PREDICTORS OF MALNUTRITION AMONG HOSPITALIZED ADULTS WITH PNEUMONIA AT THE 37 MILITARY HOSPITAL IN ACCRA, GHANA

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DECLARATION

I, Theresa Andoh, author of this thesis — Predictors of malnutrition among hospitalized adults with pneumonia at the 37 military hospital; do hereby declare that this thesis is the result of my own work carried out at the Department of Nutrition and Food Science, College of Basic and Applied Sciences, University of Ghana, under the supervision Dr. Justina Serwaah Owusu and Dr. Mohammed Husein. All references to other works have been duly acknowledged.

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DEDICATION

I dedicate this work to God Almighty for His benevolence and graciousness throughout this project. Warm regards to my parents Mr. Peter Andoh and Sarah Paintsil for their tremendous support financially, encouragement and prayers throughout the execution of this project.

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ACRONYMS

BMI	Body Mass Index
MNA	Mini Nutritional Assessment Tool
DDS	Dietary Diversity Score
MUCA	Mid- Upper Arm Circumference
CC	Calf circumference
FAO	Food and Agriculture Organization
WHO	World Health Organization
RDA	Recommended Dietary Allowance
UN	United Nations
GLIM	Global Leadership Initiative on Malnutrition
ICD	International Classification of Diseases
NHANES	National Health and Nutrition Examination Survey
NSI	Nutrition Screening Initiative
SGA	Subjective Global Assessment
MST	Malnutrition Screening Tool
GNRI	Geriatric nutrition Risk index
CCK	Cholecystokinin
GIT	Gastrointestinal tract

CI	Confident Level
OR	Odds Ratio
ASPEN	American Society for Parenteral and Enteral Nutrition
MNA	Mini Nutritional Assessment

ABSTRACT

Introduction: The aging population is the world's most pressing medical and socio demographic challenge, and addressing this issue is a key concern. In Sub-Saharan Africa and Ghana, undernutrition among older people is high. There is limited information on the malnutrition situation among the hospitalized older adults in Ghana. This study was undertaken to identify malnutrition cases and the determinants of malnutrition among hospitalized adults with pneumonia at the 37 Military Hospital in Accra.

Methodology: A cross-sectional survey was conducted with 54 hospitalized adults aged 60 and above infected with pneumonia at the 37 Military Hospital. Data were collected on socio-demographics, health status, lifestyle factors, and dietary intakes (a 24-hour dietary recall). Anthropometric data and the Mini Nutritional Assessment Tool (MNA) were used to determine the prevalence of malnutrition among the study group. Chi-square and regression analysis were used to determine the association between malnutrition and comorbidity among hospitalized adults with pneumonia.

Results: This study revealed that 85.2% of the study population were malnourished based on their Body Mass Index (BMI). Based on MNA scores, 50.0% and 40% of the participants were at risk of malnutrition and malnourished respectively. There was no significant association between dietary diversity, nutrient intake, and malnutrition using BMI and MNA-Score ($P > 0.05$), respectively. Predictors such as marital status, feeding mode, morbidity, and taking more than 3 prescriptions per day were independently associated with malnutrition with a ($P > 0.05$). The prevalence of comorbidity among the study population was (61.1%) as participants with comorbidity had higher odds for malnutrition than those who are morbid (OR =2.58: CI=0.394 16.94). Study participants with health conditions such as neuropsychological problems

had 4 times higher odds (OR 4.52:CI= 0.004-2.177) for malnutrition than those who had no neuropsychological problems. Lastly, the prevalence of anaemia among hospitalized a with pneumonia was 40.7%.

Conclusion: The prevalence of malnutrition in adult with pneumonia was high using both the MNA and the body mass index. Almost all participants had inadequacies for calcium and fibre intake while there was no association between dietary and malnutrition however carbohydrate was the only nutrient that was associated with MNA. Predictors such as marital status, taking more than 3 prescriptions per day, feeding mode, living independently, and mobility were associated with malnutrition

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

The human health revolution is a global success story that represents the triumph of medical progress, public health, and economic development over infectious diseases and injuries which has resulted in decreased life expectancy. This health revolution has moved the human survival curve upwards, improving survival at all ages but the aging population has created some current concerns about economic growth and social support networks. In Ghana, old age is characterized by a person's ability to work as well as social characteristics such as experience and leadership. As a result, a person is regarded old if he or she is unable to work due to the aging process, diminished physical strength, or health problems (WHO, 2001). Aging is mostly associated with decreased physical activity and dietary intake which may result in poor nutritional status making nutrition a crucial component of the health and functional ability of the aged, primarily affecting their physical and psychological well-being.

Undernutrition in the aging population is prevalent in hospitals and care homes. Malnutrition is an acute, subacute, or chronic state of nutrition with or without inflammation defined by (ASPEN). It can be caused by varying degrees of over-nutrition or under-nutrition (Rajendramet al., 2015). Healthy diets and exercise are frequently emphasized in nutrition to reduce the risk of lifestyle diseases. However, the nutritional need of the elderly is meet through consumption-nutrient- dense foods. Malnutrition in the elderly is linked to increased mortality and morbidity. Healthy Aging is a chosen priority of the World Health Organization on aging between 2016 and 2030. This program aims to help the elderly develop and preserve functional abilities for health, well- being and participation in society (Rudnicka et al., 2020b). Undernutrition is associated with decreased

functional ability, impaired muscle function, lower bone mass, reduced immunity, impaired cognitive function, delayed wound healing, higher hospital readmission, and mortality (Ahmed & Haboubi, 2010). The aged are more susceptible to poor nutritional status and are at risk of nutritional deficiencies than infants although, it is mostly underreported and undiagnosed (Pirlich & Lochs, 2001). Aging causes malabsorption and malnutrition, which can result from chewing and swallowing disorders, atrophic gastric disease, social deprivation, financial issues, and loneliness, which influence their nutritional status.

Persons over 60 years are disproportionally burdened with various infectious diseases and experience disease severity and mortality as these infections include Pneumonia is an inflammatory reaction of the lungs, specifically the alveoli mostly caused by a bacterium or virus, but the etiological agent is rarely identified, particularly in the aging population (Chebibet al., 2021). According to the World Health Organization, 450 million people are infected with pneumonia yearly with four million deaths accounting for 7% of the world's population (World Health Organization, 2002). In 2015, pneumonia caused 6.8 million hospitalizations worldwide with 4 million people dying and 1.1 million in-hospital deaths (World Health Organization, 2022). The rate of hospital admissions rises with age, and men have a higher rate than women. Pneumonia is prevalent in the elderly because of the physiological changes in the respiratory tree and a decreased immune response. Comorbidity, such as neurodegenerative disease, immunosuppression, poor nutritional status, cardiovascular and chronic respiratory diseases, and cerebrovascular diseases increase the risk of pneumonia in the elderly. Pneumonia and malnutrition have a synergic relationship as pneumonia increase the risk of becoming malnourished through the effect of the condition such as difficulty breathing, chest pain, fever, weight loss, and severe impaired respiratory strength also malnutrition and micro-nutrient deficiencies is associated with

decreased immune function as people age resulting in an increased risk of infectious disease (Yang et al., 2019).

1.2 PROBLEM STATEMENT

Globally, there is an unprecedented and continual change in the age structure, which is driven by increased life expectancy and decreased fertility among the population. According to Rafalimanana, (2020) the prevalence of the elderly population will double to over 1.5 million in decades three decades with the highest in developing countries however, the Ghanaian population of the elderly has increased rapidly from 0.3 million to 1.4 million persons in 1976 and 2006 respectively (Mba, 2010). The proportions of older people are expected to rise dramatically. The global proportion of people aged 65 and more is predicted to more than double between 2000 and 2050, from 6.9% to 16.4%. The share of the oldest-old (those aged 80 and up) will rise from 1.9 to 4.2 percent during this period. It is estimated that by 2030," one in every six people in the world will be 60 or older (World Health Organization, 2022).

The absolute number of elderly people in Ghana has increased, as it has in other African countries. The Population and Housing Census, (2010), indicates that the adult population in Ghana has increased sevenfold: from 215,258 in 1960 to 1,643,978 in 2010 and it is projected to rise to 2.3 million in 2025 and 5.6 million by 2050 (Ghana Statistical Service, 2010). The African population of the aged has doubled between 1990 and 2015, rising from 23 million to46 million. (United Nations, 2016). Malnutrition prevalent in the aged in the community ranges between 1.3% and 47.8% (Takedaet al., 2020) and it is higher in developing countries than in developed countries, according to studies. Evidence shows that 23% to 62% of hospitalized aged are malnourished while 85% are residents of a nursing home (Donini et al., 2013). The elderly is more susceptible to poor

nutritional status and are at risk of nutritional deficiencies than the younger population. Malnutrition is autonomously linked with 30-day mortality in hospital- acquired pneumonia and nursing home-acquired pneumonia (Falcone et al., 2018). This is due to the aging process which causes malabsorption because of chewing and swallowing disorders, atrophic gastric disease, social deprivation, financial issues, and loneliness, which influence the nutrition and health status of the aged. Pneumonia is the most common cause of infection-related morbidity and mortality among the elderly (Troeger et al., 2017a). Hospital- acquired pneumonia has caused 6.8 million hospitalizations worldwide in 2015, with 1.1 million deaths.

1.3 RATIONALE

Globally the aging population has the most important medical and socio-demographic problem worldwide (Rudnicka et al., 2020b). Ghana's National Institute of Ageing, (2004) has presented challenges in the health, social well-being, and economic status of older adults. Ghana has instituted livelihood empowerment against poverty cash transfer programs that target households with older adults as eligible beneficiaries but there has not been a holistic assessment of the situation for older adults in the country.

In Sub-Saharan Africa, undernutrition among older people ranges from 6 to 54% and is as high as 28.4% in countries with low socioeconomic status (Obeng et al., 2022). The prevalence of undernutrition among older adults in Ghana is 48% (Flegal et al., 2014). Pneumonia is one of the primary causes of infection-related morbidity and mortality in the elderly (Troeger et al., 2017a) and has caused 6.8 million hospitalizations worldwide in 2015;450 million people develop pneumonia each year and 1.1 million in-hospital deaths. Healthy Aging is a decade program by the World Health Organization (WHO) and other organizations to promote healthy aging of the

aged with a policy framework to highlight the need for action across all sectors. Healthy aging seeks to develop and preserve the functional abilities of the elderly for health well-being and participation in society (Norman et al., 2021b).

Research question

What is the prevalence of malnutrition among hospitalized older adults with pneumonia at the 37 Military Hospital in Accra?

1.4 AIMS AND OBJECTIVES.

1.4.1 Main aim

To identify malnutrition cases and the predicators of malnutrition among hospitalized adults with pneumonia at the 37 Military Hospital in Accra.

1.4.2 Specific objectives

- To determine the prevalence of malnutrition and anaemia among hospitalized adults with pneumonia.
- To assess dietary diversity and nutrient intake among hospitalized adults with pneumonia and its association with malnutrition.
- To assess gender differences in health characteristics, nutritional assessment, and nutrient intake of study participants.
- To assess the predictors (socio demographics, dietary intake, and health status) of malnutrition among hospitalized adults with pneumonia.

1.5 SIGNIFICANCE OF STUDY

The rise in the older population in sub-Saharan Africa (Ghana) is accompanied by increasing pressure on health facilities due to their higher risk of malnutrition leading to increased

susceptibility to diseases; however, there is insufficient information on geriatric nutrition in Ghana.

- This study sought to fill this gap by identifying the population of the aged who are at risk of being malnourished or are malnourished.
- This study will help identify nutritional problems that are of public health importance, as knowledge from the study will help influence nutrition intervention in the aged.
- The findings of this study will provide information on geriatric nutrition, which will be relevant to stakeholders.
- Contribute to achieving the action plan by WHO on healthy aging.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 PREVALENCE OF AGEING ON THE POPULATION

The ageing population is part of an ever-widening spectrum, ranging from healthy octogenarians to those suffering from chronic disease and disability. The elderly occupies more than two-thirds of general and acute hospital beds, and those 75years and above have longer hospital stays. Life expectancy has increased in the twenty-first century, and the population is expected to grow by 56% between 2015 and 2030 (Nations, 2010; United Nations, 2016). The elderly population in the world is set to increase dramatically, by 2050; the aging population will have increased to two billion worldwide, with 400 million people aged 80, and 80% of the elderly in developing countries (World Health Organization, 2022). Aging is a global phenomenon, but as life expectancy rises and fertility rates fall, the world's demographic structure has shifted leading to an increase in the aged population. In Ghana, the prevalence of adults 65years and older has increased with time, from 4.0% in 1984 to 5.3% in 2000, according to the Population and Housing Census Report which is anticipated to increase from 327,594 in the 1960 population census to 1,902,200 according to National Population Council, (2014) Ghana's life expectancy increased from 45.5 years in the 1960s to 67 years as of 2018 (Nationset al., n.d.).

2.1.1 Dynamics and prevalence of malnutrition among the elderly

There is no unified definition for the term malnutrition. It describes the lack of, excess of, or deficiency of nutrients, which has a detectable negative impact on body composition, function, and health outcomes. Undernutrition is a grave issue among the elderly, especially the sick, and it can be observed in hospitals, nursing homes, and communities. Undernutrition prevalence among

the elderly in the community ranges from 1.3% to 47.8% by the World Health Organization (ICOPE) and it is higher in developing countries than in developed countries, Research indicates 15% of the aged malnourished with 85% of nursing home patients are severely underweight and up to 62% of hospitalized participants and 23% of those in nursing homes are overweight (Donini et al., 2013). In Sub-Saharan Africa, undernutrition among older people ranges from 6 to 54% and is as high as 28.4% in countries with low socioeconomic status (Obeng et al., 2022). However, in Ghana, the prevalence of undernutrition among older adult's accounts for about 48% (Flegal et al., 2014). Malnutrition in the elderly is particularly common in hospitals and nursing homes (Streicher et al., 2018). Malnutrition is a public health concern characterized by reduced fat and muscle mass because of a lack of food intake or absorption. Nutrition is a critical component of the elderly's health and functional abilities, affecting their physical and psychological well-being (Norman et al., 2021a). The American Society for Parenteral and Enteral Nutrition (ASPEN) defines malnutrition as an acute, subacute, or chronic nutritional state with varying degrees of over-nutrition or under- nutrition. It is combined with or without inflammatory activity that results in changes in body fat composition and function. Nutrition transition in developing countries has increased prevalence rates of over-nutrition however undernutrition remains a public health concern (AbdAziz et al., 2017). Healthy diets and exercise are frequently emphasized in nutrition to prevent lifestyle diseases such as cardiovascular diseases, and diabetes. Malnutrition increases with age, which is mostly undiagnosed and untreated, malnutrition among the elderly is caused by complex factors such as polypharmacy, paleopathology, socioeconomic factors such as poor education, and poor financial status therefore the nutritional goals for the elderly including meeting greater nutrient needs with less energy and preventing lean muscle loss (Streicher et al., 2018).

The American Society for Parenteral and enteral Nutrition (ASPEN) and the Academy of Dietetics and Nutrition use two out of six criteria to assess malnutrition." These criteria include low energy intake, weight loss, loss of muscle mass, fluid accumulation, and handgrip strength. while the Global Leadership Initiative on Malnutrition (GLIM) states that malnutrition is associated with one of the following: weight loss, low body mass index (BMI>20kg/m2), or reduced muscle mass (Agarwal et al., 2013). The elderly are more susceptible to poor nutritional status and are at risk of most nutritional deficiencies than younger people because malnutrition in the elderly is associated with reduced functional ability, impaired muscle function, low bone mass, micro-nutrient deficiencies, delayed wound healing, increased hospitalization and readmission rates, and mortality which results from chewing and swallowing disorders, atrophic gastric disease, social deprivation, financial issues, and loneliness (Ahmed & Haboubi., 2010).

Malnutrition is also associated with physiological, environmental, social, and lifestyle factors such as loneliness, marital status, level of education, socio-economic status, and place of residence The elderly population is more prone to developing poor nutritional status due to tooth loss, reduced sense of taste, poor mobility, and these influence their dietary intake (Besora- Morenoet al., 2020). The consensus is that body fat mass increases until around the age of 75years when it begins to decline or remains stable, Evidence suggests that as fat mass decline in the central fat storage of the elderly increases which result in an increased risk of cardiovascular and another non-communicable disease (Kyle et al., 2001).

2.2 TYPES OF MALNUTRITION AMONG THE ELDERLY

2.2.1 Sarcopenia

Sarcopenia is a syndrome described as a gradual and universal reduction of skeletal muscle mass, strength, and or physical performance, admittedly as a disease and assigned an international Classification of Diseases (ICD) code (Anker et al., 2016). Insufficient protein and calorie intake results in a reduction in muscle-building hormones such as insulin-like growth factor-1, Dehydroepiandrosterone sulphate, testosterone, and oestrogen (Hickson,2006). Alteration of inflammatory pathway activation and reduced physical activities also contributes to sarcopenia (Jo et al., 2012). Aging is associated with 8% decrease in muscle mass between 40 and 70 years, which increases to 15% per decade after a reduction in physical activity. Muscle loss can occur because of injury, disease, excess fat, lack of exercise, or simply poor diet and lifestyle factors such as stress and obesity (Dupont et al., 2019). The cause and effects of sarcopenia a summarized in figure 2.1.

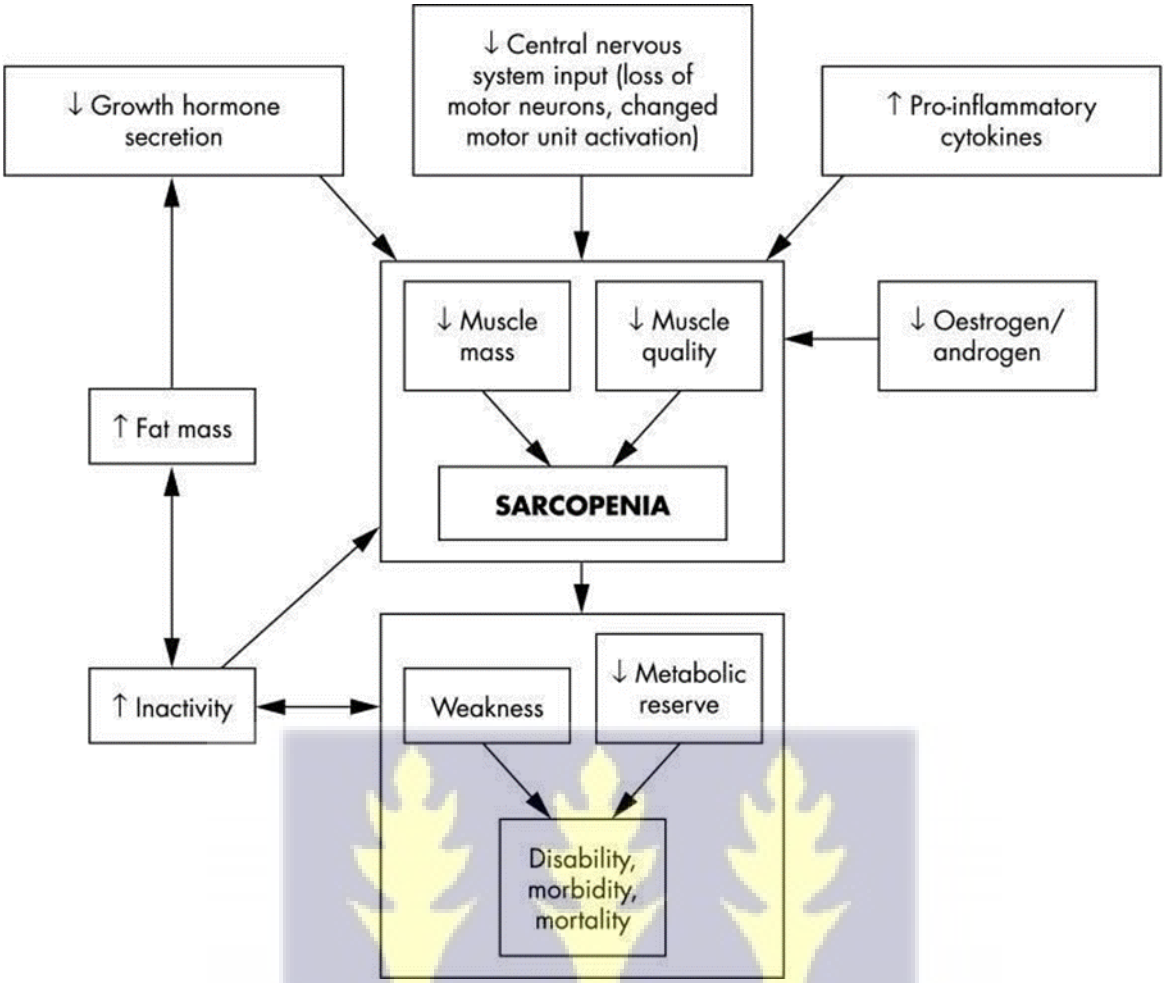

Figure 2.1 Cause and effect relation with sarcopenia and malnutrition (Roubenoff, 2000).

2.2.2 Anorexia

Anorexia of aging is an age-related change such as a decrease in energy intake and an increased risk of malnutrition as people get older, Age-related anorexia is caused by decreased chemosensory functions, reduced psychological functions, environmental changes, and reduced hormone secretions that control appetite (di Francesco et al., 2007; Malafarina et al., 2013). Daily food intake reduces by 30% between the ages of 20 and 80years, this is an age-related physiological decrease in appetite and calorie intake (Giezenaar et al., 2016) the ages of 20–29 and 70–79 years, men's daily energy intake decreased by 38% (1138 kcal) and women's daily energy intake decreased by 27% (522 kcal), according to the American National

Health and Nutrition Examination Survey (NHANES) III. Reduction in energy expenditure is responsible for most of the energy loss during aging, however, calorie intake is lower than energy expended, resulting in weight loss (Morley, 1997) Anorexia of aging is linked with cachexia, sarcopenia, poor endurance, and impaired mobility in older persons and autonomously envisages morbidity and mortality in a variety of clinical situations (Tsutsumimoto et al., 2018).

2.2.3 Wasting

Wasting necessitates a negative energy balance throughout the body, which is induced mostly by a reduced dietary intake. The mechanism involved in wasting is loss of appetite. Wasting is a type of unintentional weight loss induced by a lack of nourishment. This can occur in the setting of cachexia, sarcopenia, or both, and can be caused by sickness or psychological factors (Saunders, 2010).

2.2.4 Cachexia

Cachexia is a metabolic disorder characterized by muscle loss and fat accumulation (or both). Cachexia is defined by weight loss, a lower BMI, decreased muscle mass function, and illness with persistently high inflammatory activity (Aoyagi et al., 2015). Pro-inflammatory cytokines are thought to be important in the metabolic inflammatory process or stress. They have a significant impact on hormone balance, metabolic regulation, and direct tissue effects. These cytokines have been linked to cancer, heart failure, HIV/AIDS, and COPD (Evans et al., 2008). The immediate immune reaction releases pro-inflammatory cytokines that disrupt hormone synthesis and metabolism resulting in cachexia (Corcoran et al., 2019). The aging population has a higher risk of cachexia due to their increased risk of malnutrition, and sarcopenia. Cachexia treatment options include better food, appetite stimulants, combination pharmaceutical therapy, and exercise (Ali & Garcia, 2014; Cederholm et al., 2015)

2.3.0 MALNUTRITION SCREENING TOOLS FOR THE ELDERLY

The World Health Organization (WHO) has identified the importance of early detection of malnutrition and the provision of effective intervention to reduce the prevalence and risk of malnutrition in the elderly worldwide (Volkert et al., 2019). The ability to accurately identify malnourished individuals is dependent on the screening tool used by the researcher therefore, there are several malnutrition-screening tools based on their validity and the type to be used which include:

2.3.1 Subjective Global Assessment (SGA)

The Subjective Global Assessment is the benchmark for identifying malnutrition. It has been validated in a diverse patient population, to classify those who would benefit from intervention by taking a history of recent dietary intake, weight change, gastrointestinal symptoms, and a clinical evaluation (Prasad & Sinha, 2018).

2.3.2 Nutrition screening initiative (NSI)

The Nutrition Screening Initiative is a community-based program aimed at identifying and treating nutritional issues in the elderly. It is a questionnaire that estimates your nutritional risk by using typical warning indicators of malnutrition. The original nutrition-screening project was published in the American Journal of Clinical Nutrition (Anon., 1991). With a "**DETERMINE**" checklist which includes

Disease: any existing chronic disease that can influence the dietary intake of the elderly non-communicable diseases such as diabetes, hypertension, and cognitive problems can result in poor nutritional status of the aged.

Eating Poorly: excess or/ and inadequate consumption of nutrients can result in malnutrition as most elderly turn to have a less diverse diet due to a lack of financial support and are not able to meet their dietary requirement.

Tooth loss and mouth pain: Ageing is associated with tooth loss and dry mouth, which influence their protein intake because they cannot the most of the animal-rich - protein-rich foods that makes eating difficult.

Economic Hardship: Most of the elderly are dependent on their children for financial support since they are on retirement, and this can influence their dietary intake because they cannot consume their preferred foods and they are living below the standard resulting in malnutrition.

Reduced Social Contacts: with the empty net stage, most elderly live alone resulting in depression and loneliness, which affect their dietary intake and health.

Multiple Medication: Ageing is associated with most chronic diseases; therefore, older adults are on medications to manage such health problems however, these medications have several side effects such as loss of appetite, change in taste, drowsiness, and constipation, which influence the dietary intake of the elderly.

Involuntary weight Loss or Gain: older adults are at risk of involuntary weight loss that is mostly classified as wasting and this is due to poor dietary intake and depression.

Need Assistance in self-care: older adults need assistance with shopping, prescriptions, and cooking this is due to the reduction in bone density and vision loss of all older adult's needs and assistance for their daily activities.

Elderly 80years and above; this stage of life is mostly associated with a higher risk of frailty and health problems there optimal is key.

NSI also consists of ten questions on meal frequency, food preference, weight, meal preparation, and alcohol consumption. A total score of 0 to 2 by circling "Yes" next to each question indicates that you are well nourished while 3 to 5; you are at moderate risk of malnutrition, and above six means high-risk malnutrition (Posner et al., 1993).

2.3.3 Malnutrition Screening tool

Malnutrition Screening Instrument (MST) is a straightforward two-way question-screening tool designed for volunteers and staff who work with senior adults. MST assigns a five-point scale to reflect the seriousness of the risk of malnutrition (Wu et al., 2012). Ferguson et al developed MST in 1999; this is a quick and easy screening test that includes questions regarding appetite, nutritional intake, and recent weight loss. A score of equal to or more than 2, out of a total of 7, shows the need for a nutritional assessment and/or intervention. It is recommended for hospitalized, outpatient and institutionalized adult patients. To identify how to best assist an elderly person and what kind of follow-up is required (Serón-Arbeloa et al., 2022).

2.3.4 Nutrition Risk Screening -2002

This is a malnutrition screening tool that considers a person's recent BMI (20.5kg/m2), current weight loss, poor dietary intake, and severity of the disease. The score ranges from 0 to 7, with 0 indicating no risk of malnutrition, 1-2 indicating a lower risk, and 3-4 indicating a medium risk (Koren-Hakim et al., 2016). Its nutritional risk-screening tool is widely used in hospitals around the world.

2.3.5 Geriatric Nutritional Risk Index

The nutrition risk index was used to develop the GNRI, which is used for the development of nutrition related health problems in the elderly. The serum albumin level test, recent body weight, and ideal body weight are used to assess the nutritional status of the aged. A lower serum albumin level and weight loss indicate a greater likelihood of malnutrition-related health problems (Abd-El-Gawad et al., 2014). This formula can be used to calculate" GNRI values: [1.489serum albumin (g/l) +41. 7current body weight /ideal weight] ". An index of 98 or higher indicates no risk, 92-98 indicates lower risk, and 82 indicates a higher risk of malnutrition-related health problems (Koren-Hakim et al., 2016; Stoffel et al., 2018).

2.3.6 Mini-Nutrition Assessment

This is the commonest nutrition screening and assessment tool for the elderly. It has been approved for clinical use more than twenty years ago but has recently received additional attention and has been the subject of reappraisals to expand the practice of a full nutritional assessment of the elderly patient. MNA® has gone through three revisions since its inception in the 1990s. Geriatricians in the United States and Europe created the first MNA®. Which was a simple and reliable way of assessing the nutritional health of people over the age of 65years and including a nutrition component in the Comprehensive Geriatric Assessment. The entire MNA® comprises 18 elements to determine nourished, malnourished, or at risk of malnutrition elderly. It has been used in hundreds of research and translated into more than twenty languages since its certification in 1994. It is a tried-and-true instrument with high sensitivity, specificity, and consistency. Patients with a score greater than or equal to 24 have excellent nutritional status, whereas individuals at risk of malnutrition have a score between 17 and 23.5 (Vellas et al., 2006). "The Mini Nutrition Assessment short form (MNA-SF) originates from the MNA full questionnaire which has eighteen questions however, MNA- SF which was produced by Rubenstein and his colleagues is a complete version of the MNA full questionnaire but with six questions that can be completed within 10-15 minutes. MNA-SF is a quick nutrition assessment tool designed for the elderly, whether they are hospitalized, or not. Questions include nutritional status, health problems, motility, quality of life, cognition, mobility, and subjective health. The European Society for Clinical Nutrition and Metabolism has recommended this tool as a sensitive, specific, and accurate diagnostic rapid nutrition assessment tool for the elderly. It classifies the elderly into well nourished, malnourished, and at risk of malnutrition (Langkamp-Henken et al., 2005).

In elderly patients who are bedridden and immobile, anthropometric measurements of BMI can take a long time; however, calf circumference (CC) and mid-arm circumference can be

measured quickly, on the other hand, are two simple tape measure alternatives to BMI due to its correlation with serum albumin, calf circumference is a specific biomarker for sarcopenia (Kaiser et al., 2009). Each question has a score that is used to determine whether the person is malnourished: 12-14 indicates well nourished, 8-11 indicates malnourished, and 0-7 indicates malnourished (Koren- Hakim et al., 2016; Slee et al., 2015).

2.4 NUTRITION RELATED ISSUES OF MALNUTRITION IN THE ELDERLY

Determinants of malnutrition are classified into medical, social, and psychological. Dentition, dysgeusia, dysphagia, diarrhoea, depression, disease, dementia, dysfunction, and medications are elements that influence the elderly's diet, and these issues can harm the senior population's environment, which has been associated to poor nutrition (Poulia et al., 2012). According to studies, older individuals who live in hospitals or care homes are more likely to be malnourished than those who reside in the community (Kucukerdonmez et al., 2017). The aging process is a leading cause of malnutrition among the elderly, while there are common problems such as sarcopenia, cachexia, diminished sensory function, social and economic deprivation, existing comorbidity, and gastrointestinal changes that influence the nutritional status of the aged.

2.4.1 DIET- RELATED ISSUES AMONG THE ELDERLY

2.4.1.1 Poor Appetite

The most prevalent cause of malnutrition is anorexia, or a lack of appetite, caused by a variety of circumstances. It is an established knowledge that as people age, their energy intake decreases, resulting in nutritional deficits. The lack of appetite that occurs during the elderly is attributed to gastrointestinal-related changes and changes in the central nervous system. Aging influences the full function of the gastrointestinal tract as it affects motility, enzyme, hormone secretions, digestion, and absorption. Making it difficult to rule out pathological conditions like diabetes, pancreatitis, liver disease, and cancer.

2.4.1.2 Oral cavity

Oral health and dentition also effects food intake, which deteriorate as people age. The survey of oral health in the National Diet and Nutrition Survey reveals chewing and mouth dryness conditions such as oral candidiasis, aphthous stomatitis, and dry mouth are high among aged 65years and above, which explains the decrease in salivary quality and quantity in the elderly (D'Souza, 2007b). Chewing problems have been related to poor health and reduced quality of life. According to dietary statistics from the National Institutes of Health, edentate people had decreased energy consumption, as well as micronutrient deficiencies such as calcium, iron, vitamins A, B, C, and E, fibre, and protein.

2.4.1.2 Oesophagus

Changes in the oesophagus of the elderly have evolved over the years from pre-by- oesophagus which describes the physiologic changes in swallowing associated with aging currently, oesophageal changes in the elderly are associated with their co-morbidity which results in the decrease in oesophageal peristalsis and emptying (Robbins et al., 2006), causing oesophageal dysphagia which is food being a stick in the chest caused by the obstruction of the oesophagus or the compression of the tissue the oesophagus which increases the risk of aspiration among the elderly(Durazzo et al., 2017). According to studies, a third of the elderly has reduced saliva production, which slows peristalsis and increases the risk of constipation, slower peristalsis can potentially contribute to early satiety by delaying oesophageal emptying and early satiety is a major factor in the aged population's lower food intake (Pilgrim et al., 2015)

2.4.1.3 Decreased sensory functions.

The aged population’s sensory function deteriorates as they age, reducing their enjoyment of eating. This is the alteration of taste or an impaired sense of taste that occur during aging, it is associated with the side effects of certain medication and the lack of zinc among malnourished

aged. Dysgeusia and ageusia are linked with diseased of the nervous system (Jain & Pitchumoni, 2009). Taste and smell are associated with appetite loss due to a perceived decrease in food pleasantness; however, the loss of taste and smell is common, and it is worsened by illness and medications. Some elderly people have multiple health conditions that require at least three medications to maintain a balanced diet. The body's response to food is affected by the cephalic phase response, which prepares the body for digestion. The elderly's taste and scent are influenced by polypharmacy, resulting in a lack of appetite also, the loss of taste and smell can be attributed to the decreased receptors functioning in cell membranes involved in the taste sensation. Appetite and thirst will be dysregulated because of sensory alterations. Food may lose its attraction due to sensory changes, and the elderly may find it difficult to cook and eat normally when their vision deteriorates (Amarya et al., 2015). According to Siddique et al., (2017) about 74% of the elderly population experience taste impairment while more than 60% of the elderly subject in a study conducted by Ahmed& Haboubi, (2010) also had reduced sense of taste and smell and this may also be because of certain medications. These changes and other factors such as poor dietary intake, loneliness, and physiological, and health changes influence their nutritional status.

2.5 GASTROINTETINAL CHANGES DURING AGEING

The elderly is 85% more likely to become malnourished due to changes in the gastrointestinal tract. A combination of stomach wall relaxation and the hormone cholecystokinin determines satiety. As people get older, their CCK levels rise, and their stomach emptying slows. TNFa, IL1, IL6, and serotonin are all known to cause anorexia and may contribute to accelerated muscle breakdown and nitrogen losses. These chemicals are also known for appetite regulation, causing loss of appetite in the elderly.

2.5.1 The stomach

Ageing is associated with the alteration of the gastric microbat, reduced mucosal protective mechanism, and decreased gastric blood flow. There is a reduction in the secretion of gastric acid and pepsin as people age, which limit the digestion and absorption of nutrients such as vitamin B12, iron, and protein (Corcoran et al., 2019). The decline in gastric acid secretion is associated with a high prevalence of helicobacter pylori infection, atrophic gastritis, and peptic and gastric ulcers in the elderly. Sensitive changes in the gastrointestinal tract are linked with a decline in gastric fundus receptive relaxation, resulting in faster antral filling of the stomach, slower peristalsis, and constipation (D'Souza, 2007a). Insulin levels are higher in the elderly, which enhances satiety by increasing leptin while blocking ghrelin, the hormone that promotes appetite (Ahmed & Haboubi, 2010).

2.5.2 The small intestine

Hormone secretion and absorption in the small intestine are not significantly altered in the elderly compared to their younger counterparts (D'Souza, 2007b). In the absence of a concurrent illness, minor abnormalities in the small intestine such as abnormal mucosal immunity and motility are found, but these are clinically insignificant. A study on humans found that while certain morphologic changes may occur, they are typically not significant enough to result in malabsorption (Drozdowski & Thomson, 2006).

2.5.3 Large intestine

It has been investigated to determine if the aging process affects gastrointestinal motility and lengthens colon transit time. It is still unclear whether age is a risk factor for issues with large intestine motility because the results of this research were conflicting. While Metcalf et al., (1987) discovered that aging did not affect colon transit time, Madsen & Graff, (2004) discovered the opposite, that aging increased colon transit time in those aged 80 and up.

However, there is a change in human gut microbiota that occurs in the large intestine because Bifidobacterium and an adult dominate an infant's microbiota however in the elderly these Bacteroidetes and firmicutes can result in inflammatory bowel disease and metabolic abnormalities (Magrone & Jirillo, 2013).

2.5.3 Health -related issues of malnutrition in the elderly

The Central Nervous System is also involved in food intake regulation, as are numerous neurotransmitters. Nitric oxide may be important in appetite regulation coordination. Opioids are thought to increase food consumption in young adults, and the loss of opioid receptors and lower levels of endogenous opioids in the brain is linked to aging, which influences food intake (Chapman, 2004).

2.5.4 Gastroesophageal Reflux Disease

This is the commonest condition associated with aging affecting about 23% of the elderly in the nursing home according to (Moore et al., 2012). GERD occurs after eating as the reflux of the stomach context results in complications. This may be due to motility disorder, decreased saliva, and cause heart burns. Changes in the oesophageal can also result in odynophagia and community- acquired pneumonia. Poly-pharmacology can also result in the inflammation of the oesophagus and ulceration affecting the dietary intake of this group thereby increasing their risk of malnutrition (Wilcox, 2013).

2.5.5 Oropharyngeal dysphagia

This is the sensational difficulty in chewing and swallowing caused by the neuromuscular mechanism that regulates the throat, tongue, pharynx, and upper oesophageal sphincter (Durazzo et al., 2017), this is common in the elderly with neuromotor disorders. About 50% of aged in nursing homes have this condition and are not aware until it gets complicated which results in aspiration pneumonia, malnutrition, and dehydration. Symptoms include cough with swallowing, food sticking in the throat, and nasal regurgitation (Cabre et al., 2010).

2.5.6 Depression and other psychological problems

Alzheimer's disease can lead to weight loss and changes in eating and drinking patterns. 50% of patients with Alzheimer's disease lose their capacity to eat, drink, and smell which is a key component of taste. Weight loss and changing eating patterns are well-known indicators of advanced psychological diseases. This could have an impact on the eating patterns and food consumption of these patients (Gilbert et al., 2022). Poor dietary intake is a hallmark of depression, and research has shown that bereavement is a common determinant of weight loss and malnutrition among the aged.

2.5.7 Comorbidity

The coexistence of two or more related medical conditions in the elderly also affects their nutritional status because these conditions such as hypertension, diabetes, and metabolic syndrome increase their risk of malnutrition, as all these conditions results in multiple medications and dietary modifications that prevent the aged from consuming their preferred food choices, and with their decreased appetite, these conditions affect their dietary intake resulting in malnutrition.

2.6 SOCIO-ECONOMIC RELATED FACTORS TO MALNUTRITION

The health and nutrition status of people relates to demographic features, socioeconomic status, adequate and proper nutrition, and access to essential social amenities such as food, water, and electricity. Age, gender, township status, and ethnicity, are all key factors in demography that affects the elderly's quality of life and nutritional health. Ghana, like other African countries in similar socioeconomic situations, is no exception when it comes to the poor health of the elderly. The elderly is on retirement making them less active and lonely which makes them more dependent on others and this affects their health and financial status. Loneliness and isolation from society and children have a profound influence on nutrition as it limits their functional capabilities and social status and difficult in accessing social services, however,

loneliness has been associated with depression and poor dietary intake increasing their risk of malnutrition as the Chinese proverbs state that elderly death does not come with age but with abandonment. A study by Pranjic et al., (2011) reported that loneliness is a predictor of anorexia nervosa and increased the risk of malnutrition affecting their quality of life, information on isolation and income from the "National Diet and Nutrition Survey" for the elderly indicates that aged who lived alone consumed less energy than those who lived with others. Lower-income people consumed much less energy, protein, fibre, and a variety of micronutrients. Social factors such as poverty and low levels of education among the aged can result in inadequate knowledge about nutrition resulting in a monotonous diet that predisposes them to malnutrition and affects food availability and nutritional status through their inability to shop and cook (Donini et al., 2013). Economic hardship during this stage affects the elderly population on their food and nutrition security as they turn to consume energy-dense food which is less nutritive resulting in poor nutritional status moreover poverty is associated with lower educational level because most elderly who were not enrolled in government work is not entitled to a pension fee, therefore, they will rely on older children for financial support. The most indigent elderly group must choose between buying prescribed drugs and healthy food (Besora-Moreno et al., 2020). Figure 2.2 show the effects ageing on nutrition.

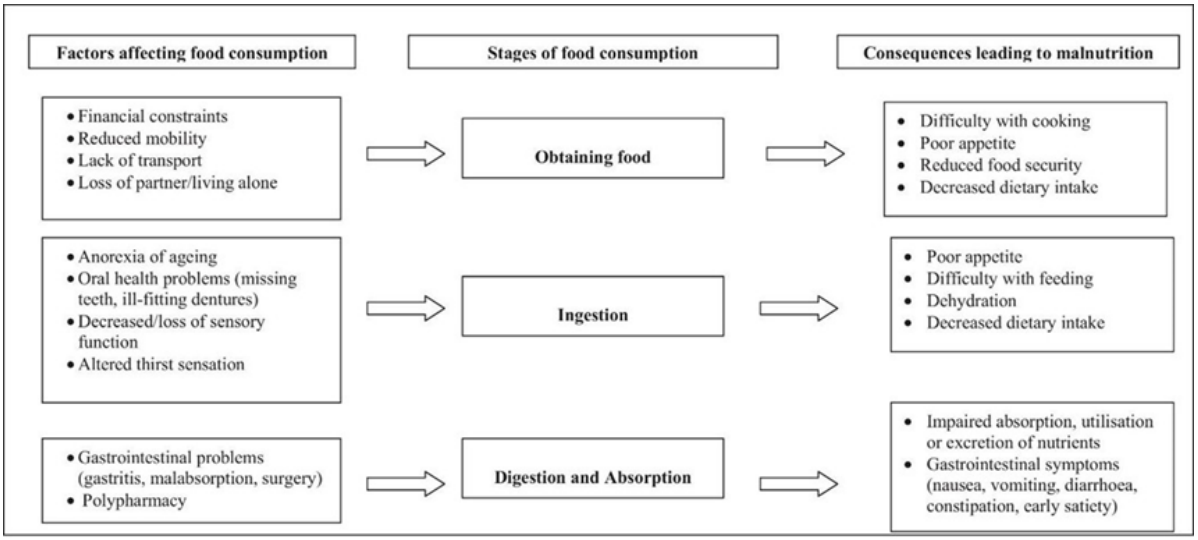

Figure 2.2 Effects of ageing on nutrition

2.7 EFFECTS OF MALNUTRITION ON THE ELDERLY

2.7.1 Immune dysfunction

Immune senescence, or the aging of the immune system, has long been connected to negative alterations in the immune system. Malnutrition has a substantial effect on the immunity of the elderly, raising the risk of sepsis. As we age, the body amasses damage to molecules, cells, and organs, resulting in weak immunity and an increased risk of disease (Pae et al., 2012), the immune system is affected by aging, the impact is not equal; certain immune system components are more dramatically damaged than others as they grow older (Amarya et al., 2015). The elderly has a weakened immune system and are more prone to disease, which is influenced by inadequate diet. Nutrients such as zinc, vitamin E, and vitamin D stand out as nutritional components recognized to be significantly crucial for healthy immunity, however, the elderly are lacking in these micronutrients, resulting in immune system dysregulation. (Pae & Wu, 2017) Even while low zinc serum levels and vitamin E levels are common in the elderly, zinc deficiency can cause immune system abnormalities such as impaired T-cell response, decreased lymphocyte proliferation, and a diminished delayed-hypersensitivity response. However, appropriate micronutrient consumption at daily-recommended levels has been found

to help the elderly regain their immune systems and lower the risk of respiratory infections. Vitamin D is necessary for bone metabolism, and insufficiency is significantly more common among the elderly, leading to an increased risk of infection (Pae & Wu, 2017).

2.7.2 Nutrient deficiency

Decreased appetite among the elderly is associated with reduced nutrient intake while the changes in the GIT are also associated with decreased absorption resulting in nutrient deficiencies that can influence the nutritional status of the aged (Ahmed & Haboubi, 2010), due to the age-related decrease in the production of an intrinsic factor for the absorption of vitamins B12 in the gut and this is associated with impaired cognitive development, increased levels of homocysteine and macrocytic anaemia (Wells & Dumbrell, 2006).

2.7.3 Folate deficiency

Folate absorption decreases with aging with about 50% of the hospitalized elderly deficient in vitamin B9. Folate deficiency is associated with an increase risked of cardiovascular disease, colorectal cancer, dementia, and depression in the elderly (Ahmed & Haboubi, 2010; Reynolds, 2002)

2.7.4 Vitamins D and calcium deficiency

The aging process is linked with the wear and tear of bones de Vries et al., (2013) and the decrease in food intake during this process can result in inefficient levels of vitamins D and calcium that are needed for bone mineralization. This decline in vitamins D and calcium may result in reduced mobility and increased risk of fractures, especially among elderly women resulting in osteoporosis, this is high in women because of the lack of testosterone due to menopause therefore supplementation and dietary modification are key at this stage to prevent hip fractures (Ahmed & Haboubi, 2010; Wells & Dumbrell, 2006).

2.7.5 Iron deficiency anaemia

Hospitalization, disability, mortality, a deterioration in physical performance, reduced quality of life, and diminished muscle strength are all associated with anaemia, which is one of the most prevalent micronutrient deficiencies among the elderly (Penninx et al., 2003). According to the World Health Organization (WHO), anaemia is defined as a drop in haemoglobin concentration of more than 13 g/dL in men and more than 12 g/dL in women, with mild grade anaemia defined as Hb concentration of 10.0 to 11.9 g/dL in women and 10.0 to 12.9 g/dL in men. Approximately 3 million older adults are anaemic, with more than 20% between the ages of 85 and above, and 11 percent and 10.2 percent for men and women 65 and older, respectively. Two-thirds of the elderly who are anaemic have two or more associated diseases. (Guralnik et al., 2004). The commonest form of anaemia among the elderly is iron deficiency anaemia; however, there are four main types of anaemia in the elderly, depending on the causes of anaemia: nutrient deficiencies, chronic kidney disease, chronic disease, or inflammation (ACI) or chronic renal disease, and unexplained anaemia (UA) (Bianchi, 2016).

2.7.6 Diseased and disabilities

Malnutrition may result in increased hospitalization and all forms of infection resulting in high dependence and increased cost. The elderly is prone to several diseases due to poor nutritional status as the high risk of malnutrition worsens illness among this group resulting in disabilities or morbidities or even death.

To conclude malnutrition is more common in the aged as body composition and energy storage change with age, making it a public health concern. Because malnutrition among the elderly is so complex, several extra aspects must be addressed to build effective treatment regimens. Although providing adequate dietary intake and nutrients is critical in the treatment of malnutrition, an intervention will not be effective if it is not combined with lifestyle and socioeconomic factors.

2.8 PNEUMONIA INFECTION AND UNDERNUTRITION IN THE GHANAIAN ELDERLY POPULATION

Pneumonia consistently is the leading cause of morbidity and mortality worldwide (Lozanoet al., 2012). It is defined as an inflammatory condition of the lung primarily the alveoli mostly caused by a variety of microorganisms such as bacteria, viruses, and fungi. Pneumonia is one of the leading causes of infection-related morbidity and mortality in elderly patients (Troeger et al., 2017b). In 2015, pneumonia was the 4th cause of death in low- and middle- income countries however community-acquired pneumonia is underestimated because a patient with mild infection does not seek medical attention therefore CAP is underreported (Heron, 2017). Pneumonia is one of the most common and fatal infectious diseases worldwide. It is a bigger issue among the aging population as there is an increase in the number of cases and deaths every decade. The elderly and younger patients have different clinical presentations of pneumonia due to multiple factors, including functional status (self-reliance and immobility), comorbidities, nutritional status, and swallowing difficulties among the elderly. Pneumonia in the elderly is distinguished by where it is acquired (Mandell et al., 2007).

The prevalence of community-acquired pneumonia (CAP) is approximately 3 episodes/per 1000 persons in those aged between 65 and 69 years and increases to 22/1000 persons between the ages of 85 and 89 years (Millett et al., 2013). Clinical pneumonia caused 6.8 million hospitalizations worldwide in 2015, with approximately 1.1 million deaths. Hospital admission of pneumonia increases with age and is prevalent in men. The increased prevalence of pneumonia among the aged is attributed to the physiological changes associated with the aging process of the respiratory tree and reduced immunity. Streptococcus pneumonia is the commonest pathogen that causes CAP it enters the lower respiratory through aspiration of the oropharyngeal section progressing to cause pneumonia, however, this progression is dependent on the virulence of the pathogen to the host immune system, the volume of aspiration,

frequency of the aspiration and the inoculum of the pathogen (Torres et al., 2013a). Streptococcus pneumonia is a bacterial pathogen that colonizes the host's nasopharynx and upper airway mucosal surfaces (Willis et al., 2009). These organisms can travel from the upper respiratory tract to the sterile parts of the lower respiratory tract by a combination of virulence-factor activity and the capacity to elude the early components of the host immunity, resulting in pneumonia (Kadioglu et al., 2008).

2.8.1 Classification of pneumonia

- Community-acquired pneumonia (CAP); is an infection acquired outside of the hospital setting.
- Nursing home-acquired pneumonia (NHAP); infection acquired over a stay within the nursing home.
- Hospital-acquired pneumonia (HAP) or ventilator-associated pneumonia is defined as pneumonia that occurs 48 hours or more after hospitalization, whereas VAP usually occurs more than 48–72 hours after endotracheal intubation.
- Healthcare-acquired pneumonia (HCAP) occurs in patients with frequent contact with the health system, numerous antibiotic intakes, and/or a functional state of frailty.

2.8.2 Risk factors of community-acquired pneumonia among the elderly.

Everyone is at risk of acquiring pneumonia however studies shows that the aged and infants are at more increased risk of acquiring pneumonia because the infant has an underdeveloped immune system with makes them more vulnerable to most infection while the aged are at risk because of lifestyle activities, nutritional status, comorbidity, overcrowded household, poor dental care, and age.

2.8.3 Lifestyle activities

Lifestyle activities such as high alcohol intake, smoking, and regular contact with children are linked with an increased risk of Community-Acquired Pneumonia. These lifestyle activities such as smoking and alcoholism have harmful to the respiratory epithelial tissue and the clearance of pathogens from the respiratory tract while alcohol is associated with a negative impact on the immune system resulting in an increased risk of CAP (Nelson & Kolls, 2002) and frequent contact with children can also result in CAP among the elderly (Schnoor et al.,2007).

2.8.4 Comorbidities

Several comorbidities are associated with CAP and these include cardiovascular disease, COPD, history of respiratory diseases, patients with cerebrovascular and neurological disorders are twice at risk of CAP because these conditions are associated with swallowing problems, aspiration, and the use of sedative drugs for comorbidity is such as diabetes, chronic renal failure and cancer are associated with impaired immunity which will result in ahigh risk of CAP (Schlienger et al., 2007; Torres et al., 2013b).

2.8.5 Nutritional status

The nutritional status of an individual can also increase the risk of pneumonia because a person's nutritional status affects his/her immune system and increases nutritional deficiencies thereby the pathogen can easily progress in the host. Under-nourished individuals are at a higher risk of acquiring pneumonia and an individual with normal bodyweight.

2.8.6 Age and Poor dental care

Age increases the risk of acquiring pneumonia due to the changes that occur during aging and the decreased immune function (Cillóniz et al., 2013). Poor dental care can also increase the risk of CAP due to the formation of cavities, which are caused by bacteria and these bacteria can travel into the respiratory tract and then progresses to pneumonia.

CHAPTER THREE

3.0 METHODOLOGY

3.1 STUDY SITE

This study was conducted at the Public Health department of the 37 Military Hospitals in the Greater Accra region of Ghana. The 37 Military hospital is the largest military hospital in Ghana; it is a specialist hospital in Greater Accra located between Airport Road and Accra central. It is about five (5) miles from the University of Ghana. This hospital is a referral and tertiary hospital in Greater Accra with Public Health Unit that caters for infectious diseases and has the capacity as well as medical expertise to manage bacterial infections.

3.1.1 Study design

This study was cross-sectional that involves a one-time data collection; this study design allows research to be conducted on an entire population or subgroup to establish an association between an exposure and an outcome in a population at a specific time. This design is used to ascertain the prevalence and generate hypotheses, which serve as a ground for future research (Olsen et al., 2004; Gordis 2009). This study uses a quantitative research method.

3.2 STUDY POPULATION, SAMPLE SIZE DETERMINATION AND SAMPLING TECHNIQUE

3.2.1 Study population

This study was conducted among the elderly 60years and above who has been diagnosed with pneumonia at the 37 Military Hospital, Participants who qualified for the study were provide with an informed consent and then recruited from each hospital after they have been suspected or diagnosed with pneumonia infection through a rapid test for pneumonia.

3.2.2 Sample Size Determination

The carriage of pneumonia in the elderly in Ghana is not known however, the prevalence of influenza and pneumonia in Ghana is 9.29% (Influenza and Pneumonia in Ghana, n.d.).

Therefore, the sample size determination was based on a formula quoted by Metcalfe, (2001)

$n = Z\ P\ (1 - P) \div \mathbf{d}^2$

Where n = sample size; Z = Z statistic for a level of confidence; P = expected prevalence or proportion; d = precision.

Where Z=1.96 (for 95% confidence interval), P=9.29% = 0.926 (prevalence of pneumonia among adults in Ghana) and d=5% = 0.05, the formula gives a sample size of 54 participants thus, 54 pneumoniae infected patients from 37 Military hospital. Using the G-power post hoc analysis, the sample size of 54 participants used in this study had a power (1- β) of 99.7%.

3.2.3 Population Sampling

Convenience sampling was used to recruit it study participants who meet the inclusion criteria, which are patients 60years and above, who have tested positive for pneumonia and has not been in the hospital for more than 72hours.

3.2.4 Inclusion Criteria and Exclusion Criteria

Patients were included in the study if they were:

- Aged 60 years and above.
- Infected with pneumonia.
- Hospitalized for less than 72 hours.
- Willingness to participate.

Patient were excluded from the study if they were:

- Presence of lung malignancies
- Presence of upper respiratory tract infections at the time of sample collection

3.3 DATA COLLECTION

A semi-structured questionnaire was pre-tested among five (5) participants at the Mother Love clinic. This made it easier for the investigator to assess the validity, dependability, and accuracy of the instrument before the start of data collection. Pre-testing was done to estimate the time for each interview and the number of interviews the researcher would be able to conduct per day.

3.3.1 Questionnaire Survey

The information from patients who volunteered to take part in the study were gathered using semi-structured questionnaires. To compare the participants' backgrounds, socio- demographic information was obtained through interviews with the participants. This data contained information on age, marital status, education level, and occupation. Details about their health status, including comorbidities, polypharmacy, exposures, and antibiotic use were also obtained.

3.3.2 Anthropometry and Biochemical Assessment

3.3.2.1 Anthropometric Assessment

A weighing scale, a stadiometer, a measuring tape, a board maker, and a mid-upper arm circumference tape (MUAC) tape were used to evaluate anthropometric data.

3.3.2.2 Weight Measurement

A weighing scale was used to measure the weight of the elderly. They were weighed without jewellery, bulky clothing, shoes, or slippers. The shoeless adults were told to stand with their heads held high in the centre of the scale. The scale was placed on a level, solid surface, and it was tarred. Measurements were done twice and recorded to the nearest 0.1 kilograms (de Onis et al., 2004). The scale was tarred after each weighing to ensure accuracy. The pre- recoded weight of the immobile patient was taken from their file.

3.3.2.3. Height measurement

Each respondent's height was determined using a stadiometer. Without shoes or slippers, respondents' height was measured with their heads, ankles, and legs against the wall as they stood tall and straight on a smooth, flat surface (On the stadiometer). Women were advised to lower their ponytails and take off their hair accessories. Measurements were obtained twice and reported to the nearest 0.5 cm (de Onis et al., 2004). Participants, who could not stand, were measured with a tape while lying down to take their recumbent length.

3.3.2.4 Body Mass Index

Body mass index (BMI) classifications were developed based on associations between BMI and chronic disease and mortality risk in unhealthy populations. The BMI of adults considering unintentional weight loss, maintenance of lean mass, and the presence of co-morbidities that would influence the nutritional status of the elderly according to Winter et al. (2014), therefore, the body mass index of participants was categorized using this formula:

BMI (kg/m^2) = Weight (kg) / Height (m^2)

Table 3.1 Body Mass Index Classification for the elderly

BMI	NUTRITIONAL STATUS
≤ 23 kg/m^2	Under-weight
24 – 30 kg/m^2	Healthy weight
>30 kg/m^2	Overweight

Source :(Winter et al., 2014)

3.3.2.5 Mid Upper Arm Circumference

MUAC measurement was done on the left arm of the participants. The elbow of the arm was bent at a right angle. The olecranon process and the acromion were found and designated as the midpoint between the shoulder tip and the elbow tip. The tape was wrapped around the

designated location after straightening the arm. To obtain an average, two readings were collected. (WHO; UNICEF, 2009)

3.3.2.6 Calf circumference

Measurement was done with the participant sitting and the foot on the ground folded at 90 degrees, trousers and dresses were pulled up to expose the bare leg. The tape measure was wrapped on the widest part of the calf and to obtain an average, the reading was obtained twice.

3.3.2.7 Biochemical Assessment

Biochemical information was assessed using, a haemoglobin meter (URIT-12), cotton wool, strips, lancets, and 70% alcohol were utilized. The participants' haemoglobin concentrations were measured using the haemoglobin meter (URIT-12). The thump was used to obtain blood samples. To avoid contamination, the thump was wiped with cotton wool and 70% alcohol while wearing a disposable hand glove. A lancet was used to pierce the finger, and a drop of blood was then taken and placed on (URIT-12) haemoglobin meter strips then strips were put into the haemoglobin meter right away for reading and value were recorded. Participants who had recent laboratory reports on their HB levels had their values reported in g/dL.

3.3.4 Dietary Assessment

Participants and their guides were asked to provide detailed information about each food or drinks, such as its preparation technique and other properties, as well as an estimate of the portion size consumed the previous day before the interview day using a 24-hour dietary recall. With the aid of the UNICEF food models, the estimated portion sizes of the foods were recorded for dietary intake estimation. A single 24-hour dietary recall was used to assess the participants' dietary patterns.

3.3.5 Mini Nutritional Assessment tool (MNA)

The MNA® is a validated geriatric screening tool for the elderly that determines the nutritional status of participants. MNA is used to identify malnourished participants or those at risk of

malnutrition. It comprises eighteen elements divided into four categories: anthropometry, general health, dietary habits, and self-perceived health and nutrition. It is a tried-and-true method with high sensitivity, specificity, and consistency. Patients with an MNA score of > or = 24 have excellent nutritional status, patients at risk of malnutrition have a score between 17 and 23.5, and patients with MNA > 17 are malnourished" (Vellas et al., 2006).

3.4 DATA ANALYSIS

3.4.1 Questionnaire Survey

SPSS version 26 (statistical program for social science) was used for data management and analysis. Continuous values were reported as mean and standard deviation, whereas categorical variables were represented as frequencies and percentages.

3.4.2 Anthropometric data

Weight and height anthropometric data were converted to the body mass index (BMI). The body mass index of the participants was analysed by creating three categories, namely underweight, healthy weight, and overweight, by Winter et al. (2014), with a cut-off of 23.9 kg/m2 for underweight, 24kg/m2- 29.9kg/m2 for a healthy weight, and 30 kg/m2 for overweight. The formula below was used to determine the BMI cut-off values and assess the women's nutritional status in the study population. Formula for BMI (kg/m²) = Weight (kg)/Height (m²)

3.4.2.1 The mid-upper arm circumference (MUAC) and calf measurements

The mid-upper arm and calf circumference were classified by the MNA screening tool cut-off points, which were categorized into malnourished < 21 cm, at risk of malnutrition 21cm- 22cm, and well-nourished >22cm, while calf measurement indicator was categorized according to the MNA screening tool cut-off-point as is <31 cm malnourished and is >31 well-nourished.

3.4.3 Dietary diversity assessment

The Food and Agriculture Organization (FAO) guideline was also used to assess dietary diversity scores (DDS) (Kennedy et al., 2011). The dietary diversity score was categorized into low, medium, and high. If participants consume less or equal to three food groups were classified as Low dietary diversity while those who consume more than six food groups has High dietary diversity and those in the Medium dietary diversity category consume between four and five food groups. The Dietary Diversity Score was therefore categorized into adequate and inadequate dietary diversity, where <5 food groups inadequate, and >5 food groups are adequate. The Ghana Foods Nutrients Database was used to analyse the nutrient intake of the individual meals and snacks consumed by the participants, using the Ghana Foods Database, the individual meals were used to calculate the daily caloric intake and the recommended dietary intake for macronutrients, vitamins, and micronutrients. The total caloric intake for adults 60 years and above is 1600-2000kcal for women and 2000-2800kcal for men, while the dietary reference intake of the macro and micronutrients were also established (IOM, 2006).

3.4.4 Anaemia data

According to World Health Organization guidelines, anaemia is classified into four categories: normal, mild, moderate, and severe. Non-pregnant women: 12.0 g/dL or higher, 11.0 g/dL-11.9 g/dL, 8.0 g/dL-10.9 g/dL and 8.0g/dL." Men: 13.0 g/dL or higher, 12.0 g/dl-11.9 g/dL, 10.9 g/dL-9.0 g/dL, and 8.0 g/dL; thus, participants' haemoglobin levels were classified by anaemia status (anaemic vs. non-anaemic) using WHO cut-offs (WHO, 2011). Frequencies and percentages were generated for each category.

3.4.5 Health status data

Participants' health status was evaluated using self-reported and diagnosed conditions from the folders. The temperature and pulse of the participants were measured using a pulse meter and a thermometer, while a sphygmomanometer was used to measure their blood pressure results

were expressed as means and standard deviation. Comorbidity was classified as participants with more than one medical condition aside having pneumonia. Participants who were hypertensive, diabetic, or had stroke, cancer, and had coronary heart disease from the semi-structure questionnaire were classified as comorbid. A chi square analysis was done and those variables that where statistically significant were added into a regression model for further analysis to assess the relationship between comorbidity and malnutrition.

3.5 ETHICAL ISSUES

Ethical clearance was obtained from the Noguchi Memorial Institute of Medical Research institutional review board (NMIMR- IRB 006/21-22) and the Ethics and Protocol Review Committee of the 37 Military Hospital (37MH- IRB/MAS/IPN/538/21).

3.5.1 Participants consent

All study participants gave written informed consent in person, in the presence of a witness, confirming that they understood the purpose of the study and gave their consent to participate in it. The issues of obscurity, confidentiality, benefits, risks, and freedom to participate or withdraw from the study were fully explained to the participants.

CHAPTER FOUR

4.0 RESULTS

4.1 BACKGROUND CHARACTERISTICS OF PARTICIPANTS

A total of 54 pneumonia-infected individuals were involved in this study. The minimum age of participants was 60 years, with the oldest being 99 years. The mean and standard deviation of participant age is shown in Table 4.1. The majority (63.75%) of the participants were women, with more than half (64.0%) of the males being married and while (55.2%) of the females widowed. A little over half (58.6%) of the female participants were 75 years old or older, while most (68.0%) of the males were between 60 and 74 years old. Males had the tertiary education (40.0%), while most (34.5%) females had secondary and primary education. Most (92.0%) and (93.1%) of males and females had no occupation. Table 4.1 shows no significant association between demographic characteristics and gender.

Table 4.1 Socio-Demographic characteristics of participants (N=54)

Variables	Total (N=54)	Gender	
		Male (N=25) n (%)	Female (N=29) n (%)
Age			
Adults (60-74yrs)	29(53.7)	17(68.0)	12(41.4)
Older Adults (75 and above)	25(46.7)	8(32.0)	17(58.6)
Marital Status			
Married	28(51.9)	16(64.0)	12(41.4)
Divorce	3(5.6)	2(8.0)	1(3.4)
Widowed	23(42.6)	7(28.0)	16(55.2)
Level of Education			
No Formal Education	14(25.9)	4(12.0)	10(34.5)
Primary	9(16.0)	3(12.0)	6(20.7)
Secondary	18(33.3)	8(32.0)	10(34.5)
Tertiary	13(24.1)	10940.0)	3(10.3)
Occupation			
Not- working	50(92.6)	23(92.0)	27(93.1)
Working	4(7.4)	2(3.7)	2(3.7)

4.1 HEALTH – RELATED INFORMATION OF PARTICIPANTS

Study participants had a mean temperature of 36.2 °C and a mean pulse of 82.8 m/min. Systolic and diastolic blood pressures of 135.8 mm Hg and 76.7 mm Hg, respectively, and a haemoglobin level of 11.0 g/dL. The participants' mean weight was 64.4 kg, and their mean height was 164.3. In addition, the mean mini malnutrition score was 17.91, with a mean dietary diversity score of 4.59, as shown in Table 4. 2. There was a significant difference in the BMI and height of the participants. Table 4.2 Health -related information of participants (N=54)

Table 4.2 Health information of participants (N=54)

Variables	Total (N=54) Mean ± SD	Males (N=25) Mean ± SD	Females (N=29) Mean ± SD	P- value
Body temperature (ºC)	36.2 ± 0.58	36.2 ± 0.69	36.3 ± 0.47	0.69
Age	71.9 ± 13.3	71.1 ± 9.2	72.4 ± 16.3	0.73
Blood pressure Systolic (mm Hg)	135.8± 26.6	141.2 ± 26.5	131.1 ± 26.1	0.17
Diastolic (mm Hg)	79.7±19.6	79.9 ± 23.9	79.4 ± 14.2	0.94
Pulse (min)	82.8 ± 15.4	82.4 ± 15.4	83.1 ± 15.6	0.86
Weight (kg)	64.4 ± 11.1	65.8 ± 10.4	63.2 ± 11.7	0.38
Height (m)	164.3 ± 7.9	168.8 ± 6.61	160.4 ± 6.8	**0.01**
BMI (kg/m^2)	20.59 ± 3.29	19.8 ± 2.8	21.2± 3.5	**0.04**
Hemoglobin level (g/dL)	11.0 ± 2.0	10.9 ± 2.3	11.1 ± 1.9	0.92
MNA- Score	17.91 ± 4.38	18.5 ± 4.1	17.3 ± 4.6	0.31
Dietary Diversity Score	4.59 ± 1.60	4.6 ± 0.91	4.55 ± 2.01	0.84

4.1.1 Prevalence of anaemia among hospitalized adults with pneumonia

According to Table 4.3, most males (60.0%) were non-anaemic, while 40.0% were anaemic, and most females (58.6%) were anaemic, while 41.4% were anaemic. The prevalence of anaemia was 40.7%.

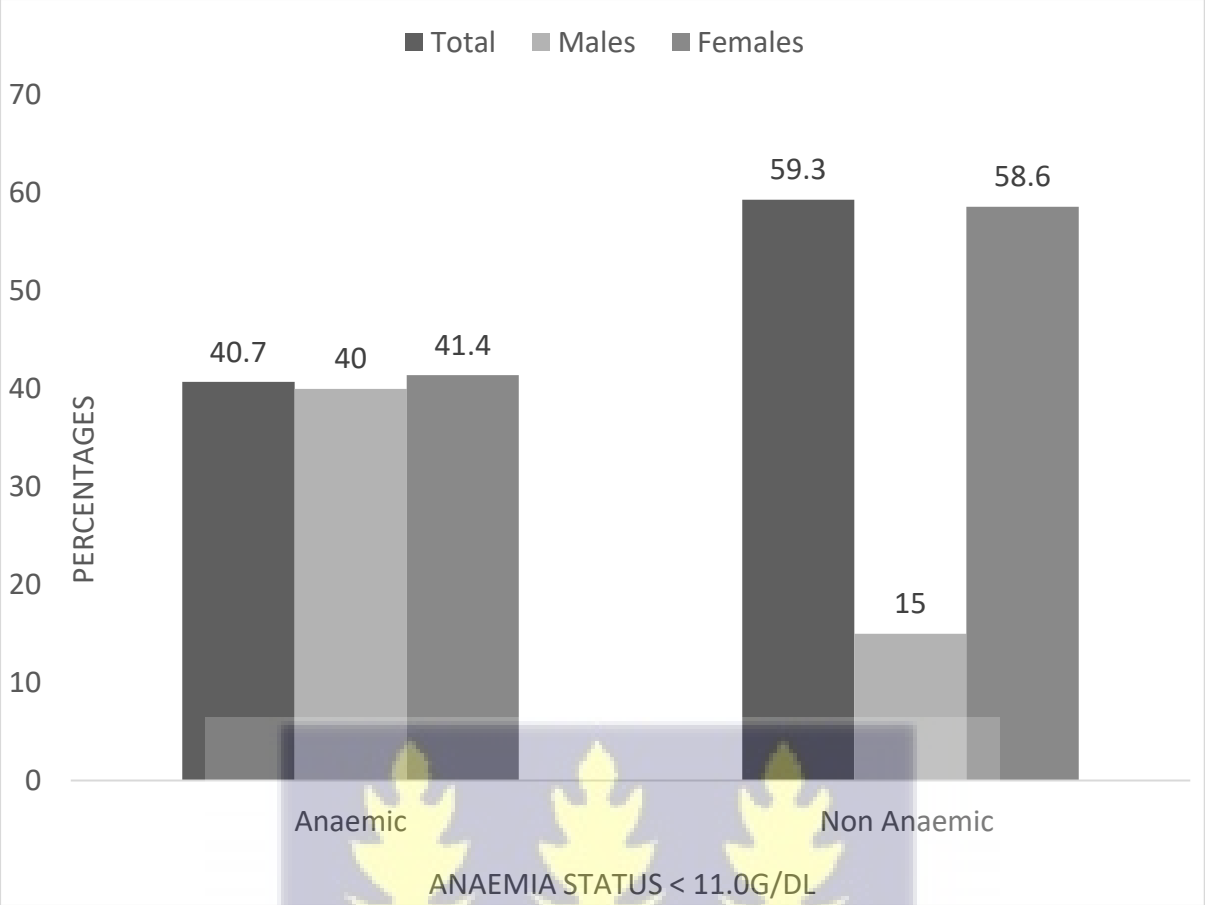

Figure 4.1 Prevalence of anaemia among study participants

4.1.2 Health related characteristics of study participants (N= 54)

Exposures and co-morbidities associated with ageing were measured in more than half (58.6%) of the females' participants. In comparison, 52.0% of males did not have diabetes. In addition, majority of the males (72.0%) had hypertension than the females. (69.0%) and (56.9%) both females and males were taking more than 3 prescriptions per day. Figures 4.2 and 4.3 show that most (61.1%) of the participants had co-morbidities, and a little over half (51.9%) used antibiotics 3-6 times per month.

Table 4.3 Health related information of participant (N=54)

Variables	Total (N=54)	Males (N =25) n (%)	Females (N =29) n (%)	P-value
Diabetes				
Yes	27(53.7)	12(48.0)	17(58.6)	
No	25(46.3)	13(52.0)	12(41.4)	0.44
Hypertension				
Yes	38(70.3)	18(72.0)	20(69.0)	
No	16(29.7)	7(28.0)	9(31.0)	0.81
Stroke				
Yes	14(25.9)	5(20.0)	9(31.0)	
No	40(74.1)	20(80.0)	20(69.0)	0.36
Alcohol intake				
Yes	13(24.1)	13(52.0)	0(00.0)	
No	41(75.9)	12(48.0)	29(100.0)	**0.01**
Smoking				
Yes	2(3.7)	2(8.0)	0(00.0)	
No	52(96.3)	23(92.0)	29(100.0)	0.12
Takes more than 3 prescriptions per day				
Yes	24(63.0)	14(56.0)	20(69.0)	
No	20(37.0)	11(44.0)	9(31.0)	0.33
Antibiotics usage				
Every month3-6 times	12(22.2)	7(24.1)	5(20.0)	0.29
1-2 times	28(51.9)	17(58.6)	11(44.0)	
Less than 1	12(22.2)	5(17.2)	7(28.0)	
	2(3.7)		2(8.0)	

4.2 NUTRITIONAL STATUS OF PARTICIPANTS

Table 4.4 shows that majority of the males (96.0%) and females (75.9%) were underweight. Albeit a few males (4.0%) and females (24.1%) being normal based on the body mass index. A little over half (55.2%) of the females and less than half of the males had Mid Upper Arm Circumference (MUAC) greater than 22 cm, while 10 out of both male (40.0%) and female (34.5%) participants had MUAC less than 21–22 cm. More than half (69.0%) of the female study participants had a calf circumference greater than 31 cm, and out of the total population, 9 out of both male (36.0%)and female (31.0%) study participants had a calf circumference less than 31 cm. Results for the dietary diversity score shows that 14 out of both male (56.0%) and

female (48.3%) study participants had an adequate dietary intake, while a little over half of the female study participants consumed less than five diverse food groups; thus, categorized as inadequate (51.7%). There is a significant association between BMI and gender, as shown in table 4.4, with a p-value > 0.05.

Table 4.4 Nutritional status study of participants (N=54)

Variables	Total (N=54)	Male (N=25) n (%)	Female (N=29) n (%)	P-value*
Mid Upper Arm Circumference				
Less than 21cm	6(11.1)	3(12.0)	3(10.3)	0.87
21 to22cm	20(37.0)	10(40.0)	10(34.5)	
Greater than 22cm	28(51.9)	12(48.0)	16(55.3)	
Calf Circumference				
Less than 31	18(33.3)	9(36.0)	9(31.0)	**0.07**
More than 31	26(66.7)	16(64.7)	20(69.0)	
Body mass index category				
Underweight	46(85.2)	24(96.0)	22(75.9)	**0.04**
Normal	8(14.8)	1(4.0)	7(24.1)	
Dietary diversity score				
Inadequate	26(48.1)	11(44.0)	15(51.7)	
Adequate	28(51.9)	14(56.0)	14(48.3)	0.57

*Based on a chi-square

4.2.1 Prevalence of malnutrition among participants using the Mini Nutrition Assessment tool.

The mini nutritional assessment tool was used to assess the nutritional status of the participant. The MNA scores are presented in Figure 4.3, which shows that 48.3% of female participants were malnourished, with an MNA score of less than 17. The prevalence of malnutrition among the elderly is 40.7%, the prevalence of participants at risk of malnutrition is 50.0%, and only 9.3% of participants were normal.

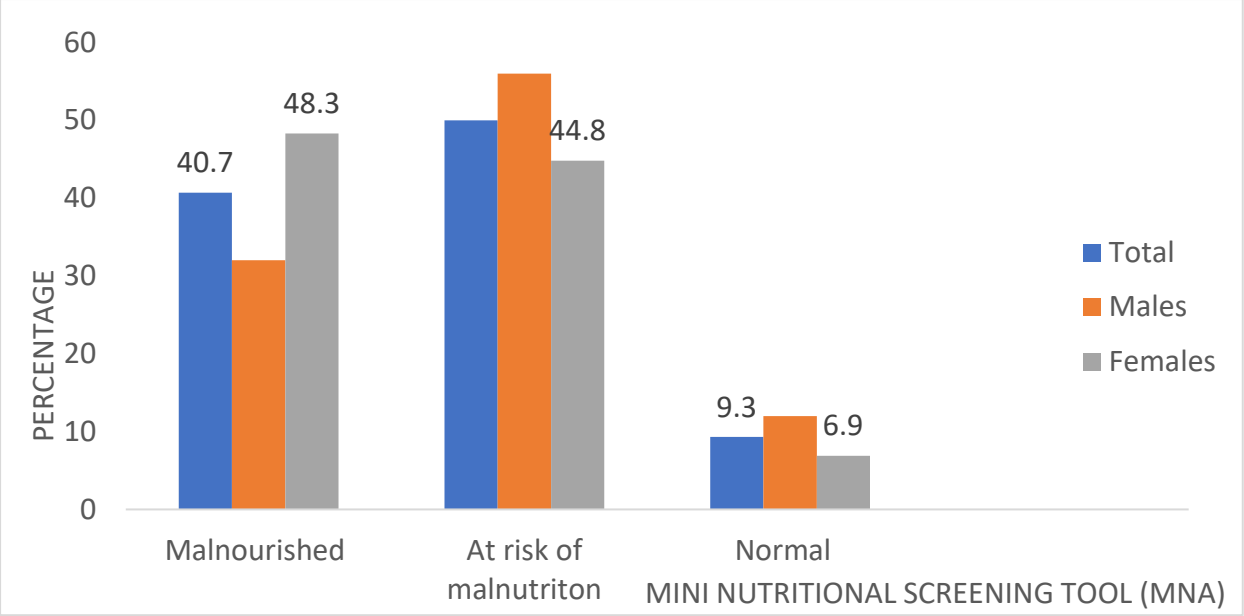

Figure 4.2 Prevalence of malnutrition based on the Mini nutritional assessment screening tool.

4.2.3 Malnutrition indicators and its association with the malnutrition screening tool (MNA score) and the body mass index (BMI).

Malnutrition can be assessed using several indicators; therefore, tables 4.5 and 6 show the association between the indicator of malnutrition and its association with the screening tool (MNA scores) and the body mass index. There was a statistical significance in mid-upper arm circumference and calf circumference ($P< 0.05$) for both the malnutrition screening tool and the body mass index. Table 4.5 Malnutrition indicators and its association with the MNA score (N=54).

Table 4. 5 Nutritional status of participants

Variable	Malnourished n (%)	At risk of malnutrition n (%)	Well, Nourished n (%)	P-value
Mid Upper Arm Circumference				
Underweight	6(100.0)	0(0.00)	0(0.00)	
At risk	10(50.0)	10(50.0)	0(0.00)	**0.02**
Normal	6(21.4)	17(60.7)	5(17.9)	
Calf circumference				
Underweight	10(27.8)	21(58.33)	5(13.87)	
Normal	12(66.67)	6(33.33)	0(0.00)	**0.02**
Body mass index				
Underweight	20(43.48)	22(47.82)	4(8.7)	
	2(25.0)	5(62.5)	1(12.5)	0.62
Normal				

MUAC= <21cm=underweight, 21-22 at risk, >22 cm Normal
Calf circumstance=> 31cm- underweight, > 31cm –Normal
BMI=<24kgm2- underweight, <24kgm2-Normal

Table 4. 6 Malnutrition indicators and its association with body mass index

Variable	Underweight n (%)	Normal n (%)	P-value
Mid Upper Arm Circumference			
Underweight	6(100.0)	0(0.00)	**0.01**
At risk.	20(100.0)	0(00.0)	
Normal	20(71.4)	8(28.6)	
Calf circumference			
Underweight	18(39.1)	0(0.00)	
Normal	28(60.9)	8(100.0)	**0.03**
MNA SCORE			
Malnourished	20(43.5)	2(25.5)	
At risk.	22(47.9)	5(62.5)	0.62
Well nourished	4(8.1)	1(12.5)	

MUAC= <21cm=underweight, 21-22 at risk, >22 cm Normal
Calf circumstance=> 31cm- underweight, > 31cm –Normal
BMI=<24kgm2- underweight, <24kgm2-Normal

4.3 NUTRIENT INTAKE OF STUDY PARTICIPANTS

The means and standard deviation of some nutrients relevant to the ageing population are reported in Table 4.6. According to Table 4.7, which shows the proportion of adequate, adequate, and insufficient nutrient intake of the most important micro- and macronutrients for the elderly, most males (92.0%) and females (89.7%) had insufficient calorie intake. All the participants had inadequacies in calcium, potassium, and fibre intake. In comparison, more than half of the males (60.0%) had adequate carbohydrate intake, and a little over half of the females (55.21%) had adequate carbohydrate intake. Zinc intake was inadequate for both males (96.0%) and females (93.1%), while the Majority (92.0%) of males and (82.8%) of females had inadequate intake of protein.

Table 4.7 Nutrient intake of participants

Nutrient intake	Total (N =54) Means ± SD	Males (N =25) Means ± SD	Females (N =29) Means ± SD	P-value
Total calories (kcal)	929.5 ± 508.5	984.4 ± 551.0	882.1 ± 473.5	0.47
Carbohydrate (g)	135.9± 67.4	147.7 ± 75.6	125.6 ± 58.9	0.23
Protein (g)	31± 16.7	33.9 ± 18.2	28.9 ± 15.1	0.28
Fibre (g)	13.2± 6.8	13.7 ± 7.9	12.8 ± 5.7	0.66
Calcium (mg)	169.5 ± 95.4	173.0 ± 108.1	166.5 ± 84	0.81
Zinc (mg)	4.3± 2.9	3.9 ± 2.8	4.5 ± 2.9	0.48
Iron (mg)	6.9± 4.1	6.2 ± 4.0	7.4 ± 4.1	0.31
Vitamins B12 (ug)	1.3± 1.6	1.6 ± 2.0	1.0 ± 1.1	0.17
Vitamins B6 (ug)	0.9± 0.5	0.8 ± 0.4	1.8 ± 0.9	0.25
Sodium (mg)	2222.9± 1142.5	2029.4 ± 1094.2	2389.8 ± 1175.6	0.22
Vitamins A(ug)	180 ± 247	196.7 ± 254.6	196.7 ±254.6	0.60
Vitamins C (mg)	57.8 ± 36.7	55.34 ±38.6	60.0 ± 35.6	0.60
Folate (ug)	221.2 ± 197.32	251.1 ± 249.7	195.4 ± 136.9	0.31
Phosphorus	539.7 ± 270.1	512.1 ± 321.8	563.6 ± 219.1	0.49
Magnesium	194.6 ± 113.1	185.3 ± 129.1	202 ± 98.3	0.58
Potassium	1346.3 ± 821.7	1252.0 ± 884.6	1427.5 ± 796.8	0.44

Table 4.8 Recommended Dietary Intake by gender.

Variables	Total (N =54)	Male (N =25) n (%)	Female (N=29) n (%)	P-value
Calorie intake				
Inadequate	49(90.7)	23(92.0)	26(89.7)	0.77
Adequate	5(9.3)	2(8.0)	3(10.3)	
Iron intake				
Inadequate	24(44.4)	12(48.0)	12(41.4)	0.75
Adequate	30(55.6)	13(52.0)	17(58.6)	
Sodium intake				
Adequate	11(20.4)	6(24.0)	5(17.2)	0.14
Excess intake	43(79.6)	19(76.0)	24(82.8)	
Vitamins B6 intake				
Inadequate	50(90.6)	22(88.0)	28(96.6)	
Adequate	4(9.4)	3(12.0)	1(4.0)	0.23
Zinc intake				
Inadequate	51(94.4)	24(96.0)	27(93.1)	
Adequate	3(5.6)	1(4.0)	2(6.9)	0.64
Calcium intake				
Inadequate	54(100.0)	25(100)	29(100)	
Vitamin B12 intake				
Inadequate	45(94.4)	23(45.1)	28(54.9)	
Adequate	3(5.6)	3(66.1)	1(33.3)	0.46
Protein intake				
Inadequate	47(87.1)	23(92.0)	24(82.8)	
Adequate	7(12.9)	2(8.0)	5(17.2)	0.31
Carbohydrate Intake	26(48.9)	10(40.0)	16(55.2)	
Inadequate	33(61.1)	15(60.0)	18(44.8)	0.27
Adequate				
Fibre intake				
Inadequate	53(98.1)	25(100)	28(96.6)	
Adequate	1(1.9)	0(0.00)	1(3.4)	0.35
Vitamins C intake				
Inadequate	40(74.1)	20(50.0)	20(50.0)	
Adequate	14(25.9)	4(28.6)	10(71.4)	0.15
Folate intake				
Inadequate	47(87.0)	20(42.6)	27(57.4)	0.15
Adequate	7(13.0)	5(71.4)	2(28.6)	
Phosphorus intake				
Inadequate	23(42.6)	10(40.0)	13(44.8)	
Adequate	30(55.6)	15(40.0)	15(51.7)	0.72
Magnesium intake				
Inadequate	46(85.2)	22(88.0)	24(82.7)	
Adequate	5(9.3)	1(4.0)	4(13.8)	0.23
Potassium intake				
Inadequate	54(100)	25(100)	29(100)	

4.3.1 Nutrient intake, dietary diversity, and its association with malnutrition

A chi-square analysis was conducted to determine the association between nutrient intake and malnutrition using malnutrition indicator scores from the malnutrition- screening tool. There was no significant difference between nutrient intake and malnutrition except for carbohydrate intake, with a P <0.05. Table 4.7 show that all the nutrients relevant in the ageing population have a P > 0.05.

Table 4.9 Nutrient intake, dietary diversity and its association with malnutrition based on MNA screening tool.

Nutrient Intake	Total (N=54)	Malnourished n (%)	At risk of malnutrition n (%)	Well-nourished n (%)	P-value
Protein(g)					
Inadequate	47(87.0)	19(40.4)	23(58.1)	5(10.6)	0.66
Adequate	7(13.0)	3(42.9)	4(57.1)	0(0.00)	
Fibre(g)					
Inadequate	53(98.1)	22(41.5)	26(49.1)	5(9.4)	0.60
Adequate	1(1.9)	0(0.00)	1(100.0)	0(0.00)	
Sodium(mg)					
Inadequate	11(20.4)	3(27.3)	6(54.5)	2(18.2)	0.39
Excess intake	43(79.6)	19(44.2)	21(48.8)	3(7.0)	
Zinc(mg)					
Inadequate	51(94.4)	20(39.2)	26(57.0)	5(9.8)	0.61
Adequate	3(5.6)	2(66.7)	1(33.3)	0(0.00)	
Vit B6(mg)					
Inadequate	50(90.6)	21(42.0)	24(48.0)	5(10.0)	0.55
Adequate	4(9.4)	1(25.0)	3(75.0)	0(0.00)	
Vit B12(µg)					
Inadequate	51(94.4)	22(43.1)	24(47.1)	5(9.8)	0.20
Adequate	3(9.4)	0(0.00)	3(100.0)	0(0.00)	
Carbohydrates (g)					
Inadequate	26(48.1)	15(57.7)	10(38.5)	1(38.1)	**0.04**
Adequate	28(51.9)	7(25.0)	17(60.7)	4(14.3)	

Folate(ug)					
Inadequate	47(87.0)	20(42.6)	18(47.7)	3(7.9)	0.52
Adequate	7(13.0)	2(28.6)	8(57.1)	2(14.3)	
Vitamins C(mg)					
Inadequate	40(74.1)	18(45.0)	19(47.5)	3(7.5)	0.49
Adequate	14(25.9)	4(28.6)	8(57.1)	2(14.3)	
Dietary Diversity scores					
Inadequate	26(49.1)	10(38.5)	15(57.7)	1(3.8)	
Adequate	28(51.9)	12(42.9)	12(42.9)	4(14.3)	0.33
Total Calorie(kcal)					
Inadequate	49(90.4)	20(40.8)	24(49.0)	5(10.2)	
Adequate	5(9.3)	2(40.0)	3(60.0)	0(0.00)	0.75
Potassium (g)					
Inadequate	54(100.0)	22(40.7)	27(50.0)	5(9.3)	
Phosphorus(g)					
Inadequate	31(57.4)	14(41.9)	13(41.9)	4(12.9)	0.31
Adequate	23(42.6)	8(34.8)	14(60.9)	1(4.3)	
Iron(g)					
Inadequate	23(43.4)	9(39.1)	11(47.8)	3(13.0)	
Adequate	30(56.6)	13(43.3)	15(50.0)	2(6.7)	0.73
Magnesium(g)					
Inadequate	46(90.2)	17(37.0)	24(52.2)	5(10.9)	
Adequate	5(9.8)	3(60.0)	2(40.0)	0(0.00)	0.53

4.3.2 Association between nutrient intake, dietary diversity, and body mass index (BMI)

A chi-square analysis was conducted to establish the association between nutrient intake, dietary diversity, and body mass index; however, there was no significance for all the nutrient, as table 4.8 show all nutrient intakes was P >0.05.

Table 4.10 Association between nutrient intake, dietary diversity and malnutrition based on body mass index (BMI)

Nutrient Intake	Total (N=54)	Underweight n (%)	Normal n (%)	P- value
Protein(g)				
Inadequate	47(87.0)	40(87.0)	7(87.5)	
Adequate	7(13.0)	6(13.0)	1(12.6)	0.97
Fibre(g)				
Inadequate	53(98.1)	45(97.8)	8(100.0)	
Adequate	1(1.9)	1(2.2)	(0.00)	0.67
Sodium(mg)				
Adequate	8(20.4)	9(81.8)	2(18.2)	
Excess intake	43(79.6)	37(86.0)	6(14.0)	0.73
Zinc(mg)				
Inadequate	51(98.9)	43(93.5)	8(100.0)	
Adequate	3(1.9)	3(6.5)	0(0.00)	0.46
Vit B6(mg)				
Inadequate	50(92.6)	42(91.3)	8(100.0)	
Adequate	4(7.4)	4(8.7)	0(0.00)	0.39
Vit B12(µg)				
Inadequate	51(94.4)	43(93.5)	8(100.0)	
Adequate	3(5.6)	3(6.5)	0(00.0)	0.46
Iron (g)				
Inadequate	37(68.5)	30(65.2)	7(87.5)	
Adequate	17(31.5)	16(34.8)	1(12.5)	0.21
Carbohydrate(g)				
Inadequate	26(48.1)	23(50.0)	3(37.5)	
Adequate	28(51.9)	23(50.0)	5(62.5)	0.51
Folate (ug)				
Inadequate	47(87.0)	39(84.8)	8(100.0)	
Adequate	7(20.0)	7(15.2)	0(0.00)	0.24

Phosphorus(g)				
Inadequate	31(57.4)	25(80.6)	6(19.4)	0.29
Adequate	23(42.6)	21(91.3)	2(8.7)	
Magnesium(g)				
Inadequate	46(90.2)	38(82.6)	8(17.4)	
Adequate	5(9.8)	5(100.0)	0(0.00)	0.58
Potassium (g)				
Inadequate	54(100.0)			
Vitamins C(mg)				
Inadequate	40(74.1)	35(87.5)	5(12.5)	
Adequate	14(25.9)	11(78.6)	3(21.4)	0.43
Total calorie(kcal)	49(90.7)	41(89.1)	8(100.0)	
Inadequate	5(9.3)	5(10.9)	0(0.00)	0.33
Adequate				
Dietary diversity score				
Inadequate	26(48.1)	23(88.5)	3(11.5)	
Adequate	28(51.9)	23(82.1)	5(17.9)	0.51

4.4 HEALTH CONDITIONS AND IT ASSOCIATION WITH MALNUTRITION

Non-communicable diseases that affect nutritional status are associated with aging. The tables below show the association between prevalent health conditions among the elderly and their association with malnutrition based on the indicators of malnutrition. According to the mini nutritional screening tool, health conditions such as neuropsychological problems were statistically significant (P <0.05). Simultaneously, there was no evidence of the health conditions and their relationship with the other indicators of malnutrition.

Table 4.11 Health condition and its association with malnutrition base on MNA screening tool.

Variables	Malnourished n(%)	At risk of malnutrition n (%)	Well Nourished n (%)	P -value
Neuropsychological problems				
Severe dementia	0(0.00)	15(60.0)	7(25.0)	
Mild dementia	1(50.0)	10(40.00	16(59.3)	**0.02**
No psychological Problem	1(50.0)	0(0.00)	4(14.8)	
Psychological stress				
No	11(32.4)	19(55.9)	4(11.8)	0.24
Yes	11(55.0)	8(40.0)	1(5.0)	
Stroke				
No	14(35.0)	21(52.0)	5(12.5)	0.20
Yes	8(57.1)	6(42.9)	0(0.00)	
Hypertension				
No	6(37.5)	9(56.3)	1(6.3)	0.79
Yes	16(42.1)	8(40.0)	4(10.5)	
Diabetes				
No	8(32.0)	13(52.0)	4(16.0)	0.20
Yes	14(48.3)	14(48.3)	1(3.4)	

Table 4.12 Health conditions and its association with Mid upper arm circumference

Variables	Malnourished n (%)	At riskn n (%)	Normaln n (%)	P-value
Neuropsychological problems				
Severe dementia	0(0.0)	0(0.0)	2(100.0)	
Mild dementia	4(16.0)	11(44.0)	10(40.0)	0.39
No psychological Problem	2(7.4)	9(33.3)	16(59.0)	
Psychological stress				
No	4(14.8)	11(40.7)	12(44.4)	0.49
Yes	2(7.4)	9(33.3)	16(59.3)	
Stroke				
No	5(12.5)	13(32.5)	22(55.0)	0.49
Yes	1(7.1)	7(50.0)	6(42.9)	
Hypertension				
No	1(6.3)	7(43.8)	8(50.5)	0.68
Yes	5(13.2)	13(34.2)	20(52.6)	
Diabetes				
No	3(12.0)	8(32.0)	14(56.0)	0.78
Yes	3(10.3)	12(41.4)	14(48.3)	

Table 4.13 Health conditions and its association with Body Mass Index (BMI)

Health conditions	Underweight n (%)	Normal n (%)	P-value
Neuropsychological problems			
Severe dementia	1(2.2)	1(12.5)	
Mild dementia	22(17.8)	3(37.5)	0.37
No psychological problem	23(50.0)	4(50.0)	
Physiological stress			
No	28(60.9)	6(75.6)	0.45
Yes	18(39.1)	2(25.0)	
Hypertension			
No	14(30.4)	2(25.0)	0.76
Yes	32(69.9)	6(75.0)	
Diabetes			
No	23(50.6)	2(25.0)	0.19
Yes	23(50.6)	6(75.0)	
Stroke			
No	34(85.0)	6(15.0)	
Yes	12(85.7)	2(14.3)	0.95

Table 4.14 Health condition and its association with Calf Circumference

Health conditions	Malnourished n (%)	Normal n (%)	P-value
Neuropsychological problems			
Severe dementia	0(0.00)	2(100.0)	
Mild dementia	12(48.0)	13(52.0)	0.09
No psychological Problem	6(22.2)	21(77.8)	
Physiological stress			
No	10(29.4)	24(70.6)	0.43
Yes	8(40.0)	12(60.0)	
Hypertension			
No	5(31.1)	11(68.8)	0.83
Yes	13(34.2)	25(65.5)	
Diabetes			
No	8(32.0)	17(68.0)	0.86
Yes	18(33.3)	19(65.5)	
Stroke			
No	12(30.0)	28(70.0)	0.38
Yes	6(42.9)	8(57.1)	

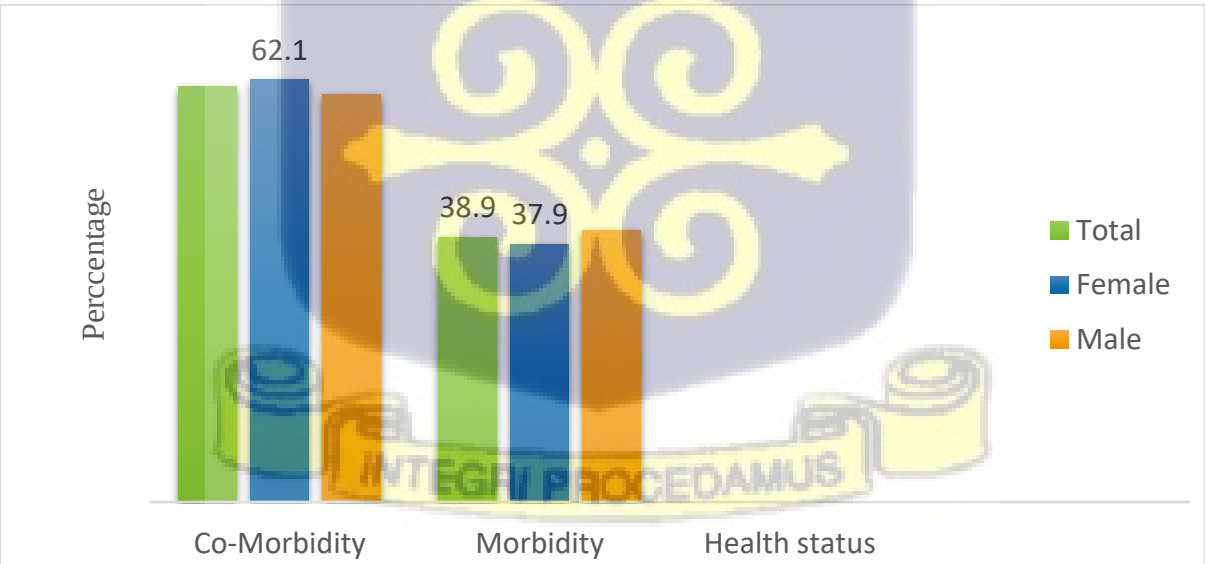

Figure 4.3 Prevalence of Co-morbidity among study participants

(P= 0.876): Comorbidities include hypertension, diabetes, and stroke.

4.5 COMORBIDITY AND ITS ASSOCIATION WITH MALNUTRITION

A binary regression model was used to establish the association between patients with comorbidity and malnutrition. There was R2 (4%) variance predicted by the model in the development of malnutrition with x2 (df 1) = chi-square value (1.003) and a p-value of 0.317, which is >0.05; table 4.15 show that patients with comorbidities are (2.58) times at risk of being malnourished than patients without any comorbidities.

Table 4.15 Bivariate analysis of co-morbidity and malnutrition

Variables	N=54 n (%)	OR	95%CI	P-value
Patient with comorbidity				
No	21(38.9)			
Yes	33(61.1)	2.58	0.394 – 16.949	0.32

Comorbidity: Diabetes, Hypertension, and Stroke

4.6 PREDICTORS OF MALNUTRITION

Malnutrition among the elderly can be determined using certain predictors using a chi square analysis predicator such as marital status, mode of feeding and mobility were statistically significant with the MNA score with a p-value <0.05 as shown in table 4.16.

Table 16 Predicators of malnutrition and its association with Mini Nutritional Assessment tool (MNA)

Variables	Malnourished n (%)	At risk of malnutrition n (%)	Well nourished n (%)	P-value*
Marital status				
Married	7(25.0)	0(0.00)	15(65.22)	
Divorced	19(67.89)	3(100.0)	5(21.74)	**0.03**
Widowed	2(7.14)	0(0.000	3(13.04)	
Live independently				
Yes	3(30.0)	5(50.0)	2(20.0)	0.34
No	19(43.18)	22(50.0)	3(6.82)	
3 or more prescription per day				
Yes	6(35.29)	11(64.70)	3(17.64)	0.34
No	16(47.06)	16(47.06)	2(5.88)	
Mode of feeding				
Unable to eat without assistance.	8(100.0)	0(0.00)	0(0.00)	**0.01**
Self- fed with difficult	9(60.0)	6(40.0)	0(0.00)	
Self - fed with no problem	5(16.13)	21(67.74)	5(16.13)	
Mobility				
Bed or chair bound	11(78.57)	3(21.43)	0(0.00)	
Able to get out of bed	9(42.8)	10(47.62)	2(9.52)	**0.01**
Goes out	2(10.53)	14(73.68)	3(15.78)	
Level of education				
No Formal Education	7(50.0)	5(35.71)	2(14.29)	
Primary	2(22.2)	6(66.6)	1(11.11)	0.69
Secondary	7(38.89)	9(50.0)	2(11.11)	
Tertiary	6(46.15)	7(53.85)	0(0.00)	
Age				
Adult	9(31.03)	17(58.62)	3(10.34)	0.27
Older adults	13(52.0)	10(40.0)	5(9.26)	

**Based on Chi square*

Table 4.17 Predication and its association with Mid upper Arm Circumference

Variables	Underweight n (%)	At risk n (%)	Normal n (%)	P-value*
Marital status				
Married	1(3.6)	10(35.7)	17(60.7)	
Divorced	0(0.0)	0(0.00)	3(100.0)	**0.03**
Widowed	5(21.1)	10(43.5)	8(34.8)	
Live independently				
Yes	5(11.4)	16(36.4)	23(52.3)	0.14
No	1(10.0)	4(40.0)	5(50.0)	
3 or more prescriptionper day	2(10.0)	7(35.0)	11(55.5)	**0.02**
No	4(11.8)	13(38.2)	17(50.0)	
Yes				
Mode of feeding				
Unable to fed without assistance	0(0.00)	5(62.5)	3(37.5)	0.43
Self- fed with difficult	3(20.0)	6(40.0)	6(40.0)	
Self-fed with no problem	3(9.7)	9(29.0)	19(61.3)	
Mobility				
Bed or chair bound	2(14.3)	7(50.0)	5(35.7)	
Able to get out of bed	3(14.3)	7(33.3)	11(52.4)	0.64
Goes out	1(5.3)	6(31.6)	12(63.2)	
Level of education				
No Formal Education	2(14.3)	7(50.0)	5(35.7)	
Primary	0(0.00)	4(44.4)	5(55.6)	0.38
Secondary	3(16.7)	3(16.7)	12(66.7)	
Tertiary	1(7.7)	6(46.2)	6(46.2)	
Age				
Adult	3(10.3)	9(31.0)	17(58.6)	0.26
Older adults	3(12.0)	11(44.0)	11(44.0)	

**Based on Chi square*

4.6.1 Predicator and its association with malnutrition indicators

Malnutrition in the elderly can be predicted using specific predictors. Table 4.18 shows that marital status and taking more than three prescriptions per day were statistically significant predictors of malnutrition based on BMI.

Table 4.18 Predicators and its association with Body mass Index (BMI)

Variables	Underweight n (%)	Normal n(%)	P-value
Marital status			
Married	25(54.3)	3(37.5)	
Divorced	1(2.2)	2(25.0)	**0.03**
Widowed	26(43.2)	3(37.5)	
Live independently	36(60.9)	8(100.0)	0.14
Yes	10(21.7)	0(0.00)	
No			
3 or more prescriptionper day.			
No	20(43.5)	26(56.5)	
Yes	0(0.00)	8(100.0)	**0.02**
Mode of feeding			
Unable to eat without assistance.	6(13.0)	2(25.0)	0.48
Self- fed with difficult	14(30.4)	1(12.5)	
Self-fed with no Problem	26(56.5)	5(62.5)	
Mobility			
Bed or chair bound	12(26.1)	2(25.0)	
Able to get out of bed	19(41.3)	2(25.0)	0.59
Goes out	15(32.6)	4(50.0)	
Level of education			
No Formal Education	12(26.1)	2(25.0)	
Primary	6(13.0)	3(37.5)	
Secondary	17(37.0)	1(12.5)	0.22
Tertiary	11(23.9)	2(25.0)	
Age			
Adult	23(50.0)	6(75.0)	
Older adults	23(50.0)	2(25.0)	0.19

Table 4.19 Predicators and its association with malnutrition based on Calf circumference.

Variables	Malnourished n (%)	Normal n (%)	P-value
Marital status			
Married	6(21.4)	22(78.6)	**0.03**
Divorced	0(0.0)	3(100.0)	
Widowed	12(52.2)	11(47.8)	
Live independently			
Yes	15(34.1)	29(65.9)	0.80
No	3(30.0)	7(70.0)	
3 or more prescriptionper day.			
No	5(25.0)	15(75.5)	0.32
Yes	13(38.2)	21(61.8)	
Mode of feeding			
Unable to eat without assistance.			
Self- fed with difficult	4(50.0)	4(50.5)	
Self-fed with noproblem	6(40.0)	9(60.0)	0.33
	8(25.8)	23(74.2)	
Mobility			
Bed or chair bound	8(57.1)	6(42.6)	
Able to get out of bed	5(23.8)	16(76.2)	0.09
Goes out	5(26.3)	14(73.7)	
Level of education			
No Formal Education	5(42.4)	8(57.1)	
Primary	3(16.7)	6(66.7)	0.29
Secondary	3(16.7)	15(83.3)	
Tertiary	6(46.2)	7(53.8)	
Age			
Adult	7(24.1)	22(75.9)	
Older adults	11(44.0)	14(56.0)	0.12

Based on chi square

4.7 SOCIO- DEMOGRAPHIC CHARACTERISTICS AND ITS ASSOCIATION WITH MALNUTRITION

The nutritional status of the elderly is influenced by socio-demographic characteristics such as age. The older the participant, regardless of education level or gender, the greater the likelihood of malnutrition. Table 4.16 shows the odds and P-values of socio-demographics and malnutrition.

Table 4.20 Binary logistic regression of sociodemographic characteristics and its association with malnutrition.

Variables	N (54) n (%)	Unadjusted OR	95%CI	P-value	Adjusted OR	95%CI	P-value
Gender							
Male	25(46.3)						
Females	29(53.7)	1.84	0.285 -12.01	0.53	0.56	0.065 – 4.968	0.61
Age							
Adults (60-47yrs)	29(53.7)						
Olderadult (74 and above)	25(46.3)	1.33	0.203 -8.65	0.77	0.63	0.068 – 5.748	0.68
Education							
No formal education	14(25.1)						
Formal education	40(74.9)	2.06	0.306 – 13.79	0.46	0.38	0.047 – 3.117	0.37
Marital status							
Married	28(51.9)						
Unmarried	26(48.1)	0.59	0.575 -218.9	0.58	1.91	0.224 –16.28	0.56
Live independently							
No	44(81.5)						
Yes	10(18.5)	0.07	0.00 – 0.00	**0.01**	2.92	0.351 – 24.23	0.32

Adjusted for all the significant socio- demographic characteristics.

Table 4.21 Bivariate analysis of predictors and its association with malnutrition

Variables	N=54 n (%)	Unadjusted OR	95% CI	P-value	Adjusted OR	95%CI	P-value
Diabetes							
No	25(46.3)						
Yes	29(53.7)	0.19	0.020- 1.803	0.15	0.12	0.006– 2.53	0.17
Mobility							
Goes out	19(35.2)						
Immobile	35(35.8)	3.09	0.469- 20.40	0.24	3.89	0.321 – 47.09	0.27
Stroke							
No	40(74.1)						
Yes	14(25.9)	0.00	0.00-0.00	**0.01**	0.00	0.00 – 0.00	0.99
Neurophysiological problems							
No dementia	27(50.0)	4.52	0.004-2.177	0.19	1.29	0.101– 16.63	0.84
Dementia	27(50.0)						
Takes 3 prescriptionPer day.							
No	20(37.0)	0.18	0.00 -0.00	**0.01**	1.83	0.123 – 26.18	0.66
Yes	34(63.0)						

Binary logistic regression adjusting other significant variables in the table.

4.7.1 Predictors of malnutrition among participants

Table 4.21 shows that participants who had stroke and were taking more than 3 prescriptions per day had a significant association with malnutrition with (P< 0.5) and a lower odd of (OR 0.00, 0.18) respectively, in contrast all other predictors of malnutrition were no significant with a (P >0.05)

CHAPTER FIVE

5.0 DISCUSSION

5.1 SOCIO- DEMOGRAPHIC CHARACTERISTICS

Currently, Ghana has the highest proportion of people 60 years of age and older in sub-Saharan Africa due to public health advancements and declining fertility rates (Aganiba et al., 2015). This study was a cross- sectional among 25 males and 29 females hospitalized with pneumonia from the 37 military hospital. Most (63.7%) participants were female, which agrees with the recent population and housing census, which shows that females outnumber males in Ghana (Ghana Statistical Service,2021). This study also shows that most (68.0%) of the male participants were between 65-74 years, while (58.0%) of the females were 75years and above, which agrees with a study conducted on life expectancy by Ginter & Simko,(2013), which states that women live longer than men because men are more exposed to occupational hazards, smoking and alcohol intake making men more susceptible to cardiovascular disease and mortality than women also from the study most females were widowed as compared to males while most of the males were married, this can be attributed to women having longer life span than men also, most women stays single after the death of their spouse because of the widowhood right and other traditions unlike men, most men remain married till they die or remarried after the death of their spouse (Waite, 2004). In early studies, widowed women were more susceptible to malnutrition due to loneliness, which affects their dietary intake, increasing their risk of mortality, illness, and disability Wylie et al., (1999); this agrees with the result of this study. As shown, (43. 2%) of the widowed participants were underweight. Most participants were not working and had no formal education, especially the females, which resulted in high dependency on the extended family or older children affecting their health, economic and social well-being.

5.2 LIFESTYLE PATTERN AND HEALTH STATUS OF STUDY PARTICIPANTS

Ageing is associated with deteriorating health, loneliness, and decreased mobility, which collectively affects the normal physical function and health status of the elderly. The elderly has weaker immunity, making the elderly more susceptible to disease and infections (Lesourd, 1997). Numerous studies have shown the effects of alcohol and tobacco on nutritional status. Moderate alcohol consumption and quitting smoking has been demonstrated to be advantageous for healthy aging and protect against stroke; however, the result of this study indicates that most of the participants did not consume alcohol, nor do they smoke; the relatively low consumption of alcohol in participants can be attributed to the age group used for the study.

Chronic non-communicable diseases are prevalent among the elderly, with the most common ones as diabetes and hypertension (Joyce et al., 2005). Globally, 74% of deaths are from NCDs, with 41 million deaths yearly, most of which are from cardiovascular diseases. According to estimates, 77% of these fatalities occur in low- and middle-income nations, driven by unhealthy lifestyles, urbanization, globalization, and the aging population (World Health Organization, 2022). All age groups are susceptible to the risk factors of NCDs, but the rate is higher among the elderly and prevalent among women (World Health Organization, 2003). This is consistent with the results of this study, as the most prevalent NCD was cardiovascular diseases, especially hypertension, with the mean and standard deviation for diastolic and systolic blood pressure (135.8 ± 26.6,79.7± 19.6), and it was more prevalent in the females than males. The result of this study shows a 61.1% prevalence of comorbidity among hospitalized adults with pneumonia, and this can be attributed to the study population as it already established that the elderly a prone to non-communicable diseases, and the study site Accra, is an urban area where most people a prone to nutrition transition and less physical activities. This study reveals that most of the elderly take more than three prescriptions daily due to comorbidities, which

influence their dietary intake, thereby increasing their risk of malnutrition. The elderly has a weaker immune system, making them more susceptible to infectious diseases like pneumonia. Streptococcus pneumonia is a common bacterial infection and drug- resistance (Islam et al., 2019). The study result shows that most of the pneumonia-infected participants use antibiotics 3-6 times a month, and this can be associated with self-medication because there are no comprehensive care or specialist for the aged in the hospitals and the fact that Out-Of-payments continue to make up the single greatest portion of health care financing in Ghana according to Akazili et al., (2012) so they turn to buy drugs over the shelve until the condition becomes critical, they would not go to the hospitals.

5.3 NUTRITIONAL ASSESSMENT OF THE ELDERLY

This study used the body mass index to assess the nutritional of participants, with a mean of 20.59kg/m2, which is relatively lower compared to European studies (de Groot et al., 1992). This can also be attributed to the participant's current health status, as infection can result in malnutrition, pneumonia symptoms, and difficulty breathing. Chest pain can lead to low food intake or even tube feeding, which makes leads to poor dietary intake as eating may result in aspiration pneumonia which occurs when food particles or other substances are inhaled into the airways instead of air which can become fatal according to Sanivarapu & Gibson, (2022) thereby resulting in a participant with lower BMI. The present study shows a prevalence of malnutrition, as 85% were underweight. In comparison, 15% were normal, this is almost double the prevalence of malnutrition in community-dwelling participants in a study done in Ghana by Aganiba et al. (2015), which was 48% using the body mass index. Present study used the BMI of adults considering intentional weight loss, maintenance of lean mass, and the presence of co- morbidities that would influence the nutritional status of the elderly Winter et al. (2014), which agree with a study conducted by Kıskaç et al., (2022) which establishes the optimum BMI ranges for young and middle-aged people should not recommended for older patients; as

BMI values between 25 and 35 kg/m2 increases risk of malnutrition, reduced muscle strength, and problems with balance, walking, and mobilizing.

Haemoglobin levels of participants were high as 59.1% were non – anaemic, which is high compared to Patel, (2008) other studies; this can be attributed to certain medications given to them in the hospital and the age group used. The calf and mid-arm circumferences were measured to assess the nutritional status of the elderly using the malnutrition-screening tool. Half of the participants were at risk of malnutrition using the MNA score, most males. In comparison, 40.5% were malnourished, female, which can be attributed to the high dependency rate and loneliness among females. The present study agrees with a systematic study done in 12 countries with 24 data sets containing details on the full MNA screening tool. The prevalence of malnutrition for the combined study was 22.8%, but there were significant variations amongst the settings, such as rehabilitation at 50.5%, hospital at 38.7%, nursing home at 13.8%, and the community at 5.8%. The "at-risk" group had a prevalence of 46.2% in the combined database; as a result, about two-thirds of the research participants were either undernourished or at risk for malnutrition (Kaiser et al., 2010). The prevalence of malnutrition in this study was lower than that of Larrazabal et al. (2021), where the prevalence of malnutrition among adults with COVID-19 was 73%, using the subjective Global Assessment tool (SGA) and was significant for the community- and hospital-acquired pneumonia.

Malnutrition indicators such as mid-upper arm and calf circumference were significant for both BMI scores. The MNA score agrees with a study conducted in India that established a strong correlation between MUAC, CC, and body mass index. The study assessed the sensitivity and specificity of MUAC as 82% and 76%, respectively, and the sensitivity and specificity of calf circumference as 78.9% and 74%, respectively (Selvaraj et al., 2017).

Furthermore, a study conducted among hospitalized adults indicates that MUCA was significant with other indicators using the ROC curve at a cut-off- point of 28.5 with high

specificity and sensitivity (Leandro-Merhi et al., 2013). A repeated 24-hour dietary recall was used to assess the minimum dietary diversity among the study population, with 51.1% having adequate dietary diversity. Total calorie intake was low among the study population. This can be attributed to reduced appetite and decreased sensory function during aging, gastrointestinal-related changes, and changes in the central nervous system that cause poor appetite. Aging influences the full function of the gastrointestinal tract as it affects motility, enzyme, hormone secretions, digestion, and absorption. In addition, the reduction in sensory functions such as taste and smell are associated with appetite loss due to a perceived decrease in food pleasantness; however, the loss of taste and smell is common and is worsened by illness and medications. The present study shows a majority of older persons were found to have inadequate intake of macronutrients like fibre and protein as well as micronutrients like vitamins B6, B12, C, E, folate, iron, calcium, and zinc, as the population's mean intakes were lower than recommended daily intake, a study conducted in America associated inadequate calcium intake for the elderly population to increases risk of osteoporosis due to poverty which is consistent with the present findings Marshall et al.,(2020) while other studies are also concise with the macro and micronutrient inadequacies (Organ & Rakicioğlu, 2015; Volpi et al., 2013).

Skipping meals, poor functional ability to shop, loneliness and prepare food, a lack of financial support and poor health are all causes of macro- and micronutrient deficiencies (Hayfron et al., 2021; Steiner- Asiedu et al., 2010). Nutritional deficiencies in the elderly occur because of insufficient food intake, abnormalities in the absorption process, or failure to convert nutrients into active forms (Bauer et al., 2013). These are very concerning because they increase their risk of malnutrition, chronic illnesses like diabetes, hypertension, cardiovascular diseases, and infections (Steiner-Asiedu et al., 2010). These conditions will adversely affect the public health system and impose a financial burden on the affected families.

5.4 SOCI-DEMOGRAPHIC CHARACTERISTICS AND THEIR ASSOCIATION WITH MALNUTRITION.

Demographics such as age and gender were associated with malnutrition. Results of the study show that women are almost 1.84 times more at risk of being malnourished than men. This is consistent with Ferede et al. (2022) and can be a result that most women are financially independent and therefore rely on families more than men. The risk of being under-weight increases with age, as the odds for older adults 75years and above were 1.33times higher as compared to adults 60-74years and this could be because of aging-related changes associated with impaired olfactory function and oral health as well as a general loss in appetite according to metabolic (2017), making it difficult to enjoy food and maintain regular eating habits, which will lead to malnutrition. Findings were consistent with a study conducted in Ethiopia, where the risk of undernutrition among older adults 75 years and older was adults 3.81 times higher as compared to adults 65-74 years (Ferede et al., 2022)

5.5 PREDICTOR VARIABLES AND ITS ASSOCIATION WITH MALNUTRITION

In this study, variables independently associated with malnutrition were the mode of feeding, participant mobility, taking more than three prescriptions per day, and marital status. Mode of feeding was associated with malnutrition based on the MNA; this is because some of the study participants were tube fed, where they are mostly fed with liquid foods due to the pneumonia infection to prevent aspiration pneumonia which is when food particles enter the airways also a participant with stroke had difficulty in feeding with can result in decreased food intake and underweight this concise with a study done among hospitalized adult with stroke (Ojo & Brooke,2016). Present study also indicates marital status as a predictor of malnutrition which was consistence with a study done in the northern part of Ghana by Aganiba et al., (2015) similarly found that the elderly who are widowed or divorced are exposed to social isolation,

loneliness, depression, and financial problems, all of which can impair food intake and increase their risk of undernutrition.

Present study results show that participants who take more than 3 prescriptions per day had (1.83) higher odds of becoming malnourished. Polypharmacy among the elderly is a predictor of malnutrition. This is due to drug-nutrient interaction and comorbidities. The aged with diet-related chronic disease are at more risk of malnutrition due to changes in diet to prevent the complication of the condition and the inability to consume their preferred meals due to the conditions at hand. In addition, the taste and olfactory function of the elderly are influenced by polypharmacy, resulting in a lack of appetite; therefore, food may lose its attraction due to sensory changes. Motility was also associated with malnutrition, as the study shows that participants who are immobile are 3.09 times more at risk of malnutrition than those who are mobile. This is caused by the aging process, which is linked to the wear and tear of bones, according to (de Vries et al.,2013). The decrease in food intake during this process can result in inefficient levels of vitamin D and calcium, which are needed for bone mineralization resulting in weaker bone, osteoporosis among the women, or disabilities. The elderly may find it difficult to cook and normally eat as their vision deteriorates with age (Amarya et al., 2015)

5.6 HEALTH CONDITIONS AND ITS ASSOCIATION WITH MALNUTRITION

This study shows that health conditions such as Neurophysiological problems are 4.52 odds of being malnourished, and this agrees with a study conducted by Reuther et al., (2013)in Germany, which indicates that the prevalence of malnutrition among elderly with dementia was 10% higher than those who are not, and this could be attributed to the dependency rate of the condition, such as dementia affect the cognitive function of the individual as assistance is needed for feeding and other basic things, it also affects the physical and emotional well-being of the individual results in malnutrition (Meijers et al., 2014). In addition, according to Galesi

et al., (2013), the increased prevalence of malnutrition among dementia patients is due to their increased nutritional needs.

Patients with neurophysiological problem were 1.29 odds of malnutrition after adjusted for other covariates and this can be explained by the existing comorbidities among stroke patients, eating difficulties, lack of functional abilities, and polypharmacy that can increase their risk of malnutrition (Foley et al., 2009). Dysphagia is a major risk factor for malnutrition among stroke patients as most patients are tube fed with puree or fluid foods (Professor Emeritus et al., 2008; (Scharver et al., 2009). Present results indicate that the mode of feeding and mobility are the predictors of malnutrition. Most stroke patients have eating difficulties and reduced morbidity, which results in decreased physical activities and loss of muscle mass and strength, thereby causing wasting and sarcopenia among the elderly (Scherbakov & Doehner, 2011). There were (1.83) higher odds of malnutrition among patients who takes more than 3 prescription per day which can be attributed to some medications interact with nutrients. From this study, participants with diabetes had no association with malnutrition, however, a study done in Nigeria indicates that participants with T2DM who had poor glycaemic control were 7 times at risk of malnutrition compared with those with optimal glycaemic control (Junaidet al., 2022). This can be attributed to certain dietary changes or restrictions that diabetic patients make to prevent diabetic complications. Also, it can be explained as diabetes as a catabolic condition, the effect of medication, reduction of appetite due to disease state, and psychosocial factors such as poverty and loneliness (Husam Ayub et al., 2018).

Results from this study show that participants with comorbidities are 2.58 odds of malnutrition. This can be explained as the coexistence of two or more related medical conditions in the elderly affects their nutritional status because these conditions, such as hypertension, diabetes, and metabolic syndrome, increase their risk of malnutrition as they result in multiple medications and dietary modifications which prevent them from consuming their preferred

food choices, and with their decreased appetite these conditions affect their dietary intake resulting in malnutrition. A study by Amasene et al., (2022) reveals that participants who are malnourished or at risk of malnutrition have a doubled risk of comorbidities, which was higher than 3.5 times in frail participants.

5.7 LIMITATION OF THE STUDY

Even though this study was conducted carefully based on the World Health Organisation (WHO) standard with minimized human error, some limitations were invertible and may have implications for the results. This study used a single 24- hour recall to establish the dietary pattern of participants, and findings show that most of the participants had inequalities for almost all the nutrients that are of relevance to the age group; this may introduce some level of bias in the findings since the dietary assessment tool use is dependent on the memories of the participants. The study design used cannot be used to inference cause- effect association. This study was done in only one hospital due to the timeframe and funding therefore findings cannot to generalize.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The prevalence of malnutrition among hospitalized adults with pneumonia was almost double that of healthy adults in Ghana using the body mass index for assessment. Half of the study population were at risk of malnutrition using the Mini nutritional assessment tool, with most males and most females being malnourished; less than 10% of the study population was normal. The prevalence of anaemia was high even though most of the study participants were non–anaemic. All the study participants had inadequacies in calcium and fibre. There was no association between dietary diversity, nutrient intake, and malnutrition.

Predictors such as marital status, taking more than three prescriptions per day, feeding mode, living independently, and mobility were associated with malnutrition. Health conditions such as stroke, diabetes, and neurophysiological problems were independently associated with malnutrition.

Final, people with comorbidities were twice as likely to be malnourished.

6.2 Recommendation

- Calf circumference and MUAC should be used as a rapid assessment tool of malnutrition among the aged.
- The ministry of health should have a guideline that state the necessity of screening for malnutrition among elderly with co-morbidities.
- Healthcare providers should be trained to recognize the signs and symptoms of malnutrition and to implement effective nutritional interventions.
- Interdisciplinary collaboration between healthcare providers, dietitians, and nutritionists is necessary to ensure that elderly patients with pneumonia receive adequate nutrition.

- Public health campaigns should be launched to raise awareness of the importance of nutrition in maintaining health, especially in the elderly population, and to educate people on healthy eating habits.

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APPENDIX I- QUESTIONNAIRE

NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH, COLLEGE OF HEALTH SCIENCES, UNIVERSITY OF GHANA.

GENOMICS OF HOST-PATHOGEN INTERACTIONS UNDERLYING STREPTOCOCCUS PNEUMONIAE INFECTION IN THE GHANAIAN ELDERLYPOPULATION.

Study questionnaire for infected persons

Project ID number…… #PAR.| ||

number (Registration folder no. where applicable) | | | | | | |

1. Name

2.Sex (M, F). | |

3. Date of birth1 ..... / / Age | |

4. Nationality If foreigner, state Nationality

5. Patient/Contact Phone no. | | | |-| | | | | |

House Address.

1If only month and year is known then enter this, if only year is known then enter this. If year is not certain write 'Estimate' before year.

= ID for exposed persons from PAR001 – PARxxx. NR=Not reported; DK=Don't know

Vitals

7. Axillary Temperature | | |.| |

8. Pulse | | | |

9. Blood Pressure (mmHg) | | | |/| | |

10. Weight (kg) | | |.| |

11. Height (cm) | | | |

12. BMI | | | |

Socioeconomic status (nurse)

13. Is the patient literate? Yes| | No| | DK| |

14. What is the patient's highest level of education? (0= None, 2= primary school, 3= secondary school, 4= higher education) | |

15. Is patient employed? Yes| | No| | DK| |

If yes, state the occupation.

History and treatment of pneumonia before hospital attendance (nurse)

16. Has the patient had a fever within the last 24 hours? Yes| | No| |

17. Has the patient had any cough within the last 24 hours? Yes| | No| |

18. Has the patient taken any treatment for the disease? Yes| | No| | DK| |

If yes, state name of treatment ……

19. Has the patient taken any herbal medications for the disease? Yes| | No| | DK|

|20. Has the patient had "an injection" of unknown content Yes| | No| | DK| |

21. Has the patient been seen by a traditional healer during the infection/illness?

Yes| |No| |

Antibiotic usage

22. How often do you take antibiotics?

Every month | |3-6 times per year | |

1-2 times per year | |

Less than 1 time per year | |

Never | |

Co-morbidities Yes| | No| | DK| |

Diabetes | | Hypertension| | Cancer| | Immunosuppression| |

Asthma [ ] Chronic respiratory disease [ ] Chronic heart disease [ ]Chronic liver disease[ ] Chronic kidney disease [ ]

Others……

Exposures Yes| | No| | DK| |

Alcoholism | | Cigarette smoking| | Malnutrition| |

Others …….

Laboratory samples/measurements

23. HB level Yes| | No| |
24. Filter paper blot made Yes| | No| |
25. Malaria Rapid Diagnostic Test (RDT) done? Yes| | No| |
26. RDT result Positive| | Negative| |
27. Venous blood taken (50 ml) Yes| | No| |
28. If positive for RDT, have you been recommended for anti-malarial treatment? Yes| |No| |

Clinical examination (doctor)

29. General condition (well, chronically ill-looking, cachectic, clubbing, cyanosis) |
30. Temperature Yes| | No| | NR| |
31. Respiratory rate Yes| | No| | NR| |
32. Heart rate Yes| | No| | NR| |
33. Blood pressure Yes| | No| | NR| |

34. Pulse oximetry/Oxygen saturation Yes| | No| | NR| |

35. Productive Cough Yes| | No| | NR|

36. Pleuritic chest pain… Yes| | No| |NR|

Radiography

37. Chest ray performed… Yes| | No| | NR| |

38. Pulmonary infiltrates Lobular [ ] Bilateral [ ] Unilateral [ ] Interstitial[ ]

Other comments Name of interviewer:

Date:

Sign:

Time:

PREDICTORS OF MALNUTRITION AMONG HOSPITALIZED ADULTS WITH PNEUMONIA AT THE 37 MILITARY HOSPITAL

Mini Nutritional Screening Tool (MNA-FULL)

Date of assessment……..| | | || | || | | |

Project ID number …….#PAR.| | | |

Name .

Age (years)……...| |

|Sex (M, F). | |

Weight (kg) | | |.|

Height(m) | | |

| BMI (kg/m2) | | | |

Mini Nutrition Assessment (MNA®)

1. Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties? | |

0 = severe decrease in food intake

1 = moderate decrease in food intake

2 = no decrease in food intake

2. How much weight has he/she lost during the last 3 months? |

|0 = weight loss greater than 3kg (6.6lbs)

1 = does not know

2 = weight loss between 1 and 3kg (2.2 and 6.6 lbs)3 = no weight loss

3 Mobility | |

0 = bed or chair bound

1 = able to get out of bed/chair but does not go out

2 = goes out

4 Has suffered psychological stress or acute disease in the past 3 months?

|0 = yes 2 = no

5 Neuropsychological problems | |

0 = severe dementia or depression

1 = mild dementia

2 = no psychological problems

6 Body Mass Index (BMI) = weight in kg / (height in m)2 |

|0 = BMI less than 19

1 = BMI 19 to less than 21

2 = BMI 21 to less than 23

3 = BMI 23 or greater

7 Lives independently (not in nursing home or hospital) |

|1 = yes 0 = no

8 Takes more than 3 prescription drugs per day | |

0 = yes 1 = no

9 Pressure sores or skin ulcers

0 = yes 1 = no

10 How many full meals does the patient eat daily? | |

0 = 1meal

1 = 2 meals

2 = 3 meals

11 Selected consumption markers for protein intake

•At least one serving of dairy products yes no

(milk, cheese, yoghurt) per day

•Two or more servings of legumes yes no

or eggs per we

•Meat, fish, or poultry every day yes no

0.0 = if 0 or 1 yes

0.5 = if 2 yes

1.0 = if 3 yes | |

12 Consumes two or more servings of fruit or vegetables per day. | |

0 = no

1 = yes

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

0.0 = less than 3 cups

0.5 = 3 to 5 cups

1.0 = more than 5 cups

14 Mode of feeding | |

0 = unable to eat without assistance

1 = self-fed with some difficulty

2 = self-fed without any problem

15 Self-view of nutritional status| |

0 = views self as being malnourished

1 = is uncertain of nutritional state

2 = views self as having no nutritional problem

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

0.0 = not as good

0.5 = does not know

1.0 = as good

2.0 = better

17 Mid-arm circumference (MAC) in cm…….. cm | |.| |

0.0 = MAC less than 21

0.5 = MAC 21 to 22

1.0 = MAC greater than 22

18 Calf circumference (CC) in cm …….. ……cm | |

0 = CC less than 31

1 = CC 31 or greater

Total Assessment (max. 30 points) | || |

Malnutrition Indicator Score

24 to 30 points Normal nutritional status

17 to 23.5 points At risk of malnutrition

Less than 17 points Malnourished.

APPENDIX 11-ETHICAL CLEARANCE

FEDERALWIDE ASSURANCE FWA 00001824 **IRB0000127**

NMIMR-IRB CPN 006/21-22 **IORG0000908**

On 3rd November 2021, the Noguchi Memorial Institute for Medical Research (NMIMR) Institutional Review Board (IRB) at a full board meeting reviewed and approved your protocol titled:

TITLE OF PROTOCOL	:	**Genomics of host-pathogen interactions underlying *Streptococcus pneumonia* infection in the Ghanaian elderly population**
PRINCIPAL INVESTIGATOR	:	**Dr. Augustina Frimpong**
CO-INVESTIGATORS	:	**Dr. Eliza Mari Kwesi-Maliepaard, Dr. Beverly Egyir, Dr. Kwadwo Asamoah Kusi & Dr. Nicholas T. K. Dzifa Dayie**

Please note that a final review report must be submitted to the Board at the completion of the study. Your research records may be audited at any time during or after the implementation.

Any modification of this research project must be submitted to the IRB for review and approval prior to implementation.

Please note that a final review report must be submitted to the Board at the completion of the study. Your research records may be audited at any time during or after the implementation.

Any modification of this research project must be submitted to the IRB for review and approval prior to implementation.

Please report all serious adverse events related to this study to NMIMR-IRB within seven days verbally and fourteen days in writing.

This certificate is valid till 2nd November, 2022. You are to submit annual reports for continuing review.

Signature of Chair: .....

Dr. Abraham Hodgson
(NMIMR – IRB CHAIR)

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Email: nirb@noguchi.ug.edu.gh | www.noguchimedres.org | wwwug.edu.gh

Institutional Review Board
37 Military Hospital
Neghelli Barracks
ACCRA

Tel: 059 1759506
Email: irbmilhosp@gmail.com

19 October 2021

ETHICAL CLEARANCE

37MH-IRB/MAS/IPN/538/21

On 28 September 2021 the 37 Military Hospital (37MH) Institutional Review Board (IRB) approved your protocol.

TITLE OF PROTOCOL: Genomics of host-pathogen interactions underlying Streptococcus pneumoniae infection in the Ghanaian elderly population

PRINCIPAL INVESTIGATOR: Augustina Frimpong, PhD

Please note that a final review report must be submitted to the Board at the completion of the

Please note that a final review report must be submitted to the Board at the completion of the study.

Please report all serious adverse events related to this study to 37MH-IRB within seven (7) days verbally and fourteen (14) days in writing.

This certificate is valid till 27 September 2022.

DR EDWARD ASUMANU
(37MH-IRB, Vice Chairman)

19 OCT 2021
MILITARY HOSPITAL · ACCRA

Cc: Brig Gen NA Obodai
Commander, 37 Military Hospital