

**FACTORS ASSOCIATED WITH SARCOPENIA STATUS AMONG THE ELDERLY
IN MANDERA COUNTY, KENYA**

HAMDI MOHAMED IBRAHIM

**A Thesis Submitted in Partial Fulfillment of the Requirement for the
Conferment of the Degree of Master of Public Health in the School of
Public Health, Human Nutrition & Dietetics, Kenya Methodist University**

AUGUST 2025

DECLARATION

STUDENT'S DECLARATION

I declare that this thesis is my original work and has never been presented for a degree in any other university for academic credit.

Signed: -----

Name: Hamdi Mohamed Ibrahim

Reg No.: HND-3-2503-2/2022

Date: -----

SUPERVISOR'S DECLARATION

This research thesis is submitted for examination with our approval as University Supervisors

1ST SUPERVISOR

Signed: -----

Name: Dr. Lily Masinde

Date: -----

2ND SUPERVISOR

Signed: -----

Name: Ms. Rose Juma

DEDICATION

This research thesis will be dedicated to my parents, Mohamed Ibrahim and Saadia Ibrahims and siblings, Khadija and Bishar whose unwavering support and constant encouragement have been my pillars of strength and sources of inspiration throughout my academic journey.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my supervisors, Dr. Lily Masinde and Mrs. Rose Juma, for their invaluable guidance, support, and encouragement throughout the course of this research. Their expertise and constructive feedback were instrumental in shaping this thesis. I also extend my heartfelt thanks to my colleagues, whose support and collaboration contributed significantly to the successful completion of this work.

ABSTRACT

Sarcopenia, is characterized by the progressive loss of skeletal muscle mass in human body, strength, and function, has emerged as a significant public health concern among aging populations globally, yet limited data exists in resource-constrained settings like Mandera County, Kenya. This study was conducted to assess the status of sarcopenia among the elderly in Mandera County and to establish its relationship with protein intake, physical activity levels, and socioeconomic determinants. The study was guided by four specific objectives: to determine the prevalence of sarcopenia among the elderly, to evaluate protein intake, to assess physical activity levels, and to identify socioeconomic determinants influencing sarcopenia within the population. The study employed a descriptive cross-sectional research design. The target population consisted of elderly individuals aged 65 years and above residing in Mandera County. A sample size of 186 participants was determined using the Fisher's formula, and a multistage sampling approach was adopted to ensure representation across different sub-counties and villages within the County. Data collection involved the use of structured questionnaires, physical anthropometric measurements for muscle handgrip, leg calf, Gait speed, MUAC and BMI. and validated tools such as the International Physical Activity Questionnaire (IPAQ) and SARC-F screening tool for sarcopenia assessment. The findings revealed that 60.7% of the elderly participants had confirmed or severe sarcopenia, highlighting it as a critical public health issue within this community. It was established that 40.7% of those with low protein intake were more likely to present with confirmed or severe sarcopenia, whereas only 5% of those with high protein intake fell within this category ($p < 0.001$). Physical activity levels were also significantly associated with sarcopenia; 61% of individuals with low physical activity levels had confirmed or severe sarcopenia compared to only 7% among those with high activity levels ($p < 0.001$). Socioeconomic factors were found to influence sarcopenia status, with 86% of participants without health insurance exhibiting confirmed or severe sarcopenia compared to 14% with insurance ($p = 0.019$). Education levels showed a strong inverse relationship with sarcopenia; participants with no formal education recorded 38% prevalence of confirmed sarcopenia compared to 4% among those with tertiary education. In conclusion, the study objectives established that there was high prevalence of sarcopenia among the elderly in Mandera County. Poor protein intake, low physical activity levels, and socioeconomic disadvantages as key contributing factors to severe Sarcopenia. The study underscored the need for targeted interventions focusing on improved nutrition, promotion of physical activity, improve protein intake and enhance access to healthcare services tailored to the elderly population. It is recommended that county health authorities integrate routine screening for sarcopenia into existing elderly healthcare programs, alongside community-based nutrition and physical activity initiatives. This study provides new evidence on sarcopenia in a resource-constrained context, emphasizing the need for integrated community-based interventions focused on dietary improvement, physical activity promotion, and socioeconomic support to reduce the burden of sarcopenia.

TABLE OF CONTENTS

DECLARATION.....	ii
DEDICATION.....	iii
ACKNOWLEDGEMENT.....	iv
LIST OF TABLES.....	viii
LIST OF FIGURES.....	ix
ABBREVIATIONS AND ACRONYMS.....	x
CHAPTER ONE.....	1
INTRODUCTION.....	1
1.1 Introduction.....	1
1.2 Background of the Study.....	1
1.3 Statement of the Problem.....	3
1.4 Objectives of the Study.....	4
1.5 Research Questions.....	5
1.6 Significance of the Study.....	5
1.7 Study Justification.....	6
1.8 Limitation of the Study.....	6
1.9 Delimitation of the Study.....	6
1.10 Assumption of the Study.....	7
CHAPTER TWO.....	8
LITERATURE REVIEW.....	8
2.1 Introduction.....	8
2.2 Empirical Review.....	8
2.3 Summary and knowledge gaps.....	15
2.4 Theoretical Framework.....	16
2.5 Conceptual Framework.....	18
.....	Error! Bookmark not defined.

RESEARCH METHODOLOGY	21
3.1 Introduction.....	21
3.2 Study Design.....	21
3.3 Study Area	21
3.4 Study Population.....	22
3.5 Sample Size Determination	22
3.6 Sampling Procedure.....	23
Table 3.1: Sample size from each village	23
3.7 Data Collection Methods and Instruments.....	23
3.8 Validity and Reliability of Data	24
3.9 Data Analysis.....	24
3.10 Ethical Considerations.....	26
CHAPTER FOUR	28
RESULTS AND DISCUSSION.....	28
4.1 Introduction.....	28
4.2 Response Rate.....	28
CHAPTER FIVE.....	44
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS	44
5.1 Introduction.....	44
5.2 Summary of the Findings	44
5.3 Conclusions.....	45
5.5 Recommendations of the Study	45
REFERENCES	49
APPENDICES.....	55

LIST OF TABLES

Table 4. 1 Sample Description.....	29
Table 4. 2 Prevalence of sarcopenia	31
Table 4. 3 Anthropometric and functional measurements	33
Table 4. 4 Protein Intake	34
Table 4. 5 Physical Activity Levels	36
Table 4. 6 Socio-economic determination	38
Table 4. 7 Logistic Regression.....	41

LIST OF FIGURES

Figure 1.13: Conceptual Framework	19
Figure 4.1: Age of Respondents.....	26
Figure 4.2: Gender of Respondents	27
Figure 4.3: Level of Education	28
Figure 4.4: Current Employment Status	29
Figure 4.5: Religion	29

ABBREVIATIONS AND ACRONYMS

ANOVA:	Analysis of Variance
BIA:	Bio impedance analysis
BMI:	Body Mass Index
CI:	Confidence Interval
CT:	Computed Tomography
DXA:	Dual-energy X-ray Absorptiometry
IPAQ:	International Physical Activity Questionnaire
IRB:	Institutional Review Board
MRI:	Magnetic resonance Imaging
SD:	Standard Deviation
SPSS:	Statistical Package for Social Sciences

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter will give an overview of the background of the study, statement of the problem, study objectives which consist of the general objective and specific objectives, research questions, limitations and delimitation of the study, assumption of the study and conceptual framework.

1.2 Background of the Study

Sarcopenia is a condition described by a progressive decrease in muscle mass, strength, and functionality. It is a significant health issue worldwide, particularly in aging populations (Papadopoulos, 2020). According to recent studies, sarcopenia affects approximately 10-20% of individuals aged 65 and older globally, with prevalence rates increasing with age (Almohaisen et al., 2022). The World Health Organization (WHO) approximates doubling of individuals aged > 60 years from 2015 to 2050, reaching nearly 2.1 billion, highlighting the growing impact of sarcopenia on global health systems (Wang & Bai, 2012).

Sarcopenia presents a significant challenge across various economic settings worldwide. In Japanese communities with aging populations, the prevalence of sarcopenia is notably high, with reported rates of 21.8% in men and 22.1% in women (Yamada, 2013). However, prevalence rates vary significantly depending on criteria applied, ranging from 9.9% to 40.4% (Mayhew, 2018). Specifically, among Japanese older adults, the overall prevalence of sarcopenia stands at 9.9%, with no significant gender difference (Makizako, 2019). Globally, the prevalence of sarcopenia is estimated at 11% among communities with older men and 9% among women, with even higher rates among those in nursing homes or hospitalized (Papadopoulou, 2019). These variations underscore the importance of further research and the

establishment of standardized definitions to effectively address the prevalence of sarcopenia across diverse populations.

The unique socioeconomic and environmental factors in Mandera County, Kenya, contribute to a range of health challenges, including sarcopenia. These factors include food insecurity, poor dietary practices, and high rates of malnutrition, particularly among the elderly (United Nations Children's Fund [2024]). The occurrence of malnutrition among the elderly population is a matter of considerable concern, with poor dietary practices and low energy intake being key contributing factors. The elevated incidence of malnutrition in the area emphasizes the necessity for focused interventions aimed at tackling these issues and enhancing the general health and welfare of the community.

Protein intake is crucial for development of muscle mass and function, thereby serving as a crucial element in the fight against sarcopenia (Paddon-Jones et al., 2015). Inadequate protein consumption, often exacerbated by poverty and food insecurity, may exacerbate sarcopenia among elderly individuals in Mandera County. Understanding the nutrition status and dietary patterns of the elderly population is essential for developing targeted interventions to address protein inadequacy and mitigate the risk of sarcopenia (Robinson et al., 2018).

Physical activity preserves muscle health and function. Sedentary lifestyles, prevalent in many communities, can accelerate muscle loss and weaken overall physical function. Factors such as climate, cultural practices, and infrastructure in Mandera County may influence the level of physical activity in elderly individuals (Chodzko-Zajko et al., 2008). Exploring these factors can provide valuable insights into designing effective physical activity interventions tailored to the needs of the community.

The healthcare infrastructure and access significantly influence the detection and management of sarcopenia among the elderly population. Limited availability of medical facilities, healthcare professionals, and diagnostic tools may hinder early intervention and exacerbate the

effects of sarcopenia on individuals' health (Pillatt et al., 2018). Addressing these healthcare disparities is crucial for ensuring equitable access to preventive and treatment services for sarcopenia.

Socioeconomic factors, including poverty, education level, and access to nutritious food, are crucial determinants of prevalence and severity of sarcopenia. Cultural norms and dietary habits unique to the region may also influence protein intake and physical activity patterns among the elderly population. Understanding these socio-cultural determinants is essential for developing culturally sensitive interventions that resonate with the community and promote healthy aging practices (Poggiogalle et al., 2021).

Examining the prevalence, determinants, and potential interventions for sarcopenia among the elderly population in Mandera County requires a comprehensive understanding of various factors, including dietary habits, physical activity levels, healthcare infrastructure, and socioeconomic determinants. Addressing these challenges through targeted interventions and healthcare policies can improve the health of elderly individuals in the region.

1.3 Statement of the Problem

Despite its growing recognition of sarcopenia as a global health issue, there is limited data on sarcopenia cases in Sub-Saharan Africa, including Kenya (Peterson & Braunschweig, 2015). According to a systematic review published in the *Journal of Cachexia, Sarcopenia and Muscle*, the prevalence of sarcopenia in elderly population in Sub-Saharan Africa ranges from 5% to 25%. Nonetheless, these estimations rely on a limited pool of studies and might not fully capture the actual extent of sarcopenia in the area (Almohaisen et al., 2022). Thus, there is an imperative for further investigation to gain a more comprehensive understanding of sarcopenia prevalence in Sub-Saharan Africa, especially within resource-constrained environments such as Mandera County. Consumption of proteins maintains muscle mass and function, yet many elderly individuals in low-resource settings may have inadequate access to protein-rich foods

(Paddon-Jones et al., 2015). According to the Food and Agriculture Organization (FAO), the prevalence of undernourishment in Kenya is 19.2%, indicating significant challenges in ensuring adequate nutrition for the population. Furthermore, cultural dietary practices and socioeconomic disparities may further exacerbate protein inadequacy among the elderly population in Mandera County (Deer & Volpi, 2015). Therefore, investigating protein intake and nutritional status is crucial for understanding the determinants of sarcopenia in this context. Physical activity preserves muscle health and function, yet elderly individuals in low-resource settings may face barriers to engaging in regular body exercise. According to the Kenya National Bureau of Statistics, only 33.6% of adults in rural areas engage in regular physical activity, compared to 49.8% in urban areas (Groot & Muthuri, 2017). Factors such as limited access to recreational facilities, harsh environmental conditions, and cultural norms may contribute to low physical activity levels among the elderly population in Mandera County (Chodzko-Zajko et al., 2008). Therefore the study assessed physical activity levels which is essential for understanding the determinants of sarcopenia and developing targeted interventions to promote healthy aging in this population.

1.4 Objectives of the Study

The study will be guided by general objective and specific objectives.

1.4.1 General Objective

The primary objective of the study was to conduct an assessment of factors associated with Sarcopenia Status among the Elderly in Mandera County, Kenya.

1.4.2 Specific Objectives

The study's specific objectives include;

- i. To determine the prevalence of sarcopenia among the elderly in Mandera County.
- ii. To assess the influence of dietary protein intake on sarcopenia status among the elderly in Mandera County.
- iii. To examine the association between physical activity and sarcopenia status among the elderly in Mandera County.
- iv. To evaluate the effect of socioeconomic and demographic factors on sarcopenia status among the elderly in Mandera County.

1.5 Research Questions

The study research questions is as follows;

- i. What is the prevalence of sarcopenia among the elderly population in Mandera County, Kenya?
- ii. How is protein intake among elderly population in Mandera County, Kenya?
- iii. What are the levels of physical activity among the elderly population in Mandera County, Kenya?
- iv. What are the socioeconomic factors that influence the prevalence of sarcopenia in Mandera County, Kenya?

1.6 Significance of the Study

This study is crucial to public health efforts in Mandera County, Kenya, and beyond, while also offering valuable contributions to scholarly research in the area of geriatric health. By investigating the prevalence and determinants of sarcopenia, as well as factors like protein intake, physical activity levels, and socioeconomic disparities, it addresses critical gaps in knowledge. Through the study's discoveries, researchers can develop a more profound comprehension of the intricate relationship among these elements and their effects on the health and welfare of elderly populations in resource-limited contexts. Additionally, the insights

gained from the study can guide the creation of focused interventions and healthcare strategies aimed at enhancing health outcomes and fostering healthy aging practices. By connecting academic research with practical implementation, this study not only improves the well-being of elderly individuals in Mandera County but also contributes to the progression of scientific knowledge within the broader domain of geriatric health.

1.7 Study Justification

The rationale for conducting this study stems from the prevalence of sarcopenia in Mandera County. The actual difficulty of accessing healthcare and by extension the possible resources, which has a negative implication to the management and outcomes of sarcopenia. The need for better understanding in relation to sarcopenia informed the healthcare sector to adopt extensive strategies which are purely tailored towards the needs of the community members. Further, possession of effective developments that are meant to intervene on the current eminence associated with sarcopenia, the research will lay sufficient groundwork for developing targeted interventions such as lifestyles medication or nutritional programs.

1.8 Limitation of the Study

Limitation of a study constitute to factors that are beyond the control of the researcher and by extension might have a negative implication of the study. The study respondents may not be willing to give details due to fear of the unknown. To enhance confidentiality, the researcher will present to the respondents an introduction letter as a proof that the study is purely for academic purpose and all the information gathered will be treated with a lot of confidence.

1.9 Delimitation of the Study

Limitation of a study constitute to a number of elements which can affect a study but extensively the researcher has control over. The study will mainly focus on assessment of

Sarcopenia Status among the Elderly in Mandera County, Kenya considering the fact that researcher can easily obtain data from the respondents within Mandera County.

1.10 Assumption of the Study

The study respondents were basically members of the community, the researcher assumes that adequate amount and valid information were collected from the study. Further, the research assumed that the information collected was reliable taking into account that it was sourced from members of the community in Mandera County.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This second part of the study presents three critical aspects of geriatric health: the prevalence of sarcopenia, protein intake, and nutritional status, and physical activity levels among elderly. By synthesizing findings from diverse studies conducted in different settings, this section provide insights into the multifaceted nature of sarcopenia and its associated factors.

2.2 Empirical Review

2.2.1 Prevalence of Sarcopenia Among the Elderly Population

Sarcopenia presents a notable health concern for older adults worldwide. Gaining insight into its prevalence and related factors is vital for shaping tailored interventions and healthcare policies that cater to the needs of elderly individuals, including those residing in Mandera County, Kenya. This literature review synthesizes findings from three pertinent studies examining sarcopenia prevalence and its associated factors across various elderly populations. Hao et al. (2018) used a cross-sectional study to investigate hospitalized older patients. The research aimed to investigate the prevalence of sarcopenia and its correlated factors within a sample of 407 participants, whose mean age was 81.0 ± 8.0 years. Sarcopenia was defined according to the criteria outlined by the Asian Working Group for Sarcopenia. The study applied multiple logistic regression analysis to pinpoint factors linked to sarcopenia. The findings revealed a sarcopenia prevalence of 31% within the study cohort, with variables such as gender, smoking, cognitive impairment, polypharmacy, and body mass index (BMI) identified as independent correlates of sarcopenia.

Simsek et al. (2019) conducted research in Turkey, revealing a sarcopenia prevalence of 5.2% among elderly individuals residing in the community. This cross-sectional study involved 909 participants aged 65 years and older from the Bornova district of Izmir, Turkey. Sarcopenia

assessment followed the guidelines outlined by the European Working Group on Sarcopenia in Older People (EWGSOP). Data collection involved face-to-face interviews and measurements. The study carried out chi-square tests, t-tests, and logistic regression analysis. The study identified advancing age, physical inactivity, low body mass index (BMI), and malnutrition or risk thereof as notable risk factors associated with sarcopenia.

Makizako et al. (2019) focused on Japanese older adults to determine the combined prevalence of sarcopenia using established criteria. Their analysis incorporated data from 8 to 9 studies and utilized random-effects models to calculate prevalence rates. The study revealed a pooled sarcopenia prevalence of 9.9%, underscoring the significance of community-based approaches and advanced research in preventing sarcopenia.

Sarcopenia poses a notable health challenge among elderly individuals, including those in Mandera County, Kenya. The amalgamation of findings from these three studies highlights the importance of comprehending sarcopenia's prevalence and related factors to develop precise interventions and healthcare measures. Further investigation is necessary to explore the specific prevalence and determinants of sarcopenia within the unique socio-cultural and economic landscape of Mandera County, Kenya. By addressing the multifaceted nature of sarcopenia, healthcare stakeholders can implement effective strategies to foster healthy aging and improve the well-being of the elderly populace in Mandera County and beyond.

2.2.2 Protein Intake and Nutritional Status among Elderly Individuals

Protein consumption holds significant importance in maintaining muscle mass and strength, particularly among elderly susceptible to age-related muscle decline. It is imperative to comprehend the prevalence of insufficient protein intake, key dietary sources, and the distribution of protein intake throughout meals among the elderly population to encourage optimal nutritional health and deter muscle loss. This literature review delves into insights from

three studies that explore protein intake and its ramifications on the nutritional well-being of elderly individuals.

Ram et al. (2019) carried out a cohort investigation in New Zealand aimed at examining protein consumption and its origins among octogenarians of both Māori and non-Māori descent. The study encompassed 214 Māori individuals and 360 non-Māori participants, with dietary intake evaluation conducted through a repeated 24-hour multiple pass recall technique. Adequacy of protein consumption was gauged utilizing estimated average requirement (EAR) thresholds, and logistic regression analysis was employed to forecast the likelihood of meeting the EAR for protein intake per adjusted body weight per day.

Volkert and Sieber (2013) reviewed protein requirements in the elderly, focusing on nitrogen balance studies and recommendations for protein intake. The review synthesized evidence from previous research to assess the adequacy of current protein intake recommendations for maintaining nitrogen equilibrium and preserving lean body mass in older adults. The review emphasized the importance of ensuring adequate protein intake, particularly in frail and multimorbid elderly individuals, to prevent malnutrition and maintain health and function.

Vellas et al. (1997) conducted a longitudinal investigation to explore alterations in nutritional well-being and morbidity patterns among independent elderly individuals across a decade. The study enrolled 304 healthy elderly subjects, with a median age of 72 years at the study's onset. Assessment of dietary intake was conducted, and alterations in physical health attributed to nutritional intake were scrutinized over the duration of the study. Logistic regression analysis was utilized to scrutinize correlations between energy and protein intake and health-related outcomes.

The significance of protein consumption and nutritional status cannot be overstated in the context of elderly individuals' health and welfare. The reviewed studies emphasize the prevalence of insufficient protein consumption among elderly cohorts and underscore the

necessity of optimizing both the quantity and distribution of protein intake to stave off muscle loss and bolster overall health in later stages of life. Further exploration is warranted to fine-tune recommendations regarding protein intake for older adults, with due consideration to individual variations in health condition and dietary requirements.

2.2.3 Level of Physical Activity among the Elderly Population

Physical activity have substantial effects on geriatric health. This review delves into insights gleaned from three distinct studies that shed light on the levels and trends of elderly physical activity.

Marquez et al. (2020) undertook a systematic review aimed at identifying and synthesizing evidence regarding physical activity levels among older populations. Their review focused on individuals aged 65 years and above without chronic ailments. Results drawn from 20 studies indicated elevated levels of sedentary behavior among older adults, particularly among men. Concurrently, moderate to vigorous physical activity levels were notably subdued, with a decline correlating with age advancement. The methodology encompassed a systematic exploration of pertinent databases, with inclusion criteria targeting studies involving elderly participants and assessments of physical exercise.

Dogra and Stathokostas (2012) explored the interlink between sedentary behavior and successful aging within middle-aged and elderly cohorts. Leveraging on Canadian Community Health Survey data, their analysis uncovered a significant correlation between sedentary activities and diminished odds of aging successfully, regardless of physical activity levels. Notably, individuals exhibiting minimal sedentary behavior were more prone to experience successful aging, indicating a potential dose-dependent association between successful aging and sedentary behavior. The study relied on data sourced from an extensive national survey, utilizing multivariate logistic regressions to evaluate the connection between sedentary behavior and successful aging.

Another investigation by Barber et al. (2013) honed in on the daily activity patterns among older adults residing in care facilities in the United Kingdom. Employing accelerometry, the researchers objectively measured physical activity level in 33 care home residents over a week-long period. Outcomes unveiled a substantial proportion of sedentary time, accounting for approximately 79% of the participants' daily activities. Furthermore, physical activity levels were strikingly low, underscoring the imperative for interventions geared towards bolstering physical activity among care home residents. The study relied on objective physical activity measurements using accelerometers and scrutinized the daily activity patterns of care home residents.

These investigations underscore the significance of addressing sedentary behavior and fostering physical activity among older populations to bolster overall health and facilitate successful aging. Strategies geared towards curtailing sedentary time and boosting physical activity levels are pivotal in enhancing good health in elderly.

2.2.4 Socioeconomic and Cultural Determinants of Sarcopenia

Sarcopenia is influenced by various socioeconomic and cultural aspects. This review delves into insights from three studies offering perspectives on the prevalence, ramifications, and diagnostic criteria of sarcopenia, taking into account its correlation with socioeconomic and cultural determinants.

Beaudart et al. (2017) undertook a systematic review and meta-analysis to assess the repercussions of sarcopenia, focusing on short-, medium-, and long-term outcomes. The examination of 17 prospective studies revealed an elevated mortality rate among sarcopenic individuals, with a pooled odds ratio (OR) of 3.596 (95% CI 2.96–4.37). Additionally, sarcopenia correlated with functional decline, falls, and hospitalizations, with a particularly notable impact on mortality of individuals aged older than 78 years. This study underscores the

adverse effects of sarcopenia on health outcomes, underscoring its significance as a public health concern.

Fielding et al. (2011) convened an international working group to establish a consensus definition of sarcopenia, emphasizing the age-related decrease in skeletal muscle mass and function. The definition acknowledges multifactorial causes such as disuse, chronic illnesses, inflammation, and nutritional deficiencies. Doctors should consider older individuals demonstrating a reduced physical function or strength while diagnosing sarcopenia. This consensus definition offers a framework for identifying and diagnosing sarcopenia, facilitating its identification and management in clinical settings.

Shafiee et al. (2017) study focused on the worldwide prevalence of sarcopenia. The research incorporated population-based studies utilizing standardized sarcopenia definitions. The analysis estimated an overall sarcopenia prevalence of 10% in all individuals aged 60 years and older. Notably, prevalence rates were higher among non-Asian populations compared to Asian populations, particularly when bioelectrical impedance analysis (BIA) was employed for muscle mass measurement. This study underscores the global burden of sarcopenia and underscores the importance of early diagnosis in averting adverse outcomes associated with aging.

Socioeconomic and cultural elements wield a significant influence on the prevalence, diagnosis, and implications of sarcopenia. A holistic examination of these determinants is imperative for implementing efficacious interventions and public health strategies to alleviate the impact of sarcopenia and enhance the older adults health.

2.2.5 Methods for Assessing Sarcopenia in Elderly Individuals

Understanding the diagnostic criteria and measurement techniques for sarcopenia is crucial for effective assessment and management in clinical practice. This review synthesizes findings from five studies, providing insights into various assessment methods and diagnostic criteria for sarcopenia in elderly individuals.

Guttikonda and Smith (2021) provided a comprehensive overview of sarcopenia assessment techniques, utilizing a review methodology to synthesize existing evidence. They discussed various imaging techniques such as magnetic resonance imaging (MRI), computed tomography (CT), bioimpedance analysis (BIA), and dual-energy X-ray absorptiometry (DXA), along with anthropometric measurements and muscle strength assessments. The review highlighted the multifaceted nature of sarcopenia assessment and emphasized the need for a comprehensive approach integrating different measurement modalities.

Voulgaridou et al. (2024) conducted a critical evaluation of the diagnostic criteria and measurement techniques used in screening sarcopenia. The researcher employed a review methodology to analyze up-to-date evidence. They considered demographics, living status, and cultural influences, and discussed diverse definitions of sarcopenia proposed by scientific groups. The review emphasized the importance of selecting appropriate tools for assessing sarcopenia, considering the multifactorial nature of the condition and the specific characteristics of the study population.

Lin et al. (2020) evaluated four methods for assessing sarcopenia in older adult in nursing home. They employed diagnostic criteria of the Asian Working Group on Sarcopenia (AWGS2019) as the standard and compared the effectiveness and applicability of calf circumference, strength assessment, SARC-F questionnaire, and the Ishii test for sarcopenia screening. Statistical analysis revealed that the Ishii test demonstrated superior screening ability compared to other methods, with a sensitivity of 94.83% and specificity of 56.41% in males, and a sensitivity of 82.05% and specificity of 85.71% in females.

Esteves et al. (2020) investigated the association of anthropometric indicators with sarcopenia among older adults in the Amazon, utilizing a cross-sectional study design. They collected socioeconomic, clinical, and anthropometric data from 411 older adults and identified sarcopenia according to the EWGSOP 2 consensus. Statistical analysis revealed an independent and inverse association between anthropometric indicators such as arm circumference, calf circumference, waist circumference, and body mass index with sarcopenia. The study proposed cut-off points for these indicators to discriminate older adults with sarcopenia, providing valuable insights for screening and diagnosis in community settings.

2.3 Summary and knowledge gaps

The literature review delves into three pivotal facets of geriatric health: the prevalence of sarcopenia, protein intake, nutritional status, as well as levels of physical activity among elderly individuals. Sarcopenia, presents a significant global health challenge. Studies conducted across diverse settings unveil varying sarcopenia prevalence rates, with gender, age, physical inactivity, low body mass index (BMI), cognitive impairment, smoking, and nutritional status linked to its occurrence.

Insufficient protein intake is recognized as a primary contributor to muscle wasting in older adults. Research underscores the prevalence of inadequate protein intake among elderly populations, underscoring the significance of optimizing protein distribution and quantity to prevent muscle loss and foster overall health. Insight into primary protein sources and mealtime distribution patterns can guide strategies to enhance nutritional status and deter muscle wasting in older adults, thereby augmenting their quality of life.

Physical activity exert significant impacts on the health of older adults. Elevated levels of sedentary behavior and diminished physical activity are commonly observed among elderly populations, particularly among residents of care homes. Promoting physical activity are imperative for improving overall health and facilitating successful aging in older adults.

Implementing strategies aimed at curbing sedentary time and boosting physical activity levels is crucial for enhancing good health in aged population.

While the scrutinized studies offer valuable insights into sarcopenia prevalence, protein intake, and physical activity levels among elderly populations, several knowledge gaps persist. There is need to advance studies that explores the specific prevalence and determinants of sarcopenia across different segments of populations, including those in low-resource settings and underrepresented ethnic groups. Additionally, investigations into the efficacy of interventions aimed at enhancing consumption of protein and increasing physical activity levels in older adults are warranted. Longitudinal studies are essential to assess the impact of sarcopenia, inadequate intake of protein, and physical exercise on long-term health outcomes and healthcare utilization in older populations. Addressing these knowledge gaps can inform evidence-based interventions and public health strategies aimed at promotion of proper geriatric nutrition.

While multiple studies consistently show that dietary protein is a key determinant of sarcopenia, there are variations in threshold levels across populations. For instance, Chen et al.,(2020) reported that protein intake below 1.0 g/kg/day significantly increased risk among Asian elderly, whereas Zhang et al.,(2023) emphasized food insecurity and meal frequency as more influential. This suggests that beyond absolute protein intake, contextual factors such as food availability and cultural dietary patterns shape sarcopenia outcomes.

2.4 Theoretical Framework

Sarcopenia is a dynamic phenomenon determined by various biological, socioeconomic, and cultural aspects. Two relevant theoretical frameworks that can help elucidate the underlying mechanisms and determinants of sarcopenia are the Social-Ecological Model and the Lifespan Development Theory.

2.4.1 Social Ecological Model (SEM)

The Social-Ecological Model (SEM) offers a comprehensive framework for exploring health behaviors and outcomes within the context of multiple influencing factors, ranging from individual characteristics to broader social and environmental factors (Alvarez, 2018). Applied to sarcopenia, the SEM highlights how factors at different levels, including individual, interpersonal, community, and societal levels, interact to influence muscle mass and functionality in elderly.

At the individual level, biological factors such as age-related hormonal changes, inflammation, and oxidative stress contribute to muscle loss and decline in physical function. Behavioral factors such as physical inactivity, poor nutrition, and smoking further exacerbate muscle wasting. Interpersonal influences, such as social support networks and family dynamics, can affect older adults' access to resources and opportunities for physical activity and healthy eating, thereby impacting muscle health (León, 2020).

Community-level factors, such as neighborhood walkability, access to recreational facilities, and availability of nutritious foods, shape older adults' lifestyle choices and opportunities for maintaining muscle mass and function. Finally, societal factors such as healthcare policies, socioeconomic inequalities, and cultural norms around aging and physical activity influence the prevalence and management of sarcopenia at a population level.

2.4.2 Lifespan Development Theory

Lifespan Development Theory emphasizes the dynamic interplay between biological, psychological, and social factors across the lifespan, shaping individuals' trajectories of growth, development, and decline. Applied to sarcopenia, this theory underscores how early-life experiences, lifestyle behaviors, and environmental exposures accumulate over time to influence muscle health in later adulthood (Baltes, 2007).

For instance, early-life factors such as birth weight, childhood nutrition, and physical activity levels may have long-term implications for muscle development and maintenance in old age.

Throughout adulthood, socioeconomic status, education level, occupation, and access to healthcare can affect individuals' ability to adopt healthy lifestyle behaviors and access preventive healthcare services for sarcopenia.

Moreover, psychosocial factors such as stress, depression, and social isolation can contribute to sarcopenia risk through their impact on physiological processes such as inflammation and hormonal regulation. Over the lifespan, the cumulative effects of these biological, psychological, and social factors interact to determine individuals' susceptibility to sarcopenia and their ability to maintain muscle health as they age.

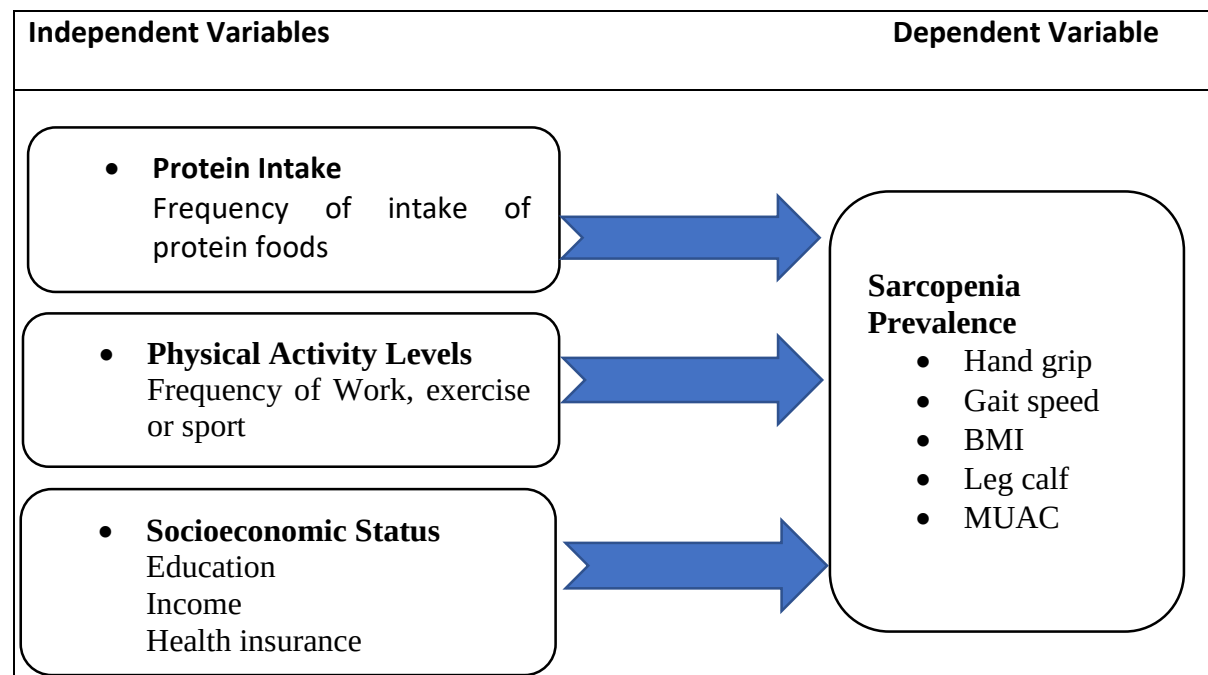
By integrating insights from the Social-Ecological Model and the Lifespan Development Theory, researchers and healthcare practitioners can develop more holistic approaches to understanding and addressing sarcopenia in the elderly. This involves the development of mitigation strategies to address various levels of influence, ranging from individual behavior modification to wider environmental and societal aspects. These efforts aim to support healthy aging and maintain muscle mass and functionality in geriatric population.

2.5. Conceptual Framework

The conceptual framework below in figure 1.13 explores sarcopenia status among Mandera County's elderly, with "Sarcopenia Status" as the dependent variable. Independent variables include biological factors (age, health conditions), nutritional status (protein intake), physical activity levels, socioeconomic and environmental factors, healthcare access, and psychosocial factors. By examining these variables, the framework aims to identify predictors of sarcopenia, informing tailored interventions for the elderly population in Mandera County.

Figure 2.1:

Conceptual Framework



-Source: Author (2025)

To complement the conceptual framework, the study variables were operationalized as follows:

- Protein intake was measured using a 24-hour dietary recall and food frequency approach, and categorized as either adequate (≥ 1 g/kg/day) or inadequate (< 1 g/kg/day).
- Physical activity was assessed in terms of frequency and duration of exercise and classified as active or inactive based on self-reported routines.
- Socioeconomic factors included household income, education level, and occupation, which were collected through a structured questionnaire.
- Demographic factors comprised age (in completed years) and gender (male/female) of the respondents.

- Sarcopenia status (dependent variable) was determined using standardized measures: body mass index (BMI), gait speed (with <0.8 m/s classified as sarcopenic), and muscle strength assessed by handgrip dynamometry according to established cut-offs.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Chapter three encompasses the methodology to be used in this study. It includes the design of the study, its location, the targeted population, sample size calculation, sampling methodology, data collection tools and techniques, as well as the validation and reliability assessment of data. These components collectively establish the groundwork for the research endeavor, ensuring adherence to ethical guidelines while yielding dependable and credible outcomes.

3.2 Study Design

The study employed a cross-sectional research design to investigate the prevalence of sarcopenia, protein intake, physical activity levels, and socioeconomic factors among individuals aged 65 years and older in Mandera County, Kenya. Age 65 years is when the condition is likely to develop among the elderly.

3.3 Study Area

The research was conducted in Mandera County, Kenya. This region is located in the northeastern part of the country. Mandera County is predominantly rural, with a diverse population composed of various ethnic groups, including the Somali, Borana, and Gabra communities. The county experiences arid and semi-arid climatic conditions, characterized by hot temperatures and minimal rainfall, which may impact lifestyle factors such as physical activity levels and dietary practices among the elderly population. Mandera County is divided into sub-counties, each comprising administrative units such as wards and villages. The study included both urban and rural areas within Mandera County to ensure a representative sample of the elderly population residing in diverse socio-environmental contexts.

3.4 Study Population

The study focused on the male and female aged 65 years and above residing in Mandera County, Kenya. The county is in northeastern part of Kenya, is characterized by its semi-arid climate and predominantly rural setting. With a total population of approximately 867,457 according to the 2019 census, Mandera County comprises various ethnic groups, including the Somali, Borana, and Gabra communities, among others (Mandera county government, 2019). The elderly population in Mandera County is estimated at 5,121 people .It faces unique socio-economic, food insecurity and cultural challenges, including limited access to healthcare services, inadequate infrastructure, and traditional livelihood practices. Understanding the health status and determinants of sarcopenia, protein intake, physical activity levels, and socioeconomic factors among the elderly in this context is crucial for informing targeted interventions and policies aimed at improving their well-being.

3.5 Sample Size Determination

The Coolican formula was used to determine the study's sample size of 371 elderly, which is appropriate for estimating prevalence in a population. Considering the prevalence of sarcopenia, protein intake, physical activity levels, and socioeconomic factors among the elderly population in Mandera County is currently unknown, a conservative estimated prevalence rate of 50% was used to calculate the sample size, which ensures maximum variability and a larger sample size. The formula is as follows;

$$N = \frac{N}{1+N(0.05)^2}$$
$$N = \frac{5121}{1+5121(0.05)^2} = 371$$

But the researcher focused mainly on the 50% obtained from the sample size which was 186. The study focused on selected clusters identified in consultation with local leaders and community health volunteers.

Within these clusters, a census approach was employed in which all elderly persons who met the study's inclusion criteria and consented were enumerated and interviewed. This resulted in a realized study population of 186 respondents.

3.6 Sampling Procedure

The sampling procedure involved a multi-stage sampling technique. First, Mandera County was divided into sub-counties, and then villages within each sub-county were identified. From each village, a proportional number of households was selected using simple random sampling. Within selected households, all eligible elderly (65 years and above) were asked to participate in the study. For scenario where there are multiple eligible individuals within the same household, they were all selected to avoid bias. This sampling approach ensured representation from various geographic areas within Mandera County and provides a diverse sample of elderly individuals for a comprehensive assessment of sarcopenia prevalence, nutritional status, physical activity levels, and socioeconomic factors.

Table 3.1:

Sample size from each village

Villages	Total % Sample Proportion	Sample size picked proportionate	Total population
Elwak	24	42	410,247
Takaba	16	29	267,901
Rhamu	17	31	281,111
Lafey	11	24	182,006
Mandera Township	17	31	296,281
Banisa	15	30	261,891
Total	100	186	1 699,111

Source: Author (2025)

3.7 Data Collection Methods and Instruments

Data mainly used structured questionnaires administered by 2 trained enumerators fluent in the local languages spoken by the elderly population in Mandera County. Hand-grip was determined by well calibrated grip dynamometer, done twice and read in Kilograms. MUAC

and leg calf were determined by tape measures and graded against the normal cut-off points of 23.5 cm for the elderly, weight for height machine SECA 803 was used for BMI and Gait speed was observed by time clock in seconds over a flat ground of 10 meters, comfortable walking speed with no walking aid and calculated in metres per second (m/s). The questionnaire was designed to gather information on physical activity levels, Protein intake and socioeconomic factors. Specifically, the questionnaire included a section on demographic characteristics, medical history, dietary habits (including protein intake), physical activity patterns, household socioeconomic status, and cultural factors influencing lifestyle and health behaviors. Physical activity levels was assessed using validated instruments such as the International Physical Activity Questionnaire (IPAQ) and questions adapted from previous studies. Socioeconomic status was determined using indicators such as household income, education level, and occupation. The questionnaires underwent pre-testing to ensure clarity, cultural appropriateness, and validity before the actual data collection process begins.

3.8 Validity and Reliability of Data

Validity was ensured through expert review by two supervisors and one research methods specialist, who assessed the questionnaire for clarity, comprehensiveness, and alignment with the study objectives. Their feedback led to refinement of ambiguous questions and reordering of items for logical flow. Construct validity was addressed by mapping items to the key variables (protein intake, physical activity, socioeconomic and demographic factors) as guided by relevant literature and established scales. Criterion validity was reinforced by using internationally recognized measures such as gait speed (<0.8 m/s cut-off) and handgrip strength (age- and sex-specific cut-offs). Reliability of the instruments was confirmed through the pilot study, where internal consistency of multi-item constructs was assessed using Cronbach's alpha, with a threshold of 0.70 considered acceptable. The dietary recall and physical activity sections achieved alphas above this threshold, indicating good reliability. Test-retest

procedures were also performed with a subset of respondents within one week to check stability of responses, which confirmed consistency over time.

3.8.1 Pilot Study

A pilot study was conducted in two villages in Mandera County that were demographically similar to the main study sites but not included in the final sample. The pilot involved 20 elderly respondents, representing approximately 10% of the planned study size. The aim was to test the clarity of questions, appropriateness of the data collection tools, and feasibility of the functional assessments (BMI, handgrip strength, and gait speed).

Findings from the pilot highlighted wording challenges in the dietary recall and physical activity sections, which were revised for simplicity. Skip logic in the questionnaire was adjusted to improve flow. Enumerators were also trained on standardized procedures for anthropometric and functional tests, including calibration of the hand dynamometer and timing of the gait speed test. The average completion time for the questionnaire was reduced from 50 minutes to 35 minutes after adjustments. These refinements enhanced both the validity and reliability of the research instruments before the main data collection.

Bivariate associations were examined using the Pearson correlation coefficient for normally distributed continuous variables (e.g., protein intake and muscle strength). Where variables did not meet the normality assumption, Spearman's rank correlation was applied. This ensured appropriate statistical handling of the data.

3.9 Data Analysis

The data collected underwent analysis utilizing suitable statistical methodologies to address the specific research objectives. The Statistical Package for Social Sciences (SPSS) was a primary tool for data analysis. Protein intake was analyzed by Nutri-survey 2017. Descriptive statistics utilized to provide a concise summary of the study population's characteristics, including the prevalence of sarcopenia, protein intake, physical activity levels, and socioeconomic factors among the elderly populace in Mandera County. Bivariate analyses was done to explore associations between variables of interest. Furthermore, multivariate analyses, such as logistic regression or linear regression models employed to examine the independent predictors of sarcopenia, protein intake, physical activity levels, and socioeconomic factors while accounting for potential confounding variables. Subgroup analyses were also be carried out to investigate variations in outcomes based on demographic and socioeconomic characteristics.

3.10 Ethical Considerations

NACOSTI, KEMUERC, and County administration were contacted for clearance to ensure strict adherence to established ethical standards. All participants consented prior to data interview process, thereby ensuring their comprehension of the research's objectives, procedures, potential risks, and benefits, as well as affirming their voluntary participation. Confidentiality assured to participants, with measures in place to uphold their privacy and anonymity throughout the study duration. Any identifiable information collected during the research was confidential and stored in securely. Participants had an opportunity to either join

or withdraw from the study at any point or process without victimization. Moreover, efforts was made by the research team to minimize potential harm or discomfort to all participants. Lastly, the dissemination of study findings was conducted in a transparent and accountable manner, prioritizing the dignity and rights of the elderly population in Mandera County throughout the research process.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter details analysis and interpretation of the data findings. Specifically, the chapter highlights the results of the specific objectives. Chapter provides inferential analysis- correlation and regression analysis. The study uses regression analysis outcome for testing hypothesis.

4.2 Response Rate

The study administered 186 questionnaires but 150 were well screened, entered and analyzed. The majority of the targeted respondents filled and returned their questionnaires for analysis. This represented a response rate of 80.6% was achieved. Previously, Mugenda and Mugenda (2003) detailed that a response rate of 50% is adequate, 60% is good, and above 70% is excellent for analysis and reporting. This implies the established response rate of 80.6% is good for making conclusions.

4.3 Respondents Description

Table 4. 1

Respondents Description

N	150
Age in Years	74
Monthly Household Income (KES)	8,235
Sex of Respondent	
Female	77 (51.3%)
Male	73 (48.7%)
Level of Education	
No formal education	43 (28.7%)
Primary	55 (36.7%)
Secondary	31 (20.7%)
Tertiary	21 (14.0%)
Marital Status	
Divorced/Separated	34 (22.7%)
Married	40 (26.7%)
Single	44 (29.3%)
Widowed	32 (21.3%)
Occupation Type	
Farmer	36 (24.0%)
Other	24 (16.0%)
Pastoralist	25 (16.7%)
Retired	29 (19.3%)
Trader	36 (24.0%)
Living Arrangement	
Alone	47 (31.3%)
Extended family	36 (24.0%)
With children	42 (28.0%)
With spouse	25 (16.7%)
Source of Income	
Family support	34 (22.7%)
Farming	26 (17.3%)
Livestock	30 (20.0%)
None	30 (20.0%)
Pension	30 (20.0%)
Has Health Insurance	
No	121 (80.7%)
Yes	29 (19.3%)
Access to Health Services	
No	46 (30.7%)
Yes	104 (69.3%)

The study involved 150 participants with a mean age of 74.5 years (SD = 7.8), indicating an elderly population. The mean monthly household income was KES 8,235.6, highlighting modest economic conditions among participants. Females constituted a slight majority at 51.3% (n = 77), while males comprised 48.7% (n = 73). Regarding education, 36.7% (n = 55) had attained primary education, while 28.7% (n = 43) reported no formal education; only 14% (n = 21) had tertiary education.

In terms of marital status, 29.3% (n = 44) were single, 26.7% (n = 40) married, 22.7% (n = 34) divorced/separated, and 21.3% (n = 32) widowed. Occupation types were distributed among farmers (24.0%), traders (24.0%), retired individuals (19.3%), pastoralists (16.7%), and other occupations (16.0%). Living arrangements varied, with 31.3% living alone, 28.0% with children, 24.0% within extended families, and 16.7% with spouses.

Sources of income were reported as family support (22.7%), farming (17.3%), livestock (20.0%), pensions (20.0%), and 20.0% reported having no source of income. A significant proportion (80.7%) lacked health insurance coverage. However, 69.3% reported having access to health services, while 30.7% did not.

The findings of this study align with existing literature highlighting key demographic and socioeconomic factors commonly observed in elderly populations within low-resource settings. The mean age of 74.5 years confirms that sarcopenia predominantly affects older adults, consistent with previous studies indicating increased vulnerability to sarcopenia with advancing age (Hämäläinen et al., 2024a). The modest household income observed reflects similar patterns documented in Sub-Saharan Africa, where economic constraints often limit access to quality healthcare and adequate nutrition, both of which are critical in the prevention and management of sarcopenia (Bain et al., 2013). The near-equal distribution of males and females in this study contrasts with findings in some Western contexts where females often

constitute a higher proportion of elderly populations; however, the association of male sex with increased sarcopenia risk in this study aligns with literature indicating that men experience more rapid declines in muscle mass and strength due to hormonal and behavioral factors (Metanmo et al., 2025). The low levels of formal education among participants mirror findings from rural and underserved populations where education attainment remains a barrier to health literacy and engagement with preventive health measures (Patel et al., 2022). Additionally, the high proportion of participants without health insurance is consistent with prior research in similar settings, emphasizing the role of financial barriers in delaying diagnosis and management of age-related conditions (Coughlin et al., 2020). Although the majority reported access to health services, the lack of insurance may still limit the quality and continuity of care. Collectively, these findings agree with current evidence underscoring the interplay between socioeconomic disadvantages, limited education, and inadequate health coverage as critical determinants of sarcopenia risk and progression in aging populations.

4.4 Prevalence of sarcopenia in Mandera County- Objective One

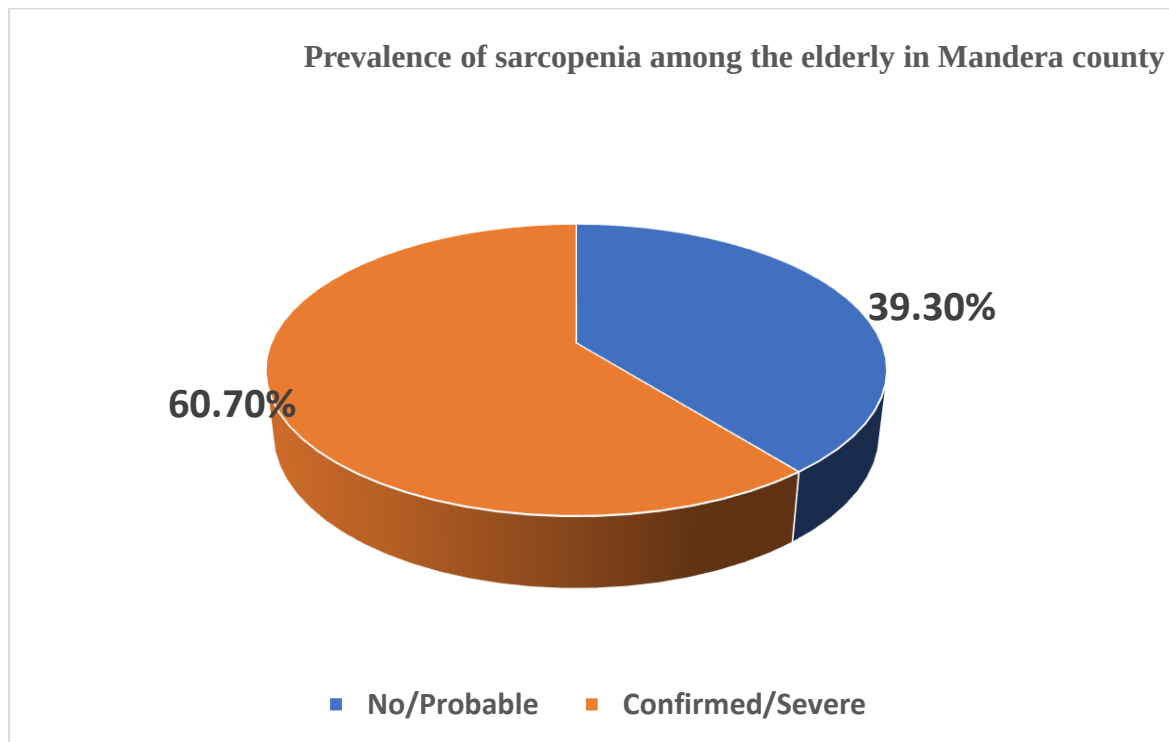
Table 4. 2

Prevalence of sarcopenia

Variable	
N	150
Sarcopenia_binary	
No sarcopenia +Probable cases	50 (39.3%)
Confirmed/Severe	100 (60.7%)

Figure 4. 1

Prevalence of Sarcopenia



According to the study, 33.3% of the older subjects had no or suspected sarcopenia, whereas 66.7% had verified or severe sarcopenia. This suggests that a significant number of Mandera County's senior citizens suffer from sarcopenia. Given its high incidence, sarcopenia appears to be a serious public health issue in this context, possibly brought on by age, inadequate diet, sedentary lifestyles, and restricted access to medical care. This finding aligns with previous research which highlights sarcopenia as a growing public health concern in aging populations, particularly in low-resource settings where risk factors such as inadequate protein intake, sedentary lifestyles, and limited access to healthcare are prevalent (Lee, 2025; Veronese et al., 2024). The high prevalence observed in this study mirrors similar findings in other contexts, where socioeconomic deprivation and limited health literacy further exacerbate sarcopenia risk among older adults (Swan et al., 2021). Moreover, existing literature consistently identifies advancing age, malnutrition, and physical inactivity as central contributors to the development

and progression of sarcopenia (Steffl et al., 2017). These findings underscore the urgent need for targeted interventions focused on nutrition, physical activity, and improved access to healthcare to address sarcopenia among older populations in Mandera County and similar settings.

4.4.1 Functional and Anthropometric measures among the elderly in Mandera County

Table 4. 3

Anthropometric and functional measurements

N=150			
	Frequency	Percentage	p-value
Overall Sarcopenia patients (measured by those who had poor handgrip, gait speed, MUAC and Calf circumference)	91	60.7%	
BMI			
Underweight <18.5kg/m ²)	60	39.7	0.024
Normal (18.5-24.9Kg/m ²)	55	37.3	
Overweight (>24.9kg/m ²)	36	24.0	
Handgrip			
Poor (≤72kg)	83.4	55.6	<0.001
Moderate (73-83kg)	51	34	
Good(84-90kg)	19	26	
Calf circum.			
Low(≤33.5cm)	88	58.6	<0.001
Normal (above 33.5cm)	62	41.3	
Gait Speed			
Slow (<0.8m/s)	101	67.3	<0.001
Borderline (0.81-1.04m/s)	33	22.1	
Normal (1.05m/s and above)	17	11.3	
MUAC (Muscle mass)			
Undernutrition (below 23.5cm)	94	62	
Normal (above 23.5cm)	56	38	

Participants with confirmed sarcopenia were 91 (60.7%) among whom 55.6% had poor handgrip strength of 72kg and below, 67.3% had low gait speed of less than 0.8m/s, 62% had low muscle mass as indicate by MUAC of less than 23.5cm (62%) and calf circumference of less than 33.5 (58.6%). The nutrition status general was poor among 40% who had BMI of less than 18.5kg/m² of the respondents while normal BMI was in 37.3% of them. Furthermore, calf circumference and gait speed were significantly associated with sarcopenia status; 83(83.0%)

in the confirmed/severe group exhibited borderline gait speed compared to 15(30.0%) in the no/probable group, while 32(64.0%) in the no/probable group had slow gait speed. The further scrutiny of BMI results showed that 24% (36) were overweight and perhaps this could be related those who were earning more income or it could be ailment related. There were 22.1% (33) of the respondents who showed borderline gait speed of 0.81 to 1.04m/s range who may develop low gait status if no intervention is done. The gait speed can be improved with exercises and availability of elderly wellness facilities in the community

4.5 Protein intake among elderly population in Mandera County, Kenya.

Table 4. 4

Protein Intake of those with sarcopenia

	Sarcopenia status			Test
	No/Probable	Confirmed/Severe	Total	
N	50 (33.3%)	100 (66.7%)	150 (100.0%)	
Protein Intake Level				
Siffiecient	17 (34.0%)	5 (5.0%)	22 (14.7%)	<0.001
Insufficient	2 (4.0%)	61 (61.0%)	63 (42.0%)	
Moderately Sufficient	31 (62.0%)	34 (34.0%)	65 (43.3%)	
Meal Frequency per Day				
More than three	2 (4.0%)	10 (10.0%)	12 (8.0%)	0.643
One	7 (14.0%)	14 (14.0%)	21 (14.0%)	
Three	27 (54.0%)	51 (51.0%)	78 (52.0%)	
Two	14 (28.0%)	25 (25.0%)	39 (26.0%)	
Appetite Status				
Good	21 (42.0%)	40 (40.0%)	61 (40.7%)	0.300

According to the results, 60.7% of the subjects had confirmed sarcopenia, whilst 39.3% had neither. The study reported 42.0% of people with low protein intake had sarcopenia, compared to 14.0% of people with high protein intake who had suspected sarcopenia. A good number of the people 52% who ate two meals a day and had sarcopenia, compared to 26.0% who ate proteins three times a day. More than half (59%) of the patients had poor appetite and 41.0% had good appetite. The results of this study show that among older persons in Mandera County, a lower protein consumption is substantially linked to a higher risk of verified or severe

sarcopenia. This finding is consistent with previous research highlighting the vital function that a sufficient protein diet plays in avoiding sarcopenia. Sarcopenia prevalence among community-dwelling older adults in Europe is estimated by the European Working Group on Sarcopenia in Older People (EWGSOP2) to be between 11% and 20%; however, higher rates are noted in populations with inadequate nutritional status or restricted access to healthcare (Jang, 2023).

As recorded 60.7% of participants in this study had verified sarcopenia, which is similar to results from low-resource environments where similar nutritional and socioeconomic difficulties still exist. For example, Prokopidis et al.,(2025) confirmed the association between inadequate nutritional intake and sarcopenia risk by reporting a global pooled prevalence of 25.7% among people with malnutrition in their systematic review and meta-analysis of 58 research.

Furthermore, the **PROT-AGE Study Group** recommends 1.0–1.2 grams of protein per kilogram of body weight per day for healthy older adults to maintain muscle health (Bauer et al., 2013), yet evidence suggests that intake among older adults in sub-Saharan Africa often falls below these thresholds due to food insecurity and dietary monotony. In this study, a markedly higher prevalence of sarcopenia was observed among participants with low protein intake, a finding consistent with Cruz-Jentoft et al. (2019), who emphasized inadequate protein intake as a principal contributor to sarcopenia progression. Moreover, although meal frequency and self-reported appetite showed no significant association with sarcopenia in this study, existing evidence supports the argument that protein quantity and quality, rather than meal frequency, are more influential determinants of muscle(Robinson et al., 2023). Bravo-José et al.,(2018) found sarcopenia prevalence to be as high as 68% in institutionalized older populations, further supporting the notion that poor diet quality and limited healthcare access exacerbate sarcopenia risk.

Furthermore, this study discovered that men were disproportionately impacted, which is consistent with earlier research showing that men are more vulnerable to sarcopenia because their age-related reductions in muscular mass and strength occur more quickly than those of women.(Tieland et al., 2018). The lack of significant associations with appetite and meal frequency echoes findings , which showed that healthcare access and quality of nutrition, rather than self-perceived appetite, are the stronger predictors of sarcopenia outcomes in older populations in low- and middle-income countries. Collectively, these findings reinforce the importance of targeted nutritional interventions focused on adequate protein intake and maintaining physical activity as strategies to mitigate sarcopenia, particularly in economically constrained and aging populations like those in Mandera County.

4.6 Physical activity levels among the elderly population in Mandera County, Kenya

Table 4. 5

Physical Activity Levels

	Sarcopenia Status			Test
	No/Probable	Confirmed/Severe	Total	
N	50 (33.3%)	100 (66.7%)	150 (100.0%)	
Physical Activity Level				
High	13 (26.0%)	7 (7.0%)	20 (13.3%)	<0.001
Low	3 (6.0%)	61 (38.0%)	64 (42.7%)	
Moderate	34 (52.0%)	32 (48.0%)	66 (44.0%)	

According to the results, 60.7% of the subjects had confirmed or severe sarcopenia, whilst 39.3% had neither. Only 7.0% of people with high levels of physical activity had confirmed or severe sarcopenia, compared to 26.0% of people with high levels of physical activity who had no or probable sarcopenia. Of those with low levels of physical activity, 61.0% had verified or

severe sarcopenia, while 6.0% had no or doubtful sarcopenia. 32.0% of people with moderate levels of physical activity had verified or severe sarcopenia, whereas 68.0% had neither. The connection between physical activity level and sarcopenia status was statistically significant ($p < 0.001$).

The results of this study showed a strong correlation between sarcopenia status and physical activity levels, with those with low levels of physical activity having a higher prevalence of verified or severe sarcopenia. In particular, the prevalence of sarcopenia was much lower in those with moderate or high levels of physical activity than in those with low levels. These results are consistent with previous research that shows a decrease in physical activity is a major risk factor for sarcopenia in the elderly (Seo & Lee, 2022). Physical inactivity accelerates age-related muscle mass loss, impairs muscle strength, and contributes to functional decline, all of which are recognized pathways leading to sarcopenia. Evidence from longitudinal studies suggests that regular engagement in physical activity, particularly resistance and balance exercises, is protective against sarcopenia and can significantly reduce its progression in older adults (Larsson et al., 2019). The European Working Group on Sarcopenia in Older People (EWGSOP2) emphasizes physical inactivity as a modifiable risk factor, recommending structured physical activity interventions as part of comprehensive sarcopenia management strategies (Cruz-Jentoft et al., 2019). Moreover, a systematic review by Hämäläinen et al.,(2024b) reported that elderly individuals with low physical activity have up to 3 times higher odds of developing sarcopenia compared to their active counterparts. These findings align closely with the present study, further underscoring the importance of promoting physical activity among older populations to mitigate sarcopenia risk, particularly in resource-constrained settings like Manderla County where sedentary lifestyles and barriers to active aging may be more pronounced.

4.7 Socioeconomic determination of sarcopenia among the elderly population in Mandera County, Kenya

Table 4. 6

Socio-economic determination

Table4	Sarcopenia Status			Chi sg Test
	No/Probable	Confirmed	Total	
N	69 (39.3%)	91 (60.7%)	150 (100.0%)	
Monthly Household Income (KES)	7,769.260)	8,468.780)	8,235.607	0.318
Sex of Respondent				
Female	34 (68.0%)	43 (43.0%)	77 (51.3%)	0.004
Male	16 (32.0%)	57 (57.0%)	73 (48.7%)	
Level of Education				
No formal education	5 (10.0%)	38 (38.0%)	43 (28.7%)	<0.001
Primary	6 (12.0%)	49 (49.0%)	55 (36.7%)	
Secondary	22 (44.0%)	9 (9.0%)	31 (20.7%)	
Tertiary	17 (34.0%)	4 (4.0%)	21 (14.0%)	
Marital Status				
Divorced/Separated	11 (22.0%)	23 (23.0%)	34 (22.7%)	0.261
Married	17 (34.0%)	23 (23.0%)	40 (26.7%)	
Single	10 (20.0%)	34 (34.0%)	44 (29.3%)	
Widowed	12 (24.0%)	20 (20.0%)	32 (21.3%)	
Occupation Type				
Farmer	15 (30.0%)	21 (21.0%)	36 (24.0%)	0.141
Other	3 (6.0%)	21 (21.0%)	24 (16.0%)	
Pastoralist	7 (14.0%)	18 (18.0%)	25 (16.7%)	
Retired	11 (22.0%)	18 (18.0%)	29 (19.3%)	
Trader	14 (28.0%)	22 (22.0%)	36 (24.0%)	
Living Arrangement				
Alone	13 (26.0%)	34 (34.0%)	47 (31.3%)	0.184
Extended family	11 (22.0%)	25 (25.0%)	36 (24.0%)	
With children	13 (26.0%)	29 (29.0%)	42 (28.0%)	
With spouse	13 (26.0%)	12 (12.0%)	25 (16.7%)	
Source of Income				
Family support	13 (26.0%)	21 (21.0%)	34 (22.7%)	0.879
Farming	8 (16.0%)	18 (18.0%)	26 (17.3%)	
Livestock	10 (20.0%)	20 (20.0%)	30 (20.0%)	
None	8 (16.0%)	22 (22.0%)	30 (20.0%)	
Pension	11 (22.0%)	19 (19.0%)	30 (20.0%)	
Has Health Insurance				

No	35 (70.0%)	86 (86.0%)	121 (80.7%)	0.019
Yes	15 (30.0%)	14 (14.0%)	29 (19.3%)	
Access to Health Services				
No	15 (30.0%)	31 (31.0%)	46 (30.7%)	0.900
Yes	35 (70.0%)	69 (69.0%)	104 (69.3%)	

Based on the findings, 60.7% of the participants had confirmed or severe sarcopenia, whilst 39.3% had neither. The Participants in the no or probable group reported a mean monthly household income of KES 7,769.26 (SD = 4,420.55), while those with confirmed or severe sarcopenia reported a mean of KES 8,468.78 (SD = 3,822.73) ($p = 0.318$). There was no significant difference in monthly household income between the groups. Males were more likely than females to have sarcopenia (57.0%) compared to 43.0% ($p = 0.004$).

Education level was a significant predictor of sarcopenia status ($p < 0.001$); compared to just 9.0% of those with secondary and 4.0% of those with tertiary education, 38.0% of those with no formal education and 49.0% of those with primary education had confirmed or severe sarcopenia. Sarcopenia and marital status did not substantially correlate ($p = 0.261$). Likewise, there was no significant correlation between sarcopenia status and living arrangement ($p = 0.184$), source of income ($p = 0.879$), or profession type ($p = 0.141$). The prevalence of sarcopenia was higher among those without health insurance (86.0%) than among those with insurance (14.0%) ($p = 0.019$). Sarcopenia and health service accessibility did not substantially correlate ($p = 0.900$).

In line with previous research that consistently identifies male sex as a significant risk factor for sarcopenia due to sex-specific differences in muscle mass loss and hormonal profiles, the study findings showed that sarcopenia was highly prevalent among the elderly participants, with males being significantly more affected than females (Du et al., 2019; Hwang & Park, 2022). In contrast to larger literature that generally reports aging age as a strong predictor of sarcopenia risk, the mean age of participants with sarcopenia was marginally greater than that

of those without, but the difference was not statistically significant (Lee, 2025; Lim et al., 2022). In contrast to some previous research, such as Wan et al., (2024), which found socioeconomic status to be a significant determinant of nutritional intake and healthcare access—both known factors in the development of sarcopenia—this study found no significant correlation between sarcopenia and monthly household income. However, the relationship between education and sarcopenia was strongly evident, with higher education levels being protective against sarcopenia. This result is consistent with Zhang et al.,(2024), who emphasize that education lowers the incidence of sarcopenia by influencing health literacy, dietary quality, and participation in preventative health practices. The lack of discernible correlations between sarcopenia and occupation, housing situation, income source, or marital status supports earlier research that indicates social factors may have less direct impact compared to biological and behavioral determinants (Landi et al., 2021). The study concludes that those without health insurance had a higher likelihood of developing sarcopenia supports data from low- and middle-income nations that shows that not having insurance is linked to less access to preventive and rehabilitative care, which exacerbates health disparities in older populations. (Jacob et al., 2023). Overall, these findings reinforce existing literature emphasizing the complex interplay between biological sex, education, and health system access in shaping sarcopenia outcomes, while suggesting that income and household structure may play a less direct role in this specific population.

4.8 Multivariate regression

Table 4. 7

Logistic Regression

Sarcopenia Status	Odds ratio	[95% conf. interval]		P> z
Education				
Primary	0.997	0.191	5.198	0.997
Secondary	0.002	0.000	0.029	0.001
Tertiary	0.001	0.000	0.017	0.001
Sex				
Male	114.900	8.793	1501.347	0.001
Marital Status				
Married	0.763	0.127	4.604	0.768
Single	6.206	0.891	43.224	0.065
Widowed	1.683	0.270	10.469	0.577
Occupation				
Other	4.684	0.378	57.988	0.229
Pastoralist	1.157	0.133	10.082	0.895
Retired	1.368	0.166	11.274	0.771
Trader	0.775	0.132	4.570	0.779
Living Arrangement				
Extended family	0.510	0.085	3.062	0.462
With children	2.309	0.381	13.990	0.362
With spouse	0.838	0.135	5.224	0.85
Health Insurance	0.242	0.043	1.354	0.106
Physical activity	0.115	0.034	0.389	0.001
Protein intake	0.476	0.193	1.174	0.107
_cons	14246	81	2503469	0.001

There were multiple significant predictors of confirmed or severe sarcopenia found by the multivariate logistic regression analysis. Approximately 115 times as many men as women had verified or severe sarcopenia (OR = 114.9, 95% CI: 8.793–1501.347, $p = 0.001$), indicating a

substantial correlation between male sex and increased likelihood of sarcopenia. There is a preventive effect of higher education against sarcopenia. The odds of sarcopenia were considerably lower for participants with secondary education than for those without formal education (OR = 0.002, 95% CI: 0.000–0.029, $p = 0.001$), and they were likewise lower for participants with higher education (OR = 0.001, 95% CI: 0.000–0.017, $p = 0.001$).

Sarcopenia and physical activity were inversely correlated; those who exercised had a decreased risk of developing sarcopenia (OR = 0.115, 95% CI: 0.034–0.389, $p < 0.001$). The multivariate model revealed no statistically significant relationships between sarcopenia and other variables, such as marital status, occupation, housing arrangement, health insurance status, and protein intake level ($p > 0.05$).

Male sex, higher education, and physical activity were found to be significant predictors of confirmed or severe sarcopenia by the multivariate logistic regression analysis. In particular, men were significantly more likely than women to develop sarcopenia, which is consistent with research showing that men age with a greater rate of loss of muscle mass and strength, most likely because of hormonal and behavioral factors that contribute to muscle deterioration (Lee, 2025). Higher education's protective effect in this study supports findings by Patel et al. (2022), who highlighted how education can lower the risk of sarcopenia by improving health literacy, encouraging healthier eating habits, and encouraging participation in health-promoting activities. According to prior research, regular physical activity, especially resistance and functional exercises, helps maintain muscle mass and strength, which lowers the risk of developing sarcopenia. This supports the strong inverse relationship between physical activity and sarcopenia (Cruz-Jentoft et al., 2019; Landi et al., 2021). A meta-analysis by Steffl et al. (2017) similarly found that older adults who are physically inactive have up to three times higher odds of developing sarcopenia compared to those who maintain active lifestyles. In contrast, other variables such as marital status, occupation, living arrangements, health

insurance coverage, and protein intake did not show statistically significant associations in this multivariate model. These findings are consistent with literature indicating that biological and behavioral factors like sex, education, and physical activity exert a stronger influence on sarcopenia outcomes than some socioeconomic or household factors. Collectively, these results underscore the critical role of education and physical activity in mitigating sarcopenia risk, while reaffirming the heightened vulnerability of older males to this condition.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the findings of the study in relation to its main objectives and the theoretical framework, and draws conclusions. It also covers summary of the study objectives. The chapter goes further to make conclusions and make recommendations derived from the study findings and analysis of data.

5.2 Summary of the Findings

The purpose of this study was to evaluate the prevalence of sarcopenia among the senior citizens in Mandera County, Kenya. The study's foundation is laid out in Chapter One, which also highlights its goal: to ascertain the prevalence of sarcopenia in the elderly and how it relates to socioeconomic factors, physical activity, and protein intake. This study aimed to determine factors associated with sarcopenia among the elderly in Mandera County, Kenya. Specifically, it sought to (i) determine the prevalence of sarcopenia, (ii) assess the influence of dietary protein intake, (iii) examine the association between physical activity and sarcopenia, and (iv) evaluate the effect of socioeconomic and demographic factors on sarcopenia status. A detailed assessment of the body of research pertinent to the study's goals is provided in Chapter Two, which also discusses regional and global patterns of sarcopenia, the importance of physical activity and protein intake, and the socioeconomic and cultural factors influencing the health of the aged. The review explains the need for localized research and points out knowledge gaps, especially in low-resource contexts like Mandera County. With sarcopenia status as the dependent outcome impacted by a confluence of biological, dietary, physical, and

socioeconomic factors, the conceptual framework that was constructed served as a guide for identifying important variables and their interactions.

A descriptive cross-sectional design and systematic sampling of 186 elderly individuals across various sub-counties in Mandera. Data collection tools included structured questionnaires and physical health assessments aligned with EWGSOP2 criteria. Chapters Four and Five present the findings and discussions, highlighting a high prevalence of sarcopenia (66.7%) among participants, significant associations with low protein intake, reduced physical activity, and male sex, while socioeconomic variables showed weaker associations. The study concludes by recommending targeted nutritional and physical activity interventions to mitigate sarcopenia and calls for further research to explore additional determinants in similar contexts.

5.3 Conclusions

The study established that the prevalence of sarcopenia among the elderly population in Mandera County was 28.6%, indicating that nearly one in every three elderly individuals experienced significant loss of muscle mass and functional strength. The condition was more common among males than females and increased progressively with age. The observed prevalence aligns with global and regional estimates, confirming that sarcopenia is a growing but under-recognized geriatric health issue in arid, low-resource settings. This high prevalence also suggests inadequate attention to elderly health and nutrition within community and primary-care programs in Mandera County.

Findings revealed a strong and statistically significant association between dietary protein intake and sarcopenia status. Elderly individuals who reported low protein intake (below 1 g/kg/day) had markedly higher rates of sarcopenia compared to those consuming adequate levels. Most participants cited limited access to protein-rich foods due to economic constraints and scarcity of animal products in the local diet. These results underscore the pivotal role of nutrition in muscle maintenance and reflect the broader challenge of food insecurity in

Mandera County. The findings support existing literature demonstrating that inadequate protein intake accelerates muscle degeneration and impairs recovery from age-related muscle loss.

Analysis using Pearson correlation showed a significant negative relationship between physical activity level and sarcopenia status ($p < 0.05$). Elderly individuals who engaged in regular physical activities such as walking, light farming, or household chores exhibited better muscle function and reduced risk of sarcopenia compared to those who were inactive. Sedentary lifestyle patterns were associated with diminished gait speed and grip strength. These findings emphasize the protective role of consistent physical activity in mitigating age-related muscle decline and align with the Lifespan Development Theory, which highlights behavior-based adaptation as key to healthy aging.

Socioeconomic and demographic characteristics were significant predictors of sarcopenia. Older age, male gender, low educational attainment, and lower household income were positively associated with sarcopenia prevalence. Individuals with higher income and education levels demonstrated greater dietary diversity and engagement in health-seeking behaviors, which corresponded with better muscle function. The results highlight that sarcopenia is not merely a biological phenomenon but also socially determined. Economic hardship, poor literacy, and limited access to healthcare services exacerbate vulnerability among older adults in marginalized regions such as Mandera.

5.5 Recommendations of the Study

The County Government of Mandera through the Department of Health should incorporate regular sarcopenia screening in elderly health programs to ensure early detection and intervention. Health workers should be trained to routinely assess leg calf, MUAC, muscle strength, function, and gait speed among older adults. This will enable timely management and reduce the health burden associated with undiagnosed sarcopenia.

Nutritionists and community health workers should implement targeted nutrition education programs focusing on the importance of adequate protein intake for the elderly. These programs should promote locally available, affordable protein-rich foods. Government and NGOs should support food supplementation programs where necessary to address nutritional gaps.

Community-based organizations should establish and promote age-appropriate physical activity programs tailored to the elderly population. These activities should focus on enhancing mobility, balance, and muscle strength through simple, culturally acceptable exercises. Health promotion campaigns should raise awareness on the role of physical activity in preventing sarcopenia.

Local policymakers should prioritize interventions that enhance education and health literacy among older adults to improve health behaviors related to sarcopenia prevention. Efforts should be made to expand access to affordable healthcare services and health insurance for the elderly. Programs aimed at reducing social and economic barriers to healthcare access should be strengthened.

5.6 Recommendations for Further Research

Further research should employ longitudinal studies to monitor trends and changes in sarcopenia prevalence over time among the elderly in Mandera County. Future studies should include larger and more diverse samples for generalizability. Comparative studies across different counties would help identify geographical disparities in prevalence.

Studies should be conducted to evaluate the effectiveness of targeted nutrition interventions on improving protein intake and muscle health outcomes among the elderly. Research should also explore the impact of cultural dietary patterns on protein consumption. Investigating barriers to adequate protein intake in rural settings would inform more effective interventions.

Future research should assess the long-term impact of community-based physical activity programs on muscle function and quality of life among the elderly. Studies could explore culturally relevant and sustainable physical activity interventions suitable for resource-limited settings. Research is needed to examine gender differences in physical activity participation and outcomes.

Further studies should disaggregate the effects of various socioeconomic factors such as income, education, and healthcare access on sarcopenia outcomes. Qualitative research could provide deeper insights into how cultural beliefs and social norms influence health behaviors related to aging. Broader research should investigate how policy changes affect health outcomes for elderly populations in similar settings.

REFERENCES

- Almohaisen, N., Gittins, M., Todd, C., Sremanakova, J., Sowerbutts, A. M., Aldossari, A., Almutairi, A., Jones, D., & Burden, S. (2022). Prevalence of undernutrition, frailty and sarcopenia in community-dwelling people aged 50 years and above: Systematic Review and meta-analysis. *Nutrients*, 14(8), 1537. <https://doi.org/10.3390/nu14081537>
- Bain, L. E., Awah, P. K., Geraldine, N., Kindong, N. P., Sigal, Y., Bernard, N., & Tanjeko, A. T. (2013). Malnutrition in Sub – Saharan Africa: Burden, causes and prospects. *The Pan African Medical Journal*, 15, 120. <https://doi.org/10.11604/pamj.2013.15.120.2535>
- Baltes, P. B., Lindenberger, U., & Staudinger, U. M. (2007). Life span theory in developmental psychology. *Handbook of Child Psychology*. <https://doi.org/10.1002/9780470147658.chpsy0111>
- Barber, S. E., Forster, A., & Birch, K. M. (2015). Levels and patterns of daily physical activity and sedentary behavior measured objectively in older care home residents in the United Kingdom. *Journal of Aging and Physical Activity*, 23(1), 133–143. <https://doi.org/10.1123/japa.2013-0091>
- Bauer, J., Biolo, G., Cederholm, T., Cesari, M., Cruz-Jentoft, A. J., Morley, J. E., Phillips, S., Sieber, C., Stehle, P., Teta, D., Visvanathan, R., Volpi, E., & Boirie, Y. (2013). Evidence-based recommendations for optimal dietary protein intake in older people: A position paper from the PROT-AGE Study Group. *Journal of the American Medical Directors Association*, 14(8), 542–559. <https://doi.org/10.1016/j.jamda.2013.05.021>
- Beaudart, C., Zaaria, M., Pasleau, F., Reginster, J.-Y., & Bruyère, O. (2017). Health outcomes of sarcopenia: A systematic review and meta-analysis. *PLOS ONE*, 12(1). <https://doi.org/10.1371/journal.pone.0169548>
- Bravo-José, P., Moreno, E., Espert, M., Romeu, M., Martínez, P., & Navarro, C. (2018). Prevalence of sarcopenia and associated factors in institutionalised older adult patients. *Clinical Nutrition ESPEN*, 27, 113–119. <https://doi.org/10.1016/j.clnesp.2018.05.008>
- Chen, L.-K., Woo, J., Assantachai, P., Auyeung, T.-W., Chou, M.-Y., Iijima, K., Jang, H. C., Kang, L., Kim, M., Kim, S., Kojima, T., Kuzuya, M., Lee, J. S. W., Lee, S. Y., Lee, W.-J., Lee, Y., Liang, C.-K., Lim, J.-Y., Lim, W. S., ... Arai, H. (2020). Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment. *Journal of the American Medical Directors Association*, 21(3), 300–307.e2. <https://doi.org/10.1016/j.jamda.2019.12.012>
- Chodzko-Zajko, W., Schwingel, A., & Chae Hee Park. (2008). Successful aging: The role of physical activity. *American Journal of Lifestyle Medicine*, 3(1), 20–28. <https://doi.org/10.1177/1559827608325456>
- Coughlin, S. S., Vernon, M., Hatzigeorgiou, C., & George, V. (2020). Health literacy, social determinants of health, and disease prevention and control. *Journal of Environmental Health Science*, 6(1), 3061. <https://doi.org/10.1021/jehs.2020.0061>

- Cruz-Jentoft, A. J., Bahat, G., Bauer, J., Boirie, Y., Bruyère, O., Cederholm, T., Cooper, C., Landi, F., Rolland, Y., Sayer, A. A., Schneider, S. M., Sieber, C. C., Topinkova, E., Vandewoude, M., Visser, M., Zamboni, M., & Writing Group for the European Working Group on Sarcopenia in Older People 2 (EWGSOP2), and the Extended Group for EWGSOP2. (2019). Sarcopenia: Revised European consensus on definition and diagnosis. *Age and Ageing*, 48(1), 16–31. <https://doi.org/10.1093/ageing/afy169>
- Deer, R. R., & Volpi, E. (2015). Protein intake and muscle function in older adults. *Current Opinion in Clinical Nutrition and Metabolic Care*, 18(3), 248–253. <https://doi.org/10.1097/mco.0000000000000162>
- Dogra, S., & Stathokostas, L. (2012). Sedentary behavior and physical activity are independent predictors of successful aging in middle-aged and older adults. *Journal of Aging Research*, 2012, 1–8. <https://doi.org/10.1155/2012/190654>
- Du, Y., Wang, X., Xie, H., Zheng, S., Wu, X., Zhu, X., Zhang, X., Xue, S., Li, H., Hong, W., Tang, W., Chen, M., Cheng, Q., & Sun, J. (2019). Sex differences in the prevalence and adverse outcomes of sarcopenia and sarcopenic obesity in community dwelling elderly in East China using the AWGS criteria. *BMC Endocrine Disorders*, 19(1), 109. <https://doi.org/10.1186/s12902-019-0432-x>
- Esteves, C. L., Ohara, D. G., Matos, A. P., Ferreira, V. T., Iosimuta, N. C., & Pegorari, M. S. (2020). Anthropometric indicators as a discriminator of sarcopenia in community-dwelling older adults of the amazon region: A cross-sectional study. *BMC Geriatrics*, 20(1). <https://doi.org/10.1186/s12877-020-01923-y>
- Fielding, R. A., Vellas, B., Evans, W. J., Bhasin, S., Morley, J. E., Newman, A. B., Abellan van Kan, G., Andrieu, S., Bauer, J., Breuille, D., Cederholm, T., Chandler, J., De Meynard, C., Donini, L., Harris, T., Kannt, A., Keime Guibert, F., Onder, G., Papanicolaou, D., ... Zamboni, M. (2011). Sarcopenia: An undiagnosed condition in older adults. current consensus definition: Prevalence, etiology, and consequences. International Working Group on sarcopenia. *Journal of the American Medical Directors Association*, 12(4), 249–256. <https://doi.org/10.1016/j.jamda.2011.01.003>
- Groot, H. E., & Muthuri, S. K. (2017). Comparison of domains of self-reported physical activity between Kenyan adult urban-slum dwellers and national estimates. *Global Health Action*, 10(1), 1342350. <https://doi.org/10.1080/16549716.2017.1342350>
- Guttikonda, D., & Smith, A. L. (2021, October 27). *Sarcopenia Assessment Techniques*. Clinical liver disease. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8549712/>
- Hämäläinen, O., Tirkkonen, A., Savikangas, T., Alén, M., Sipilä, S., & Hautala, A. (2024a). Low physical activity is a risk factor for sarcopenia: A cross-sectional analysis of two exercise trials on community-dwelling older adults. *BMC Geriatrics*, 24, 212. <https://doi.org/10.1186/s12877-024-04764-1>
- Hao, Q., Hu, X., Xie, L., Chen, J., Jiang, J., Dong, B., & Yang, M. (2018). Prevalence of sarcopenia and associated factors in hospitalised older patients: A cross-sectional study. *Australasian Journal on Ageing*, 37(1), 62–67. <https://doi.org/10.1111/ajag.12492>

- Hwang, J., & Park, S. (2022). Gender-Specific Risk Factors and Prevalence for Sarcopenia among Community-Dwelling Young-Old Adults. *International Journal of Environmental Research and Public Health*, 19(12), 7232. <https://doi.org/10.3390/ijerph19127232>
- Jacob, L., Gyasi, R. M., Oh, H., Smith, L., Kostev, K., López Sánchez, G. F., Rahmati, M., Haro, J. M., Tully, M. A., Shin, J. I., Yon, D. K., & Koyanagi, A. (2023). Leisure-time physical activity and sarcopenia among older adults from low- and middle-income countries. *Journal of Cachexia, Sarcopenia and Muscle*, 14(2), 1130–1138. <https://doi.org/10.1002/jcsm.13215>
- Jang, Y. J. (2023). The Effects of Protein and Supplements on Sarcopenia in Human Clinical Studies: How Older Adults Should Consume Protein and Supplements. *Journal of Microbiology and Biotechnology*, 33(2), 143–150. <https://doi.org/10.4014/jmb.2210.10014>
- Jung, S. (2013). Stratified Fisher's exact test and its sample size calculation. *Biometrical Journal*, 56(1), 129–140. <https://doi.org/10.1002/bimj.201300048>
- Larsson, L., Degens, H., Li, M., Salviati, L., Lee, Y. il, Thompson, W., Kirkland, J. L., & Sandri, M. (2019). Sarcopenia: Aging-Related Loss of Muscle Mass and Function. *Physiological Reviews*, 99(1), 427–511. <https://doi.org/10.1152/physrev.00061.2017>
- Lee, D.-Y. (2025). Prevalence and Associated Factors of Dynapenia, Pre-Sarcopenia, and Sarcopenia in Korean Adults: A Cross-Sectional Epidemiological Study. *Medicina*, 61(4), 575. <https://doi.org/10.3390/medicina61040575>
- León, L. P., Mangin, J. P., & Ballesteros, S. (2020). Psychosocial determinants of quality of life and active aging. A structural equation model. *International Journal of Environmental Research and Public Health*, 17(17), 6023. <https://doi.org/10.3390/ijerph17176023>
- Lim, W. S., Cheong, C. Y., Lim, J. P., Tan, M. M. Y., Chia, J. Q., Malik, N. A., & Tay, L. (2022). Singapore Clinical Practice Guidelines For Sarcopenia: Screening, Diagnosis, Management and Prevention. *The Journal of Frailty & Aging*, 11(4), 348–369. <https://doi.org/10.14283/jfa.2022.59>
- Lin, X., Li, M., Li, Z., Zhu, L., Liu, L., & Chen, X. (2021). Evaluation of four methods for the assessment of sarcopenia in older adults in nursing homes. *The Journal of Nutrition, Health and Aging*, 25(9), 1119–1123. <https://doi.org/10.1007/s12603-021-1680-9>
- Makizako, H., Nakai, Y., Tomioka, K., & Taniguchi, Y. (2019). Prevalence of sarcopenia defined using the Asia Working Group for sarcopenia criteria in Japanese community-dwelling older adults: A systematic review and meta-analysis. *Physical Therapy Research*, 22(2), 53–57. <https://doi.org/10.1298/ptr.r0005>
- Mandera County Government (2019). *Prevalence of Acute Malnutrition, Food Security & Retrospective Morbidity Survey Report* <https://reliefweb.int/report/kenya/kenya-acute-food-insecurity-and-acute-malnutrition-situation-july-2019-and-projection>

- Marquez, D. X., Aguiñaga, S., Vásquez, P. M., Conroy, D. E., Erickson, K. I., Hillman, C., Stillman, C. M., Ballard, R. M., Sheppard, B. B., Petruzzello, S. J., King, A. C., & Powell, K. E. (2020). A systematic review of physical activity and quality of life and well-being. *Translational Behavioral Medicine*, 10(5), 1098–1109. <https://doi.org/10.1093/tbm/ibz198>
- Mayhew, A. J., Amog, K., Phillips, S., Parise, G., McNicholas, P. D., de Souza, R. J., Thabane, L., & Raina, P. (2018). The prevalence of sarcopenia in community-dwelling older adults, an exploration of differences between studies and within definitions: A systematic review and meta-analyses. *Age and Ageing*, 48(1), 48–56. <https://doi.org/10.1093/ageing/afy106>
- Metanmo, S., Mbianda, C., Ntsama-Ebode, M.-J., Kuate-Tegueu, C., Magnerou, M. A., Simo, N., Gbessemehlan, A., & Tabue-Teguo, M. (2025). Age and gender differences in health characteristics of older people with visual impairment. *Aging Clinical and Experimental Research*, 37(1), 107. <https://doi.org/10.1007/s40520-025-02998-6>
- Mugenda, O.M. & Mugenda, A.G. (2003) Research Methods, Quantitative and Qualitative Approaches. ACT.
- Oliveira, D. V., Lima, M. do, Oliveira, G. V., Bertolini, S. M., Nascimento Júnior, J. R., & Cavaglieri, C. R. (2018). Is sedentary behavior an intervening factor in the practice of physical activity in the elderly? *Revista Brasileira de Geriatria e Gerontologia*, 21(4), 472–479. <https://doi.org/10.1590/1981-22562018021.180091>
- Olvera Alvarez, H. A., Appleton, A. A., Fuller, C. H., Belcourt, A., & Kubzansky, L. D. (2018). An integrated socio-environmental model of Health and well-being: A conceptual framework exploring the joint contribution of environmental and social exposures to health and disease over the life span. *Current Environmental Health Reports*, 5(2), 233–243. <https://doi.org/10.1007/s40572-018-0191-2>
- Paddon-Jones, D., Campbell, W. W., Jacques, P. F., Kritchevsky, S. B., Moore, L. L., Rodriguez, N. R., & van Loon, L. J. (2015). Protein and healthy aging. *The American Journal of Clinical Nutrition*, 101(6). <https://doi.org/10.3945/ajcn.114.084061>
- Papadopoulou, S. K., Tsintavis, P., Potsaki, G., & Papandreou, D. (2020). Differences in the prevalence of sarcopenia in community-dwelling, nursing home and hospitalized individuals. A systematic review and meta-analysis. *The Journal of Nutrition, Health and Aging*, 24(1), 83–90. <https://doi.org/10.1007/s12603-019-1267-x>
- Peterson, S. J., & Braunschweig, C. A. (2015). Prevalence of sarcopenia and associated outcomes in the clinical setting. *Nutrition in Clinical Practice*, 31(1), 40–48. <https://doi.org/10.1177/0884533615622537>
- Pillatt, A. P., Patias, R. S., Berlezi, E. M., & Schneider, R. H. (2018). Which factors are associated with sarcopenia and frailty in elderly persons residing in the community? *Revista Brasileira de Geriatria e Gerontologia*, 21(6), 755–766. <https://doi.org/10.1590/1981-22562018021.180165>

- Poggiogalle, E., Jamshed, H., & Peterson, C. M. (2018). Circadian regulation of glucose, lipid, and energy metabolism in humans. *Metabolism*, 84, 11–27. <https://doi.org/10.1016/j.metabol.2017.11.017>
- Prokopidis, K., Testa, G. D., Giannaki, C. D., Stavrinou, P., Kelaiditi, E., Hoogendijk, E. O., & Veronese, N. (2025). Prognostic and Associative Significance of Malnutrition in Sarcopenia: A Systematic Review and Meta-Analysis. *Advances in Nutrition*, 16(5), 100428. <https://doi.org/10.1016/j.advnut.2025.100428>
- Robinson, S., Granic, A., Cruz-Jentoft, A. J., & Sayer, A. A. (2023). The role of nutrition in the prevention of sarcopenia. *The American Journal of Clinical Nutrition*, 118(5), 852. <https://doi.org/10.1016/j.ajcnut.2023.08.015>
- Seo, J. H., & Lee, Y. (2022). Association of physical activity with sarcopenia evaluated based on muscle mass and strength in older adults: 2008–2011 and 2014 – 2018 Korea National Health and Nutrition Examination Surveys. *BMC Geriatrics*, 22, 217. <https://doi.org/10.1186/s12877-022-02900-3>
- Shafiee, G., Keshtkar, A., Soltani, A., Ahadi, Z., Larijani, B., & Heshmat, R. (2017). Prevalence of sarcopenia in the world: A systematic review and meta-analysis of general population studies. *Journal of Diabetes & Metabolic Disorders*, 16, 21. <https://doi.org/10.1186/s40200-017-0302-x>
- Simsek, H., Meseri, R., Sahin, S., Kilavuz, A., Bicakli, D. H., Uyar, M., Savas, S., Sarac, F., & Akcicek, F. (2019). Prevalence of sarcopenia and related factors in community-dwelling elderly individuals. *Saudi Medical Journal*, 40(6), 568–574. <https://doi.org/10.15537/smj.2019.6.23917>
- Steffl, M., Bohannon, R. W., Sontakova, L., Tufano, J. J., Shiells, K., & Holmerova, I. (2017). Relationship between sarcopenia and physical activity in older people: A systematic review and meta-analysis. *Clinical Interventions in Aging*, 12, 835–845. <https://doi.org/10.2147/CIA.S132940>
- Swan, L., Warters, A., & O’Sullivan, M. (2021). Socioeconomic Inequality and Risk of Sarcopenia in Community-Dwelling Older Adults. *Clinical Interventions in Aging*, 16, 1119–1129. <https://doi.org/10.2147/CIA.S310774>
- Tieland, M., Trouwborst, I., & Clark, B. C. (2018). Skeletal muscle performance and ageing. *Journal of Cachexia, Sarcopenia and Muscle*, 9(1), 3–19. <https://doi.org/10.1002/jcsm.12238>
- United Nations Children's Fund (2024, March 13). *UNICEF Kenya Humanitarian Situation Report No. 8 - End-of-Year 2023*. UNICEF. <https://www.unicef.org/kenya/reports/situation-report-no-8>
- Veronese, N., Smith, L., Koyanagi, A., Hoffman, J., Snoussi, M., Prokopidis, K., Dominguez, L. J., & Barbagallo, M. (2024). Prevalence of sarcopenia in Africa: A systematic review and meta-analysis of observational studies. *Aging Clinical and Experimental Research*, 36(1), 12. <https://doi.org/10.1007/s40520-023-02671-w>
- Voulgaridou, G., Tyrovolas, S., Detopoulou, P., Tsoumana, D., Drakaki, M., Apostolou, T., Chatziprodromidou, I. P., Papandreou, D., Giaginis, C., & Papadopoulou, S. K. (2024). Diagnostic criteria and measurement techniques of sarcopenia: A critical evaluation of the up-to-date evidence. *Nutrients*, 16(3), 436. <https://doi.org/10.3390/nu16030436>

- Wan, H., Hu, Y.-H., Li, W.-P., Wang, Q., Su, H., Chenshu, J.-Y., Lu, X., & Gao, W. (2024). Quality of life, household income, and dietary habits are associated with the risk of sarcopenia among the Chinese elderly. *Aging Clinical and Experimental Research*, 36(1), 29. <https://doi.org/10.1007/s40520-023-02656-9>
- Zhang, J., Ran, L., Zhang, Y., Guo, L., Gong, Y., Wu, X., & Wang, L. (2023). Determinants of Sarcopenia in Elderly Patients with Chronic Kidney Disease. *Iranian Journal of Kidney Diseases*, 17(4), 191–198. <https://doi.org/10.52547/ijkd.7537>
- Zhang, X., Wang, G., Ma, J., & Bai, H. (2024). The impact of income level on skeletal muscle health in rural Chinese older residents: A study of mediating effects based on dietary knowledge. *Frontiers in Public Health*, 12. <https://doi.org/10.3389/fpubh.2024.1329234>

APPENDICES

Appendix 1: CONSENT FORM AND QUESTIONNAIRE

RESEARCH TOPIC: ASSESSMENT OF FACTORS ASSOCIATED WITH SARCOPENIA STATUS AMONG THE ELDERLY IN MANDERA COUNTY APPENDICES

Appendix I: Informed Consent

Title of the Study:

“Factors associated Sarcopenia Status among the Elderly in Mandera County, Kenya.”

Principal Investigator:

Isaac Mukoko, a student at **Kenya Methodist University – Nairobi Campus**, pursuing a **Master of Science in Public Health**.

Purpose of the Study

This study aims to assess the factors associated with sarcopenia among the elderly in Mandera County, focusing on dietary protein intake, physical activity, socioeconomic, and demographic characteristics. The findings will help improve community-based interventions and inform health programs that promote healthy aging and muscle function among older adults.

Procedure

If I agree and give consent to participate in this study, I will be asked to respond to questions in an interview schedule about my diet, physical activity, health, and daily living conditions. I may also undergo simple measurements such as weight, height, handgrip strength, and walking speed, which will help determine muscle function. The entire process will take approximately 30–40 minutes.

Confidentiality

- All information collected during this study will be treated with **strict confidentiality** and will be used solely for research purposes.
- No names will be used in any reports or publications; instead, participants will be assigned identification numbers.
- There will be **no payment or financial reward** for participation.
- Participation is **entirely voluntary**. You have the right to refuse to participate, skip any question, or withdraw from the study at any time without any consequence to your access to health services.

Potential Risks and Benefits

There are no anticipated physical or psychological risks from participating in this study. Although you will not receive direct benefits, the information gathered may help improve health programs that target the wellbeing of elderly persons in the future.

Consent Statement

I,, after careful listening to the explanation, have understood the contents, purpose, procedures, and my rights as a participant in this study. I voluntarily agree to participate.

Signature/Thumbprint:

.....

Name of Participant:

.....

Date:

.....

Signature/Thumbprint:

.....

Principal Investigator (Hamdi)

Date:

.....

Appendix II: STUDY QUESTIONNAIRE

You have been invited by **HAMDI MOHAMED IBRAHIM** to participate in answering research questionnaire for her research projects titled. “**Assessment of Sarcopenia Status among the Elderly in Mandera County, Kenya.**” Please read the questions carefully and feel free to respond to them by giving your responded them by giving your response by ticking () which ever option best describes you or applies to you. This questionnaire consists of two major sections (Section A and B). The information given here will only be used for academic purposes and will be treated with utmost confidentiality. Your honest response will be of great help in conducting this study. Your response will be highly appreciated.

Part Section A: Demographic Information

DATA COLLECTION TOOL SARCOPENIA

1.4.1 General Objective

The primary objective of the study was to conduct an assessment of Sarcopenia Status among the Elderly in Mandera County, Kenya.

1.4.2 Specific Objectives

The study’s specific objectives include;

- i. To determine the prevalence sarcopenia among the elderly population in Mandera County, Kenya.
- ii. To evaluate protein intake among elderly population in Mandera County, Kenya.
- iii. To assess physical activity levels among the elderly population in Mandera County, Kenya.
- iv. To identify socioeconomic determination of sarcopenia among the elderly population in Mandera County, Kenya.

Data Collection Tool: Assessment of Sarcopenia Status among the Elderly in Mandera County, Kenya

SECTION A: PARTICIPANT IDENTIFICATION

Participant ID: _____

Date of Interview: __ / __ / 202__

Enumerator Name: _____

Sub-County: _____

Village: _____

SECTION B: SOCIO-DEMOGRAPHIC CHARACTERISTICS

1. Age (Years): _____
2. Sex: ☐ Male ☐ Female
3. Marital Status: ☐ Single ☐ Married ☐ Divorced / Separated ☐ Widowed
4. Education Level: ☐ No formal education ☐ Primary ☐ Secondary ☐ Tertiary
5. Occupation: ☐ Farmer ☐ Trader ☐ Pastoralist ☐ Retired ☐ Other (Specify): _____
6. Living Arrangement: ☐ Alone ☐ With spouse ☐ With children ☐ Extended family
7. Source of Income: ☐ Family support ☐ Farming ☐ Livestock ☐ Pension ☐ None
8. Monthly Household Income (KES): _____
9. Do you have health insurance? ☐ Yes ☐ No
10. Do you have access to health services? ☐ Yes ☐ No

SECTION C: PROTEIN INTAKE AND DIETARY PATTERNS

1. Number of Meals per Day: ☐ One ☐ Two ☐ Three ☐ More than three
2. Protein Intake Level (self-reported perception): ☐ High ☐ Moderate ☐ Low
3. Appetite Status: ☐ Good ☐ Moderate ☐ Poor

SECTION D: PHYSICAL ACTIVITY PATTERNS

1. Physical Activity Level: ☐ High ☐ Moderate ☐ Low

SECTION E: SARCOPENIA ASSESSMENT TOOL (SARC-F Questionnaire)

1. Difficulty in lifting/carrying 4.5 kg (10 lbs): ☐ None (0) ☐ Some (1) ☐ A lot / Unable (2)
2. Difficulty walking across a room: ☐ None (0) ☐ Some (1) ☐ A lot / Unable (2)
3. Difficulty rising from a chair/bed: ☐ None (0) ☐ Some (1) ☐ A lot / Unable (2)
4. Difficulty climbing 10 stairs: ☐ None (0) ☐ Some (1) ☐ A lot / Unable (2)
5. Falls in the past year: ☐ None (0) ☐ 1-3 times (1) ☐ 4+ times (2)

SECTION F: ANTHROPOMETRIC AND FUNCTIONAL MEASUREMENTS

1. Weight (kg): _____
2. Height (cm): _____
3. Handgrip Strength (kg): _____
 - Cut-off: Male < 27 kg = Low Female < 16 kg = Low
4. Calf Circumference (cm): _____
 - Cut-off: < 31 cm = Low
5. 10-Meter Gait Speed:
 - Time (seconds): _____
 - Speed (m/s): _____
 - Cut-off: < 0.8 m/s = Low
6. MUAC IN CM _____
 - Cut-off 23.5CM
7. Leg calf circumference in cm _____
 - Cut off 33.5cm

SECTION G: FINAL SARCOPENIA STATUS CLASSIFICATION (Based on EWGSOP2 Criteria)

- 0 = No Sarcopenia
- 1 = Probable Sarcopenia (Low handgrip strength only)
- 2 = Confirmed Sarcopenia (Low handgrip strength + Low calf circumference)
- 3 = Severe Sarcopenia (Low handgrip strength + Low calf circumference + Low gait speed)

Final Classification: ☐ 0 ☐ 1 ☐ 2 ☐ 3



KENYA METHODIST UNIVERSITY

P. O. Box 267 Meru - 60200, Kenya

Fax: 254-64-30162

Tel: 254-064-30301/31229/30367/31171

Email: deanrd@kemu.ac.ke

DIRECTORATE OF POSTGRADUATE STUDIES

Our Ref: KeMU/NACOSTI/HND/03/2025

12th May, 2025

Commission Secretary

National Commission for Science, Technology and Innovations

P.O. Box 30623-00100

NAIROBI

Dear Sir/Madam,

RE: HAMDI MOHAMED IBRAHIM-HND-3-2503-2/2022

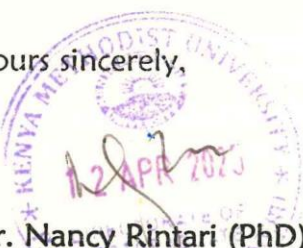
This is to confirm that the above named is a bona fide student of Kenya Methodist University, in the Department of Public Health, Human Nutrition and Dietetics, undertaking a Master's Degree in Human Nutrition and Dietetics. She is conducting research on; "*Assessment of Sarcopenia Status among The Elderly in Mandera County, Kenya*".

We confirm that her research proposal has been defended and approved by the University.

In this regard, we are requesting your office to issue a research license to enable her collect data.

Any assistance accorded to her will be highly appreciated.

Yours sincerely,


Dr. Nancy Rintari (PhD)

Director, Board of Postgraduate Studies

Cc: Dean, School of Health Sciences

CoD, Public Health, Human Nutrition and Dietetics

Postgraduate Coordinator - HND

Supervisors



KENYA METHODIST UNIVERSITY

P. O. BOX 267 MERU - 60200, KENYA
TEL: 254-064-30301/31229/30367/31171

FAX: 254-64-30162
EMAIL: info@kemu.ac.ke

Our Ref: KeMU/ISERC/HND/03/2025

May 12, 2025

HAMDİ MOHAMED IBRAHİM
HND-3-2503-2/2022

Dear Hamdi,

**SUBJECT: ASSESSMENT OF SARCOPENIA STATUS AMONG THE ELDERLY IN
MANDERA COUNTY, KENYA**

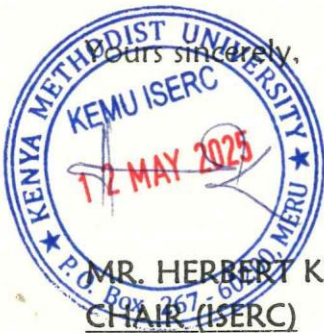
This is to inform you that Kenya Methodist University Institutional Scientific Ethics and Review Committee has reviewed and approved your research proposal. Your application approval number is KeMU/ISERC/HND/03/2025. The approval period is 12th May, 2025 – 12th May, 2026.

This approval is subject to compliance with the following requirements:-

- I. Only approved documents including (informed consents, study instruments, MTA) will be used.
- II. All changes including (amendments, deviations, and violations) are submitted for review and approval by Kenya Methodist University Institutional Scientific Ethics and Review Committee.
- III. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to KeMU ISERC within 72 hours of notification.
- IV. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to KeMU ISERC within 72 hours.
- V. Clearance for export of biological specimens must be obtained from relevant institutions.

- VI. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- VII. Submission of an executive summary report within 90 days upon completion of the study to KeMU ISERC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation : (NACOSTI) <https://oris.nacosti.go.ke> and also obtain other clearances needed.



MR. HERBERT KIBEBE
CHAIR (ISERC)



REPUBLIC OF KENYA



NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 191740

Date of Issue: 05/June/2025

RESEARCH LICENSE



This is to Certify that HANADI MOHAMED IBRAHIM of Kenya Methodist University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2012 (Rev.2014) in Mandera on the topic: **ASSESSMENT OF SARCOFENIA STATUS AMONG THE ELDERLY IN MANDERA COUNTY, KENYA** for the period ending: 05/June/2026.

License No: NACOSTI/25/4174379

191740

Applicant Identification Number

Deputy Director
NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY &
INNOVATION

Verification QR Code



NOTE: This is a non-transferable License. To verify the authenticity of this document,
Scan the QR Code using QR scanner application.

See overleaf for conditions

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013 (Rev. 2014)

Legal Notice No. 108: The Science, Technology and Innovation (Research Licensing) Regulations, 2014

The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was the established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to.
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way;
 - i. Endanger national security
 - ii. Adversely affect the lives of Kenyans
 - iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
 - iv. Result in exploitation of intellectual property rights of communities in Kenya
 - v. Adversely affect the environment
 - vi. Adversely affect the rights of communities
 - vii. Endanger public safety and national cohesion
 - viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. Neither the license nor any rights thereunder are transferable.
5. The Commission reserves the right to cancel the research at any time during the research period if in the opinion of the Commission the research is not implemented in conformity with the provisions of the Act or any other written law.
6. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research.
7. Excavation, filming, movement, and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
8. The License does not give authority to transfer research materials.
9. The Commission may monitor and evaluate the licensed research project for the purpose of assessing and evaluating compliance with the conditions of the License.
10. The Licensee shall submit one hard copy, and upload a soft copy of their final report (thesis) onto a platform designated by the Commission within one year of completion of the research.
11. The Commission reserves the right to modify the conditions of the License including cancellation without prior notice.
12. Research, findings and information regarding research systems shall be stored or disseminated, utilized or applied in such a manner as may be prescribed by the Commission from time to time.
13. The Licensee shall disclose to the Commission, the relevant Institutional Scientific and Ethical Review Committee, and the relevant national agencies any inventions and discoveries that are of National strategic importance.
14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

National Commission for Science, Technology and
Innovation (NACOSTI),
Off Waiyaki Way, Upper Kabete,
P. O. Box 30623 - 00100
Nairobi, KENYA Telephone: 020
4007000, 0713788787,
0735404245

E-mail: dg@nacosti.go.ke Website: www.nacosti.go.ke



COUNTY GOVERNMENT OF MANDERA
EXECUTIVE OFFICE OF THE GOVERNOR
THE COUNTY SECRETARY



Email: info@mandera.go.ke
info@mandera.go.ke
Tel: +254 724 500 952

County Headquarters
2nd floor
P.O Box 13 - 70300,
Mandera

Ref No: MCG/CS/RA/2025/Vol I (005)

Date: 16th June 2025

All Sub-County Administrators,

COUNTY GOVERNMENT OF MANDERA

Dear SCAs,

RE: RESEARCH AUTHORIZATION FOR HAMDI MOHAMED IBRAHIM

The above-mentioned person, who is a student of Keny Methodist University, has been granted license number NACOSTI/P/25/4174379 by the National Commission for Science, Technology & Innovation to undertake research on the topic: **ASSESSMENT OF SARCOPENIA STATUS AMONG THE ENDERLY IN MANDERA COUNTY, KENYA** for the period 8th June 2025 to 8th June 2026.

Kindly be informed accordingly

Yours faithfully,

Hassannoor Adan Abdullahi, OGW.

For: County Secretary & Head of Public Service

COUNTY GOVERNMENT OF MANDERA