the following website for further instructions: http://www.uregina.ca/research/for-faculty-staff/ethics-compliance/human/forms1/ethics-forms.html.

Dr. Larena Hoeber, Chair
University of Regina Research Ethics Board
Please send all correspondence to: