Prevalence and consequences of hospital malnutrition associated outcomes at a teaching hospital in Ghana

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24914754

Mini-dissertation submitted in partial fulfilment of the requirements for the degree *Magister Scientiae* in Nutrition at the Potchefstroom Campus of the North-West University

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PREFACE

This mini-dissertation will be presented in article format. Dzifa Nyatefe, the *Magister Scientiae* (MSc) student, wrote the article: ‘’Prevalence and consequences of hospital associated malnutrition at a teaching hospital in Ghana’’ following the authors’ instructions of the journal *Ghana Medical Journal* to which the article (Chapter 3) will be submitted.

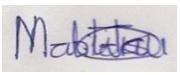
The co-authors of this article (Chapter 3), Dr. R.C. Dolman, Prof. R. Blaauw, Dr M. Asante and Mrs Arista Nienaber granted permission for the article to be submitted for examination purposes. The article has yet to be submitted to the journal; therefore no permission was sought from the editor of the journal.

The signatures and declaration below confirm the co-authors’ roles as mentioned in the article (Chapter 3) and their permission for the MSc. student to include the article “Prevalence and consequences of hospital associated malnutrition at a teaching hospital in Ghana”, in this mini-dissertation for examination purposes in partial fulfilment of the requirements of the degree *Magister Scientiae* in Nutrition.

“I declare that I have approved the above-mentioned article, and that my role in the study, as indicated in the article, is representative of my contribution. I hereby give my consent that the article may be published in the mini-dissertation of Miss D. Nyatefe as part of the *Magister Scientiae* in Nutrition.”

Dr R.C. Dolman

Prof. R. Blaauw



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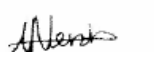

Mrs Arista Nienaber

ABSTRACT

Background

At admission, malnutrition in hospitalised adults is a highly prevalent problem and has been associated with adverse clinical outcomes. Therefore, nutritional risk screening has been recommended as a quick and easy way to improve the detection and treatment of malnutrition in this population. By the time of discharge, malnutrition prevalence has been shown to increase. The European Society for Clinical Nutrition and Metabolism (ESPEN) recommends the Nutritional Risk Screening Tool-2002 (NRS-2002) for the identification of patients at risk of malnutrition in all hospital settings. Amidst the high rates of malnutrition documented worldwide and its associated consequences, little is known on this topic in the Ghanaian hospital setting. The aim of this study was to determine the prevalence of adult hospital malnutrition on admission and discharge, the association between nutritional risk and patient outcomes, as well as the identification of at-risk patients by hospital staff for immediate referral for nutritional support.

Methods

Over a five-month study period, adult patients newly admitted to the Korle Bu Teaching Hospital (KBTH) (≥18 years) with a minimum length of stay of 24 hours were recruited. Patients were screened according to the NRS-2002 within 48 hours of admission. Nutritional risk was defined as an NRS-2002 score ≥3. Length of stay in hospital (LOS) was captured for every patient. For patients that stayed longer than seven days, other clinical outcomes (complications and mortality) were recorded until discharge or compulsory date of discharge, day 28 for patients. A subsequent follow-up was done via telephone call to a subsample one month after discharge to assess the impact of malnutrition after discharge. The additional outcome of readmissions was included at this stage.

Results and discussion

A total of 402 patients, predominantly female (56.5%), were included. The mean age was 47.1 ± 15.9 years and mean LOS was 8.6 ± 0.3 days. Nutritional risk defined as a function of the NRS-2002 was very high (71.4%) ranging from 62.5% in the cardiothoracic unit to 81.2% in the department of general medicine. Nutritional risk was associated with a significantly prolonged LOS (9.70 days versus 5.95 days, $p<0.001$, $d=0.74$) and adverse clinical outcomes during hospitalisation and one month after discharge.' The incidence of complications (7.8%) and mortality (7.2%) occurred only in those that were at nutritional risk during hospitalisation ($p=0.002$ each). Additionally, deaths occurred only in the at-risk group (8.1%, $p=0.002$) one

month after discharge. The rates of complications were greater in the group that was not at nutritional risk compared with the at-risk group although the difference was not statistically significant (10% versus 2.7%, p=0.625). Readmission rates were significantly greater in the group that was not at nutritional risk, but this occurred in only one out of the 10 patients that were not at nutritional risk compared to 10 out of the 123 patients that were at nutritional risk (p=0.012). The prevalence of nutritional risk did not change at discharge (n=172). More than 93% of the nutritionally at-risk patients were undetected for nutritional risk by attending physicians and hence were not referred for nutritional support.

Conclusion and recommendations

There was a high prevalence of nutritional risk in this study population, all of whom should have been referred for immediate dietetic assessment and possible nutritional support. NRS-2002 was predictive of LOS, which is a surrogate measure of patient recovery in at-risk patients. In general, the incidence of adverse clinical outcomes was associated with being at nutritional risk. Considering the alarming high prevalence of nutritional risk, education of hospital staff on the identification and prompt referral of nutritionally at-risk patients is warranted. Local and national hospital policies should make the practice of nutritional screening mandatory and the dietetic department should be supported to deal with optimising patients' nutritional status.

KEYWORDS

Malnutrition, nutritional risk, NRS-2002 score, LOS, complications, hospital readmissions, mortality

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LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
ASPEN	American Society of Parenteral and Enteral Nutrition
AUC	Area under the curve
BAPEN	British Association for Parenteral and Enteral Nutrition
BMI	Body Mass Index
CEN	Centre of Excellence for Nutrition
Cohen's d-value	Cohen's value/ effect size
CONUT	Controlling for Nutritional Status tool
COPD	Chronic Obstructive Pulmonary disease
CRP	C-reactive protein
CSPEN	Chinese Society for Parenteral and Enteral Nutrition
DRG	Diagnosis-related group
DRM	Disease-related malnutrition
ERAS	Enhanced Recovery After Surgery
ESPEN	European Society for Clinical Nutrition and Metabolism
EuroOOPS	European Undernutrition in Hospitals
feedM.E.	(Medical Education) Global Study Group
FFMI	Fat free mass index
HIV	Human Immunodeficiency Virus
IBM SPSS® Statistics 23	Statistical Package for Social Sciences, NY, USA
ICD-9-CM	The International Classification of Diseases, Ninth Revision, Clinical Modification

ICU	Intensive care unit
KBTH	Korle Bu Teaching Hospital
LMF	Lipid mobilising factor
LOS	Length of stay in hospital
MAA	Malnutrition Audit Assessment Tool
MUAC	Mid-Upper Arm Circumference
MNA	Mini Nutritional Assessment
MNA-SF	Mini-Nutritional Assessment short-form
MST	Malnutrition Screening Tool
MUAC	Mid-Upper Arm Circumference
MUST	Malnutrition Universal Screening Tool
NCD	Non-Communicable Diseases
NHS	National Health Service
NICE	National Institute for Health and Clinical Excellence
NNSC	Northumbria Nutrition Score Chart
NNSF	Nursing Nutritional Screening Form (NNSF)
NRI	Nutritional Risk Index
NRS-2002	Nutritional Risk Screening Tool-2002
NRST	Nutritional Risk Screening Tool
NRSTs	Nutritional Risk Screening Tools
NWU	North-West University
ONS	Oral nutritional supplements
OPD	Outpatient department

PG-SGA	Patient-Generated Subjective Global Assessment
PIF	Proteolysis factor-1
PREDyCES	Prevalence of Hospital Malnutrition and Associated Costs in Spain
RCTs	Randomised Control Trials
ROC	Receiver operating characteristic
SGA	Subjective Global Assessment
SNAQ	Short Nutritional Assessment Questionnaire
TB	Tuberculosis
UK	United Kingdom
USA	United States of America
X^2	Chi-square tests

LIST OF SYMBOLS AND UNITS

%	percentage
<	less/ lower than
>	greater than or higher than
≤	less than or equal to
≥	greater than or equal to
kg	kilogram
m	metre

CHAPTER ONE: INTRODUCTION

CHAPTER ONE: INTRODUCTION

1.1 General Introduction

A balanced and optimal nutritional status is an important foundation of good health for all groups of people at any phase of life (Beck *et al.*, 2002). In the hospitalised patient, an optimal nutritional status can be offset by the acute or chronic disease condition, causing rapid loss of weight and thereby predisposing the patient to nutritional risk, which may result in eventual malnutrition specifically undernutrition (Norman *et al.*, 2008; Steenhagen, 2015). Several strategies to provide adequate nutritional care of patients and to manipulate patient outcome have evolved but have proved inadequate amidst prevailing non-compliance with sound nutritional care practices (Souza *et al.*, 2015).

Worldwide prevalence rates of malnutrition amongst hospitalised patients are alarmingly high. Between 20% and 60% of hospitalised patients worldwide are malnourished as a result of a condition termed disease-related malnutrition (DRM) (Barker *et al.*, 2011; Hébuterne *et al.*, 2014; Jensen, 2010; Planas *et al.*, 2016; Sorensen *et al.*, 2008; Tangvik *et al.*, 2015; White *et al.*, 2012). In studies conducted in Europe, North and South America and Asia, regardless of the differences in clinical settings, unique patient populations and the use of different diagnostic criteria for classifying malnutrition, the findings have led to consistently disturbing prevalence rates (Correia *et al.*, 2017; Fávaro-Moreira *et al.*, 2016; Sorensen *et al.*, 2008; Yang *et al.*, 2016). Malnutrition is described as a condition caused by inadequate nutrition due to the reduced intake, absorption or assimilation of nutrients that alters body composition (decreased fat-free mass) and body cell mass, leading to suboptimal physical and mental function as well as impaired clinical outcomes from disease'' (Sobotka, 2012). In acute or chronic illness, there may be disease-specific inflammation and metabolic alterations whose effects on malnutrition are more pronounced amongst a host of other factors, including surgical procedures, appetite loss, insufficiency in food intake, depression and increased age (Norman *et al.*, 2006; Norman *et al.*, 2008).

The reasoning behind the interest in a good nutritional status in disease is based mainly on the benefits an optimal nutritional status confers on the patient. In this regard, several studies, including a systematic analysis, have reported the importance of a good nutritional status in several groups of patients, including orthopaedic, medical and surgical patients (Freijer *et al.*, 2013; Gupta, 2011; Lim *et al.*, 2012; Michalak *et al.*, 2016; Shahin *et al.*, 2010). In these patients, clinical outcomes that were positively impacted included an improved appetite, better wound healing, a boosted immune system, maintenance of muscle mass, a better survival rate, decreased length of stay in hospital (LOS), lower non-elective readmissions and reduced

hospitalisation costs. These clinical outcomes are commonly used as surrogate measures of a patient's well-being. In contrast, a recent systematic review and meta-analysis of 22 randomised controlled trials (RCTs) of 3736 patients has found nutritional therapy effective in increasing caloric and protein intake and body weight but with little effect on clinical outcomes overall except for non-elective readmissions (Bally *et al.*, 2016). The other study outcomes included hospital-acquired infections, functional outcome and LOS. The studies under review were however of poor quality.

On the other end of the spectrum in the hospitalised malnourished ill patient, poor nutrition intake and severity and duration of disease may lead to changes in body habitus and metabolic alterations associated independently with the patient's risk of developing negative but potentially avoidable outcomes such as increased morbidity through impaired wound healing and infectious complications, LOS, higher mortality, greater health-care costs and a poor quality of life (Almeida *et al.*, 2013; Norman K. *et al.*, 2008; Ostrowska & Jeznach-Steinhagen, 2016). In a study conducted in 31 Spanish public hospitals, the prevalence of hospital malnutrition and associated costs in Spain (PREDyces) revealed that, overall, 23.7% of patients were malnourished (Álvarez Hernández *et al.*, 2012). They had an increased LOS, especially in patients admitted without malnutrition, but who presented with malnutrition at discharge. The LOS was 15.2 days for those who were malnourished at discharge versus eight days for the well-nourished group throughout their hospital stay ($p<0.001$), with an associated additional hospital cost of €5,829 per patient. In this regard, malnutrition is an economic issue. Paradoxically, large numbers of patients at discharge, including previously well-nourished patients, would have deteriorated nutritionally whilst in the hospital (Allard *et al.*, 2016; Braunschweig *et al.*, 2000). These studies together illustrate the importance of the maintenance of a good nutritional status of patients whilst ill.

Key to the success of nutritional care pathways for patients is referring patients to a dietitian to receive complete nutritional intervention. Available literature from Australia, however, shows that at least one third of patients at nutritional risk, including the general hospital population and patients with hip fractures, fail to be referred to dietetic services for appropriate treatment (Bohringer & Brown, 2016; Klemm *et al.*, 2016). As is the practice in most developed countries such as Australia, dietetic referrals for complete nutritional assessment and intervention are done mostly by a medical officer (Gout *et al.*, 2009).

A myriad of personal factors and organisational factors have been pointed to as reasons for the poor nutritional status of patients (Cederholm *et al.*, 2017; Holst *et al.*, 2013). As early as the 1970s, a landmark paper by Butterworth (1974) brought this to the attention of the medical community, where the level of awareness of patients' nutritional status was reported to be poor.

The long-term consequences of malnutrition include increased rehabilitation needs and follow-up visits after discharge (Marshall *et al.*, 2016). Additionally, malnourished patients have a shorter survival time and/or higher readmission rates evident for up to three years post-discharge (Gomes *et al.*, 2016; Lim *et al.*, 2012).

An American Society for Parenteral and Enteral Nutrition (ASPEN) consensus paper which highlights the aetiology-based contribution of inflammation in disease recommends that adequate nutrition be provided in the hospital setting but that, inflammatory states must first of all, be addressed in patients stricken with acute or chronic disease (Jensen, 2010; White *et al.*, 2012). The three classifications of malnutrition include chronic starvation without inflammation in conditions such as *anorexia nervosa*, chronic and acute disease-associated malnutrition which elicit mild to moderate or severe degrees of inflammation, respectively. These include conditions such as organ failure in chronic disease-associated malnutrition or major infections in acute disease (White *et al.*, 2012). A patient may transition from one to another of these classifications.

International nutrition societies strongly recommend nutritional screening as that crucial first step in the nutritional care process for identifying nutritional risk before a definitive diagnosis through nutritional assessment is done (Cederholm *et al.*, 2017). Nutritional Risk Screening Tools (NRSTs) are designed to detect risk of malnutrition (Cederholm *et al.*, 2015; Kondrup *et al.*, 2003a). They are generally quick to complete, often comprising two or three questions, and include non-invasive procedures which do not require special expertise. Of more than 70 published nutritional screening tools for use in the hospital setting, the Nutritional Risk Screening Tool-2002 (NRS-2002) is graded highest as the most rapid, valid and reliable of all screening tools in its ability to predict sufficiently the incidence and severity of postsurgical complications, LOS, morbidity and mortality in several groups of patients, including acute care and gastrointestinal surgical patients (Raslan *et al.*, 2010; Raslan *et al.*, 2011; Schiesser *et al.*, 2008). The NRS-2002 was validated against 128 controlled nutrition trials in a retrospective study to evaluate whether it could distinguish patients with a positive clinical outcome due to nutrition intervention from those that showed no benefit from nutrition support (Kondrup *et al.*, 2003b). In this case it showed a high validity of predicting patient outcomes due to nutrient repletion or depletion as patients with an NRS-2002 of ≥3 were found to be the most responsive to nutrition depletion. It was rated with a Grade 1 recommendation for use in the hospital setting out of eleven NRSTs (Skipper *et al.*, 2012). Several studies, including systematic reviews, have highlighted its high diagnostic accuracy of more than 80% in determining nutritional risk and feasibility in the hospital setting (Platek *et al.*, 2015; Skipper *et al.*, 2012).

The NRS-2002 comprises the following criteria: an impairment of nutritional status (weight loss>5% between one to three months), reduced Body Mass Index (BMI), recent changes in dietary intake in the previous week, severity of illness as a reflection of increased nutrition requirements and an age-component based on the nutritional frailty associated with age (Kondrup *et al.*, 2003b). The NRS-2002 is widely used, particularly in European and Chinese hospitals (Cederholm *et al.*, 2015; Jie *et al.*, 2010). From the abundant literature on the need to identify nutritional risk early to avert poor clinical outcomes, it could be assumed that the benefits of identifying nutritional risk in patients is established practice in hospitals worldwide. This topic has however not been explored on the African content.

1.2 Rationale for the study

In the search of the literature on African prevalence studies, there are very few published findings on malnutrition rates for general adult hospital-based malnutrition (Asiimwe *et al.*, 2015; Blanckenberg, 2012; Dannhauser *et al.*, 2007; Niyongabo *et al.*, 1999). Also, no NST has been validated for diagnosing nutritional risk on the African continent. At the same time, anthropometric measurements are very rarely taken in these hospitals (Antwi, 2008). The multicentre EuroOOPS study found a prevalence of risk of malnutrition between 13% and 100% in Libyan and Egyptian patients. These studies depicted vast heterogeneity in all the patient populations. An unpublished study conducted in the Tygerberg hospital in Cape Town, South Africa found that the NRS-2002 score performed better than six other internationally recognised nutritional screening tools in predicting clinical outcomes in critically ill patients (Blanckenberg *et al*., 2012). Another earlier unpublished South African study using the NRS-2002 observed high prevalence rates of 40-60% in the general hospitalised population (Dannhauser *et al.*, 2007). In these studies, malnutrition was determined using the NRS-2002. Eastern African studies have reported malnutrition rates from 25% to 77.8% in varying populations of Human Immunodeficiency Virus or Acquired Immune Deficiency Syndrome (HIV/AIDS) infected individuals or heart failure patients (Amare *et al.*, 2015; Asiimwe *et al.*, 2015; Mulu *et al.*, 2016; Niyongabo *et al.*, 1999). These studies defined malnutrition by measures of BMI, mid-upper arm circumference (MUAC), serum albumin and triceps skinfold thickness.

According to the most recent Ghana Demographic and Health Survey, the prevalence of community-based malnutrition was 16% undernutrition in both males and female adults (Ghana Statistical Service *et al.*, 2015). This figure may be an indication of an equally high or even higher prevalence of undernutrition in the hospitalised Ghanaian adult population and also after discharge. Quantifying the prevalence of undernutrition in hospital and comparing this with available statistics in the community will help to reveal where to concentrate scare resources and manpower. Despite the substantial amount of literature available on prevalence rates in

other continents, a gap exists between the magnitude of nutritional risk in the Ghanaian hospitalised population and the consequences suffered throughout the continuum of medical care of patients. This research will also be one of the few in Africa to determine the prevalence of malnutrition rates in the general hospital setting in adults using the NRS-2002. Based on the high diagnostic accuracy of the NRS-2002 presented by studies including the one in the Tygerberg hospital in South Africa, the use of this tool in the acute-care and medical-surgical population is worthy of focus.

The findings of this research will provide a framework of evidence around nutritional care so as to influence Ghanaian health professionals to give priority to the screening of all patients seeking treatment and then to provide them with early and adequate levels of nutrition support to reduce the rates of malnutrition amongst hospitalised patients. Theoretically and practically this is said to facilitate recuperation during hospitalisation and post-discharge as evidenced in a group of Australian patients with hip fractures treated by an early and more intensive approach compared with standard protocol within 48 hours of admission, for whom a significantly lower incidence of pressure injuries and a shorter LOS occurred (Klemm *et al.*, 2016). When hospitalisation outcomes are improved, the overall financial toll on the patients and/or their families and hospital resources is lessened and money is spared for more productive use.

The 2014 Research Priority Focus Areas of the ASPEN has been grouped into five sections. Three of those deal directly with malnutrition assessment, diagnosis and related outcomes (Chan, 2013). Additionally, Goal Two of the Sustainable Development Goals seeks to end all forms of malnutrition by 2030 and this includes the hospitalised population (International Council for Science & International Social Science Council, 2015). Conducting this study in the adult Ghanaian hospitalised population is therefore timely and relevant. A conceptual framework linking the rationale for the current research with the outcomes to be investigated has been captured in Figure 1-1 below:

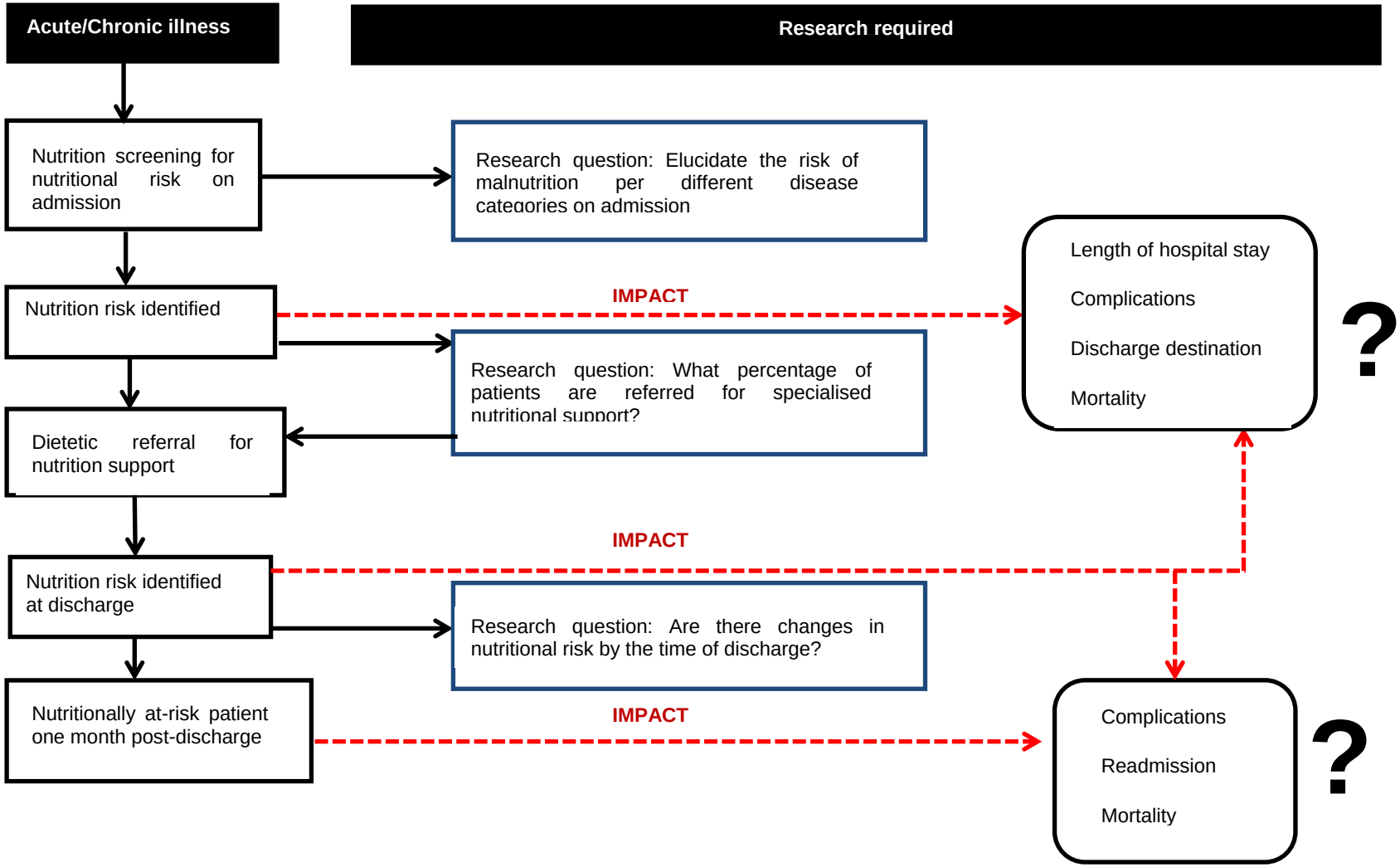

Figure 1-1: A conceptual framework linking the rationale for the research with the outcomes to be measured

1.3 Research aim

The aim of this descriptive, observational, cross-sectional study was to determine the prevalence of risk of malnutrition in newly admitted adult patients on admission and discharge from hospital and the association thereof with selected in-hospital and post-discharge nutrition/medical indicators.

1.4 Research objectives

The objectives of this research were to:

1. assess the prevalence of risk of malnutrition in adult patients on admission to hospital;
2. describe the risk of malnutrition profile per different disease categories on admission;
3. determine changes in risk for malnutrition that may occur during the course of hospitalisation;
4. investigate the association between risk of malnutrition and in-hospital and post-discharge nutritional/medical indicators; and
5. determine what percentage of nutritionally at-risk patients were referred for specialised nutrition support.

1.5 Structure of this mini-dissertation

This mini-dissertation will be presented in article format based on the postgraduate guidelines of the North-West University (NWU). It is made up of four chapters. Decimal numbers are used to number the headings to ensure a logical sequence. The directives of the NWU were strictly followed for the language format and referencing of this mini-dissertation. A full bibliography of references will be provided at the end of each chapter. The references used in the unpublished chapters one, two and four are presented in the NWU Harvard referencing style at the end of these chapters.

Chapter one provides a brief introduction to the research that states the aim and objectives and describes the research outputs that will arise from this research. It also gives details of the contributions of the different research team members.

Chapter two presents a review of the available literature on hospital malnutrition in the general adult patient population. This is intended to provide an adequate understanding of the

background of the topic and to assist in the interpretation of the data presented in the article in Chapter three. The literature review focuses on the definition, prevalence, development, consequences, the recognition and the treatment of hospital malnutrition to demonstrate the expediency of nutritional risk screening. The second part of the review centres on nutritional risk screening and the five most recommended NSTs based on validity studies; their common characteristics, relevance and feasibility for use in assessing the risk of malnutrition, and the results of clinical studies and systematic reviews will be discussed. The factors that influenced the choice of the NRS-2002 for use in this study will be mentioned. The review concludes by giving a summary of the key issues that motivated the choice of study topic.

Chapter three is the article that contains the data output of this research project. This article, titled “Prevalence and consequences of hospital associated malnutrition at a teaching hospital in Ghana’’, will be submitted for publication to the Ghana Medical Journal. In Chapter three, the headings, tables and figures are numbered. The paragraphs are also justified and line spacing of one-and-a-half used and a left and right paper margin of 0.98 and 0.79 inches respectively, contradicting the guidelines of this journal so as to ensure uniformity with the other chapters. The referencing style will follow the Vancouver style of referencing, where the references of the article in Chapter three will be provided at the end of the chapter according to the instructions provided to authors by the Ghana Medical Journal to which the article will be submitted for publication.

Chapter four concludes this mini-dissertation, providing a summary of the work and the final conclusions, as well as recommendations and perspectives for further research. This chapter is based on the aim and key objectives that have been identified.

1.6 Research outputs emanating from this study

An article will be submitted for publication to the Ghana Medical Journal. Feedback on the study results in the form of a PowerPoint presentation, will be provided to staff of the Korle Bu teaching hospital (KBTH) where the study was conducted as well as to the Centre of Excellence for Nutrition (CEN), North-West University, Potchefstroom campus.

1.7 Contributions of members of the research team

The contributions of the researchers listed as authors in the article and who were part of this research project are described in Table 1-1.

Table 1-1: List of members and their contribution to this research project

Name and signature	Affiliation	Contribution in this study
Miss D. Nyatefe (M.Sc. student)	CEN within the School of Physiology, Nutrition and Consumer Science of the NWU	Responsible for planning, implementing, managing and executing this project. Compiled the literature review, conducted the statistical analysis, interpreted the data and did the write-up of this mini-dissertation.
Dr R.C. Dolman (Supervisor)	CEN within the School of Physiology, Nutrition and Consumer Science of the NWU	Supervisor of Miss D. Nyatefe in the completion of this mini-dissertation. Played a supervisory role in the planning and execution of the research project as well as the statistical analysis and interpretation of data
Prof. R. Blaauw (Co-supervisor)	Division of Human Nutrition, Faculty of Medicine and Health Science, Stellenbosch University	Co-supervisor of Miss D. Nyatefe in the completion of this mini-dissertation. Conceptualised the study. Also played a supervisory role in the planning and execution of the research project as well as the statistical analysis and interpretation of data
Mrs Arista Nienaber (Assistant supervisor)	CEN within the School of Physiology, Nutrition and Consumer Science of the NWU	Assistant supervisor of Miss D. Nyatefe in the completion of this mini-dissertation. Played a supervisory role in the planning and execution of the research project

CEN: Centre of Excellence for Nutrition; NWU: North-West University

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CHAPTER TWO: LITERATURE REVIEW

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2.1 Introduction

The earliest findings about malnutrition among hospitalised adults can be traced to the landmark article by Butterworth (1974). In this article “Skeleton in the hospital closet”, Butterworth advocated that special attention be paid to these vulnerable patients in respect of the significant repercussions of a poor nutritional status on patient prognoses and the high economic costs it brought to the patient, the hospital and the country. Shortly after this pivotal study, two other publications affirmed the prevalence of this problem in more than half of both medical and surgical inpatients studied in the hospital setting (Bistrian *et al.*, 1974; Bistrian *et al.*, 1976). Several publications since then have detailed the magnitude of this problem. A new evaluation and appraisal of the prevalence of malnutrition reveals that only marginal progress has been made, with continuous neglect of this group (Souza *et al.*, 2015). Hospitalised patients more commonly experience a prolonged LOS (length of stay), a greater incidence of infectious complications, falls, impaired wound healing, high mortality and greater healthcare costs **(**Azad *et al.*, 1999; Bauer *et al.*, 2007; Edington *et al.*, 2000; La Torre *et al.*, 2013; Lim *et al.*, 2012; McWhirter & Pennington, 1994; Patel *et al.*, 2014; Pirlich *et al.*, 2003). This has far-reaching social, economic, political and ethical repercussions. The benefits of an optimal nutritional status have proven to be innumerable (Kondrup *et al.*, 2003b; Lim *et al.*, 2012). Despite this, malnutrition tends to be underdiagnosed and inappropriately addressed (Adams *et al.*, 2008; Souza *et al.*, 2015). The adverse outcomes of malnutrition may be attenuated if sound nutrition care, such as early screening on admission and nutritional intervention for patients confirmed as being at nutritional risk or malnourished, is practised as advised by international nutrition bodies such as the European Society for Clinical Nutrition and Metabolism (ESPEN) and the American Society of Parenteral and Enteral Nutrition (ASPEN). Improved communication channels between health care providers, the patient, friends and family, as well as operational hospital and national policies, can optimise solutions to resolve this long-standing canker (Cederholm *et al.*, 2015; Kovacevich *et al*., 2005).

In this review of the literature, the researcher starts by reviewing the scope of hospital malnutrition. The definition, prevalence, development, consequences, recognition and treatment of hospital malnutrition are provided to demonstrate the expediency of nutritional risk screening. The second part of the review centres on screening for nutritional risk and a few examples of internationally validated NSTs; their relevance and feasibility for use in assessing risk for malnutrition are discussed. The review concludes by giving a summary of the key issues that motivated the use of the ESPEN recommended Nutritional Risk Screening Tool-2002 (NRS-

2002) for conducting this research; its development, validation, validity and feasibility in the general adult patient population will be discussed as well as the choice of study topic for this mini-dissertation.

2.2 Hospital malnutrition

2.2.1 Definition

Despite many attempts by nutrition organisations and experts to define hospital malnutrition, there is no universally accepted definition for disease-related malnutrition (DRM) (Cederholm *et al.*, 2017; Cederholm *et al.*, 2015; White *et al.*, 2012). This limits the diagnosis of malnutrition and the provision of adequate nutritional intervention. In general terms, malnutrition refers to two extreme states of poor nutrition: overnutrition (intakes in excess of dietary requirements) and undernutrition (intakes less than dietary requirements) which alter growth, function, tissue and/or body form in disease and attenuate the effects of inflammation and stress metabolism (Green & Watson, 2005; Holmes, 2003; Kinosian & Jeejeebhoy, 1995). In this review, the use of the term malnutrition refers to undernutrition. This is not to downplay the known health effects of being overweight or obese (Norman K. *et al.*, 2008). However, in the event of severe chronic disease or a major traumatic event such as in those with malignant disorders and post organ transplantations, in the overweight or obese patient, the rapid loss of muscle mass occurs in a clinical term, sarcopenic obesity (Cederholm *et al*., 2017). This is an indication of nutritional risk and has well-established adverse effects on patient prognosis. Furthermore, many obese patients do not have adequate nutrition as high-calorie diets are often high in carbohydrates and fat but have little nutritional value (Golladay *et al.*, 2016). Furthermore, heightened inflammation leading to malnutrition due to adipocytes in excess has been noted in obese patients (Cederholm *et al.*, 2017).

In light of these arguments, malnutrition may therefore be described as an acute, subacute or chronic state of nutrient insufficiency (*e.g*. protein, specific nutrient deficiencies) caused by inadequate nutritional intake, the impaired utilisation or loss of micro- and/or macronutrients, and in disease, an increase in metabolism and inflammation (Hoffer, 2001; Jeejeebhoy, 2000; Poulia *et al.*, 2017; White *et al.*, 2012). de Ulíbarri Pérez (2014) refers to this state of malnutrition as clinical undernutrition, where this altered nutritional state is caused by an illness, the complications associated with illness or the treatment procedures during hospitalisation. Together, these factors lead to changes in tissue shape, size and body composition which have been associated with reduced functional capacity and adverse clinical outcomes (Lennard-Jones, 1992; Kelly *et al.*, 2000; Sobotka L., 2011).

2.2.2 Prevalence

The earliest published cases of hospital malnutrition by Butterworth in 1974 and numerous studies since then prove hospital malnutrition to be a significant public health problem. A worldwide prevalence between 20% and 60% of hospital malnutrition at admission has been reported, with 30-55% of all patients being at risk of malnutrition at the time of admission (Dannhauser *et al.*, 2007; Deer & Volpi, 2016; Lim *et al.*, 2012; O'Flynn *et al.*, 2005; Rizzi *et al.*, 2016; Velasco *et al.*, 2011). Table 2-1 below shows the prevalence rates of malnutrition in different countries. Within each table, the studies are organised chronologically starting with earlier published studies. In two metropolitan teaching hospitals in Australia, the average malnutrition rate was 36% (Middleton *et al.*, 2001). In a German study in 13 hospitals, 27.4% of patients were malnourished (Pirlich *et al.*, 2003). A recent study in Singapore reported prevalence rates of 29% (Lim *et al.*, 2012). A more recent study of a heterogeneous adult population of Vietnamese respiratory disease in patients showed an even higher prevalence rate of 33.3% (Huong *et al.*, 2014). These studies confirm the widespread problem of malnutrition. Differences between prevalence rates are influenced by the country, unique socio-demographic characteristics, main diagnosis and the incidence of other comorbidities in existing disease and the use of different diagnostic criteria (Correia *et al.*, 2017; Sorensen *et al.*, 2008).

Furthermore, in reviewing published work in which the prevalence of malnutrition was assessed, each study defined malnutrition or nutritional risk using different methodology or criteria. The implications for this are that different rates of malnutrition/nutritional risk with different interpretations are drawn (Lamb *et al.*, 2009). Moreover, comparing prevalence rates between studies is difficult because studies are rarely replicated in similar contexts. Even within studies which use different tools and produce a similar overall proportion of malnutrition/nutritional risk between tools, the risk categories for nutritional risk differ and this may forge practical difficulties in managing patients and providing nutritional intervention (Wood *et al.*, 2004). This was demonstrated in a cross-sectional study done in a study population of 100 surgical patients (Mourao *et al.*, 2004). Using BMI, the McWhirter and Pennington criteria, Subjective Global Assessment (SGA) and dynamometry, the prevalence of malnutrition was 7%, 9%, 56% and 69% respectively. In a group of cardiac inpatients from Sri Lanka (n=526), the prevalence of malnutrition differed as assessed by each of six tools: SGA, Short Nutritional Assessment

Table 2-1: Prevalence of malnutrition and/or nutritional risk in the general adult hospitalised population

Authors	Country	Patient population	Age group (years)	Sample size	Prevalence of malnutrition and/or nutritional risk	Method of assessment
Bruun *et al.*, 1999	Norway	Surgical gastrointestinal and orthopaedic patients	≥18	244	39%	Weight loss during the past 3 months, BMI
Niyongabo *et al.*, 1999	Burundi	Internal medicine patients (predominant HIV-seropositive population)	≥18	226	47.3%	Percentage of body weight loss calculated by reference to usual body weight
Middleton *et al.*, 2001	Australia	General population	≥18	819	36%	SGA
de Kruif & Vos, 2003	Netherlands	Surgery, internal medicine, gynaecology, neurology	≥18	200 (first phase), 114 (second phase)	First phase- At nutritional risk-11.5% Malnutrition-7.5% Second phase- At nutritional risk-11.4% Malnutrition-7.01%	NNSF
Wyszynski *et al.*, 2003	Argentina	General population	≥18	5115	47%	SGA
Kruizenga *et al.*, 2003	Netherlands	General population	≥18	6150	13%	>10% Unintentional weight loss during the past 6 months
Correia *et al.*, 2003b	Argentina, Brazil, Chilli, Costa Rica, Cuba, Dominican Republic, Mexico, Panama, Paraguay, Peru, Puerto Rico, Venezuela, Uruguay (Latin American countries)	General adult patients	≥18	9348	50.2%	SGA

Authors	Country	Patient population	Age group (years)	Sample size	Prevalence of malnutrition and/or nutritional risk	Method of assessment
O'Flynn *et al.*, 2005	UK	All adult patients admitted in year 1998, 2000 and 2003 consecutively	≥16	686 780 817	23.5% 20.4% 19.1%	MAA
Sorensen *et al.*, 2008	Middle Eastern countries: Libya, Egypt, Lebanon Western and eastern European countries: Spain, Egypt, Germany, Switzerland, Hungary, Romania, Poland, Slovakia, Czech Republic	Oncology, surgery, internal medicine, intensive care, gastroenterology, geriatrics	≥18	5051 Western and Eastern European countries: 4086 Middle East countries: 95	Western European countries: 13-100% Middle East countries: 37-97%	NRS-2002
Lamb *et al.*, 2009	UK	General medical, surgical, orthopaedic and critical care	≥16	328	Total prevalence (MUST≥1)-44% Medium risk (MUST>4-5)-11.9% At high risk (MUST>6-7)-32% Highest risk (MUST≥2) associated with older age: <60 years-20.6% 60-79 years-29.7% ≥80 years-39.4% Low risk (NNSC, 0-3)-67.3% Medium risk (NNSC, 4-5)-19% High risk (NNSC≥6)-13.7%	MUST NNSC

Authors	Country	Patient population	Age group (years)	Sample size	Prevalence of malnutrition and/or nutritional risk	Method of assessment
Imoberdorf *et al.*, 2010	Switzerland	Medical inpatients	≥18 years	32,837	General population-18.2% Amongst age-groups: <45 years-8% 45-64 years-11% 65-84 years-22% >85 years-28%	NRS-2002
Pressoir *et al.*, 2010	France	Oncology patients	≥18	1545	Malnutrition-30.9% Severe malnutrition-12.2%	BMI, weight loss
Marco *et al.*, 2011	Spain	Internal medicine	≥18	1567,659	Malnutrition-1.4%	ICD-9-CM
Velasco *et al.*, 2011	Spain	Internal medicine and surgery	≥18	400	31.5% 34.5% 35.3% p<0.001 58.5%	MUST NRS-2002 SGA MNA
Álvarez Hernández *et al.*, 2012	Spain	General, orthopaedic, rehabilitating, geriatric and long-stay purpose patients	≥18	admission-1,707) discharge-1,597)	23.7% 35.7%	NRS-2002
Blanckenberg *et al*., 2012	South Africa	ICU	≥18	206	Malnutrition-72.8%, Nutritional risk-26.7% Malnutrition-98.3% Nutritional risk-78.2% Malnutrition-30.1% Nutritional risk-18.9% Malnutrition-16.5% Nutritional risk-52.9% Malnutrition-29.1% Nutritional risk-6.8%	NRS-2002 NRI MST MUST MNA-SF SNAQ

Authors	Country	Patient population	Age group (years)	Sample size	Prevalence of malnutrition and/or nutritional risk	Method of assessment
					Moderate and severe malnutrition-49%	SGA
Lim *et al.*, 2012	Singapore	Medical and surgical patients	18-74	818	29%	SGA
Huong *et al.*, 2014	Vietnam	Gastroenterology diseases, surgery, intensive care unit, respiratory disease, endocrinology	19+	571	33.3%	BMI
Hébuterne *et al.*, 2014	France	Oncology patients	≥18	1303	44.1%	BMI and weight loss
Asiimwe *et al.*, 2015	Uganda	HIV-seropositive population	≥18	318	25-59% 47% 59% 25%	BMI<18.5 kg/m^2 MNA-SF≤20 cm-males MNA-SF ≤19 cm-females MUAC
Jayawardena *et al.*, 2016	Sri Lanka	Cardiac inpatients	≥18	526	4.2% 22.7% 40% 47.9% 56.3% 69.6%	SGA SNAQ MUST MST NRS-2002 MNA-SF
Deer & Volpi, 2016	USA	Acutely ill elderly patients	>65	74	25.7% 74.3% 60.8% 55.4% 31.1%	BMI<20 kg/m^2/>5% unintentional weight loss in the past 6 months MNA-SF NRS-2002 SGA

Authors	Country	Patient population	Age group (years)	Sample size	Prevalence of malnutrition and/or nutritional risk	Method of assessment
					21.6%	MUST MST
Afful, 2016	Ghana	In-patients with NCD	18-60	100	6%	BMI
Mulu *et al.*, 2016	Ethiopia	HIV-seropositive patients	≥18	109	46.8% 44.1%	BMI<18.5 kg/m^2 MUAC ≤20 cm
Rojer *et al.*, 2016	The Netherlands	Acutely ill patients from general internal medicine, gastroenterology, dermatology, rheumatology or nephrology, general surgery, surgical oncology	Age not defined in study, mean age: (57.6 ± 17.7)	349	30% 15%	SNAQ New ESPEN consensus definition of malnutrition

SGA: Subjective Global Assessment, BMI: Body Mass Index, ICU: Intensive care unit, NNSF: Nursing nutritional screening form, MAA: Malnutrition Audit Assessment Tool, MUST: Malnutrition Universal Screening Tool, ICD-9-CM: International Classification of Diseases, 9th Revision Clinical Modification, NRS-2002: Nutritional Risk Screening Tool-2002, MNA: Mini Nutritional Assessment, MNA-SF: Mini Nutritional Assessment short-form, MUAC: mid-upper arm circumference, NRI: Nutritional Risk Index, SNAQ: Short Nutritional Assessment Questionnaire, HIV: Human Immunodeficiency Virus, USA: United States of America.

Assessment Questionnaire (SNAQ), Malnutrition Universal Screening Tool (MUST), Malnutrition Screening Tool (MST), and the NRS-2002, and Mini Nutritional Assessment short-form (MNA-SF) detected 4.2%, 22.7%, 40%, 47.9%, 56.3% and 69.6% malnourished patients respectively (Jayawardena *et al.*, 2016). Issues of misclassification may be resolved by conducting large-scale randomised trials that examine important clinical and physiological outcomes. Aside from the use of different measures of nutritional determination, differences exist in the clinical settings, age groups, disease severity and cut-offs or reference values at which a patient is regarded as malnourished or at nutritional risk. Generally, there is a lack of evidence base for the use of reference values as these reference values have never been determined in cohort studies, thereby undermining their relevance in certain populations (Covinsky *et al.*, 2002; Kyle *et al.*, 2003; Lin *et al.*, 2016; Naber *et al.*, 1997a).

Also of concern is the decline in the nutritional status of patients by the time of discharge. In a group of 404 American hospitalised patients using the SGA as a method of measurement, the prevalence of malnutrition rose from 54% at admission to 59% at discharge for patients that stayed in the hospital longer than seven days (Braunschweig *et al.*, 2000). In another prospective cohort study conducted across 18 Canadian hospitals, the prevalence of malnutrition, determined by using the SGA, increased by 20% by the time of discharge (Allard *et al.*, 2016). This study was also conducted in patients that spent more than seven days in the hospital. In a sub-analysis of the PREDyCES® study, there was an increase in the prevalence of nutritional risk from 33.9% to 36.4% amongst 401 oncology patients (Planas *et al.*, 2016). Unlike the two previously cited studies, nutritional risk was determined for all patients irrespective of the date of discharge in this study.

Very few DRM prevalence studies have been conducted in Africa. One earlier identified study which sought to implement nutritional risk screening internationally had two African countries, Libya and Egypt, represented in the predominantly European represented study, the European Undernutrition in Hospitals (EuroOOps) study (Sorensen *et al.*, 2008). These two countries were combined with an Asian country, Lebanon, and described as Middle Eastern countries in the article. Nutritional risk as defined by NRS-2002 amongst general oncology, surgery and internal medicine in patients ranged from 37-97% in these Middle Eastern countries. The earliest identified African study on malnutrition found a malnutrition prevalence rate of 47.3% in an HIV-endemic area in Burundi, using the percentage of body weight loss as a measure of a poor nutritional status (Niyongabo *et al.*, 1999). Since this study by Niyongabo *et al.* (1999) was conducted in a predominantly HIV population, another study evaluated the prevalence of malnutrition in a similar HIV-seropositive population. The authors identified 25-59% Ugandan patients as being malnourished, based on three different nutritional status measures: BMI,

MNA-SF and mid-upper arm circumference (MUAC) (Asiimwe *et al.*, 2015). Recently, Mulu and colleagues assessed malnutrition rates using BMI and MUAC among Ethiopian HIV-seropositive patients and found a malnutrition prevalence rate of 46.8% (Mulu *et al.*, 2016). Amare and fellow co-researchers observed a prevalence as high as 77.8% in an Ethiopian hospital amongst a cohort of heart failure patients (Amare *et al*., 2015). Malnutrition was defined by serum albumin and triceps skin fold thickness. Two South African studies have reported a 72.8% and 26.7% of malnutrition and nutritional risk respectively in 206 critically ill patients (ICU) at the Tygerberg hospital and a prevalence of 40-60% in hospitalised patients in an unpublished retrospective study in Bloemfontein, both using the NRS-2002 score (Blanckenberg *et al*., 2012; Dannhauser *et al.*, 2007). In Ghana, there is even less data available. Only two unpublished studies could be traced. In a total of 150 Ghanaians aged 21 to 86 years also screened in the same hospital where the current study was conducted, the combined prevalence of medium and high risk of malnutrition using the MUST tool was 13.4% (Ampofo, 2013). However, this study was conducted at the outpatient department (OPD). In an unpublished study conducted in two private Ghanaian hospitals, the prevalence of malnutrition defined by BMI in a hospitalised population of patients with NCD (n=100) was 6% (Afful, 2016). It should be mentioned that these Ghanaian studies had methodological limitations as they were conducted in selected groups of disease conditions, in small samples and, of these two studies, one study failed to use validated and holistic measures of screening nutritional status (Afful, 2016). There is therefore currently no data on the prevalence of malnutrition in a general Ghanaian heterogeneous inpatient population necessitating the need for conducting adequately powered studies in the general adult population using validated measures of screening for nutritional risk and prevalence.

2.2.3 Aetiology of malnutrition

A host of factors can impair nutritional status. Besides the well-established role of a reduced dietary intake in the hospital, the underlying disease leads to a malnourished state which is referred to as cachexia (Norman *et al*, 2008) (Figure 2-1). Cachexia is characterised by severe weight loss, due to loss of muscle mass with or without fat loss (Cederholm *et al.*, 2017). The association between malnutrition and disease has been described as a synergistic vicious cycle due to the complementary influence each has on the other (Stratton et al., 2003). In Figure 2-1, it can be seen that the disease state leads to increased nutrient and energy requirements and losses and elevated resting energy expenditure through the effect of mediators like interleukin-1 for many disease states, which has been shown to be lower in the general healthy population (Saunders & Smith, 2010). Characteristically, in disease there is decreased uptake and intake of nutrients due to decreased utilisation of nutrients, reduced dietary intake, poor absorption,

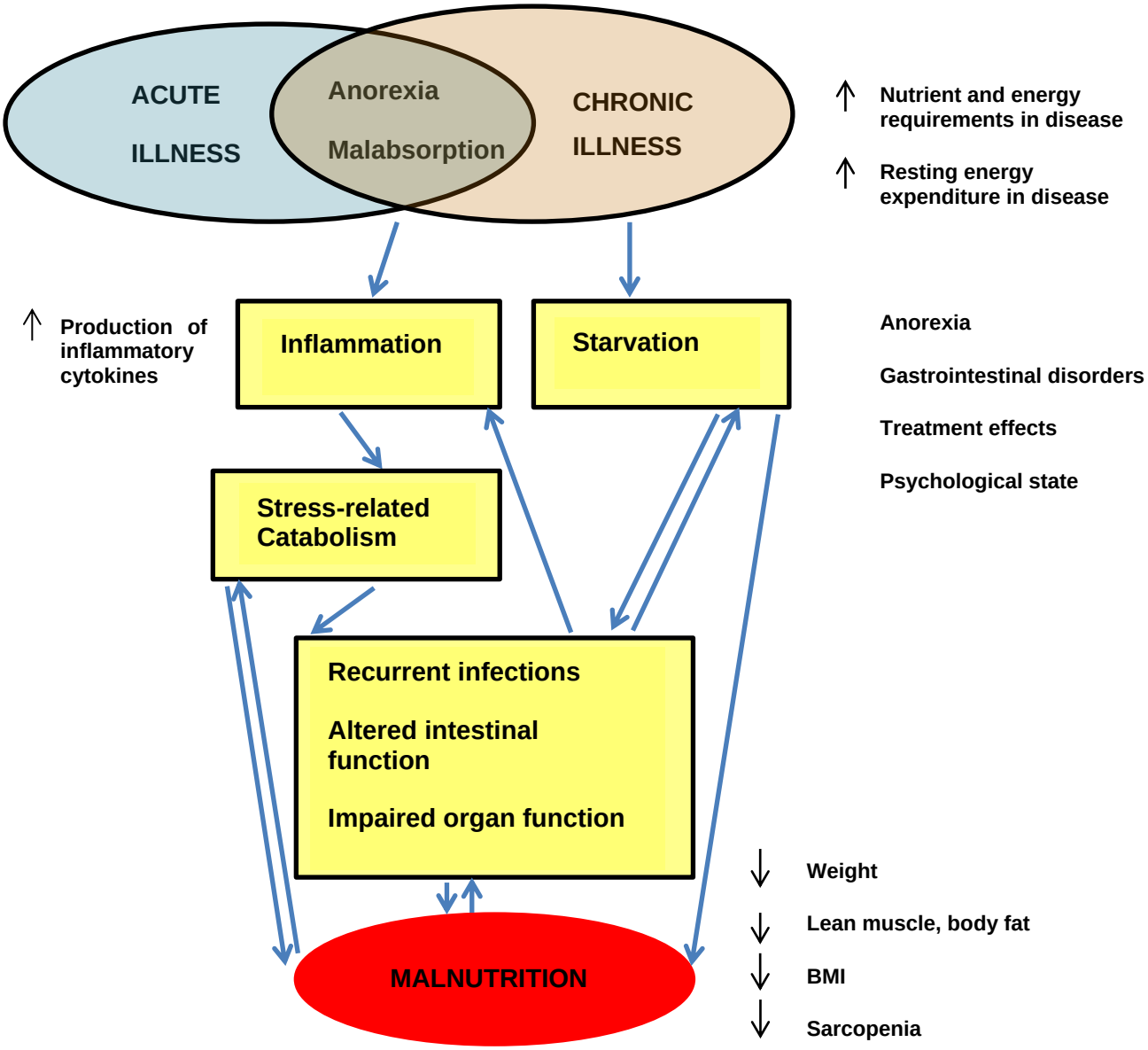

Figure 2-1: Schematic representation of the vicious cycle of the development and progression of disease-related malnutrition

Adapted from Norman *et al.* (2008)

decrease in intestine motility, dysphagia, vomiting, nausea and diarrhoea (Alberda *et al.*, 2006; Detsky *et al.*, 1987; Jensen *et al.*, 2009; Jensen, 2010; Norman *et al.*, 2008). Malnutrition additionally lowers the body's immunity to infections (Norman, 2008). Where vitamin and mineral deficiencies occur, enzyme systems that repair damaged tissues are affected, thereby impairing wound healing and putting the patient at risk of developing pressure ulcers (Ulibarri *et al.*, 2005; Sorenson *et al.*, 2008).

Alterations in physiological processes and metabolic responses elicit reductions in appetite sensation due to changes in cytokines, glucocorticoids, insulin and insulin-like growth factors (Cederholm *et al.*, 2017; Reichenberg *et al.*, 2001).

In disease, the effect of starvation or anorexia is exacerbated to a greater extent through an inflammatory response and other related compensatory mechanisms which alter nutrient requirements (Norman *et al.*, 2008). Additionally, an increase in energy expenditure, nitrogen excretion and stress-related catabolism causes significant alterations in body composition through the loss of lean muscle and adipose tissue in a process called proteolysis (Mueller *et al.*, 2011). The following may also result: fluid shift to the extracellular compartment, causing hypo-protein oedema and ascites, acute-phase protein changes, inhibited protein synthesis and repair, hyperglycaemia, muscle catabolism and apoptosis (Karateke *et al.*, 2013; Keusch, 2003). As a result of the decreased synthesis of negative acute-phase proteins, there are reductions in concentrations of albumin, transferrin, prealbumin and retinol-binding protein, which are vital indicators of poor prognoses in malnourished patients.

Stress brought about by disease impairs immune function and the resistance to infectious diseases and contributes to organ, muscle and intestinal dysfunction, inflammation and wasting in a continuous vicious cycle (Mujico Fernández *et al.*, 2012; Norman *et al.*, 2008). Especially in oncology patients, host factors such as proteolysis factor-1 (PIF) and lipid mobilising factor (LMF) and the tumour itself have largely been implicated in tissue catabolism in cachexia that upregulates degradative pathways in both skeletal muscle and adipose tissue (Bing, 2005; Cederholm *et al.*, 2017; Deans *et al.*, 2009). A common symptom of malnutrition in disease together with hypo-protein oedema is shock (Karateke *et al.*, 2013). The failure to control both malnutrition and inflammation before, during and after hospitalisation will continue this deleterious cycle (de Ulíbarri Pérez, 2014; Mujico Fernández *et al.*, 2012).

The lack of a general consensus on the definition of malnutrition and diagnoses among adult patients has fostered the misclassification and inappropriate treatment of a poor nutritional state (Cederholm *et al.*, 2017; White *et al.*, 2012). In light of this, an updated approach to diagnosing malnutrition syndrome has been proposed by an International Consensus Guidelines Committee under the auspices of ASPEN and the ESPEN (see Figure 2-2). This committee acknowledged the aetiology-based role of inflammation in contributing to malnutrition in ill patients. The committee explained that starvation-related malnutrition lacks a component of inflammation since it is due to pure chronic starvation noted in conditions like anorexia nervosa

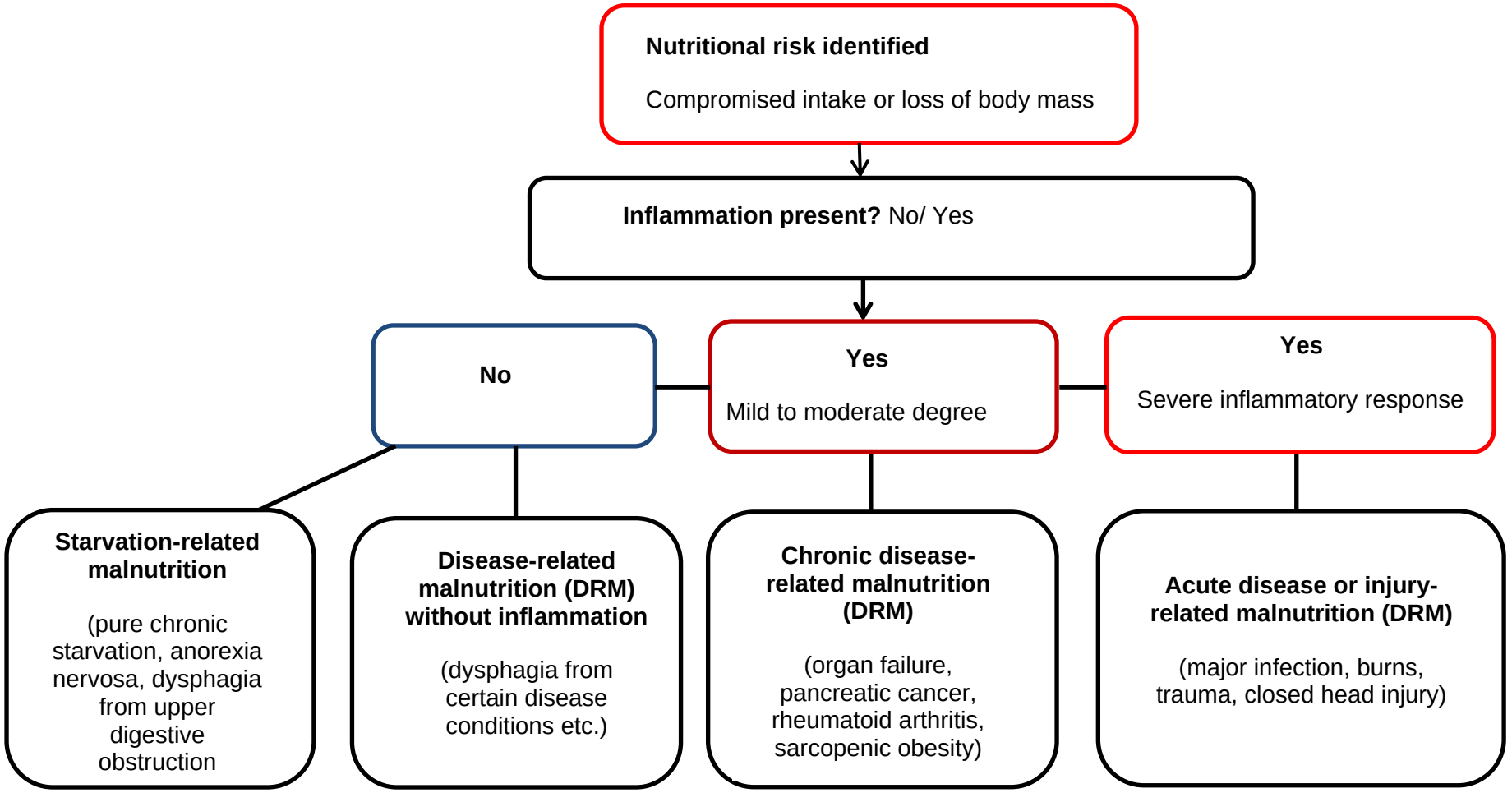

Figure 2-2: Aetiology-based types of malnutrition in disease

Adapted from Cederholm *et al.*, 2017 & White *et al.*, 2012

or the loss of appetite in disease whilst the latter two, chronic DRM and acute disease or injury related malnutrition, elicit either mild/moderate or severe degrees of inflammation respectively. Patients may be classified under one or more of these categories and may transit from one state to another. An increased inflammatory state which induces a catabolic state of lean body mass and has an effect on acute-phase proteins is well-known to slow responses to nutrition intervention, increase the risk of mortality and raise costs of human and financial resources necessary to restore a patient to good health (Cederholm *et al.*, 2017; Correia *et al.*, 2003; Deans *et al.*, 2009; Freijer *et al.*, 2013; Rizzi *et al.*, 2016).

Inflammation for clinically relevant malnutrition includes C-reactive protein (CRP) levels (>5-40 mg/L) and reduced serum albumin concentrations (<3.5 g/dl) (Cederholm *et al.*, 2017). A new ESPEN consensus statement has outlined that inflammation may not always be present in disease (non-cachectic DRM) (Cederholm *et al*., 2017). This includes dysphagia occurring from upper digestive obstruction and neurologic conditions such as Parkinson's disease, psychiatric conditions like depression or advanced aging without inflammation (Cederholm *et al*., 2017; Roy *et al.*, 2016).

Different causes of DRM have been pinpointed in both the developed and developing world. In the developed world, people become malnourished during illness, while the patient in the developing world almost chronically has an inadequate intake of food (Norman *et al.*, 2008).

There are a myriad of factors linked with the incidence of malnutrition in disease; these include disease severity, degree of disability or trauma and difficulty in treatment and practice of health care (Deans *et al.*, 2009; Kubrak & Jensen, 2007). The contributing factors to the decline in patients' nutritional status have been broadly classified as belonging in two main categories: factors pertaining to the patient (personal) and those pertaining to the organisation (malpractice by the hospital). The personal factors have further been subclassified under physical and social causes. The physical factors ascribed to malnutrition include disease, age and treatment states like oncology, diabetes and cardiac or gastrointestinal disorders and polypharmacy, which reduce the patient's intake and uptake of food and the distribution of nutrients in the body (Bozzetti *et al.*, 2000; de Ulíbarri Pérez, 2014; Lambert *et al.*, 2017; Rizzi *et al.*, 2016). Age, disease and complex treatment procedures may also impede nutritional status because of restrictions in chewing and swallowing, nausea/vomiting bouts, taste and smell impairments (Brisbois *et al.*, 2006; Comeau *et al.*, 2001; Correia & Waitzberg, 2003; Grobbelaar *et al.*, 2004; Liu *et al.*, 2002; Pressoir *et al.*, 2010). Several studies have identified an increase in age as a risk factor for malnutrition in the elderly, particularly in those above 65 years (Álvarez Hernández *et al.*, 2012; Mourao *et al.*, 2004; Pirlich *et al.*, 2006). The elderly and chronically ill are the most affected by the social causes of malnutrition owing to the reduced ability to buy,

cook or consume food, poor mobility which affect the ability to feed oneself, physical dependence and dementia (Roy *et al.*, 2016).

Organisational factors in the health care setting that contribute to malnutrition include diffusion of responsibility for patient care, unnecessary periods of starvation, the overdependence on saline or glucose parenteral nutrition which may not be adequate to support the patient's increasing energy requirements, the inadequacy of monitoring patient's dietary intake, the absence of nutritional screening or assessment and documentation, the failure to recognise malnutrition or to provide nutrition support and a low nurse-to-patient ratio to assist with feeding (Campbell *et al.*, 2002; Holmes, 2003; McWhirter & Pennington, 1994; Pedersen, 2005; Zadak *et al.*, 2013). Drug-related side effects are common with some treatments such as antibiotics, chemotherapy, morphine derivatives and sedatives, which may cause anorexia and interfere with the ingestion of food (Pressoir *et al.*, 2010; Zadak *et al.*, 2013). Treatment factors that may cause a change in energy expenditure include surgery, mechanical ventilation, drugs and ostomies (Alves *et al.*, 2016; Reeves *et al.*, 2016; Thomas *et al.*, 2016; Zadak *et al.*, 2013). The lack of documentation of patient's health and weight and food intake is a common practice in hospitals as nutrition is not regarded as a priority issue in patient recovery (Antwi, 2008; Willson *et al.*, 2016). High plate wastage (31%) in a tertiary hospital has been reported and this study suggested that food with an adequate amount of nutrients to support the patient's necessary basal metabolic needs may not be the only solution to support food intake (Kowanko *et al.*, 1999). Assisted feeding and better ways of serving food to patients (bulk versus plated food serving) to improve food palatability have been advised Kowanko *et al.*, 1999).

2.2.4 Consequences of malnutrition

Malnutrition in disease alters the function and recovery of multiple organ and tissue systems that cause impairment at a cellular, physical and psychological level (Allison, 2000; Cederholm *et al.*, 2017; Holmes, 2007; Kubrak & Jensen, 2007; Saunders & Smith, 2010). On a cellular level, it is known that malnutrition alters immune competence, increases infection risk, increases the risk of developing pressure ulcers, slows wound healing, reduces nutrient intestinal absorption, changes thermoregulation and alters renal function (Allison, 2000; Holmes, 2007; Kubrak & Jensen, 2007). On a physical level, malnutrition causes the catabolism of muscle and fat mass, reduces respiratory muscle and cardiac function and promotes the atrophy of visceral organs (Chandra, 1997; Holmes, 2007; Kubrak & Jensen, 2007). The increased incidence of pneumonia in malnourished patients has been attributed to the deterioration of muscle function that results accompanied by a compromised immune function and impaired wound healing (Fiol-Martínez *et al.*, 2017). Falls, unsteady gait and fractures also occur, more especially in the malnourished geriatric population (Löser, 2010). Finally, at a psychological level, malnutrition is

associated with fatigue and the lack of will to recover, which prolongs recuperation, stay in hospital and quality of life (Kubrak & Jensen, 2007).

2.2.4.1 Clinical studies on the effects of malnutrition

Many studies have investigated the influence of malnutrition on patient outcomes, including, LOS, the rate of developing complications and mortality. It has been shown that malnutrition is an independent predictor of greater rates of infections and medical complications than diabetes and obesity, inadvertently prolongs hospital LOS and results in higher mortality (Barker *et al.*, 2011; Lim *et al.*, 2012; Martins *et al.*, 2006; Sorensen *et al.*, 2008). Also, malnourished patients have been proved to respond slowly to treatment or tolerate treatment procedures poorly (Alexandre *et al.*, 2007; Van Cutsem & Arends, 2005).

LOS is an important outcome parameter of nutritional risk or status (Gupta, 2011). Numerous studies have reported that malnutrition prolongs LOS by up to seven days (Braunschweig *et al.*, 2000; Gupta, 2011; Lim *et al.*, 2012). A group of malnourished patients in a Singapore setting had longer hospital stays (6.9 ± 7.3 days versus 4.6 ± 5.6 days, $p<0.01$) (Lim *et al.*, 2012). An earlier study conducted in the United States of America (USA) observed adult patients that were hospitalised for more than seven days and investigated the impact nutritional decline had on outcomes, namely LOS, complications and hospital cost (Braunschweig *et al.*, 2000). Compared with the reference group that were well-nourished at admission, patients who were admitted with some form of malnutrition at admission and those who became nutritionally compromised on admission had significantly longer LOS by approximately four days than patients who maintained a good nutritional status both on admission and at discharge. A prolonged LOS was associated with malnutrition in French oncology patients (19.3 ± 19.4 days) compared with their well-nourished peers (13.3 ± 19.4 days) (Pressoir *et al.*, 2010). Other large national studies in Germany and Brazil have observed a significantly longer LOS of 4-13 days in malnourished patients compared with well-nourished patients (Pirlich *et al.*, 2006; Waitzberg *et al.*, 2001). Though it is evident that there is an association between nutritional status and LOS, there are significant differences among individual studies due to the distinct study populations, study design, sample size and diagnostic measure of determining nutritional status (Gupta, 2011).

LOS reflects the extent and impact of the disease, the role of genetics, treatment duration, quality of care and especially the adverse effects of malnutrition such as poor wound healing, an impaired functional status, quality of life and hospital cost (Kyle *et al.*, 2003; Planas *et al.*, 2004; Pressoir *et al.*, 2010). However, the use of LOS as an outcome parameter has been questioned because it can be influenced by many non-nutritional factors (Kyle *et al.*, 2006). LOS is affected by disease severity as severely ill patients require more complex medical treatment

(Gupta *et al*., 2011; Sun *et al*., 2015). On the other hand, a more severely ill patient will have a reduced LOS due to premature death (Gupta *et al*., 2011). Resolving malnutrition through nutrition intervention has been shown to reduce LOS and this has been used as a cost-effective measure to reduce health care costs, the risk of infections and nosocomial infections and to improve patients' quality of life (Laky *et al.*, 2010).

Malnourished patients are more predisposed to complications than well-nourished patients (Braunschweig *et al.*, 2000; Naber *et al.*, 1997b). Complications occur when a secondary disease or condition develops in the course of a pre-existing disease without being related specifically to the existing disease (Farlex Partner Medical Dictionary, 2012). This was typified in a German study that assessed a group of gastrointestinal patients preoperatively and found that patients at nutritional risk had significantly higher rates of complications than patients who were not at nutritional risk (Schiesser *et al.*, 2009). In a retrospective review of files of patients in 25 Brazilian hospitals, malnourished patients had a significantly higher incidence of complications (27% versus 16.8%) (Correia & Waitzberg, 2003).

A natural consequence of a high complication risk is increased mortality (Michalak *et al.*, 2016). Independent of complication risk, malnourished patients are prone to death (Bell *et al.*, 2016; Lim *et al.*, 2012; Löser, 2010; Sorensen *et al.*, 2008). On the other hand, some studies have found no association between malnutrition and patient outcomes. Naber *et al.* (1997b) investigated the association between nutritional status and the rate of complications amongst internal medicine patients. They controlled for indicators of severity of disease such as the presence of malignant disease, number of drugs used, duration of hospital stay and functional capacity. The effect of malnutrition and complications was lost after this adjustment. Half (45%) the rate of complications have been found to occur after patients are discharged from hospital, highlighting the need for an assessment of nutritional status throughout the continuum of care, including at discharge (Forster *et al*., 2003).

The rates of readmissions are also greater in patients that are malnourished (Agarwal *et al.*, 2013; Kassin *et al.*, 2012; Lim *et al.*, 2012). A multicentre Spanish study recorded a higher readmission rate at 15, 30 and 90 days in the malnourished group compared with the well-nourished group (Álvarez Hernández *et al.*, 2012). In a chronic pulmonary obstructive geriatric group, hospital use of oral nutritional supplements (ONS) was associated with a decrease in the probability of 30-day readmissions from 0.34 to 0.29 ($p<0.01$)(Snider *et al.*, 2015). A recent systematic review and meta-analysis of 22 RCT with 3736 medical study participants found that the rate of readmissions was significantly decreased from 29.6% to 20.5% in the intervention group that was given nutritional support (including counselling and oral and enteral feeding) (Bally *et al.*, 2016). Although the caloric and protein intake of study participants improved

significantly with body weight, there was no significant effect of nutrition support on the other clinical outcomes, such as mortality, hospital-acquired infections or functional outcome. These RCTs had a high heterogeneity and a low study quality with a risk of bias. In a randomised controlled intervention study involving only patients who were at nutritional risk, the rates of readmissions were lower in the malnourished group that was provided with nutritional support than in the control group that received standard hospital care (26.6% versus 45.9%, p=0.027) (Starke *et al.*, 2011). Another systematic review and meta-analysis of 1190 mostly geriatric study participants in nine RCTs across various community and hospital settings reported a similar reduction in readmissions from 33.8% to 23.9% after the administration of ONS (Stratton *et al.*, 2013).

In summary, the similarity of results from several international studies conducted amongst heterogeneous populations in a wide variety of clinical settings lends credence to the premise that malnutrition has preventable debilitating consequences on clinical outcome.

2.2.4.2 Economic costs of malnutrition

In light of the higher rates of adverse outcomes in malnourished patients discussed in section 2.2.4.1, the use of prescribed medication and the greater use of hospital resources, it is evident that malnutrition takes a huge economic toll on both the patient and hospital (Amaral *et al.*, 2007; Boltong *et al.*, 2013; Elia *et al.*, 2006; Freijer *et al.*, 2013; Jean-Claude *et al.*, 2012; Marco *et al.*, 2011). This makes it a priority health and economic issue which must be solved particularly in resource-limited settings and countries that can put scarce funds to more productive use. Studies have shown increased malnutrition-related costs by up to 30-70% greater for the patient and billions of dollars to the care settings (Elia, 2009). To illustrate accrued costs as a result of the wide-spread prevalence of DRM malnutrition, the UK National Health Service (NHS) loses an annual amount of more than £19.6 billion, which is almost five times the projected cost of obesity-related problems (£4.2 billion) (Morgan & Dent, 2010; National Institute for Health and Care Excellence, 2015). In an Australian hospital, the deficit in reimbursement suffered by the hospital as a result of not detecting 136 malnourished patients was $125,311 (Lazarus & Hamlyn, 2005). Similarly, a retrospective review of hospital costs amongst a Brazilian malnourished cohort admitted to 25 hospitals showed up to 308% additional costs spent on daily expenses, medications and tests (Correia & Waitzberg, 2003). In a more current study in the Netherlands, €1.9 billion in 2011 were recorded as losses which equalled 2.1% of the total Dutch national health expenditure and 4.9% of the total costs of the health care sectors (Freijer *et al.*, 2013).

As discussed in section 2.2.4.1**,** the variables most predictive of hospital charges were LOS, as well a history of surgery, complications during admission and nutrition risk/status category (Braunschweig *et al.*, 2000; Freijer *et al.*, 2013; Jean-Claude *et al.*, 2012). Some hospitals in countries like the United States also lose unpaid reimbursements by the government when malnourished patients are not identified (Barker *et al.*, 2011; Thomas *et al.*, 2016). Demonstrating this with a preventative approach, Thomas *et al.* (2016) observed that including malnutrition in the diagnosis-related group (DRG) coding system amongst a group of German elective surgical patients (n=1244), led to a reimbursement of €1979.67 for each patient at risk of malnutrition and a total reimbursement of €79,186.73 for all patients at risk of malnutrition. The authors concluded that adequately treating malnutrition was a prudent measure in compensating for increased hospital costs. A large USA study that evaluated the cost-effectiveness of nutritional intervention 90 days post-discharge provided to malnourished patients versus placebo patients in 622 malnourished elderly patients established that the intervention group that received oral nutritional supplements had an estimated cost savings ratio of $33 818 (Zhong, 2016).

The evidence from numerous studies supports the fact that increased economic costs are associated with malnutrition.

2.3 Recognition and current referral rates of malnutrition

Given the extent of malnutrition in the hospitalised population, the literature continues to reveal that it is a condition often unrecognised or untreated (Barker *et al.*, 2011; Waitzberg *et al.*, 2001). Identifying nutritional risk/malnutrition through routine screening followed by nutritional intervention in hospitals is hindered by the absence of a standard definition of malnutrition. The aetiology-based definition of DRM through the role of inflammation described by White and colleagues in section 2.2.3 is a great stride in defining malnutrition (White *et al.*, 2012). Currently, a working group of the ASPEN has recommended that for a definite assessment of nutritional status, the incidence of at least two of the following characteristics of malnutrition should be taken into consideration: an insufficient energy intake, weight loss, the loss of muscle mass, the loss of subcutaneous fat, fluid accumulation and diminished handgrip strength (White *et al.*, 2012). A very recent ESPEN Consensus statement recommended any of two basic definitive criteria for the diagnosis of malnutrition for all clinical settings and irrespective of type of disease of either a BMI<18.5 kg/m^2 or a combined involuntary weight loss with reduced gender-specific fat-free mass index (FFMI)/ age-specific BMI cut-offs (Cederholm *et al.*, 2015). These two bodies are yet to unify both consensuses for diagnosing malnutrition (Jensen, 2016).

In some countries like the Netherlands, the Dutch Health Care Inspectorate mandates the compulsory screening of patients in all Dutch hospitals using validated Nutritional Risk Screening Tools (NRSTs) such as the SNAQ (Dutch Malnutrition Steering Group, 2011). Screening rates within the first 24 hours of hospital admission in this country continue to increase and stand at 65%. Studies universally have shown, however, that screening is not routinely done or is performed outside stipulated guidelines (Geiker *et al.*, 2012). Across 173 Austrian hospitals for instance, just 20% of the clinicians were found to implement nutritional screening for their patients (Hübner *et al.*, 2015).

In hospitals in other parts of the world where screening is mandatory, the prompt referral of patients for dietetic treatment has been poor. In a Melbourne tertiary teaching hospital in Australia, 23% of 275 patients were found to be malnourished as defined by the SGA (Gout *et al.*, 2009). Only 36% of those identified as malnourished were referred to the dietitian for review and only 7 out of 24 patients were correctly documented in the folder by the dietitian. In a geriatric population in which 51.4% were at high risk of malnutrition, none of these patients received dietetic referrals or any form of nutrition support (Geurden *et al.*, 2015). Further studies have also shown similar findings to the studies previously described. Medical staff of an Australian study identified only one out of 137 malnourished patients whilst 21 of the malnourished patients received nutrition intervention (Soeters *et al.*, 2008). Also, only 7% of malnourished elderly patients that experienced a recent loss of weight and 9% of those that experienced the loss of appetite, in a population of 30 malnourished elderly patients were referred for dietetic assessment (Adams *et al.*, 2008). More convincingly, a large intervention study across seven Swiss hospitals provided nutritional support to 70% of nutritionally at-risk patients (Imoberdorf *et al.*, 2010). Some reasons for the lack of intervention in the remainder were short hospitalisation, refusal of the patients to receive nutritional intervention and emergency operation. Within a period of three years (2003-2006), nutritional intervention increased from 63% to 72% to 78% in this population.

In the African context, there are no published studies of compliance with compulsory screening and assessment in hospitals. However, in an unpublished study in the setting of a public teaching hospital amongst Ghanaian outpatients, 79.3% of patients did not receive dietetic referrals (Ampofo, 2013). These studies highlight that the poor awareness of malnutrition by medical staff is a problem due to the belief that malnutrition is a guaranteed comorbidity of disease, amongst other factors.

Some organisations are seeking to close the gap on conducting screening protocols and nutritional intervention before surgery (Miller *et al.*, 2014). For instance, the multidisciplinary Enhanced Recovery After Surgery (ERAS) care pathway in surgical practice in several Western

countries is designed to optimise early recovery after surgery by attenuating surgical stress in patients and the risk of the development of infections and wound complications, and by maintaining preoperative body composition and organ function (Steenhagen, 2015). It includes the optimisation of nutrition as a key component among various surgical and anaesthetic regimes.

2.4 Benefits of the treatment of Disease-Related Malnutrition (DRM)

Dietary fortification, oral supplementation and patient counselling are first-line strategies used in many hospitals to treat malnourished patients (Cederholm *et al.*, 2017). Several RCTs, meta-analyses and Cochrane reviews have found profound benefits associated with dietary counselling and particularly a high energy and protein supplementation in significantly improving indicators of good nutritional status and patient outcomes: slower weight loss, an improvement in weight gain, reduced complications such as dysgeusia, reduced unplanned readmissions post-discharge, a decreased LOS and lowered disease-specific mortality (Baldwin & Weekes, 2011; Bally *et al.*, 2016; Isenring *et al.*, 2004; Jensen, 2010; Ravasco *et al.*, 2012; Ravasco *et al.*, 2005a; Ravasco *et al.*, 2005b; Stratton *et al.*, 2003). However, not much evidence exists for the use of patient counselling except to improve energy intake (Stratton, 2005). A study that evaluated the cost-effectiveness of nutritional therapy found that screening and treatment reduced hospitalisation by a day and reduced corresponding hospital expenses by up to €900. (Kruizenga *et al.*, 2005b). Perioperative nutritional support in malnourished patients decreases postoperative complications such as wound infections and sepsis in various groups of patients including geriatric and gastrointestinal oncology patients (Anbar *et al.*, 2014; Shukla *et al.*, 2016). Nutrition support may include dietary counselling, oral nutritional supplements, assisted feeding, enteral nutrition and parenteral nutrition, which improve outcomes by reducing the incidence of complication, LOS and the costs of admission (Mourao *et al.*, 2004; O'Flynn *et al.*, 2005; Odelli *et al.*, 2005; Stanga *et al.*, 2007). ESPEN has guidelines specific to treating various groups of malnourished patients (Correia *et al.*, 2014; Ukleja *et al.*, 2010).

The poor detection of malnutrition or nutritional risk in hospitals has an influence on patients who would receive nutritional intervention. From the "unscreening" of patients to the negligence of staff to the importance of nutrition as a part of nutrition therapy, large percentages of at-risk patients do not receive the nutritional support they require (Lamb *et al.*, 2009; Hébuterne *et al.*, 2014). One study reported the inability of the staff of a hospital to screen, though mandatory in this hospital, all of its patients using the Northumbria Nutrition Score Chart (NNSC); 68.9% of patients were screened, of which 13.7% were identified as being at high nutritional risk, out of which 45.2% were appropriately referred for dietetic advice (Lamb *et al.*, 2009). The rest of this high-risk group had no action taken on them (38.7%) or received various forms of nutritional

support without any dietetic advice (16.1%). In this same study, 14 more of those that were unscreened by the staff were found to be at high risk by the investigators. A large French national study in 154 hospitals including both outpatients and inpatients showed that 43.4% of the malnourished patients as defined by BMI and/weight loss failed to be provided with nutrition support although 28.4% of the well-nourished patients received nutrition support because they were erroneously perceived as being at nutritional risk (Hébuterne *et al.*, 2014).

The positive benefits of nutrition support to the malnourished patients through macronutrients such as protein, energy and other essential micronutrients are slow where inflammation exists, as explained in section 2.2.3 (Jensen *et al.*, 2009). However, early, adequate feeding within the first three days attenuates this and has proved to improve morbidity and mortality (Simpson & Doig, 2005). Intervention studies have been conducted to demonstrate the effects of providing early and adequate nutritional support. In a multicentre, cohort study amongst Chinese abdominal surgical patients in China (n=1085), the rate of complications was significantly lower in the preoperative nutrition group compared with the control group (25.6% versus 50.6%, p=0.008) (Jie *et al.*, 2012). Additionally, a significantly shorter LOS was seen in the preoperative nutrition group compared with the control group (13.7 ± 7.9 days versus 17.9 ± 11.3 days, p=0.018). In a large, multicentre study of 1831 hospitalised patients recruited from selected departments in an American hospital and two other Chinese teaching hospitals, similar outcomes were found (Jie *et al.*, 2010). Of patients that were nutritionally at-risk, the complication rate was significantly lower in the intervention group compared with the control group (20.3% versus 28.1%, p<0.001). No difference in complications was seen in patients that were not at nutritional risk regardless of the treatment or lack of treatment they were given (p=0.10). The findings of these large, high quality studies, amongst others, suggest that nutritional support protects against the incidence of complications and other adverse clinical outcomes and is thus beneficial to patients.

Though modern nutritional therapy with the numerous benefits it confers exists, studies worldwide have shown that a regrettably small percentage of malnourished patients are provided with adequate nutritional support (Correia *et al.*, 2003; McWhirter & Pennington, 1994; Rasmussen *et al.*, 2004). Many strategies have been put in place to increase attention to nutrition care and to improve awareness. A Nutrition Care Pathway which is simple and can be used in varied health care settings was recently proposed by the Medical Education Global Study Group (feedM.E.) (Correia *et al.*, 2014). The Pathway recommends that hospitals screen, intervene and supervene *i.e*. screen newly admitted patients' nutrition status or on initiation of care, intervene in a timely manner when needed and supervene routinely with an evaluation, adjustment or reinforcement of nutrition care plans until the patient is discharged from the

hospital. The Medicare Condition of Participation earlier provided similar requirements for the accreditation of US healthcare facilities (Centre for Medicare & Medicaid Services, 2006). A patient that is found to be malnourished should be put on a nutrition care plan which will involve the nutrition support team, physician, dietitian, other appropriate health workers and the patient's family or caregivers (Ukleja *et al*., 2010). The nutrition care plan for the patient should define the rationale for nutrition therapy, describe the planned and appropriate intervention and, as an extension of the assessment process, monitor and outline recommended reassessment and re-evaluation parameters. Infection prevention strategies should be used when providing enteral and parenteral nutrition. Furthermore, the proper storage of formulations is advised. Nutrition care should be conducted under hospital-specific policies and protocols (Ukleja *et al*., 2010).

2.5 Screening for nutritional risk

2.5.1 Introduction

Understanding the negative implications of a poor nutritional status highlights the need to address malnutrition as a priority key issue. The first step in the nutritional care plan in treating malnutrition is making a correct diagnosis through the process of nutritional screening (Cederholm *et al.*, 2017). Screening tools have evolved from solely being single measures of nutritional status or indices of laboratory and biochemical data such as albumin and total lymphocyte count for instant repletion, to a composite number of measurements to determine appropriate nutrition care, including percentage of weight loss during a specified period of time, BMI, reduced food intake in the week preceding admission and the presence of disease and its severity (Cederholm *et al.*, 2017; Elia, 2003; Kondrup *et al.*, 2003b) .

2.5.2 Limitations of individual parameters

Single nutritional parameters have lost their significance in determining nutritional status as single parameters may not take into consideration the host of factors involved in undernutrition thereby misdiagnosing a patient's true nutritional status; instead, multiple measures are used (Barbosa-Silva, 2008; Campillo *et al.*, 2004; Fuhrman *et al.*, 2004; Jeejeebhoy, 2000; Pennington, 1997). BMI is used as an index of chronic protein-energy undernutrition but can be confounded by dehydration, oedema, ascites, disease and age (Sorensen *et al.*, 2008; Stratton *et al.*, 2003). BMI is also reportedly not sensitive in predicting the loss of fat-free mass as obese patients may experience clinically significant weight changes which may still fall within normal BMI limits (Gupta, 2011; Pressoir *et al.*, 2010). Degree of oedema and ascites can, however, be adjusted for by subtracting the amount of weight contributed by oedema from the raw weight

measured from the patient (Johnson & Williams, 1985). A more recent innovation to determine malnutrition in patients with oedema is the use of bioelectrical impedance and dual-energy X-ray absorptiometry (Alves *et al.*, 2015; Weyer *et al.*, 2014). These are costly, however, and require specialised training limiting their use in routine clinical practice.

Again, there remains a lack of uniform reference standards for classifying nutritional status. Unintentional weight loss is a sensitive measure of predicting weight loss and adverse patient prognosis but may be confounded by patient recall or deliberate weight loss (Corish & Kennedy, 2000; Detsky *et al.*, 1987; Morgan *et al.*, 1980; Naber *et al.*, 1997a; Omran & Morley, 2000; Parekh & Steiger, 2004). Inflammation can be identified using laboratory tests via acute-phase proteins (White *et al.*, 2012). Contrary to what was previously thought, inflammation is not a direct and a reliable marker of nutritional status (Kyle *et al.*, 2006). Albumin and prealbumin are unreliable markers of nutrition status because they reflect inflammatory metabolism, surgical risk and mortality (Barbosa-Silva, 2008; Delgado-Rodríguez *et al.*, 2002; Fuhrman *et al.*, 2004; Jensen, 2006; Lawson & Daley, 2015; van Houwelingen *et al.*, 2013). An analysis of patients that had been exposed to various states of poor nutrition revealed that their blood acute-phase proteins did not fall consistently to match their weight loss (American Dietetic Association, 2012). Serum albumin and transferrin synthesis are influenced by disease status and acute interventions including the use of medication, hydration status and age (Chertow *et al.*, 2000; Robinson *et al.*, 2003).

Measures of anthropometry and functional status are also not exempted from the extremes of health and age and the lack of specific cut-offs limits their usage (Jeejeebhoy, 2000; Pennington, 1997; Persson *et al.*, 2002). A population study in Switzerland did not find a higher level of association between albumin and weight loss>10% or poor appetite (Kyle *et al.*, 2006). The Controlling for Nutritional Status (CONUT) tool which was developed as an automated malnutrition screening tool and alert tool to identify nutritional risk at any point in time in patients hospitalised with acute conditions has been criticised for its use as a screening tool because its three indices, serum albumin, total cholesterol and total lymphocyte count, are laboratory measures with inherent limitations and the underestimation of malnutrition, especially in older patients (Drescher *et al.*, 2010; Ulibarri *et al.*, 2005). However, de Ulíbarri Pérez (2014) contends that these measures detect changes in plasma of the body functions related to nutritional risk at an early stage and with more precision when anthropometric measures will fail at detecting nutritional risk until three weeks have elapsed. Additionally, these laboratory measures are proposed to help the physician decide on the most efficient but least aggressive treatment the patient needs to recuperate quickly. Available orthopaedic literature also indicates the usefulness of using laboratory markers in screening (Golladay *et al.*, 2016).

In spite of these limitations, these single parameters are more commonly included in nutritional screening because of some strengths. A low BMI is relevant in detecting malnutrition in the absence of weight loss and selecting patients at risk of increased mortality (OR=6.01; 95% CI (4.92-7.33) (Kruizenga *et al.*, 2003; Pressoir *et al.*, 2010). Weight loss (>10% in the preceding six months) has demonstrated good predictive ability and is a feature of most measures of nutritional status such as SGA and NRI (Nutritional Risk Index) (Buzby *et al.*, 1988; Detsky *et al.*, 1987; Kondrup *et al.*, 2003b). Biochemical markers inversely correlated with metabolic stress, are potent indicators of inflammatory metabolism and are useful in predicting poor patient outcomes such as immune incompetence, the incidence of infection, morbidity and mortality (Barbosa-Silva, 2008; Chertow *et al.*, 2000; Fuhrman *et al.*, 2004; Jeejeebhoy, 2000; Jensen, 2006; Robinson *et al.*, 2003).

2.5.3 Reasons for screening

According to a very current ESPEN consensus statement, nutritional screening is a rapid process performed to identify patients that are at nutritional risk using an appropriate validated tool (Cederholm *et al.*, 2017). Furthermore, the 2003 ESPEN's guidelines reason that the intent of nutrition screening is to predict the possibility of a better or worse outcome due to nutrition factors and whether nutrition treatment is going to influence this (Kondrup *et al.*, 2003a).

Identifying patients that are at nutritional risk, and further subclassifying the extent of nutritional risk amongst at-risk patients, holds numerous benefits for patients, including elective surgical patients, since providing appropriate nutritional support is known to optimise postoperative outcomes (Lawson & Daley, 2015). There is evidence to suggest that well-nourished patients including postoperative surgical patients, benefit from nutritional risk screening followed by assessment and nutritional intervention (Braga *et al.*, 2002; Jie *et al.*, 2010; Jie *et al.*, 2012).

International nutrition and healthcare bodies such as ESPEN, the National Institute for Health and Clinical Excellence (NICE) and The Joint Commission on Accreditation of Healthcare Organisations in the USA recommend early screening within the first 24-48 hours of admission (ASPEN Board of Directors & Clinical Guidelines Task Force, 2002; Cederholm *et al.*, 2017; Joint Commission on Accreditation of Healthcare Organisations, 2008; Kondrup *et al.*, 2003b; Kyle *et al.*, 2006; Weekes *et al.*, 2004). The accreditation of healthcare institutions in the USA is dependent on screening all patients on admission, amongst other requirements (Joint Commission on Accreditation of Healthcare Organisations, 2008).

It is important that results of screening are documented and communicated and the required intervention provided within the time frame specified by the hospital (Ukleja *et al.*, 2010). Timely

nutritional assessment is the second step in the nutrition care process for patients that are identified as being at nutritional risk or clearly malnourished (Charney, 2008; Field & Hand, 2015). Nutrition assessment according to ASPEN is a comprehensive process of diagnosing e nutrition problems by employing anthropometric, biochemical, clinical and dietary data (Teitelbaum *et al.*, 2005). Assessment tools in comparison with screening tools are more time-consuming, more complex and may employ the use of a broad questionnaire that focuses on several areas of a patient's nutritional intake. Additionally, the completion of nutrition assessment is constrained by a lack of human skills and physical resources (Patel *et al.*, 2014; Russell, 2007). Consensus statements by the Academy of Nutrition and Dietetics/ASPEN and the ESPEN, previously elaborated on in section 2.3, are the most recent diagnostic criteria for malnutrition (Cederholm *et al.*, 2015; White *et al.*, 2012). Because nutritional screening is the initial step recommended in diagnosing malnutrition due to its high utility in identifying malnutrition, nutritional screening was performed in the study (Cederholm *et al.*, 2015). It proves valuable in clinical practice where resources of time and money are limited.

2.6 Selection of Nutritional Risk Screening Tools (NRSTs)

Without NRSTs, patients with malnutrition will not be recognised. Moreover, adverse outcomes related to being at nutritional risk may not be promptly recognised and averted, as previously explained in sections 2.2.4. More than 100 available nutrition screening tools exist. NRSTs are generally flexible, simple, rapid, easy to interpret, valid, reliable and acceptable to patients because they are less invasive in various patient populations (Green & Watson, 2005; Jones, 2002; Mourao *et al.*, 2004).

Many NRST were designed for specific purposes. These include the assessment of nutritional risk in patients such as the MNA, prediction of poor clinical outcome related to malnutrition such as the SGA, identification of the need for nutritional intervention such as the MUST, prediction of healthcare use such as the NRI or prediction of the clinical effects of nutritional interventions such as the NRS-2002 (Detsky *et al.*, 1987; Guigoz *et al.*, 1997; Kondrup *et al.*, 2003b; Stratton *et al.*, 2004; Wolinsky *et al.*, 1990). However, NRST are used for various purposes other than their intended purposes. For instance the NRI is used to determine the prevalence of nutritional risk whilst the MNA originally designed for elderly populations is used in younger populations (Kyle *et al.*, 2004; Raslan *et al.*, 2010). Some well-known validated NRST include NRS-2002, MST, SNAQ, NRI, MUST, SGA and MNA (Ferguson *et al.*, 1999; Green & Watson, 2005; Guigoz *et al.*, 1997; Kondrup *et al.*, 2003b; Kruizenga *et al.*, 2005a; Stratton *et al.*, 2003; Wolinsky *et al.*, 1990).

With regard to ease of completion, there are those NRSTs that are described as “quick and easy tools” because they do not require calculations or anthropometric measurements, clinical examinations or biochemical tests. These include the MST and the SNAQ (Ferguson *et al.*, 1999; Kruizenga *et al.*, 2005a). Other screening tools such as the SGA, NRS-2002 and MNA are complex and qualify as assessment tools since they are more time-consuming and may involve clinical evaluations, medical examination and test of cognitive function; nevertheless they give a better background of a patient’s nutritional status (Baker *et al.*, 1982a; Detsky *et al.*, 1987; Guigoz *et al.*, 1997; Kondrup *et al.*, 2003b).

The major difficulties encountered in accurately diagnosing malnutrition are posed by the lack of a universal definition of malnutrition (Cederholm *et al.*, 2015; White *et al.*, 2012). Cut-off points for parameters to classify what constitutes normal and poor nutrition in the general as well as in specialised patient populations, including the elderly, have not been standardised, bringing divergent conclusions in studies (Platek *et al.*, 2015; Stratton *et al.*, 2003). Additionally, most of these NRST are difficult to use or implement, cannot be applied in different patient populations, have not been tested for validity or reliability or do not indicate a plan for nutrition care (Chumlea *et al.*, 2006; Green & Watson, 2005; Hamirudin *et al.*, 2014; Koren-Hakim *et al.*, 2016).

Screening tools generally consider two aspects of being at nutritional risk *i.e*. whether the person is malnourished presently and whether the person might become malnourished in the future (Kondrup *et al.*, 2003a). Some NRST receive the commendation of international nutrition societies such as the NRS-2002 by ESPEN and the NRI by the British Society for Parenteral and Enteral Nutrition (BAPEN) (Kondrup *et al.*, 2003b; Veterans Affairs Total Parenteral Nutrition Cooperative Study Group, 1991). The choice of a NRST for use should be dependent on the following characteristics: 1) validity (well established face validity, content validity, criterion validity, concurrent validity and predictive validity) 2) reliability (high interrater agreement and test-retest agreement), and 3) should be linked to implementation plans for action and 4) should be practical to use (Elia, 2003; Elia & Stratton, 2011; Kondrup *et al.*, 2003a; Streiner & Norman, 2003). Though the most preferred NRST is the one that has been validated for the particular care setting and for the population and should best predict clinical outcomes, it has been suggested that head-to-head RCTs should be included to provide strong evidence for the predictive ability of NRSTs to predict clinical outcomes in studies where many extraneous factors such as age and disease severity confound the results of observational studies (Isenring *et al.*, 2003; Phillips & Zechariah, 2017; Stratton *et al.*, 2004; Wu *et al.*, 2009). Many NRSTs have not been rigorously tested for validity, reliability, sensitivity and specificity; all the NRSTs also fail to show consistency in their validity studies (Arrowsmith, 1999; Green &

Watson, 2005). It has been suggested that future studies designed according to international guidelines of conducting research are needed to investigate the most valid NRSTs to screen and assess hospitalised patients along with a rigorous audit of actual hospital practices and not the development of new NRSTs (Patel *et al.*, 2014).

With the lack of a standard definition of malnutrition, various reference standards are used to validate NRST, which reduces comparability and makes the implementation of care plans for findings of NRST problematic (van Venrooij *et al.*, 2007). These reference standards are used in developing NRST and include objective assessment by a nutrition professional and a full nutritional assessment (Amaral *et al.*, 2008; Guaitoli *et al.*, 2014; Kruizenga *et al.*, 2003; Kyle *et al.*, 2006; Velasco *et al.*, 2011). The reference method is therefore considered as being superior to the NRST to be validated, which may create misjudgements if compared with another tool. The use of varying reference standards becomes confusing when for instance, the NRS-2002 is validated with the SGA as a reference method while in another study, the SGA is validated against the NRS-2002 (Kyle *et al.*, 2006; Martins *et al.*, 2006). The use of screening tools, single measures of anthropometry such as BMI, and laboratory methods are described as less valid reference methods (Campillo *et al.*, 2004; Elia & Lunn, 1997; Klein *et al.*, 1997).

Selecting a NRST from the numerous ones available for the hospital setting can be problematic. In the literature search for this review, five well-known validated NRST developed specifically for the general adult patient population were identified and were considered for use in the current study. These NRSTs have been summarised in Table 2-3, highlighting some important characteristics of these tools.

The common characteristics some of the tools have are weight, unintentional recent weight loss, percentage of weight loss, BMI, disease severity or acuity of disease level (Ferguson *et al.*, 1999; Healy *et al.*, 2014; Kondrup *et al.*, 2003b; Kruizenga *et al.*, 2005a). These parameters have a sound evidence base in the literature and have been associated with changes in clinical outcome and function (Kondrup *et al.*, 2003a; Vigano *et al.*, 2017). Several attempts have been made to define the best tool for the adult patient population. Till date, this has not been achieved since various tools have been used in different patient populations with different age groups and reference standards, and varying methodological limitations, thus hindering comparability between studies. Past reviewers have systematically pooled results of validity studies of different NRST to assess their performance in diagnosing nutritional risk and predicting clinical outcomes (Table 2-2).

In 2014, Guaitoli and reviewers systematically identified 32 screening tools applicable to the general hospital setting on which validity studies had been conducted (Guaitoli *et al.*, 2014).

Table 2-2: Common malnutrition screening tools developed for the adult hospitalised patient population

Screening tool	Target population	Parameters used risk scores	Risk scores	Advantages	Limitations
MST	Adult hospitalised population (1)	Three-question tool: loss of appetite, incidence of unintentional weight loss, amount of recent unintentional weight loss.	MST score: 2-7-risk of malnutrition, 0-2: no risk of malnutrition	Regarded as a "quick and easy" screening tool out of more than 30 tools in a systematic review (<3 minutes)(2) Showed the best clinically relevant sensitivity and specificity out of more than 31 tools in 27 studies (2). N.B. No analytic accuracy studies conducted on the NRS-2002 by the time of review; moreover, the NRS-2002 was regarded as a complex tool.	Bias in the diagnostic studies of MST because there was no blinding and no cross-validation has been done where the NRSTs were developed. Sensitivity is decreased when MST>1 or ≥3, thus causing unnecessary dietetic consultations (1).
MUST	Adult hospitalised patients (3)	Three-question tool: BMI, unintentional weight loss, acute disease effect (3)	MUST score: 0-low risk, 1-medium risk, ≥2-high risk	Requires less specialised training (4)	Overestimates high nutritional risk since the presence of disease is automatically generated as a MUST score of 2. Also happens in patient populations with significant oedema and ascites due to BMI overestimation (4). Underestimates medium nutritional risk. Complex tool which overestimates nutritional risk in patient populations with significant oedema and ascites which increase

Screening tool	Target population	Parameters used risk scores	Risk scores	Advantages	Limitations
					BMI and weight loss Systematic review by (2) revealed MUST validity studies did not reach criteria of clinically relevant sensitivity and specificity
NRS-2002	Adult hospitalised patients (5).	Initial screening phase: (BMI, recent unintentional weight loss, reduced dietary intake, severity of illness) impairment of nutritional status) final screening phase (impaired nutritional status, severity of disease (5). An additional section is old age for patients older than ≥70 years due to the nutritional frailty in this age-group	NRS<3-not at nutritional risk, NRS≥3-at nutritional risk	Preferred tool in European hospital settings (1, 6) Because it has a higher feasibility than the MNA, the NRS-2002 is an alternative NRST for the MNA for elderly patients where problems of feasibility are likely. Acknowledges the role of disease state in hospital malnutrition. Highly specific because it allows for the gradation of disease effect from a score of 0-3.	Except initial retrospective development and revalidation RCT, very few RCT conducted to evaluate the NRS-2002's ability to identify patients who will benefit from nutrition intervention (5, 7, 9). Underestimates risk just like the MUST (8, 10).

Screening tool	Target population	Parameters used risk scores	Risk scores	Advantages	Limitations
SGA	Adult hospitalised patients (12)	9-item questionnaire: weight loss, dietary intake changes, gastrointestinal symptoms lasting>two weeks, functional impairment, loss of subcutaneous fat, loss of muscle mass, presence of ankle/sacral oedema /ascites) (11-12, 14).	SGA A-well-nourished, SGA B- moderately malnourished., SGA C-severely malnourished (12)	Used as a surrogate gold standard due to extensive evidence of its validity (15) Alternative method for the MNA /MNA-SF since the SGA correlates strongly with these tools (16). Better predictive ability of postoperative infections than objective measures which are confounded by disease severity and treatment (16) The SGA is the most useful tool at detecting established malnutrition (12, 17). Systematic analysis showed the SGA demonstrated a good predictive ability of patient outcomes in almost half of the studies but not in geriatric patients (18). Captures subtle patterns of change in clinical parameters *e.g*. rate of weight loss over a time frame is weighted higher than absolute degree of weight loss (12).	Requires specialised training (12-13). Fails to categorise mild malnutrition or acute nutritional changes (12). The SGA might rather represent an index of sickness and has not been predictive of nutrition-associated complications (8).

Screening tool	Target population	Parameters used risk scores	Risk scores	Advantages	Limitations
MNA	Elderly (19)	Full MNA is 18-item questionnaire (19): dietary intake changes, weight change, mobility, psychological stress or acute disease, neuropsychological problems, BMI, amount of full meals per day, consumption markers for protein intake, amount of fruit and vegetables, amount of fluid, mode of feeding, perception of nutritional status, self-view of own health in comparison with other people, MUAC, calf circumference MNA-SF uses the 6 most correlated questions of the full MNA questionnaire (20). The MNA comprises anthropometry, general assessment, dietary assessment and subjective assessment.	MNA score<17 points-malnourished MNA score, 17-23.5 points-at risk of malnutrition	Shown good diagnostic accuracy in several geriatric studies because the MNA includes physical, mental and dietary parameters that are known to affect the nutritional status of the elderly (18-19). Detects risk of malnutrition at an early stage and evaluates nutritional status during and after hospitalisation.	The MNA does not apply to patients fed enterally and has not been validated in the non-geriatric population (19, 21). Found to be the least feasible NRST due to comprehensiveness of questionnaire in real-life hospital setting where patients may be severely ill, demented or unconscious (22) Earlier diagnostic studies were conducted only in frail patients, limiting evidence of its validity (19, 21).
SNAQ	Adult hospitalised patients	Three-item questionnaire: unintentional weight loss, appetite loss in past month, use of supplemental drinks or tube feeding in past month (23)	SNAQ score: 0 or 1 point-well-nourished, 2 points-moderately malnourished, ≥3 points-severely malnourished	Systematic review by (2) rated both SNAQ and MST as the quickest and easiest NRST with highest diagnostic accuracy and diagnostic gain (50%).	Limited relevance in low-resource settings where provision of nutrition support is non-existent

NRST-Nutritional Risk Screening Tool(s), MST-Malnutrition Screening Tool, MUST-Malnutrition Universal Screening Tool, MNA-Mini-Nutritional Assessment, PG-SGA- Patient-Generated Subjective Global Assessment, LOS-Length of Stay, BMI-Body Mass Index, MNA-Mini-Nutritional Assessment, MNA-SF-Mini Nutritional Assessment Short-From, SNAQ-Short Nutritional Assessment Questionnaire, NRI-Nutritional Risk Index,NRS-2002-Nutritional Risk Screening Tool-2002, GI-gastrointestinal, MUAC-Mid-Arm Circumference

(1)-Ferguson *et al.*, 1999, (2)-van Venrooij *et al.*, 2011,(3)-Stratton *et al.*, 2004, (4)-Stratton, 2005, (5)-Kondrup *et al.*, 2003b, (6)-Cederholm *et al.*, 2017, (7)-Johansen *et al.*, 2004, (8)Kyle *et al.*, 2006, (9)-Mercadal-Orfila *et al.*, 2012, (10)-Poulia *et al.*, 2012, (11)- Baker *et al.*, 1982b, (12)-Detsky *et al.*, 1987, (13)-Detsky *et al.*, 1984, (14)-Shirodkar & Mohandas, 2005, (15)-Platek *et al.*, 2015, (16)-Raslan *et al.*, 2010), (17)-Christensson *et al.*, 2002, (18)-Guaitoli *et al.*, 2014, (19)-Guigoz *et al.*, 1997, (20)-Rubenstein *et al.*, 2001, (21)-Guigoz *et al.*, 2006, (22)-Bauer *et al.*, 2005, (23)-Kruizenga *et al.*, 2005a

They concluded that none of the 32 screening tools they identified performed consistently well in individual studies under review were vast and the authors could not make unequivocal conclusions. Because the results of the previous review were carried out with various reference methods and population types, Platek et al. (2015) systematically reviewed all NRSTs that had previously used only the SGA as a reference standard and in just the medical or surgical setting. Screening tools that incorporate biochemical measures such as serum albumin in the NRI which are well known to be affected by disease and treatment, were excluded from the review (Bouillanne *et al.*, 2011; Platek *et al.*, 2011). The tools that had good specificity (>80%) were the MUST, NRS-2002 and the MST, though sensitivity was variable in all the studies (Platek *et al.*, 2015). The authors concluded that these tools could be considered in the adult acute care setting but admitted the SGA may not be entirely suitable as a "gold standard" since no general consensus had been reached. Other available published data that tested the performance of NRS-2002 in comparison with other screening tools show that NRS-2002 is better when compared with the MUST at predicting clinical outcomes in hospitalised patients and even best when combined with the SGA (Raslan *et al.*, 2010; Raslan *et al.*, 2011).

In an earlier evaluation of the 11 most valid and simple NRSTs for the hospital setting, the NRS-2002 was the only tool to receive a grade 1 recommendation for use in the hospital setting (Skipper *et al.*, 2012). Four tools, the Simple Two-Part Tool, MNA-SF, the Malnutrition Screening Tool (MST) and MUST received a grade II whilst the other seven received a grade III or V. The reliability of the NRS-2002 in the three studies, however, could not be determined since this data was not available (Bauer *et al.*, 2005; Kyle *et al.*, 2006). An earlier systematic review by van Venrooij *et al.* (2011) was limited to "quick and easy tools" and therefore the NRS-2002, MUST, SGA and the MNA were excluded from the review. Earlier reviews have been made on screening tools but the reviewers stated only the uses of the NRST but did not give ratings on the best NRSTs for the hospital setting (Green & Watson, 2005; Mueller *et al.*, 2011).

The ESPEN recently proposed a new definition for malnutrition using criteria defined out of expert opinion (Cederholm *et al.*, 2015; Kondrup *et al.*, 2003b). ESPEN's new assessment guidelines define malnourished patients using either of two options; option one requires the malnourished patient having a BMI<18.5 kg/m^2 whilst option two requires the combined finding of a mandatory involuntary weight loss>10% (indefinite of time) or 5% (in 3 months) and at least one of either low FFMI (below <15 and <17 kg/m^2 in females and males respectively) or a reduced BMI<20 kg/m^2 or <22 kg/m^2 for patients younger and older than 70 years respectively. These new criteria changed the basis on which a screening strategy could be evaluated. In light of this, the two most popular NRSTs, the NRS-2002 and MUST, were compared with these

criteria to test their diagnostic accuracy in the hospital setting (Poulia *et al.*, 2016). The MUST was better correlated with the ESPEN criteria as it identified 14.9% malnourished patients whilst the ESPEN criteria identified 11.3% malnourished patients as compared with the NRS-2002 (27.9% medium-risk patients). The chances of giving a positive malnutrition screening result with the NRS-2002 was therefore high (sensitivity=61, specificity=76.3, low predictive value= 24.8%. The agreement between the MUST and the new ESPEN criteria was perfect (k=0.843, p<0.001) whilst that between NRS-2002 and the new ESPEN criteria was poor (k=0.228, p<0.001). Likewise, receiver operating characteristic (ROC) plots and area under the curve (AUC) were higher for MUST (0.980) compared with the NRS-2002 (0.686). The authors established that the MUST was more suitable for identifying malnourished patients in hospital. One must bear in mind that these new ESPEN criteria have not been subjected to comprehensive validity studies and moreover, include only objective measurements; therefore, their use as a reference standard in this study may be divergent from the NRS-2002, which is more sensitive to nutritional changes and includes more subjective measurements than the MUST.

In a systematic review conducted in colorectal patients and another performed in an elderly population which compared the diagnostic accuracies of five screening tools, the authors suggested the MUST as the screening tool of choice for identifying malnourished patients (Håkonsen *et al.*, 2015; Poulia *et al.*, 2012). A possible reason for the differing performances of the NRS-2002 and the MUST may be the differences in the original intents of these tools. The NRS-2002, which was originally developed to screen nutritionally at-risk patients that could benefit from nutritional support in these studies, identified a large number of patients, both medium and at-risk patients who could benefit from nutritional support (Kondrup *et al.*, 2003b). The MUST, on the other hand, is the only tool designed to screen malnourished patients and so may give a better reflection of patients that are malnourished (Elia, 2003; Stratton *et al.*, 2004). In a population-based study which tested performances of the NRS-2002, the MUST and another tool, the NRI, the NRS-2002 appeared to have a higher sensitivity, specificity and predictive validity than the MUST and the NRI. Correia & Waitzberg (2003) argue that the NRS-2002 has a higher specificity than the MUST because it grades disease severity more accurately whereas acutely ill patients are automatically classified as being at nutritional risk by the MUST (Kyle *et al.*, 2006). The MUST therefore seems to overestimate high nutritional risk and underestimate medium nutritional risk.

The SGA did not seem feasible for consideration in the current study. It requires specialised training for use and a long time is needed to complete the tool, which required full involvement of the patient compared with the other four tools presented in Table 2-2 (Detsky *et al.*, 1987).

The MNA has not shown compelling evidence for use in younger populations but has relevance in the elderly population (Bauer *et al.*, 2005; Cansado *et al.*, 2009; Martins *et al.*, 2006; Persson *et al.*, 2002; Sánchez-Muñoz *et al*., 2010; Van Nes *et al.*, 2001; Visvanathan *et al.*, 2004). Moreover, usability of this tool is low (Bauer *et al.*, 2005). The MST and MUST lack variables which are relevant in holistically assessing poor nutritional risk in hospitalised patients *i*.*e*. BMI, age or disease severity. These were therefore excluded from use in the present study. From the argument presented and the evidence provided from the three systematic reviews conducted on NRST for use in the general hospitalised population so far, the NRS-2002 was the most suitable to meet the aims and objectives of the current study (Guaitoli *et al.*, 2014; Platek *et al.*, 2015; Skipper *et al.*, 2012).

2.6.1 Nutritional Risk Screening-2002 Tool (NRS-2002)

2.6.1.1 Development and validation

The NRS-2002 was developed by an ESPEN working group in 2001 and 2002 (Kondrup *et al.*, 2003b). It was developed on the premise that the development of malnutrition in disease occurs as a result of the severity of disease and the corresponding increase in nutrition requirements that results because of disease. Therefore this tool detects malnutrition and the risk of developing malnutrition in the hospital setting. It is recommended by ESPEN and the Chinese Society for Parenteral and Enteral Nutrition (CSPEN) for use in all hospital settings and is widely accepted in hospitals throughout Europe (Sorenson *et al*., 2008; Sun *et al.*, 2016).

The developers of this tool retrospectively analysed all published RCTs (n=128) that provided nutrition support to establish whether nutritional support had a positive or neutral effect on clinical outcome (Kondrup *et al.*, 2003b). The variables of this tool that were used to define nutritional risk were BMI, recent weight loss and current changes in food intake. These variables are commonly used in NRSTs and are associated with clinical and functional outcomes. A comprehensive validation study was undertaken involving 128 controlled trials (n=8944 hospitalised patients) to ascertain the effect of nutrition intervention on clinical outcomes of patients. Patients were graded according to the NRS-2002 and clinical outcomes were studied to determine if the NRS could reliably predict them. An additional score of 1 was allocated to elderly patients (≥70 years) since age-associated frailty was associated with the development of malnutrition. Its content validity was maximised by involving the ESPEN working group in the validation (Kondrup *et al.*, 2003b).

In developing and validating the NRS-2002, the authors reported anticipated missing data from measurements of height and weight or information on weight loss (Kondrup *et al.*, 2003b). They

suggested the use of Mid-Upper Arm Circumference (MAC) as way to obtain missing BMI data but this was difficult since they could not find all the different BMI and MUAC categories in the RCTs reports to establish a cut-off of MUAC to estimate BMI (Kondrup *et al.*, 2003b). When determining the interrater reliability of the NRS-2002, the NRS-2002 has demonstrated good to perfect reliability of a kappa value of 0.67 between a nurse, a dietitian, and a doctor and 0.76 between 28 doctors (Kondrup *et al.*, 2002; Sorensen *et al.*, 2008). A current study has reported a fair kappa value of 0.303 between surgeons and nutrition specialists in a retrospective study (Benoit *et al.*, 2016). Misclassifications of patients occurred by 55% of the surgeons highlighting the need to train users of this tool.

2.6.1.2 Components of the NRS-2002

The NRS-2002 comprises a pre-screening phase and a final screening phase (see Table 2-3)(Kondrup *et al.*, 2003b). The initial screening phase determines the patient's BMI, recent unintentional weight loss and reduced food intake combined with a subjective assessment of disease severity which is based on increased nutritional needs and/or metabolic stress (Kondrup *et al.*, 2003b). If the answer is ''yes'' to any question, the final screening should be performed. If the answer is ''no'' to all the questions, the patient is re-screened on a weekly basis.

Table 2-3: Nutritional Risk-Screening (NRS-2002)

<table>
<tr><th colspan="4">Nutritional Risk Screening (NRS)</th></tr>
<tr><td colspan="4">Initial screening</td></tr>
<tr><td colspan="2"></td><td>Yes</td><td>No</td></tr>
<tr><td colspan="2">Is BMI<20.5?
Has the patient lost weight within the last 3 months?
Has the patient had a reduced dietary intake in the last week?
Is the patient severely ill? (e.g. in intensive therapy)</td><td></td><td></td></tr>
<tr><td colspan="4">Yes: If the answer is ‘Yes’ to any question, the screening in table II is performed
No: If the answer is ‘No’ to all questions, the patient is re-screened at weekly intervals. If the patient e.g. is scheduled for a major operation, a preventative nutritional care plan is considered to avoid the associated risk status</td></tr>
<tr><td colspan="4">Final screening</td></tr>
<tr><td colspan="2">Impaired nutritional status</td><td colspan="2">• Severity of disease (Increase in requirements)</td></tr>
<tr><td>Absent Score 0</td><td>Normal nutritional status</td><td>Absent Score 0</td><td>Normal nutritional requirements</td></tr>
<tr><td>Mild Score 1</td><td>Weight loss>5% in 3 months or food intake below 50-75% of normal requirement in preceding week</td><td>Mild Score 1</td><td>Hip fracture*Chronic patients, in particular with acute complications: cirrhosis*, COPD*, Chronic haemodialysis, diabetes, oncology</td></tr>
<tr><td>Moderate Score 2</td><td>Weight loss>5% in 2 months or BMI 18.5-20.5 + impaired general condition or food intake 25-60% of normal requirement in preceding week</td><td>Moderate Score 2</td><td>Major abdominal surgery*Stroke*Severe pneumonia, haematologic malignancy</td></tr>
<tr><td>Severe Score 3</td><td>Weight loss>5% in 1 month (>15% in 3 months) or BMI>18.5 + impaired general condition or food intake 0-25% of normal requirement in preceding week</td><td>Severe Score 3</td><td>Head injury*Bone marrow transplantation*Intensive care patients (APACHE>10)</td></tr>
<tr><td>Score</td><td></td><td>Score</td><td>Total score:</td></tr>
<tr><td colspan="4">Score≥3: the patient is nutritionally at-risk and a nutritional care plan is initiated.
Score<3: weekly rescreening of the patient. If the patient e.g. is scheduled for a major operation, a preventative nutritional care plan is considered to avoid the associated risk status.</td></tr>
<tr><td colspan="4">*indicates that a triad directly supports the categorisation of patients with that diagnosis</td></tr>
</table>

*COPD-Chronic Obstructive Pulmonary disease

Adapted from Kondrup *et al.* (2003b)

The second phase of screening covers two main aspects, namely nutritional status and disease state. In the “impairment of nutritional status” section, a score is allocated for the variable (recent weight loss, recent reduction in food intake and BMI) that is the most affected. For example, a reduced food intake of 0-25% of usual requirements will be scored worse than a BMI of between 18.5-20.5 kg/m^2. For “severity of disease”, the patient is scored according to the illness and the severity of the illness. This means that a patient with a particular diagnosis will

not always belong to the same category; for instance, a patient with stroke who is admitted to intensive care should be given a score of 3 instead of 2. It is meant to reflect increases in protein needs caused by the stress metabolism. Generally, patients with chronic disease with one or more complications fall into the mild category, for which a score of 1 is given. They are weak but can walk and their nutrient needs can be covered by oral diet or by oral supplementation. Patients that are confined to bed due to illness and whose protein requirements are substantially increased so that artificial feeding is required fall into the "moderate" category. Finally, a score of 3 or a "severe category" should be allocated to a patient who is in intensive care requiring ventilation and whose protein requirements cannot be met even by artificial feeding. If the diagnosis is not captured in the NRS-2002 table, then clinical judgement must be used to score the patient's severity of illness. This may be ambiguous and present challenges for the clinician since disease types and acuity may vary by patients' energy and protein requirements (Joint WHO/FAO/UNU Expert Consultation, 2007; Trumbo *et al.*, 2002). It has previously been described that overall energy requirements are normal or decreased rather than increased in most disease conditions. For patients aged >70 years, an additional point of 1 is added to the worse nutritional status and disease status aspects (Kondrup *et al.*, 2003b).

A score of or equal to 3 up to a maximum score of 7 indicates a risk of malnutrition, which indicates the need to start nutritional support. Patients with scores of 0-2 should be rescreened weekly to monitor their nutritional status. Some studies stratify the scores further to give greater attention to those at a higher risk as follows; no risk=0; low risk=0-1, medium risk=3-4 and high risk=>5 (Kyle *et al.*, 2006). The NRS-2002 tool therefore does not give a definitive diagnosis of malnutrition but signifies risk of malnutrition for further assessment by the clinical dietitian (Ukleja *et al.*, 2010).

2.6.1.3 Validity studies

One main strength of the NRS-2002 is that it was developed and validated for predictive ability (Kondrup *et al.*, 2003b). Additionally, a score above 3 may be an indication for nutritional support to patients identified as being at nutritional risk. In the comprehensive validation study of this tool, which included all published RCTs (n=8944 hospitalised patients) of the effect on clinical outcomes of nutritional support versus no nutritional support or spontaneous food intake. Patients identified as being at nutritional risk using the NRS-score of ≥3 had an increased likelihood of benefiting from nutritional support compared with those that were not at nutritional risk (Kondrup *et al.*, 2003b). The patients in these trials were a clinically heterogenous group including surgical, ICU, cirrhotic and long-term care patients. The observed outcomes included reduced LOS among patients, reduced rate of complications or infections or improved

mobilisation. Several studies have also confirmed the predictive validity of the NRS-2002 as it has been shown to predict LOS, the development of moderate and severe complications, the development of post-operative complications and mortality (Kyle *et al.*, 2006; Martins *et al.*, 2006; Raslan *et al.*, 2010; Raslan *et al.*, 2011; Schiesser *et al.*, 2008; Sorensen *et al.*, 2008; Thomas *et al.*, 2016).

Few studies have reported a negative predictive validity of the NRS-2002 on clinical outcomes. In one such study, the performance of various tools, including the NRS-2002, the SGA and routine clinical laboratory measurements such as hypoalbuminaemia and anaemia were tested for predicting adverse outcomes amongst surgical and medical Chinese inpatients (n=991) against a combined index of all the tools as a reference standard (Chen *et al.*, 2015). NRS-2002 exhibited perfect sensitivity and negative predictive value but poor specificity and positive predictive value after adjusting for confounders. The authors concluded that the NRS-2002 may rather be a global indicator of disease severity since a high nutritional risk, NRS≥3 was reflected in abnormal laboratory measures. In this study, it was rather the degree of nutritional support provided to the patient, some abnormality of laboratory measures such as hypoalbuminaemia, the use of radiotherapy or chemotherapy and abnormal liver and renal function tests that predicted adverse outcomes. The authors recommended that the NRS-2002 be used more frequently during hospitalisation to improve the predictive ability of the NRS-2002 on patient outcomes as nutritional risk changes rapidly during hospitalisation. In a geriatric study, LOS was significantly predicted by MNA whereas the NRS-2002 or SGA failed to predict LOS (Bauer *et al.*, 2005).

In the EuroOOPS study, individual components of the NRS-2002 were found to be significantly associated with outcomes such as LOS and the odds for complications (Sorensen *et al.*, 2008). Significant association remained after adjusting for confounding variables, such as disease speciality, diagnoses, comorbidity, complications and discharge destination. Variables associated with a longer LOS or being discharged after 28 days included at-risk status, age≥70 years, cancer, comorbidity and complications (OR for each~0.74) but not severity of disease.

Validity studies of NRST that include RCTs to evaluate the independent predictive value of NRST are considered of a higher quality, as discussed earlier in section 2.61.1 (Elia & Stratton, 2011). In a RCT of 212 study participants, the NRS-2002 was used to identify nutritional risk and the patients were randomly assigned to either an intervention or control group (Johansen *et al.*, 2004). The control group received standard nutritional care whereas the intervention group received more comprehensive specialised nutritional treatment. The two groups were then followed up for outcomes such as rates of complications, LOS and quality of life. The authors found that LOS was significantly reduced by six days for patients with complications in the

intervention group (Johansen *et al.*, 2004). Similarly, another RCT (n=132 at-risk patients) found better outcomes, namely better nutritional status and quality of life, low complication rates and low readmissions rates in the intervention group (Starke *et al.*, 2011). The NRS-2002 is therefore unique in the sense that it has been validated by two RCTs. Another prospective study, though not a RCT (n=525 at-risk cohort), found lower occurrences of complications, particularly infectious complications, in the at-risk group that was put on nutritional support (Jie *et al.*, 2010). In a Cochrane review by Feinberg *et al.* (2015), however, the reported improvements in outcomes in nutrition intervention studies are not convincing since these studies are few and introduce bias and design errors in terms of allocation concealment, blinding and selective outcome reporting. A systematic review of the evidence is underway.

An almost perfect agreement has previously been seen between the NRS-2002 and SGA (κ=0.853) (Almeida *et al.*, 2012). In comparison with other NRSTs including the SGA, the NRS-2002 has shown moderate agreement with the SGA (κ=0.56) and an excellent criterion validity defined by conventional BMI and unintentional weight loss cut-offs (Neelemaat *et al.*, 2011; Raslan *et al.*, 2011). Other studies have shown slight to fair agreement ranging from 0.24 to 0.62 when comparing the NRS-2002 with SGA as a reference standard (Kim *et al.*, 2011; Kyle *et al.*, 2006; Velasco *et al.*, 2011). In a head and neck cancer cohort, the NRS-2002 performed almost as well as the Patient-Generated Subjective Global Assessment (PG-SGA) as the NRS-2002 showed a specificity of 77% and 98% sensitivity with substantial agreement between the tools (κ=0.78) (Orell-Kotikangas *et al.*, 2015). Fair concordance was observed (κ=0.286) in a comparison of agreement between the NRS-2002 and BMI (de Magalhães Cunha *et al.*, 2015). Corroborating this, Planas *et al.* (2016) observed that an oncology cohort group that was at nutritional risk still showed normal BMI values. No study has yet assessed the agreement between the NRS-2002 and the recent ESPEN diagnostic criteria but the findings of these two studies give an indication that there may be poor concordance between the NRS-2002 and the recent ESPEN diagnostic criteria for malnutrition, which include a low BMI cut-off<18.5 kg/m^2.

The NRS-2002 has been used in many studies to determine the nutritional status of general hospitalised patients (Cabré *et al.*, 2015; Kyle *et al.*, 2006; Ulibarri *et al.*, 2005). Additionally, the diagnostic accuracy of the NRS-2002 has been tested in a statistical comparison of three prospective studies that evaluated three other tools NRI, MUST and CONUT using the SGA as a reference standard (de Ulíbarri Pérez, 2014; Kyle *et al.*, 2006; Ulibarri *et al.*, 2005). The NRS-2002 had the highest specificity (93%) though it fared poorly with regard to sensitivity (62%) while its predictive value on prognosis was good (>80%). The high specificity observed in this study by the NRS-2002 may be attributable to the gradation of disease effect (scores 0-3) that the NRS-2002 allows (Correia & Waitzberg, 2003). More markedly, in a population-based study

by Kyle *et al.* (2006) of mixed medical and surgical inpatients, the NRS-2002, MUST and NRI were evaluated using the SGA as a reference standard. The NRS-2002 had the best test performance (sensitivity, 62%; specificity, 93%; positive predictive validity, 85%; negative predictive validity, 79%) and predicted LOS. The MUST similarly predicted LOS>11 days but had a less impressive test performance (sensitivity, 61%; specificity, 76%; positive predictive validity, 65%; negative predictive validity, 76%). With the NRI tool, test performance was as follows; sensitivity, 43%; specificity, 89%; positive predictive validity, 76%; negative predictive validity, 66%. Whereas the NRS-2002 misclassified 26.6% of patients, the MUST misclassified 41.5% of the patients. The NRI misclassified 31% of patients mainly because it does not include recent dietary intake as a component in the diagnosis of malnutrition. Though the NRI includes body weight in the diagnosis of nutritional risk, body weight may not manifest in the short-term to reveal nutritional risk as much as recent dietary intake changes does (Kyle *et al.*, 2006). Raslan *et al.* (2010) has earlier described the NRS-2002 as a "remarkably powerful nutritional screening tool" because it performed best among other NRSTs in predicting clinical outcomes and recommended it strongly for Brazilian hospital settings. In this study, the predictive validity of the tools was as follows: NRS-2002 (complications: 0.6531; very long LOS: 0.6508; death: 0.7948), MNA-SF (complications: 0.6495; very long LOS: 0.6197; death: 0.7583) and MUST (complications: 0.6036; very long LOS: 0.6109; death: 0.6363). The NRS-2002 was rated higher than the MNA and MUST, though the differences were very small (Raslan *et al.*, 2010).

The prevalence of malnutrition found using the NRS-2002 in previously conducted studies ranges from 11-87% (Bauer *et al.*, 2005; Christner *et al.*, 2016; Imoberdorf *et al.*, 2010; Korfalı *et al.*, 2009; Raslan *et al.*, 2011; Sorensen *et al.*, 2008). Owing to heterogeneous patient populations with diverse disease conditions and acuities and different hospital departments within and between studies, the end result is wide variations in nutritional risk. This was typified in a large national Turkish study where nutritional risk was more common to almost half of medical oncology patients (43.4%) whilst it was lowest in the ear, nose and throat speciality (3.9%) (Korfalı *et al.*, 2009).

2.6.1.4 Feasibility and applicability

Even though some literature describes the NRS-2002 as a complex tool, the NRS-2002 is generally rated by many as a feasible and simple tool in clinical practice (Gur *et al.*, 2009; Poulia *et al.*, 2012; Young *et al.*, 2013). The ESPEN recommends the usage of the NRS-2002 within 48 hours after admission to determine the risk of malnutrition (Cederholm *et al*., 2015). Several studies have detailed the rate of successful screenings in their patient populations when administering the NRS-2002 (Liang *et al.*, 2009; Sorensen *et al.*, 2008). In a large, international, multicentre study of 5,051 patients, it was possible to screen 99% of 750 newly admitted

patients by almost all the doctors (28 out of the 30 doctors) in a short time (Kondrup *et al.*, 2002; Sorensen *et al.*, 2008). This effect was again observed in a comparative study of three tools (MNA, SGA and NRS-2002) for ease in completing procedures (Bauer *et al.*, 2005). The NRS-2002 was completed in 98.3% of the study population whilst a lesser coverage was derived for the other tools, for as low as 66.1% for the MNA. The SGA was completed in 99.2% of study participants.

These serve to demonstrate the practicality and usefulness of this tool for health professionals and various patient populations such as the elderly population, who may be less alert and frail than the general population. It is noteworthy that most previously conducted NRS-2002 studies were carried out in general hospitalised patients and excluded patients that were demented, critically ill patients or patients who could not communicate effectively or were not well oriented to place and time; otherwise the rate of failed screenings would probably be higher (Bauer *et al.*, 2005; Jie *et al.*, 2010; Raslan *et al.*, 2011). Failed screening due to missing data (mainly a lack of clarity about the NRS-2002, missing anthropometric measurements) has been reported between 1% and 7% of users of the NRS-2002 tool (Christner *et al.*, 2016; Liang *et al.*, 2009; Sorensen *et al.*, 2008). Even in the unpublished South African ICU observational study where the NRS-2002 has been used, the rate of successful screening has been impressive: 169 (82%) within 48 hours of admission (Blanckenberg *et al*., 2012).

Clear guidelines for implementing the NRS-2002 are provided by the tool (See Figure 2-5) (Kondrup *et al.*, 2003b). One setback with this tool is the BMI component which makes it a complex tool since it involves calculations and, especially in cases when patients have oedema or ascites, this could lead to an underestimation of nutritional risk if body weight adjustments are not made for oedema (Kyle *et al.*, 2006; Sorensen *et al.*, 2008); specialised training will therefore be needed. Nevertheless the option of choosing between the use of BMI and weight change makes the NRS-2002 a flexible tool. It is a fast tool since nutrition screening can be completed in less than 10 minutes (Guo *et al.*, 2010; Velasco *et al.*, 2011).

The NRS-2002 has been studied in numerous groups of the general hospitalised population. These include elderly, oncology, cardiac, elective surgery and gynaecology patients (Christner *et al.*, 2016; Guo *et al.*, 2010; Jayawardena *et al.*, 2016; Liang *et al.*, 2009; Sorensen *et al.*, 2008). The NRS-2002 has been validated for the Chinese population (Jie *et al.*, 2010; Liang *et al.*, 2009; Pan *et al.*, 2013; Thomas *et al.*, 2016). A recent systematic review and meta-analysis in patients undergoing abdominal surgery (n=3527) has shown that patients defined as being at preoperative nutritional risk by the NRS-2002 have greater complication rates, high mortality and prolonged hospital stay after surgery (Sun *et al.*, 2015).

2.7 Conclusion

The NRS-2002 was designed originally to identify patients who were at nutritional risk and were expected to benefit from nutritional support (Kondrup *et al.*, 2003b). Most studies, however, use it solely for the purpose of assessing patients' nutritional status. This is because obvious ethical reasons make it difficult in RCT to withhold supplementation in human subjects who are nutritionally at risk merely on the basis of being in the control group to confirm the predictive validity of the NRS-2002 (Guaitoli *et al.*, 2014). Furthermore, a systematic review and meta-analysis of RCTs on adjuvant parenteral nutrition versus no parenteral nutrition done on behalf of the American Gastroenterological Association showed that the increased risks of complications, death and infections such as sepsis from some nutrition support trials compounded by high logistics make the conduct of these studies an impossibility (Koretz *et al.*, 2001). However, the validity of this conclusion has been questioned as these studies were conducted in the past century and did not have relevance as regards the type of nutrition support and also because malnutrition/ aphagia was not the only inclusion criteria. Anticipating these challenges, the NRS-2002 was developed and validated retrospectively from an analysis of 275 studies from 128 RCT and a separate controlled clinical trial that reported on the effectiveness of nutritional intervention in hospitalised patients (Johansen *et al.*, 2004; Kondrup *et al.*, 2003b). The authors classified patients as being nutritionally at risk (NRS≥3) or not at nutritional risk (NRS<3). At the end of the analysis, there was evidence to suggest that nutritionally at-risk patients identified by the NRS-2002 benefited more from nutritional intervention than patients that were not at nutritional risk.

The NRS-2002 tool takes into account undernutrition caused by inadequate food intake and uptake as well as the increased nutrient requirements brought about by stress metabolism in disease which makes this NRST unique and holistic (Kondrup *et al.*, 2003b). The endorsement of the NRS-2002 by ESPEN for use in hospitals and its rigorous validation together with its prediction of patients that would benefit from nutritional support in RCT and its overall superior performance against other tools motivated the choice of this tool in this research (Bauer *et al.*, 2005; Cederholm *et al.*, 2015; Johansen *et al.*, 2004; Kondrup *et al.*, 2003b).

The impact nutritional status has on various clinical outcomes of hospitalised patients can be assessed by how changes in nutritional risk, both declines and improvements, influence these outcomes. This data is virtually absent in the Ghanaian population. In conclusion, it is clear that the problem of malnutrition in disease represents a global health challenge compounded by the lack of a standard definition, the poor identification and treatment of malnutrition and the impact this has on the health outcomes of the patient

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CHAPTER THREE: ARTICLE

PREVALENCE AND CONSEQUENCES OF HOSPITAL ASSOCIATED MALNUTRITION AT A TEACHING HOSPITAL IN GHANA

CHAPTER THREE: ARTICLE

3.1 Title page

Prevalence and consequences of hospital associated malnutrition at a teaching hospital in Ghana

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Authors and guest editors must disclose specific information relating to any financial relationship they may have with a sponsoring organization and any interest that organisation presents, as well as with any for-profit product discussed or implied in the text of the article. Helpful guidelines related to disclosure statements have been published by the International Committee of Medical Journal Editors.

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The summary should contain not more than 250 words and must be structured (see December 2004 issue of the journal). The Summary should state:

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Participants - who, how selected, what entry and exclusion criteria, how many entering and completing the study;

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The Ghana Medical Journal is published quarterly. Subscription price: GH¢20.00 per annum for Ghanaian subscribers and 50US dollars per annum for other subscribers.

3.3 Summary

Objective: Malnutrition rates amongst hospitalised adult patients present a significant public health burden. This study formed part of a multi-country study determining the prevalence of risk of malnutrition in hospitalised patients at admission and discharge and assessed its association with length of stay (LOS), complications, hospital readmissions and mortality.

Design: Descriptive, observational, cross-sectional study.

Setting: Five inpatient adult wards at the Korle Bu teaching hospital (KBTH) in the Greater Accra Region of Ghana between January to June 2016.

Participants: 402 newly admitted adult patients were eligible for recruitment and were enrolled into the study. Eligibility was on the basis of being an adult patient (≥18 years old) that had been admitted within the past 48 hours to either of the 5 in-patient departments at the KBTH. Patients were not eligible for recruitment if they were critically ill, demented, incapable of communicating effectively with the study personnel, pregnant or lactating, burns or accident victims, on dialysis or expected to have a short LOS less than 48 hours. One hundred and seventy two of the recruited participants stayed for longer than 7 days and were interviewed at the discharge phase of the study. The number of available study participants one-month after discharge was 133.

Interventions: The Nutritional Risk Screening Tool-2002 (NRS-2002) was used to assess the malnutrition risk of patients within 48 hours after admission. Patients that stayed for more than seven days were screened again for nutritional risk at discharge and followed up telephonically one month after discharge.

Main outcome measures: The main outcome measures in this study were prevalence of risk of malnutrition, LOS, complications, mortality and hospital readmissions. The association between nutritional risk and these outcomes were determined.

Results: Of the 402 study participants, 71.4% (n=287) were identified as at nutritional risk. Nutritionally at-risk patients had a significantly longer LOS compared with those not at nutritional risk (9.8 days versus 5.2 days, $p<0.001$). Majority of these clinical outcomes were significantly associated with being at nutritional risk; complications during hospitalisation (7.8% versus 0%, $p=0.002$), mortality during hospitalisation ($p=0.002$) and mortality one month after discharge (8.1% versus 0%, $p=0.002$). However, the rates of complications one month after discharge were not significantly different between both nutritional risk groups ($p=0.625$). Additionally, significantly greater readmission rates occurred in those that were not at nutritional risk

compared to those at nutritional risk (10% versus 8.9%, p=0.012). The prevalence of malnutrition risk at discharge (n=172) was the same as at admission. Only 8 nutritional at-risk patients were referred to see a dietitian.

Conclusions: A high proportion of adult patients in this study were at risk of malnutrition and this was associated with a prolonged LOS and other adverse clinical outcomes. There is a need to support nutritional screening, and the immediate referral of at-risk patients for dietetic services to optimise health outcomes in this group.

Keywords

Hospital malnutrition, nutritional risk, NRS-2002 screening tool, length of stay, complications, mortality

TITLE: HOSPITAL-ASSOCIATED MALNUTRITION IN GHANA

3.4 Introduction

Almost forty years ago, the first reports of malnutrition and its deleterious effects on hospitalised patients were brought to the attention of the medical community in the landmark article, 'Skeleton in the hospital closet' (1). Medical professionals seldom paid attention to the nutritional status of their patients and this was accompanied by a host of other malpractices such as unnecessary fasting periods before surgical procedures, the lack of assistance in feeding patients and poor record keeping of patients' food intake (1-4). Moreover, disease had a complex impact on nutritional status, thereby worsening the already high rates of malnutrition in the hospital (2). The problem of hospital malnutrition remains relevant to this day as the global prevalence rates from developed countries range between 20-60% (3-6). Malnutrition has been independently associated with slower response to treatment, higher complications rates, higher hospital costs, a prolonged length of stay (LOS), more readmissions and high mortality (3, 6-9). By the time of discharge, the nutritional status of patients irrespective of nutritional status at admission generally deteriorates further (10). Additionally, an increased risk of complications and higher hospital costs have been associated with patients who have experienced declines in nutritional status (11).

Though the prevalence of nutritional risk/malnutrition is widespread in hospitals, the available literature has shown that its identification is poor (12, 13). Compounding this problem is the lack of a standard diagnostic criterion for malnutrition (14, 15). The routine use of a simple nutritional screening tool (NRST) is recommended as a valid way to determine the nutritional risk of every patient on admission to the hospital (16). Such a NRST should be practical, highly reliable, valid and evidence-based (14). Out of more than 70 published NRSTs, the NRS-2002 meets these criteria and is recommended by the European Society of Clinical Nutrition and Metabolism (ESPEN) as suitable for the general adult patient population (14).

After determining the nutritional risk of a patient, the affected patient should be referred for dietetic review to establish the true nutritional status of the patient and to carry out early and adequate intervention so as to optimise treatment outcomes (18). Prompt detection of nutritional risk is warranted throughout the continuum of hospitalisation as nutritional status at both admission and at discharge has been linked with adverse clinical outcomes post-discharge (19). In Africa, there is very little information on the prevalence of hospital malnutrition. Available data indicate a prevalence of 40-60% amongst the South African general hospitalised population (20). Other African hospital malnutrition prevalence studies, including the international, multicentre, European Undernutrition in Hospitals (EuroOOPS) study, have found 11-67%

prevalence rates amongst diverse Libyan and Egyptian inpatients (6). Other Eastern African studies have documented hospital malnutrition prevalence rates of 25-59% in cohorts of Human Immunodeficiency Virus (HIV)-seropositive and heart failure patients (6, 21-23). Moreover, the lack of information on nutritional screening in Africa suggests it does not form a routine part of clinical care. Furthermore, in Ghanaian hospitals, weight and height measurements, which are mainstay practices in monitoring nutritional status, are not routinely taken (24). At the same time, referral rates for dietetic consultation in other continents are also reported as being poor (18). Only when a patient cannot eat, loses significant amount of weight or has very low haemoglobin levels is nutrition support taken into consideration (25-27).

Besides investigating the prevalence of nutritional risk at admission and at discharge in this Ghanaian adult patient population, this study further seeks to determine the association between risk of malnutrition and clinical outcomes during hospitalisation and one month post-discharge, as well as dietetic referral rates for nutritional support. The findings of the study hold the potential to sensitise hospital staff on the need for the nutritional screening of all patients in order to improve nutritional management and the overall care of patients through appropriate dietetic referral and nutritional intervention. In the midst of scarce resources in this hospital setting, combating malnutrition will contribute to the delivery of efficient and cost-effective health care.

3.4.1 Methods

This was a descriptive, observational, cross-sectional study that took place at the KBTH in Accra, Ghana. This hospital is the largest in Ghana with a bed capacity of over 2000 beds, and attends to the medical needs of neighbouring countries. This study formed part of a larger multi-country study including hospitals from South Africa, Ghana and Kenya. However, this article addresses only the data obtained from the Ghana study site.

3.4.2 Subjects

Adult patients (≥18 years old) admitted within the previous 48 hours to the Departments of Surgery, Gynaecology and Obstetrics, Medicine, Cardiothoracic and Surgical/Medical Emergency were eligible to participate. Excluded participants included critically ill patients, demented patients, patients with language barriers or those who could not communicate effectively with the study personnel, pregnant or lactating mothers, burns or accident victims, patients on dialysis and patients with an expected short LOS (<48 hours) in hospital (Annexure A). These patients were excluded either because study procedures on them could not be completed or because of the inability to assess their true weight accurately. Patients that were

unable or unwilling to give their informed consent were also excluded. Approximately one fifth of the patients approached refused to participate in the study (n=101). A power analysis based on Pearson's chi square test of association indicated a minimum sample size of 348 to detect an effect of 0.15 with a power of 80% and an alpha of 0.05. This number provided a 95% confidence interval with respect to the study aims and objectives being studied. To strengthen the results and avoid loss of data, the sample was increased to 400 participants. To ensure equal representation, a distribution of 80 participants from each study department was planned. A maximum monitoring duration of 28 days was decided to be adequate based on previous findings, which showed that most patients are discharged within this period (28). All newly admitted patients in the study wards were approached by a fieldworker. Patients were informed about the aims and objectives of the study and written consent was obtained. The consent forms were available in English and the three most commonly spoken Ghanaian languages, namely Twi, Ga and Ewe (Annexures B to E).

The study was approved by the Health Research Ethics Committee of Stellenbosch University (Ethics number: N14/06/061); the Health and Research Ethics Committee of the North-West University, Potchefstroom campus (Ethics number: NWU-00091-15-A1/N14/06/061), the Ghana Health Service Ethics Review Committee (Ethics number: GHS-ERC: 06/06/15), the KBTH Scientific and Technical Committee and the KBTH Institutional Review Board (Annexures F to K).

Medical and nutritional data required for the NRS-2002 screening tool were collected using a structured interview at admission and at discharge (Annexures L to M) (17). Age and gender were obtained to describe the patient demographics while the LOS was calculated from hospital admission and discharge dates. The admission diagnosis was obtained to identify patients' diagnostic-related groups (DRG) and grade their severity of illness (which was needed for the NRS-2002 tool). The follow-up sample included only patients who had a LOS greater than seven days in order to measure the impact of a change in nutritional status. Subsequently, patients for whom complete discharge data was available were followed up telephonically one-month after discharge to assess the additional impact on patient outcomes of nutritional risk identified at discharge (Annexures N to O). The indicators of adverse patient outcomes that were noted on discharge and one-month post-discharge were the LOS, incidence of complications, rate of readmissions and mortality. A complication in this study was recognised as a secondary disease or condition that developed in the course of a primary disease or a condition that may not be specifically related to the primary disease (29).

3.4.3 Anthropometric measurements

Anthropometric measurements were performed with patients wearing light clothing and without shoes. Body weight and height were measured at the time of admission and discharge to the nearest 0.5 kg and 0.5 cm respectively, using a calibrated Seca 813 weighing scale and a Seca 213 stadiometer. Where the measurements of weight and height were not possible, weight was estimated by means of guessing expected weight, usually in consultation with the participant if deemed reliable and realistic, whilst half-arm span or bed length were used to estimate height (30-33). Weight and height were estimated in instances where the patient was feeling too weak to stand or had been amputated in rare cases by the time of discharge. Body Mass Index (BMI) was computed as weight (in kilograms) divided by the square of height (in meters squared)(34). Because of the expected possibility of oedema in patients that are malnourished, body weight adaptations according to the degree of oedema were derived by deducting actual body weight from 1, 5 and 10 kg for mild, moderate and severe degrees of oedema respectively (35). The percentage unintentional weight loss in the past 1-3 months was calculated from patient recall of weight during those time frames. In the absence of actual weight measurements, the presence of loose fitting clothes, jewellery or belt indicative of weight loss were reported. This was used to derive percentage unintentional weight loss.

3.4.4 Assessment of nutritional risk

The NRS-2002 is based on the outcome of several trials which identified that patients identified as being at nutritional risk were more likely to benefit from nutritional support (17). NRS-2002, which is endorsed by the ESPEN guidelines for the nutritional screening of patients, includes an initial screening component which comprises four criteria, including: BMI, presence of weight loss in the preceding three months, presence of low dietary intake in the preceding week and disease severity (17). A patient that scores positively for each question is eligible for the second phase of the screening. In this phase, the variables under the ‘impairment of nutritional status’- BMI, dietary intake or recent weight-loss are evaluated and scores are allocated. The highest score is noted. Within the ‘severity of disease’ component, the patient is scored and placed in either the mild, moderate or severe disease category, based on the type and severity of disease. The ‘severe’ category classifies critically ill patients for whom artificial support is needed because their nutritional requirements may be difficult to meet. These groups of patients were excluded in this study owing to practical difficulties in obtaining the NRS-2002 variables. For patients 70 years or older, an additional score of 1 is given because of the frailty of this age group.

The interpretation of the NRS-2002 scores is as follows: <3 =at no or low risk, ≥3-7= at risk that should be treated (17). Because critically ill patients were beyond the scope of this study, the highest possible NRS-2002 score was 6. The total NRS-2002 score for each patient was automatically generated in a Microsoft Excel data-capturing spreadsheet.

Referral rates for nutrition intervention of malnourished participants were determined by inquiring from the patient and viewing the patient medical records for dietetic referral letters during admission and discharge phases of the screening process.

3.4.5 Data control

Quality checks were performed on a daily basis by the principal investigator of the Ghanaian study by going through the completed questionnaires and submitting monthly reports of the Excel spreadsheet to the principal investigators of the umbrella study, who also checked for consistency. Incomplete data was resolved by confirming data from medical folders and/or the patient. At the end of the project's data collection phase, the researcher and the principal investigators reviewed the data to minimise the prevalence of data-capturing errors.

3.4.6 Data analysis

Statistical analysis was performed using IBM SPSS® Statistics 23 (Statistical Package for Social Sciences, IBM, NY, USA). All reported p-values of ≤0.05 were considered statistically significant for the purpose of hypothesis testing and were based on two-sided tests. The normality of distributions of variables was determined by using the Kolmogorov-Smirnov test, Shapiro-Wilks test, Q-Q plots and histograms. Normally distributed continuous variables are reported as arithmetic means, 95% confidence interval (Cl) and standard deviations as indicators of spread. If variables are skewed, they are reported as medians and 25^{th} and 75^{th} percentiles. However, LOS was reported as mean and standard error to measure the variability of sample means. Categorical variables are reported as percentages and frequencies. General linear models, specifically Poisson regression, were used to model the distribution and strength of the relationship between count data, being LOS and nutritional risk. Binomial tests were used to compare the proportions of the study characteristics and other clinical outcomes of the two nutritional risk groups. Chi-square tests (X^2) were also used to analyse the association between two categorical variables. Binary logistic regression was used to model the relationship between NRS-2002 score and BMI, adequacy of dietary intake and weight loss<5% within the preceding three months to admission. Multicollinearity was ruled out by testing the linear correlation between pairs of variables in which no linear correlation was statistically significant. The results of the binary logistic regression analyses are expressed as odds ratio (OR) and 95% CI. The

goodness of fit of the model was evaluated using the R^2 statistic based on the Hosmer-Lemeshow test.

3.5 Results

3.5.1 Patient demographics and nutritional risk status at admission

In total, 402 eligible participants were enrolled from the five inpatient adult departments admitted at the KBTH between January and June 2016. The baseline characteristics of these study participants are presented in Table 3-1. The study participants were aged from 18 to 96.3 years (mean age: 47.1 ± 15.9) and included more female participants (n=227; 56.5%) than males (n=175; 43.5%) though the difference was not significant. The majority of the study participants fell within the general medicine diagnostic group (48.8%), followed by surgery (22.6%), gynaecology (18.90%), oncology (7.7%) and finally, the least in the 'other' category (2%). The diagnoses included in the 'other' category were malaria (n=2), drug-induced Parkinson's disease (n=1), generalised body pain secondary to fall (n=1), achalasia (n=1), multiple sclerosis (n=1) and vaso-occlusion as a result of sickle-cell disease (n=2). The majority of study participants (91.5%) had a BMI of more than 18.5 kg/m^2. Almost two thirds (64.9%) of the study population reported a dietary intake<75% of their usual requirement in the week preceding admission whilst 69.7% of the study population reported weight loss greater than 5% in the three months prior to admission. The mean LOS of the study population was 8.6 ± 0.3 days.

Table 3-1: Patient demographics and nutritional risk profile on admission (n=402)

Characteristic	Total group N=402	Nutritional risk status (NRS-2002)		p-value
		At risk N=287	Not at risk N=115	
Age*, year	47.1 ± 15.9	46.7 ± 16.3	48.2 ± 14.9	p=0.397
	n (%)	**n (%)**	**n (%)**	
Gender:				
Males	175 (43.53)	135 (77.1)	40 (22.9)	p=0.345
Females	227 (56.47)	152 (67)	75 (33.0)	
Ward categories:				
General medicine	80 (19.9)	65 (81.2)[a]	15 (18.8)	p<0.001
Emergency	82 (20.4)	64 (78.1)[b]	18 (21.9)	
Gynaecology	80 (19.9)	55 (68.8)[ab]	25 (31.2)	
Surgery	80 (19.9)	53 (66.3)[ab]	27 (33.7)	
Cardiothoracic unit	80 (19.9)	50 (62.5)[ab]	30 (37.5)	
Diagnosis categories:				
General medicine	196 (48.8)	147 (75)[c]	49 (25)	p<0.001
Surgery	91 (22.6)	63 (69.2)[d]	28 (30.8)	
Gynaecology	76 (18.9)	50 (65.8)[cd]	26 (34.2)	
Oncology	31 (7.7)	21 (67.7)[cd]	10 (32.3)	
Other†	8 (2)	6 (75)[cd]	2 (25.0)	
BMI* (kg/m^2)	25.5 ± 6.6	24.7 ± 6.4[e]	27.5 ± 6.7[e]	p<0.001
BMI categories (kg/m^2)				
<18.5	34 (8.5)	29 (85.3)[f]	5 (14.7)[f]	p<0.001
≥18.5-20.5	59 (14.7)	48 (81.4)[g]	11 (18.6)[g]	
>20.5	309 (76.8)	210 (68)[h]	99 (32)[h]	
Dietary intake < 75% of usual requirements in the week preceding admission	261 (64.9)	247 (94.6)[i]	14 (5.4)[i]	p<0.001
Weight loss ≥ 5% of body weight within the 3 months preceding admission	280 (69.7)	235 (83.9)[j]	45 (16.1)[j]	p<0.001
Mortality	14 (3.48)	13 (92.9)[k]	1 (7.1)[k]	p=0.002
LOS‡, days	8.6 ± 0.3	9.7 ± 0.2[l]	5.9 ± 0.2[l]	p<0.001, d=0.82
LOS‡, adjusted for disease severity and age		9.8 ± 0.2[m]	6.0 ± 0.3[m]	p<0.001,d=0.74

*Age and BMI reported as mean ± standard deviation, †Other diagnosis categories include: malaria (n=2), drug-induced Parkinson's disease (n=1), generalised body pain secondary to fall (n=1), achalasia (n=1), multiple sclerosis (n=1), vaso-occlusion due to sickle-cell disease (n=2), ‡ LOS reported as mean ± standard error, [abcdefghijklm]p-value is significant between groups, BMI: Body Mass Index; d: Cohen's d-value; LOS-Length of stay; n: Sample size; NRS-2002: Nutritional Risk Score-2002; S.E.:Standard error; S.D.-Standard deviation

Nearly three-quarters (71.4%) of this study population were at nutritional risk on admission according to the NRS-2002 score (Table 3-1). A higher prevalence of nutritional risk, though not significantly so, was observed in males than in females (77.1% versus 67%, p=0.345).

Additionally, those at nutritional risk were younger, but this difference was not significant. The mean BMI of those at nutritional risk was significantly lower in comparison with those that were not at risk of malnutrition, although the former fell within normal limits of nutritional status (Table 3-1). About four fifths (80.8%) of 'at-risk' patients were oedematous. On this basis, BMI corrected for oedema was derived for all these patients.

The highest prevalence of nutritional risk was 75% in both the general medicine and the 'other diagnoses' categories (Table 3-1). Within the general medicine diagnostic category, the greatest prevalence of nutritional risk was observed in HIV infected (n=2) and tuberculosis patients (n=2, each at 100% whilst of all the diagnostic categories, neurosurgery patients had the lowest prevalence (n=10, 40%) (Figure 3-1).

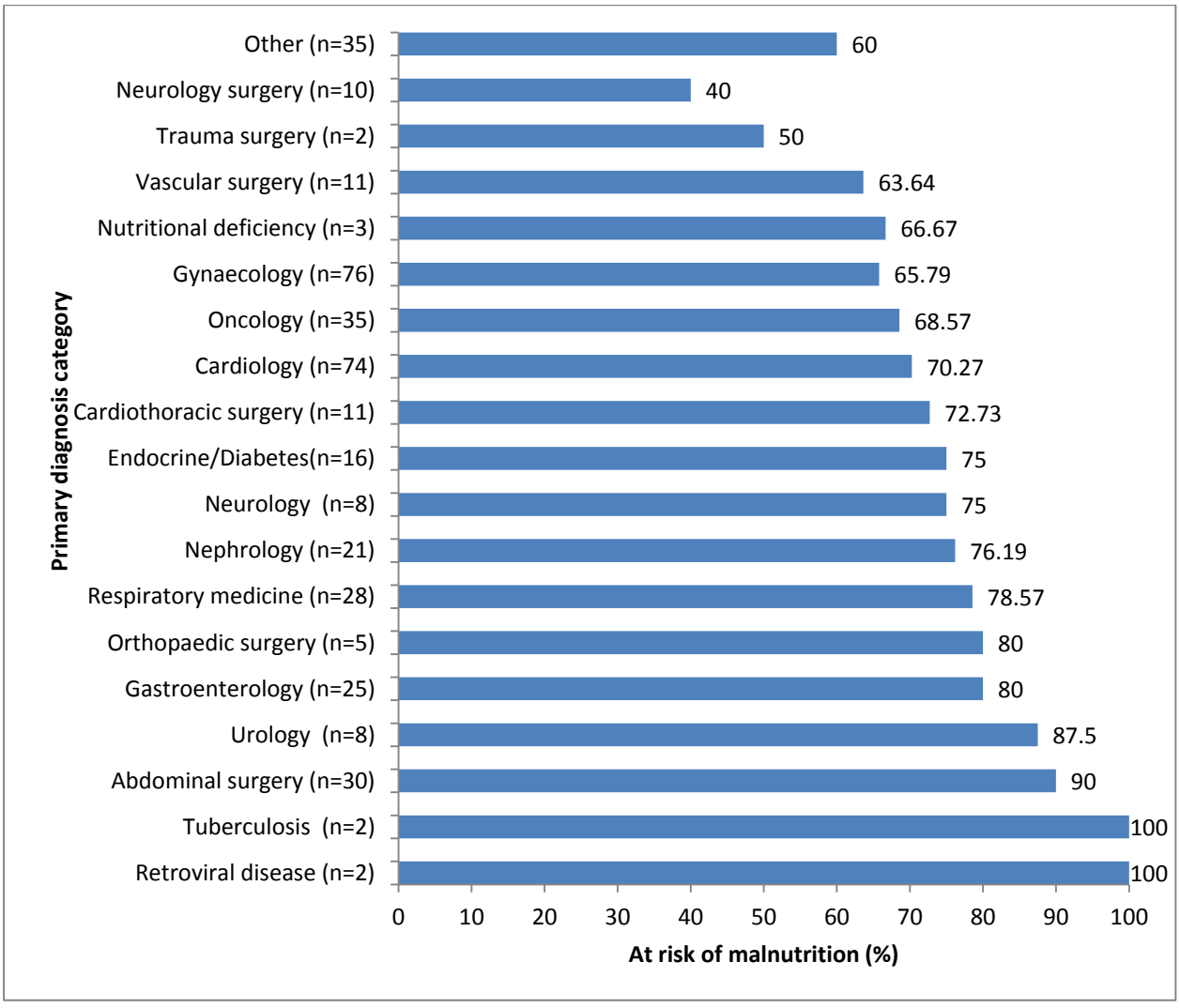

Figure 3-1: Risk of malnutrition profile per disease categories on admission (n=402)

3.5.2 Risk of malnutrition profile on admission per age groups on admission

The age-dependent distribution of the NRS-2002 is shown in Figure 3-2 and has been divided into four categories across 20 year gaps. Using the NRS-2002 reference age for elderly patients, only 32 (8%) of the study population were 70 years or older. A high prevalence of nutritional risk was noted across all the age groups though the greatest prevalence occured in the study participants above 70 year old (78.1%). However, tThe prevalence of nutritional risk was comparable amongst all the four different age categories (p=0.221).

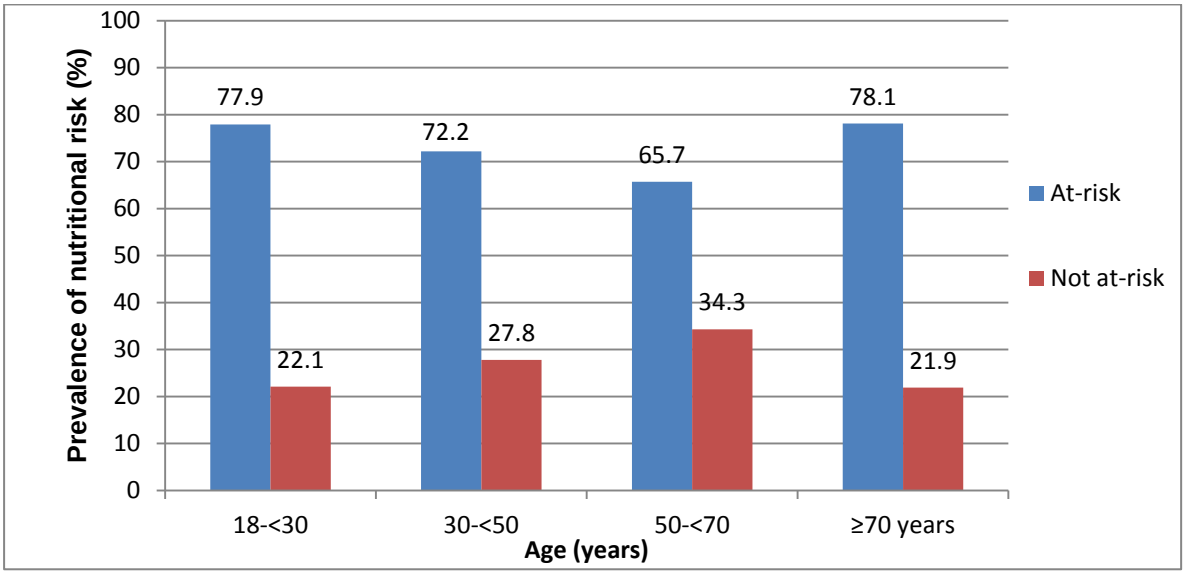

Figure 3-2: Prevalence of nutritional risk related to age
(n=402)

3.5.3 Changes in risk of malnutrition at admission and at discharge

One hundred and ninety-nine study (199) *i.e*. 49.5% participants were hospitalised for longer than seven days. However, 27 (6.7%) were lost to follow-up either due to early discharge before the final assessment could be done or refusal to continue with the study. Therefore, 172 study participants were followed up.

There was no increase in the prevalence of nutritional risk at discharge. This was because the condition of 13 patients that were at risk of malnutrition improved to not being at nutritional risk by the time they were discharged from hospital (NRS-2002 score ≤3). Conversely, 13 patients that were not at risk of malnutrition deteriorated to being at risk of malnutrition at discharge (NRS-2002 score ≥3).

3.5.4 Risk of malnutrition profile and clinical outcomes during hospitalisation and one month after discharge

3.5.4.1 Length of stay (LOS) and clinical outcomes during hospitalisation

In the total study population, there was a statistically significant difference in mean LOS between those at risk of malnutrition and those not at risk of malnutrition (9.7 versus 5.9 days; p<0.001) (Table 3-1). Multivariate analysis adjusting for disease severity and age maintained this significance (9.8 versus 6 days, p<0.001, d=0.74).

It is of interest that in the total study population, a greater proportion of patients not at risk of malnutrition had better discharge destinations than those that were at risk of malnutrition (p<0.001). Almost all patients not found to be at nutritional risk, (n=114, 99.1%) were discharged home, whilst one patient died (0.9%). On the other hand, in the category of 'at-risk' patients, 254 (88.5%) were discharged home, 13 (4.5%) died, two (0.7%) were transferred to other wards aside from study wards and 18 patients (6.3%) were admitted for longer than 28 days.

Of the 172 study participants that were followed up at discharge, ten (6.2%) developed complications. Interestingly, this occurred only in at-risk patients (7.8%) (p=0.002). In the entire study population, the incidence of deaths during hospitalisation was greater in patients that were at nutritional risk than in those that were not [13 (92.9%) versus one (7.1%)], and again this achieved statistical significance (p=0.002) (Table 3-1). In study participants that were included at the discharge phase, mortality occurred in ten patients that were all at nutritional risk during hospitalisation, just as occurred with the rate of complications (7.2%) (p=0.002).

3.5.4.2 Clinical outcomes one month post-discharge

During the follow-up stage of the study (n=133), a generally greater incidence of adverse outcomes occurred in patients that were not at nutritional risk compared with those that were at nutritional risk (Table 3-2). Complication rates were greater in the group, [1 (10%)] that were not at nutritional risk compared to the group at nutritional risk [3 (2.7%)] although this difference was not statistically significant (p=0.625). Similarly, ten patients (8.9%) in the nutritional risk group reported significantly lower hospital readmissions compared with the one patient (10%) that developed complications but was not at nutritional risk (p=0.012). Ten study participants (10.20%) in the nutritionally at-risk category died within a month post-discharge whilst no death was recorded in those that were not at nutritional risk. This difference was significant (p=0.002, 95% CI.).

3.5.5 Nutritional risk profile and referral for dietetic review

Of patients that were hospitalised for longer than seven days, only eight nutritionally at-risk patients (6.2%) were referred for nutritional support as against 6.1% of those that were not at nutritional risk, but who were nevertheless referred for nutritional support.

3.6 Predictive ability of the individual components of the NRS-2002

Direct binary logistic regression analysis was performed to assess the predictive ability of BMI, insufficient dietary intake of <75% during the preceding week, weight loss of >5% in the preceding 1-3 months and disease severity on assessing the nutritional risk of the study population (n=402), using the NRS-2002 (data not shown). With the exception of the oedema-corrected BMI and age, all the other components of the NRS-2002 tool made a unique statistically significant contribution to predicting nutritional risk (weight loss, p-value<0.001; insufficient energy intake, p<0.001 and severity of disease, p-value=0.003). Of these, the strongest predictor of nutritional risk was insufficient energy intake. Study participants that reported insufficient energy intake were 66.7 times more likely to be at nutritional risk (odds ratio of 66.74 [95% CI: 28.72-155.09]. The second strongest predictor was weight loss ≥5% in the preceding 1-3 months, since patients that reported ≥5% weight loss were 12 times more likely to be at nutritional risk (Odds ratio of 12.09 [95CI: 5.19-28.19]). This was followed by severity of disease, which predicted a five times greater chance of being at nutritional risk in patients that were more severely ill (NRS-score of 2) (Odds ratio=4.85, 95 CI [1.67-14.11]).

3.7 Discussion

This study set out to determine the prevalence of nutritional risk amongst hospitalised Ghanaian adult patients on admission and discharge. Furthermore, the association between being at nutritional risk and the development of adverse clinical outcomes during hospitalisation and one month after discharge was investigated. Considering the high prevalence of malnutrition and its association with poor patient prognoses, this study is significant as, for the first time, it provides data on this problem in a large, diverse patient population in the Ghanaian setting (9, 36). It is also one of the few studies that document the prevalence of risk of malnutrition at the time of discharge (10, 37-39).

In the current study, seven out of every ten patients admitted were classified as being nutritionally ‘at-risk’ (71.4%). This prevalence is much higher than the range of 20-65% reported internationally (6, 40, 41). The prevalence of nutritional risk was high in patients 70 years or older, although not statistically greater than patients who were below 70 years.. Several studies have found a high prevalence of nutritional risk of up to 94% in the geriatric population (42, 43).

In old age, there is decreased oral intake due to swallowing or dentition problems and reduced functional capacity compounded by the burden of disease (42). Also, the prevalence of nutritional risk was greater in the male gender (77.1%) though not significant. In a recent study of patients scheduled for elective surgery, Thomas and investigators identified male gender, age and the presence of malignant tumour as independent risk factors associated with nutritional risk (44). The heterogeneity of patients that were at nutritional risk in the current study stresses the fact that malnutrition is common in disease. The mechanism whereby malnutrition occurs in disease is the disease-specific inflammatory processes that elevate nutrient requirements, cause anorexia and increase susceptibility to infections (2, 45).

In this present study, the specific prevalence of nutritional risk across the primary disease categories ranged between 40% and 100%. Similarly, the multi-national EuroOOPS study (n=5051) reported varying prevalence rates of 13% to 100% between the different specialities (6). As was expected, nutritional risk was high in gastrointestinal disease, including abdominal, surgical and gastroenterology patients, where poor dietary intake, vomiting, diarrhoea and malabsorption are common. The highest prevalence of malnutrition was observed in HIV infected and TB patients. However, the fact that there were only two cases of each of these conditions limits the generalisability of the findings on the nutritional risk actually conferred by these diagnostic groups. In Ghana, only 2% of Ghanaian adults aged 15-49 years, are HIV positive which explains the low rates of HIV cases in the study population (46). Moreover, HIV status is not disclosed in medical folders neither was separate testing made for HIV status in this current study. It was difficult to distinguish differences between the other diagnostic groups that had between two and 25 participants.

A more representative sample was the group of 76 gynaecology patients where the prevalence of nutritional risk was 65.8%. In a German gynaecologic hospital, 142 gynaecology patients were diagnosed with less than half the prevalence of nutritional risk (35.8%) observed in the present study (47). On average, the patients were older (median age, 59 years, range 18-97 years) than the current gynaecology patients in this study (median age, 41.5, range 19.1-77.6 years) and were admitted for benign (n=135) and malignant causes (n=262). In a current retrospective analysis of the prevalence of nutritional risk amongst Swiss medical patients, the prevalence of nutritional risk was highest in oncology patients during the two consecutive study years (85.3% in 2013 and 70.2% in 2014)(49). Eight Norwegian surveys found a 7% nutritional risk prevalence amongst gynaecology patients, which was attributed to lower levels of general morbidity, non-existent stress-metabolism in disease and younger age (48). Planas *et al*. (2016) found a prevalence of nutritional risk of 33.9% in 1051 oncology patients, which is less than half the prevalence (69%) found amongst oncology patients in the current study (37). Noteworthy in

this study was the greatest prevalence of nutritional risk in the general medicine (81.2%) and emergency wards (78.1%) in comparison with the departments of surgery (66.3%), gynaecology (68.8%) and the cardiothoracic unit (62.5%), whose admissions were mostly elective cases. These results are strikingly similar to those in two studies that found that medical patients were more prone to being at nutritional risk than surgical patients, as surgical patients were admitted electively and were, therefore, less severely at nutritional risk (52, 53). The present study therefore, supports the literature on the widespread prevalence and heterogeneity of nutritional risk (54).

In addition to determining the prevalence of risk on admission, changes in nutritional risk by the time of discharge were investigated. There was no change in the prevalence of nutritional risk according to the NRS≥3 versus NRS<3 classification. Contrary to this, previous reports have observed changes in nutritional risk (37, 38). A study assessed American patients by means of the Subjective Global Assessment (SGA) tool to investigate changes in nutritional status that occurred from hospital admission to discharge for patients that were hospitalised for longer than seven days (11). Almost a third (31%) out of the 404 patients experienced declines in nutritional status by the time of discharge, with 33% severely malnourished patients experiencing further weight loss greater than 5%. Of patients that were initially nutritionally compromised, 30% improved nutritionally by discharge. Though a higher percentage of patients experienced changes in their nutritional status in that study compared with the present one, the overall change in nutritional risk/malnutrition in that study and the current one are negligible. Also, the use of the different methods of assessment to determine nutritional status/risk in both studies makes it difficult to draw direct comparisons.

The present study examined the relationship between nutritional risk on admission and LOS. Nutritionally at-risk patients spent double the time those not at risk of malnutrition spent (9.8 days versus 5.2 days). Other studies, including an international multi-centre trial, have shown that the NRS-2002 score is closely linked with a progressively increased LOS of 2-7 days in patients that were at risk of malnutrition, even after controlling for disease severity, age or matching diagnoses-related groups (3, 6, 37, 55). After adjusting for possible confounders such as age, disease severity and gender on LOS in the current study, LOS was still strongly influenced by nutritional risk.

A significant finding in this study was the influence nutritional risk had on discharge destination after patient treatment. ‘At-risk’ patients were less likely to be discharged home and more likely to remain in the hospital or die. Rasheed & Woods (2016) have previously observed that at-risk geriatric malnourished patients were more likely to be discharged to a long-term setting compared with those who had no nutritional risk (56). Similarly, in the EuroOOPS study, which

included various patient groups including medical patients, fewer at-risk patients were discharged home whilst more were discharged to a nursing home or stayed longer than 28 days when compared with patients that were not at-risk (6).

Several studies have demonstrated an association between poor nutritional status and the development of complications, early readmissions and mortality (6, 57). During hospitalisation in the current study, except for the rates of complications one month post-discharge, the incidence of adverse outcomes was significantly higher in the 'at-risk' group. Other studies have observed greater rates of adverse outcomes for as long as three years in various patient cohorts (3, 19). In a Singapore study which followed its study participants three years after discharge, a strong association between malnutrition and in-hospital and three-year mortality was observed, by which time almost half of the malnourished patients had died, whilst 90% of the well-nourished group were still alive (3). In the current study, the lack of association between the development of complications one month in the at-risk group compared with those that were not may be due to the marginal representation of complications in both risk groups. The rates of readmission were significantly higher in those that were not at nutritional risk but as this occurred in only one patient, these results should be interpreted with caution. Nevertheless, the results of the current study sufficiently show the association between nutritional risk and the development of adverse clinical outcomes in this population group, as well as the ability of the NRS-2002 to effectively predict these clinical outcomes.

Despite sound evidence provided by systematic reviews, meta-analysis studies and RCTs showing support for an optimal nutritional status and early nutritional support as antecedents to improving nutritional indicators and patient prognoses, less than a tenth of at-risk patients (6.20%) were referred for dietetic review (58-60). This raises concern as these referral statistics are lower than those recorded elsewhere. A previous audit across 19 wards in the NHSFife hospital in Scotland showed that 32% (n=48) of the undernourished population were referred for dietetic review (61). These results of the current study add to existing evidence from previously published work and confirm that malnutrition is indeed largely unidentified and undertreated in most hospitals throughout the world (56, 62, 63).

The predictive ability of the individual components of the NRS-2002 was also evaluated in this study. The independent association of a poor dietary intake, weight loss and severity of disease with the NRS-2002 demonstrated that disease and nutritional intake indeed play a unique role in nutritional risk while BMI alone failed to determine nutritional risk adequately as only 4.3% of the actual number of at-risk patients identified using the NRS-2002 scheme were detected using BMI. This aligns with most studies that have found low specificity rates of between 4.1%-10% for the risk of malnutrition using BMI (64, 65). The components of the NRS-2002 may have

presented some limitations. Weight loss may be confounded by patient recall and grading the severity of illness for disease not listed in the NRS-2002 protocol is dependent on clinical judgement (66). Altogether, the various components improved the sensitivity of the NRS-2002 score in predicting nutritional risk.

This study had certain limitations. The effect of the type of disease, surgical and other treatment procedures on nutritional risk were not ascertained at discharge. The accuracy of body composition measurements including weight are reduced by certain factors. In this study, extra weight as a result of oedema was deducted from the total body weight and through this greater sensitivity was ensured but not at the expense of misclassifying patients that were not at nutritional risk. In this study, body weights were estimated for 11.2% and 13.8% of the study population on admission and discharge respectively for whom direct weight measurements could not be done using the weighing scale.

Notwithstanding these limitations, this study also had various strengths. It adds valuable insight to the current body of literature on the prevalence of nutritional risk in a multidisciplinary hospital setting, especially in the African continent and, because this hospital is the largest referral centre in Ghana, the results are generalisable to other hospitals in the region. The results provide baseline data on the prevalence of nutritional risk in Ghana, which provide a basis for planning causality and intervention studies.

3.8 Conclusions

A high prevalence of nutritional risk was found in heterogeneous conditions in this population regardless of age group. However, the highest prevalence of nutritional risk was in patients that reported food intake below usual requirements, experienced weight loss, had a BMI>18.5, were admitted at the general medicine department, and were oedematous. The diverse characteristics of those study participants at nutritional risk necessitates the need for routine nutritional screening of all patients. Nutritional risk was clearly associated with a prolonged LOS and adverse clinical outcomes. The most sensitive indices of the NRS-2002 tool in predicting nutritional risk were found to be energy intake in reference to usual energy requirements, unintentional weight loss and then disease severity. Nutritional risk detection and referrals to receive nutritional support was poor in this study. These findings call to attention the recommendations of international nutrition bodies to adopt an interdisciplinary team approach which includes periodically providing nutritional training to medical staff and the practice of proper nutritional care of patients. The legislation and implementation of national and hospital-specific policies for compulsory screening and providing prompt dietetic attention to ‘at-risk’ patients will improve the success of these actions. The lack of adoption of any NRSTs in the

country indicates the need to perform validation and feasibility tests of well-validated NRSTs. In future studies, it will be worthwhile to evaluate the prevalence of nutritional risk and its outcomes in a large number of patients within comparable diagnostic groups with an economic arm to the study. These studies should follow international guidelines for conducting research to foster comparability of findings. The end goal of such steps is to shed light on addressing hospital malnutrition. However, this study has shown the extent of nutritional risk and the consequences of this which may draw attention and contribute to proactive efforts needed to counteract this problem. The same concerted efforts and advancement used in treating diseases in this population is required to combat nutritional risk to optimise patient outcome.

3.9 Acknowledgements

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CHAPTER FOUR: GENERAL DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

CHAPTER FOUR: GENERAL DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

4.1 Introduction

This final chapter will summarise the main findings of this research project, as well as provide general conclusions and recommendations. The aim and objectives are reiterated here for easy reference to what was to be addressed in this research project and mini-dissertation.

4.2 Research aim

The aim of this cross-sectional, observational study was to determine the prevalence of risk of malnutrition in adult patients on admission and discharge from hospital and its association with selected in-hospital and post-discharge nutrition/medical indicators.

4.3 Research objectives

The objectives of this research were to:

- assess the prevalence of risk of malnutrition in adult patients on admission to hospital;
- describe the risk of malnutrition profile per different disease categories on admission;
- determine changes in risk of malnutrition that may occur during the course of hospitalisation;
- investigate the association between risk of malnutrition and in-hospital and post-discharge nutritional/medical indicators; and
- determine what percentage of nutritionally at-risk patients were referred for specialised nutritional support.

4.4 Prevalence of nutritional risk amongst hospitalised adult patients on admission

In the current study, nearly three quarters (n=287, 71.4%) of the population was at nutritional risk at admission. This prevalence is in a higher range than the internationally reported prevalence, which ranges from 20-60% (Correia *et al.*, 2017; Khalatbari-Soltani & Marques-Vidal, 2016; Mercadal-Orfila *et al.*, 2012; Sorensen *et al.*, 2008). In the current study, on the basis of the individual components of the Nutritional Risk Screening Tool-2002 (NRS-2002) score, nutritional risk was most identifiable in patients that had a reduced food intake of <75% in the week preceding admission (86.1% at-risk patients), patients that had experienced >5%

weight loss in the preceding three months (81.9% at-risk patients) and patients with more severe disease (22% at-risk patients). Binary logistic regression confirmed these findings as the above variables in decreasing order of influence contributed uniquely to the final NRS-2002 score. However, oedema-corrected BMI failed to correlate significantly with the final NRS-2002 score as only 4.3% of the actual number of at-risk patients were identified using Body Mass Index (BMI). This is in agreement with what is reported by other researchers who have reported that a slightly higher number of malnourished patients (10%) are detected when using the BMI criterion (Nourissat *et al.*, 2007). Compared with this current study, Pirlich *et al*. (2006) have found that only 4.1% of all German inpatients that were truly malnourished (n=77) were identified using BMI (Pirlich *et al.*, 2006). Being the largest referral centre for both Ghana and neighbouring countries, the Korle Bu teaching hospital often admits 'the sickest of patients' for whom treatment is not successful in smaller hospitals. It is, therefore, expected that factors that predispose patients to malnutrition risk would be more common in this group, thus exerting a high nutritional risk. Additionally, being a developing country, Ghana suffers from an inadequacy of socioeconomic resources and chronic starvation evidenced by high malnutrition rates at community level, possibly contributing to a high malnutrition risk on hospital admission.

4.5 Profile of nutritional risk by department, diagnosis categories, age and gender

Across specialities, the highest prevalence of nutritional risk was found amongst general medicine and emergency cases rather than in departments which mostly admitted on an elective basis. The prevalence of nutritional risk across the primary disease categories was between 40 and 100%. Specifically within diagnostic groups, general medicine patients or more specifically HIV infected and tuberculosis (TB) patients had the highest prevalence of nutritional risk (n=2,100% for both). Although the number of patients in both these disease categories in the current study were too marginal to enable conclusions to be drawn, previous studies have outlined the mechanisms and causes of remarkably high malnutrition prevalence in both conditions. Though the numbers in this current study were too small and may have been unrepresentative, drawing from available studies conducted, one would expect similar results had the HIV and TB cohort been adequately powered. However, only 2% of Ghanaian adults aged 15-49 years, are HIV positive (Ghana Statistical Service *et al.*, 2015). This explains the low representation of this group; moreover, if HIV status was not recorded in the medical folder, separate testing was not done by the current study investigators. Similar to the high prevalence rates of nutritional risk in both HIV and TB patients, were those seen in gastrointestinal patients whilst neurosurgery patients had the lowest prevalence of nutritional risk (n=10, 40%).

More often in neurosurgery patients, impaired swallowing, muscle atrophy and a lower lean body mass caused by functional disability are common (Dionyssiotis, 2012; Dionyssiotis *et al.*,

2016). Especially in spinal cord injured patients, central obesity has been associated with metabolic and cardiovascular imbalances causing catabolism and increased nutritional risk. The lack of power in these groups limits the generalisability of findings, but the prevalence of malnutrition risk in all the diagnostic groups was widespread, corroborating evidence from other studies of the changes in energy expenditure, catabolism and nitrogen excretion that occur in disease.

The prevalence of nutritional risk was comparable across all the age groups (p=0.221). Whereas, the group aged over 70 years old had a prevalence of 78.1%, the group below 70 years recorded a nutritional risk prevalence of 70.8%. Elsewhere, elderly populations have reported a prevalence of up to 94% (Christner *et al.*, 2016; Holst *et al.*, 2013). In seven Swiss hospitals at the departments of internal medicine, the prevalence of malnutrition was remarkably different between the younger population aged<45 years (8%) and the group above 85 year of age, who had a nutritional risk prevalence of 28% (Imoberdorf *et al.*, 2010). Conditions of poor dentition causing chewing and swallowing problems, the lack of appetite caused by hormonal and neuro-transmitter imbalances in old age, social isolation and reduced mobility contribute to clinically significant weight loss and, therefore, nutritional risk in the older age group (Roy *et al.*, 2016).

With regard to gender, more males were at nutritional risk than females (77.1% versus 66.9%) though this was not a significant difference (p=0.345). In recent publications, male gender was significantly associated with high nutritional risk (Budzyński *et al.*, 2016; Thomas *et al.*, 2016). No exact mechanism has been proposed for this finding.

4.6 Prevalence of nutritional risk at discharge

The number of patients with malnutrition risk remained the same in the subsample (n=172) that was assessed again at discharge. This was because 13 patients that were at nutritional risk improved to a status of not being at nutritional risk whilst 13 more patients declined from a status of no risk of malnutrition to being at risk of malnutrition. An almost negligible change in nutritional risk by the time of discharge has been previously reported in a general patient cohort, in which 31% of the 404 patients declined nutritionally whilst 30% improved and were not at nutritional risk by discharge (Braunschweig *et al.*, 2000). The lack of noticeable overall changes in nutritional risk in the current study and others may be attributed to the inability of patients to report the actual degree of weight loss that occurred one to three months prior to admission to the hospital.

4.7 Association between nutritional risk and clinical outcomes

Length of stay (LOS), the incidence of complications, readmissions and mortality were used as surrogate measures of patients' well-being during hospital treatment in this study. These outcomes were observed throughout the continuum of the patient's treatment and a month after discharge. This concept of associating nutritional risk with clinical outcomes has commonly also been used to assess the predictive performance of nutritional screening tools (Aziz *et al.*, 2011; Raslan *et al.*, 2010). More importantly, predicting adverse clinical outcomes in patients at nutritional risk provides strong evidence for providing early and sufficient dietetic intervention (Correia *et al.*, 2014; Kondrup *et al.*, 2003; Koretz *et al.*, 2007).

4.7.1 Length of stay in hospital (LOS)

In this study, nutritional risk was strongly associated with a prolonged LOS (9.8 days versus 5.2 days, $p<0.001$, $d=0.74$) after adjusting for age and disease severity. Other studies, including a systematic analysis conducted in oncology patients, have reported that at-risk or malnourished patients have a significant increase in LOS compared with well-nourished patients (Amaral *et al.*, 2008; Gupta, 2011). More recently, a follow-up study in an English stroke cohort revealed that patients that had been discharged six months previously had a graded cumulative increase in LOS of between 14 to 48 days in the low-, medium- and high-risk groups using the Malnutrition Universal Screening Tool (MUST) (Gomes *et al.*, 2016). This also had economic ramifications for the groups that were at nutritional risk, as the hospital treatment costs in the high-risk group were twice those in the low-risk group (Gomes *et al.*, 2016).

Though patients with more severe disease require more intense treatment and hence spend a longer time in hospital, they may, on the other hand, die prematurely during hospitalisation, thereby reducing their LOS. It cannot be overruled that a clearer picture of the impact of nutritional risk on LOS was masked because of the greater rates of in-hospital mortality in the 'at-risk' group since a greater number of deaths occurred in the 'at-risk' group. Nonetheless, this study showed that patients that were at nutritional risk spent a longer time in hospital.

In the investigation of the LOS of patients, it was interesting to document discharge destinations of both nutritional risk groups after being discharged. Apart from the patient who died but was not at nutritional risk, the rest were discharged home whilst more at-risk patients were either transferred to other wards which were not included in the study, remained in the hospital for longer than the mandatory exit time of the study or died. Sorensen *et al.* (2008) have formerly found that significantly fewer nutritionally at-risk patients were discharged home, and more

discharged to a nursing home, spent more than 28 days in the hospital or were transferred to other departments in the hospital.

4.7.2 Complications

The development of complications during the study period occurred in 14 patients. Of these, 10 nutritionally at-risk patients developed complications in the subsample during admission (7.8%) while no participant in the group not at risk developed complications. Available studies also confirm that at-risk patients develop more complications than study patients not at risk, as reported by the European Undernutrition in Hospitals (EuroOOPS) study (30.6% versus 11.3%) (Sorensen *et al.*, 2008). In the current study, one month after discharge, three at-risk patients (2.7%) developed complications whilst one patient (10%) that was not found to be at nutritional risk developed complications. Although there was a trend for higher complications in those not at nutritional risk, the incidence of these was too low to reach statistical significance. However, the occurrence of complications in only one patient that was not at nutritional risk requires caution in data interpretation. The relatively short one-month follow-up period may have made the natural progression of complications less clear.

4.7.3 Readmissions

A significant important indicator of health care outcomes and quality of patient care is readmissions (Westert *et al.*, 2002). In the current study, ten at-risk patients were readmitted to the hospital whilst the same one patient who was found not to be at risk but developed complications was also readmitted. Though the differences in readmission rates were significantly greater in those that were not nutritional risk(10%) compared with the at-risk group (8.9%), these results must be interpreted with caution due the single case of readmission in the patient not at risk. In contrast to these findings, previous literature has reported an association between nutritional risk and readmissions. In these studies, readmission rates were found to be higher in the at-risk group compared with the group not at-risk (Agarwal *et al.*, 2013; Budzyński *et al.*, 2016). In a recent study by Budzyński *et al.* (2016), readmission rates within 14 days from hospital discharge were 6.9% in the nutritionally at-risk group versus 2.9% in the group not at risk and even higher at 30 days, where the authors reported that 13.1% had been readmitted compared with 5.9%.

4.7.4 Mortality

Mortality occurred more frequently in patients that were at nutritional risk (13/287) compared with almost no deaths in those that were not at nutritional risk (1/115). Restricting mortality to the subsample population (n=172), ten nutritionally at-risk patients died (10/139) during

hospitalisation and also one month post-discharge (10/123); there were no deaths in the group that was not at risk. The marginal representation of the incidence of death, especially in the group not at risk, limits the significance of the association between nutritional risk and the rate of deaths. Nevertheless, these data correspond with those of a current study that reported that the rate of in-hospital deaths in the at-risk group was 19.7% compared with 1% in the group not atnutritional risk (Budzyński *et al.*, 2016).

The mean ages of both nutritional risk groups were far lower than the average life expectancy of 60 years of the general Ghanaian population which may have contributed to the low mortality rates seen in this study (Ghana Statistical Service *et al.*, 2015). Medical advancements and effective treatments in recent years have seen fewer people die, especially from infectious diseases, and better treatment of non-communicable diseases. This may have boosted the survival rates in patients that were at nutritional risk who suffered more severe disease (22%) and almost eradicated preventable deaths in those not at risk of malnutrition who tended to have less severe disease (7.8%).

4.8 Identification of nutritional risk and referral for specialised nutritional support

The poor referral rates of6.2% of the at-risk population during hospitalisation in the current study, confirms previous findings on the low referral rates of at-risk or malnourished patients for dietetic treatment (Bohringer & Brown, 2016; Gout *et al.*, 2009). In an earlier study conducted in a tertiary teaching hospital, of the 19% and 53% of the actual number of malnourished patients defined by actual weight loss or appetite respectively, 7% and 9% respectively received referrals for dietetic assessment (Adams *et al.*, 2008). In two Australian Oncology Clinics, 66% of at-risk patients were referred to a dietitian (Bohringer & Brown, 2016).

Though an examination of the documentation of nutritional status by hospital staff was not one of the aims of the study, by mere observation and by deduction, this may suggest that patients that were at nutritional risk were not recognised as such. The low dietetic referrals reveal the low prioritisation of the nutritional care of patients in this hospital. Given that anthropometric measures are not taken nor is nutritional screening routinely done in this hospital, the inability to identify nutritional risk in this population was not surprising. As referring patients for nutritional support is sequential to identifying nutritional risk, a low referral rate was not unexpected, although the very low referral rate found was nevertheless disturbing. The predisposition in medical practice in this hospital appears to focus more on the treatment of disease than on optimising nutritional requirements in patients requiring feeding support and in those experiencing pronounced cachexia.

4.9 Conclusions and practical recommendations emanating from this study

The majority of the study participants were at high nutritional risk (71.4%) and demonstrated vast heterogeneity in characteristics. The highest prevalence of nutritional risk was characterised by a BMI>18.5, admission to the general medicine department, an inadequacy of food <75% of usual requirements, significant weight loss >5% and the presence of peripheral oedema. The widespread problem of nutritional risk in the study population across all age groups, its association with adverse clinical outcomes and a lack of referrals for dietetic attention necessitate automatic dietetic consultation for all patients. As this may not be feasible owing to constraints in logistics, time and staff, nutrition screening by nurses or doctors will allow for prioritisation of dietetic treatment for all at-risk patients, thus facilitating a more effective use of resources. The role of national and hospital-specific policies and an appraisal of levels of compliance will improve the current situation. A nutritional care structure should be included in these policies, one suited to the unique culture of this teaching hospital and other Ghanaian clinical settings, with frequent nutritional training of medical and nursing staff.

4.10 Limitations of the research project

Because clinical judgement was exercised in allocating NRS-2002 scores for illnesses not listed in the prototypes of disease, this may have introduced some degree of subjective bias. To reduce this limitation, extra scrutiny was given to scores of 2 to avoid overestimating nutritional risk. There are different contributing factors to nutritional risk, such as type and stage of disease, location of disease/injury, tumour type and drug treatment which produce side effects such as vomiting, nausea or diarrhoea (Odelli *et al.*, 2005; Thomas *et al.*, 2016). The effect of the type of disease, surgical and other treatment procedures on nutritional risk was beyond the scope of the study.

4.11 Future research

In the review of studies conducted on hospital malnutrition and in the conduct of the current project, gaps in knowledge have been noted which hold significant clinical implications and directions that could be addressed in future research. These include:

- Future research on the prevalence rates of nutritional risk and malnutrition in several other hospitals in Ghana, using international guidelines for the conduct of research. This is because, although the KBTH mainly admits cases which are expected to be the most severe referred from other clinical settings, a general representation of the malnutrition prevalence rates in other hospitals/clinics requires future research.

- Research to validate the NRS-2002 with the most recent ASPEN and ESPEN diagnostic criteria for malnutrition in order to assess the diagnostic accuracy and validity of the NRS-2002 tool in identifying nutritional risk in patients thereby patients who require prompt nutritional intervention in the hospitalised Ghanaian patient population.

- An adequately powered sample in all the individual diagnostic groups in future studies to provide the opportunity for drawing unequivocal conclusions on the prevalence of nutritional risk and its consequences on clinical outcomes.

- An inclusion of the effect of the treatment procedures *e.g*. surgery and chemotherapy in future studies to elucidate whether risk of malnutrition is more prevalent under these conditions.

In conclusion, it is evident that the aim and objectives of this study were achieved and that the findings of this research regardless of its limitations, provide baseline data and a central point of reference for the Ghanaian hospitalised adult population.

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ANNEXURE A: PARTICIPANT SCREENING AND SELECTION FORM

Hospital code		**Hospital name**	
Ward category		**Ward number**	

	Patient initial and surname	Ward and bed no.	Hospital admission in past 48 hours		Patient age		Patient conscious		Patient pregnant or lactating		Patient in ICU/burns/acute care/ psychiatry or eating disorder wards		Patient on dialysis		Informed consent obtained		If NO consent obtained, provide reason	If consent obtained, allocate participant study number
			YES	NO	≤ 18 yr	≥ 18 yr	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO		
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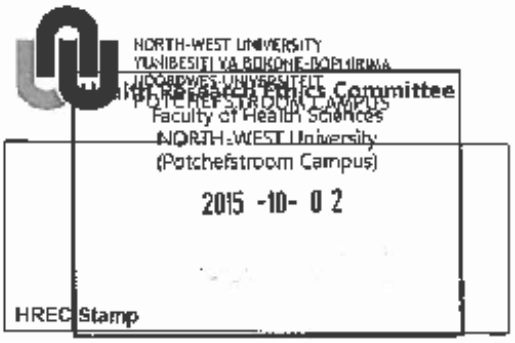
ANNEXURE B: PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM PARTICIPANTS (ENGLISH)



FORM 3-PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM FOR PARTICIPANTS

TITLE OF THE RESEARCH PROJECT: Adult hospital malnutrition: prevalence and consequences on malnutrition- associated outcomes at a teaching hospital in Ghana

REFERENCE NUMBERS:

PRINCIPAL INVESTIGATOR: Dzifa Nyatefe

ADDRESS: P.O. BOX CE 11488, COMMUNITY 11, TEMA, GHANA.

CONTACT NUMBER: +233243978997

You are being invited to take part in a research project that forms part of my Masters' thesis titled the Adult Hospital Malnutrition Study.

Please take some time to read the information presented here, which will explain the details of this project.

Please ask the researcher any questions about any part of this project that you do not fully understand.

It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved.

Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the Health Research Ethics Committee of the Faculty of Health Sciences of the North-West University (NWU, Potchefstroom) and the Ghana Health Service Ethics Review Committee. It **will be conducted according to the ethical guidelines and principles of the International Declaration of Helsinki and the ethical guidelines of the National Health Research Ethics Council.**

It might be necessary for the research ethics committee members or relevant authorities to inspect the research records.

1

What is this research study all about?

- It is known that people that are underweight (weigh less than what they used to in the past) takes longer to recover from illness or surgery and are more likely to develop infections. This results in a longer stay in hospital and extra costs.
- This study aims to get information on the number of people that are underweight when they are admitted to hospital and when they are discharged.
- It will be conducted at Korle Bu Teaching hospital during the period **December 2015** to **March 2016** or until the desired number of study participants have been reached.
- A total of 400 participants 18 years and above are needed for the study to provide meaningful results.
- In order to conduct this study, the researcher will first explain the study and ask your approval to participate.
- The information to be obtained include: asking you questions about your appetite, determining your weight and height, performing a clinical examination on you to assess for signs of weight loss.
- It should not take more than 45 minutes of your time to obtain all the information. This will be repeated again when you are discharged.
- We may also contact you telephonically 1-month after you have been discharged to ask you a few questions.

Why have you been invited to participate?

- You have been invited to participate because you are an adult-inpatient that has been admitted to this study department within the last 48 hours and you meet our inclusion criteria:

What will your responsibilities be?

- *Should you agree to be part of this study, you will be expected to:*
  1. *Carefully read the information provided by the researcher about the study* **or have the information read to you** *and to ask questions about any uncertainties you may have. To then provide your written approval to participate if you are comfortable to do so.*
  2. To keep a copy of the consent form for your own record keeping.
  3. To provide information that is accurate and honest during the interviews which will be conducted at admission, discharge and one-month post discharge.
  4. *To* speak to the researcher if you want to stop your participation any time during the study or to contact the researcher or research ethics committee if you have any queries, concerns or complaints.

Will you benefit from taking part in this research?

- There will be no direct benefits for you as a participant, but you will have the opportunity to help researchers answer the question about the nutritional status and health of Ghanaians that are admitted to hospital.

Are there risks involved in your taking part in this research?

- None of the procedures in this study will harm you. The weight and height measurements we will take are routinely done in the hospital as they are standard practice of care. The weight and height measurements will not cause you any discomfort. Depending on your health condition however, getting undressed into minimal clothing and walking to the scale and stadiometer may be a discomfort.

- We will also record some of the information as already mentioned from your hospital file. Some of your privacy might be lost during this study but your name will never be made known and your data will be handled confidentially. Only the team of researchers will work with the information that you shared. All sensitive information will be protected by locking it up and storing it on a password protected computer.

What will happen in the unlikely event of some harm/form of discomfort occurring as a direct result of your taking part in this research study?

There is an opportunity for compensation in the event of some form of harm.

Who will have access to the data?

Only the research team that is involved in data collection will have access to your medical files therefore protecting confidentiality. From time to time, sponsors of the study, study monitors or research auditors or members of the Health Research Ethics committee may also need to inspect the research records. Anonymity will be ensured by giving unique codes to each study participant rather than using names on the questionnaire. Reporting of findings will be anonymous by using these unique codes. Data will be kept safe and secure by locking hard copies in locked cupboards in the researcher's office at the Dietetics Department of the university of Ghana and for electronic data, it will be password-protected.

What will happen with the data?
This is a once off collection and the data (questionnaires) will be flown to South Africa and kept in a locked drawer at the Department of Nutrition, North-West-University, Potchefstroom Campus after which questionnaires will be discarded after 5 years.

Will you be paid to take part in this study and are there any costs involved?

You will not be paid to take part in the study

Is there anything else that you should know or do?

- You can contact Miss Dzifa Nyatefe (0243978997), Dr Matilda Asante (0540683892), Mrs Anna Amoako Mensah (0208411904) or Dr Robin Dolman (+27826597053) if you have any further queries or encounter any problems
- You can contact the Health Research Ethics Committee via Mrs Carollen van Zyl at 018 299 2089; carolien.vanzyl@nwu.ac.za if you have any concerns or complaints that have not been adequately addressed by the researcher.

How will you know about the findings?

- Your weight and height measurements will be communicated to you at the point of data collection unless your decide otherwise. The overall findings of the research will be ready from next year May 2016. You may place a call to either Dzifa Nyatefe (0243978997), Dr Matilda Asante (0540683892), Mrs Anna Amoako Mensah (0208411904) or Dr Robin Dolman (+27826597053) for these findings.

Declaration by participant

By signing below, I ..... agree to take part in a research study entitled **Adult hospital malnutrition: prevalence and consequences on malnutrition- associated outcomes at a teaching hospital in Ghana**

I declare that:

- I have read this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (*place*) ..... on (*date*) ..... 20...

....

Signature of participant **Signature of witness**

Declaration by person obtaining consent

I (*name*) ..... declare that:

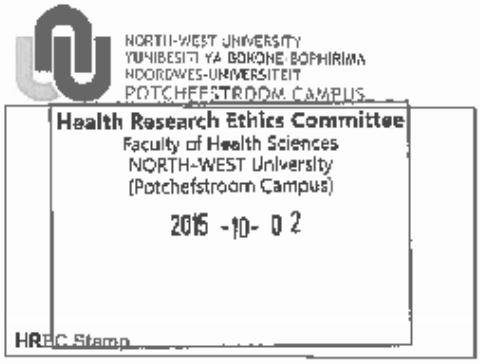
- I explained the information in this document to .....
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use a interpreter.

Signed at (*place*) ..... on (*date*) ..... 20....

....

Signature of person obtaining consent **Signature of witness**

ANNEXURE C: PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM PARTICIPANTS (EWE)



10.3 FORM 3-PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM FOR PARTICIPANTS

TITLE OF THE RESEARCH PROJECT: Adult hospital malnutrition: prevalence and consequences on malnutrition- associated outcomes at a teaching hospital in Ghana
Amenyinu mano ameteitsiwo *ƒɛ* nuɖuɖu me kple *ɛƒɛ* megbenyawo le kɔɖɛ dzi le Ghana.

REFERENCE NUMBERS:

PRINCIPAL INVESTIGATOR: Dzifa Nyatefe

ADDRESS: P.O. BOX CE 11468, COMMUNITY 11, TEMA, GHANA.

CONTACT NUMBER: +233243978997

You are being invited to take part in a research project that forms part of my Masters' thesis titled the Adult Hospital Malnutrition Study.
Mie do afɔ nawo bɛ nazu kpeɖeŋutɔ na nugɔmekuku sikɛ kuɖe nyɛ nusrosro *ƒɛ* nuŋlɔŋlɔ ŋu.

Please take some time to read the information presented here, which will explain the details of this project.
Meɖekuku nawo bɛ naza ɣeɣi vlaɖɛ eye na hlɔ nuŋlɔŋlɔ sia sikɛ aɖe nusianu gamɛ nawo tso nugɔmekuku dowɔna sia ŋu.

Please ask the researcher any questions about any part of this project that you do not fully understand.
Meɖekuku bɛ nabia numekulawo babla ɖeɖiɖeɖe tso dowɔna sia ŋu si kɛ gamɛ mɛ kɔna wo.

It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved.
Ele vevie bɛ wodzi nadze me le dowɔna sia ŋu eye wo nugɔmesese kple wo kpekpeɖeŋu na zu blibo.

Also, your participation is entirely voluntary and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.
Gakpeɖeŋu la, wo asiɖeɖe le dowɔna sia ŋu la natso wo dzime fãa ke boŋu maɖeɖe li nawo bɛ na ɖasi le emɛ le ɣe sia ɣi ke nɛ la.
Nɛ egbe la, maɖefu nawo le magbegble ɖeka nu o.

Mɔdɛdɛ lɔ nawo bɛ nadɔ lɛ dɔwɔna sia mɔ, nɛ nyɛ bɛ nɛ lɔ vayi bɛ yeawoe tsaɦ.

This study has been approved by the Health Research Ethics Committee of the Faculty of Health Sciences of the North-West University (NWU, Potchefstroom) and the Ghana Health Service Ethics Review Committee. It will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki and the ethical guidelines of the National Health Research Ethics Council.
***Fufofo* lɛ HREC, Faculty of Health Sciences, NWU kple GHS Ethics Review Committee tɔwo wo dasi dɛ nugɔmekuku sia dzi.**
Nugɔmekuku sia ayi dzi lɛ dɔdɔ tɔheadɛ ɦu sikɛ International Declaration of Helsinki kple National Health Research Ethics Council dasi *dɛ* edzi.

It might be necessary for the research ethics committee members or relevant authorities to inspect the research records.
Ava hia bɛ *fufofo* aɖɛwo woa vato nuɦlɔɦlɔ sia wo me.

What is this research study all about? Nukaɦuti ye nugɔmekuku sia kudɔ?

- It is known that people that are underweight (weigh less than what they used to in the past) take longer to recover from illness or surgery and are more likely to develop infections. These result in a longer stay in hospital and extra costs.

  Nugɔmekuku gaɖɛ ɦa bɛ amesiwo kɛ didina lɛ kpɛkpɛme tɔwu alesi kɛ wole tsaɦ la, wofɛ hayahaya tso dɔlɔlɛ me tsina megbe eye wo dɛna mɔ na dɔlɔlɛ bubuwo.
  Eva dzɔna bɛ ameyawo, wotsina kɔɔdzi tegbee eye wogblɔna ga fuu.

- This study aims to get information on the number of people that are underweight when they are admitted to hospital and when they are discharged.

  Tadodzinu na nugɔmekuku sia nye bɛ miakpɔamenɛnɛ *ɦɛ* kpɛkpɛme ye didi tso teƒi kɛ wo hɔwo da dɛ dɔba dzi vasedɛ teƒi kɛ wodasi lɛ woɦu.

- It will be conducted at Korle Bu Teaching hospital during the period December 2015 to March 2016 or until the desired number of study participants have been reached.

  Nugɔmekuku sia ayi dzi lɛ Korle-Bu kɔɔgaɦ dzi tso 'December 2015'/Dzoma dzinu amɛ lɛ 2015 va se dɛ 'March'/Tadoxe dzinu amɛ lɛ 2016 mɛ alo vasedɛ teƒi me kɛ miekpɔ amewo lɛ wo*ɦe* gbɔsusume sikɛ dzɛ nugɔmekulawo ɦu.

- A total of 400 participants 18 years and above are needed for the study to provide meaningful results.
  Mia hia ame alafa ene sikɛ ho dɛ wienyi kple edzi vɔwo akɔbe mia teɦu akpɔ nugɔmekunyawo sikɛ lɛ dɔdɔɦu.

- In order to conduct this study, the researcher will first explain the study and ask your approval to participate.

  Haɦi nugɔmekuku nayi dzi la,nugɔmekula aɖɛ nugɔmenawo eye woa biawo mɔdɛdɛ tso gbɔwo na edzi bɛ yea no me.

The information to be obtained include: asking you questions about your appetite, determining your weight and height, performing a clinical examination on you to assess for signs of weight loss.
Nya ye wo ne ku ɖe nugomekuku sia woe nya babia tso wo dzrodzro na nuɖuɖu, wo kpekpeme kple wo kokoma, ɦkulele ɖe dzesiwo ke fia bɔ wo kpekpeme ɖiɖi haa.

- It should not take more than 45 minutes of your time to obtain all the information.

  This will be repeated again before you are discharged.

  Yeɣi kɔ mia za na dowɔna sia, ma wu ga*fo*fo blaene vɔ atɔ o **(45 mins).**
  Miaga gbugbɔ a tome kple wo hafi woa ɖasi le ɦuwo.

- We may also contact you telephonically 1-month after you have been discharged to ask you a few questions.

  Mia atɔɦu aɣowo le nu*fo*mɔdzi le dzinu ɖeka megbe le wo **asiɖeɖe tso kɔɔdzi hã eye na ɖo babla vlaɖewo ɦu.**

Why have you been invited to participate? Nuka tae wo do alɔ nawo bɛ nana nugome kuku sia me?

- You have been invited to participate because you are an adult-inpatient that has been admitted to this study department within the last 48 hours and you meet our inclusion criteria:
  Ele nugomekuku sia me elabena enye ameteitsi el le dobadzi le kɔɔdzi le ɦkɛkɛ eve sie vayi.

What will your responsibilities be? **Nukawoe wo do ɖasi nye gɛ?**
Should you agree to be part of this study, you will be expected to:

Ne elɔ bɛ yana dowɔna sia me la,

1. Carefully read the information provided by the researcher about the study or have the information read to you and to ask questions about any uncertainties *you may have. To then provide your written approval to participate if you are comfortable to do so.*
   Elabe na hlen nuɦlolɦlo nyuie alo amaɖe na hlen na **wo eye na bia nusi kɛ gome me kɔ na wo. Eye na fia bɛ, ye lo ɖe edzi le nuɦlolɦlo me.**

2. To keep a copy of the consent form for your own record keeping.
   Na ho nuɦlolɦlo gbale ɖeka ɖe tsɔ ta.

3. To provide information that is accurate and honest during the interviews which will be conducted at admission, discharge and one-month post discharge.
   Na ná nuɖoɖo le nyate*fe* me kple dedienyenye me le **miafe kadodo la me tso yeɣi kɔ wo hɔ wo daɖe kɔɔ dzi vase ɖe gamayi kɛ wo ɖasi le ɦuwo le dzinu ɖeka megbe.**

4. To speak to the researcher if you want to stop your participation any time during the study or to contact the researcher or research ethics committee if you have any queries, concerns or complaints.

   Na gblɔnaa nugomekula gamɛ yɔkɛ nɛ le bɛ yea do le dowɔna sia me, alɔ nana mianya nyadeɛlade aika kuɖe dowɔna sia le ɦu.

Will you benefit from taking part in this research? Dze wakpɔ viɖe aɖe le dowɔna sia ɦu haa?

There will be no direct benefits for you as a participant, but you will have the opportunity to help researchers answer the question about the nutritional status and health of Ghanaians that are admitted to hospital.
Vida tohe adeke meli nawo o, kɛ boŋ mokpokpo li nawo bɛ na kpede nugɔmekulawo kple ɲudɔdɔwo na babiawo le Ghana dukɔmeviwo ƒe dedie nɔnɔ le amɔnyinu nuɖuɖu kple lame ɛe gome.

Are there risks involved in your taking part in this research? Nanewo li dl vovo le dɔwɔna sia ɲua?

- *None of the procedures in this study will harm you.*
  Nane kɛ medi vovo le dɔwɔna sia ɲu o.

The weight and height measurements we will take are routinely done in the hospital as they are standard practice of care.
The weight and height measurements will not cause you any discomfort. Depending on your health condition however, getting undressed into minimal clothing and walking to the scale and stadiometer may be a discomfort.
Mladzidzi wo kpɛkpɛme kple wokɔkɔme gasia ga me aɛsi wo wɔna le kɔɔdzi ɖeɖaɖe kɛ boŋ nusiwo ne do sikɛ dona wo kpɛkpɛme kple wo kɔkɔme ɖe dzi la abɔ afɔkpa kple kome nuwo mladzi bɛ naɖewo.
Ɖoɖoaɖeke meli sikɛ adefunawo alo awɔ nuveviwo.

- *We will also record some of the information as already mentioned from your hospital file.*

Some of your privacy might be lost during this study but your name will never be made known and your data will be handled confidentially.
Mla ɲɔ wo ɲutinyawo alesi wolɔ le kɔɔdzi gbalɔwo me.
Wo tɔxi vevia tɔhɛaɖewo abuɖewo gɛke wo ɲɔ madi o.

Only the team of researchers will work with the information that you shared. All sensitive information will be protected by locking it up and storing it on a password protected computer.
Mla lɛbɔ tɔhɛaɖe na wo ɲutinyawo alebe nugɔmekulawo koe akpɔ mɔnu le wo ɲutinyawo ɲu.

What will happen in the unlikely event of some harm/form of discomfort occurring as a direct result of your taking part in this research study? <u>Ne wɔnya bɛ dɔwɔna sia na he lukaɖa ɖe vae na wo la, mɔnukpokpo kae li nawo?</u>
There is an opportunity for compensation in the event of some form of harm.
Mɔnukpokpo li na wo bɛ mla ɖo teƒe na nusi kɛ buɖe wo.

Who will have access to the data? <u>Amekawoe akpɔ mɔnu le nugɔmeku nyawo ɲu?</u>

Only the research team that is involved in data collection will have access to your medical files therefore protecting confidentiality.
Nugɔmekulawo koe akpɔ mɔ nu le nugɔmeku nyawo me.

From time to time, sponsors of the study, study monitors or research auditors or members of the Health Research Ethics committee may also need to inspect the research records.
Le xexl aɖe me la, ameyo kata ne kuɖe nugɔmekuku dɔwɔna la nuti hã, akpɔ mɔnu le nugɔmeku nyawo ɲu.

Anonymity will be ensured by giving unique codes to each study participant rather than using names on the questionnaire.
Ŋkɔzaza aɖeke mele dɔwɔna sia me o.
Kɛ boŋ dzesi tɔhe ko mla zã na nugɔmeku nyawo.

Reporting of findings will be anonymous by using these unique codes.
Data will be kept safe and secure by locking hard copies in locked cupboards in the researcher's office at the Dietetics Department of the University of Ghana and for electronic data, it will be password-protected.
Nugɔmeku nyawo woa nɔ lutu le adaka me lɛ dɔwɔfe sikɛ kpɔna amegbetɔ fɛ dedie nɔnɔ lɛ nududu kple efe amenyinuwo gbɔ lɛ suku kɔkɔ University of Ghana.

What will happen with the data? Ðodo kae li na nugɔmeku nyawo?
This is a once off collection and the data (questionnaires) will be flown to South Africa and kept in a locked drawer at the Department of Nutrition, North-West-University, Potchefstroom Campus after which questionnaires will be discarded after 5 years.
Zi ɖeka nugɔmekuku fe fufofo fe dɔ koe wonyɛ, si woa tsɔ ayi suku kɔkɔ fe hɔ si nye North-West University le South Africa duko me, alebe le efe atɔ megbe la woa gble edome.

Will you be paid to take part in this study and are there any costs involved?
Fehehe ade li nawo le dɔwɔna sia me a alo gahehe ade li a?
You will not be paid to take part in the study. Neither will you incur any costs from the study.
Fehehe aɖe kɛ alo gahehe aɖeke me li nawo o le dɔwɔna sia me o.

Is there anything else that you should know or do? Nububu ade li wole bɛ na nyá alo na wo haa?

- **You can contact Miss Dzifa Nyatefe (0243978997), Dr Matilda Asante (0540683892), Mrs Anna Amoako Mensah (0208411904) or Dr Robin Dolman (+27828597053) if you have any further queries or encounter any problems.**
  Atɔhu a kɔɖe afenɔ Dzifa Nyatefe, Dr Matilda Asante, afetɔsrɔ Mrs Anna Amoako Mensah alo Dr Robin Dolman le wofe nufomɔkɔwo dzi.

- You may contact the administrative secretary of the Ghana Health Service Ethics Review Committee via Mrs Hannah Frimpong at 0507041223 or the Health Research Ethics Committee of the North-West University via Mrs Carollen van Zyl at 018 299 2089: carollen.vanzyl@nwu.ac.za if you have any concerns or complaints that have not been adequately addressed by the researcher.

  Atɔhu akɔɖe nuɖiɖiawo fe amega le Ghana Health Service, Mrs Hannah Frimpong le ɖe nufomɔ kadzi le 0507041223 alo afetɔsrɔ (Mrs) Carollen Van Zyl le 0182992089. Ne babla ɖe li la,atenu gblɔna nugɔmekula wo.

You will receive a copy of this information and consent form for your own records.
Na ho nuɖiɖiɖu gbalɛ ɖeka ɖe tsɔ ta.

How will you know about the findings? Leke nawo anya nugɔmeku nyawoa?

- Your weight and height measurements will be communicated to you at the point of data collection unless you decide otherwise.
  Wo kpɔkpɔme kple wo kɔkɔme ano nyanya me nawo le gafofo si me kɛ wo fofoe fu zi alesi kɛ ne la ɖe edzi.

The overall findings of the research will be ready from next year May 2016.
Nugɔmekuku nyawo kple emetsonyawo ano klalo le efe si kɛ gbɔna 2016 le 'May' Dame dzinu me.

Atenu ayɔ ameslwo le wofe nufomɔ ka dzi na nugɔmeku nyawo: Dzifa Nyatefe (0243978997), Dr Matilda Asante (0540683892), Mrs Anna Amoako Mensah (0208411904) alo Dr Robin Dolman (+27828597053).

5

Declaration by participant (Atamkaka)

By signing below, I ………………………………………… agree to take part in a research study entitled Adult **hospital malnutrition: prevalence and consequences on malnutrition- associated outcomes at a teaching hospital in Ghana.**

Enye nyaɓudola ……………………………lo be mano dowona sia me si ƒe ɦko nye '**Adult hospital malnutrition: prevalence and consequences on malnutrition- associated outcomes at a teaching hospital in Ghana'.**

I declare that:

I have read this information and consent form and it is written in a language with which I am fluent and comfortable.

- **Me ka atam be me hle agbale si wo kata eye me se egome le nye de gbê me eye nye dzi dzeme.**

- I have had a chance to ask questions and all my questions have been adequately answered.

  Me kpo monu eye me bia babia sike wo ɖo nye babia ɦu dedie.

- I understand that taking part in this study is voluntary and I have not been pressurised to take part.

  Mese gome be asi kpekpe ɖe dowona sia ɦu la etso nye dzime fãa.

- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.

  Ma tcɦu a do le dowona sia me le vesiavi alebe tohche aɖe ke meli namo.

- I may be asked to leave the study before it has finished, if the researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

  Wo atcɦu ana ma do le dowona sia me hafi dowona na wunu ne nye be nugomekula kpoe be ade dzinye alo ne nye me wo ɖe nugomekula ƒe ɖoɖonu o.

Signed at (*place*) ……………………………………… on (*date*) ……………………… **20…**

Dkotata le

………………………………………………… ………………………………………………

Signature of participant **Signature of witness**

6

Declaration by investigator/fieldworker **(Atamkaka tso nugɔmekula gbɔ)**

I *(name)* ..... declare that:
Enye nugɔmekula.....**ka atam bɔ:**

- I explained the information in this document to .. . .
  Medenyaŋlɔŋlo sɪ kɛ **le agbale** la me.
- I encouraged him/her to ask questions and took adequate time to answer them.
  Me de dzeƒo na **nyaŋudola** alebe **wo bia babla** sugbɔ **eye me za nari** sugbɔ **tsɔ do babiawo** ŋu.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
  Nye dzi dzome fuu le alesike **nyaŋudola tsɔ se** ŋuwo **gɔme va yi.**
- I did/did not use a interpreter.
  Me zã alo nye me zã nyagɔme dela o

Signed at *(place)* .. .. **on** *(date)* ..... **20**....
ŋkɔtata le

.....
Signature of investigator/fieldworker

.....
Signature of witness

ANNEXURE D: PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM PARTICIPANTS (GA)

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

Health Research Ethics Committee
Faculty of Health Sciences
NORTH-WEST University
(Potchefstroom Campus)
2015 -10- 02
HREC Stamp

10.3 FORM 3-PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM FOR PARTICIPANTS

TITLE OF THE RESEARCH PROJECT: Adult hospital malnutrition: prevalence and consequences on malnutrition- associated outcomes at a teaching hospital in Ghana

REFERENCE NUMBERS:

PRINCIPAL INVESTIGATOR: Dzifa Nyatefe

ADDRESS: P.O. BOX CE 11488, COMMUNITY 11, TEMA, GHANA.

CONTACT NUMBER: +233243978997

You are being invited to take part in a research project that forms part of my Masters' thesis titled the Adult Hospital Malnutrition Study.
Afɔbo nine kɛ tsɛ bo ne oba fata nia mli kwɛmɔ nifata Masters thesis ni yitso jI "Adult hospital malnutrition: prevalence and consequences on malnutrition-associated outcomes at a teaching hospital in Ghana' nikasemɔ lɛ.

Please take some time to read the information presented here, which will explain the details of this project.
Yɛ heshibaa mli lɛ, natsui ni okane sane ni woke fɔ blɛ lɛ, ni gbalaa 'project lɛ mli fitsofitso.

Please ask the researcher any questions about any part of this project that you do not fully understand.
Yɛ heshibaa mli lɛ obaanyɛ obi niamli kwɛlɔi lɛ eajii yɛ nia mli kwɛmɔ nikasemɔ lɛ lɛ he ni onuushishi.

It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved.
Ehe hia akɛ otsui annyɔ omli yɛ naimli kwɛmɔ nɛɛ mli shishinumɔ boni afee ni ole boni **okɛ ohe baawo mli oha.**

Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

1

Agbenchu lɛ ohe kɛ nitsumɔ nɛɛ mli woo lɛ ŋɛdeŋɔ bo diefitsɛ osuɔmɔ naa ni obaanyehi ni ojie ohe yɛ mli.
Keji ohee ewoomli lɛ, ekɛ naagba ko baafi onɔ mɔ.
Oyɛ hegbɛnaahu ni oshio keji shishijee lɛ ohe ewomli po akɛ obaafata he.

This study has been approved by the Health Research Ethics Committee of the Faculty of Health Sciences of the North-West University (NWU, Potchefstroom) and the Ghana Health Service Ethics Review Committee. It will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki and the ethical guidelines of the National Health Research Ethics Council.
'Health Research Ethics Committee of the Faculty of Health Sciences of the North-West University (NWU,Potchefstroom) kɛ Ghana Health Service mɛn ehe niamli kwɛmɔ nɛɛ ewomli ni abaafee nikasemɔ nɛɛ yɛ 'International Declaration of Helsinki kɛ National Health Research Ethics Council' lɛ amlai anɔ.

It might be necessary for the research ethics committee members or relevant authorities to inspect the research records.
Ehe baahia hu akɛ niamli kwɛmɔi amla nokwelai lɛ baaba ni amɛbakwɛ niamli kwɛmɔi wojih mli.

What is this research study all about? Mɛni ji niamli kwɛmɔ nikasemɔ nɛɛ?

- It is known that people that are underweight (weigh less than what they used to in the past) take longer to recover from illness or surgery and are more likely to develop infections. These result in a longer stay in hospital and extra costs.

  Wɔ lɛ akɛ gbɛmei ni mli tsɛlimɔ baashi fe tsutsu mlistiimɔ lɛ kyeɔ yɛ helaetamɔ he dani amɛ naa hewale ni efiteɔ shika hu.

- This study aims to get information on the number of people that are underweight when they are admitted to hospital and when they are discharged.

  Nikasemɔ nɛɛ hiɛnɔkamɔ lɛ jɛ akɛ abaana mei ni mlitsimɔi baashi bee ni ahe amɛ afɔ helaetsamɔhe lɛ kɛ bee ni ajieamɛ.

  It will be conducted at Korle Bu Teaching hospital during the period December 2015 to March 2016 or until the desired number of study participants have been reached.

  Nitsumɔ nɛɛ baaya nɔ yɛ Korle Bu helaetsamɔhe lɛ kejɛ Afuabe 2015 kaagbee Otsɔkrikri 2016 aloo keyaashi bee ni wobaana nikaselai fale ni wɔtawɔɔ lɛ.

- A total of 400 participants 18 years and above are needed for the study to provide meaningful results.
  Gbɛmei fals ni baashe 400 ni amɛ na efi nyɔfima kɛ kpaanyɔ kɛ ɛɛ ji mei ni wɔmlitawɔ ni amɛ kɛ amɛhe awɔ nikasemɔ nɛɛ mli koni wɔnye wɔna sɛɛnamɔ ni shishinumɔ yɛ he.

- In order to conduct this study, the researcher will first explain the study and ask your approval to participate.

Boni afee ni wokɛ nikasemonɛɛ baaba lɛ wo niamli kwɛlɔl lɛ baagbala nikasemɔlɛ mli ni amɛ baabi nyɛ hegbɛ koni nyɛ kɛ nyɛhe awo mli.

- The information to be obtained include: asking you questions about your appetite, determining your weight and height, performing a clinical examination on you to assess for signs of weight loss.
  Sajii komɛi ni wo nine baashenɔ lɛ eko ji: abaabi nyɛ boni nyɛ akɔnɔ kɛ ha niyeni yoo ahaa abaa kwɛ nyɛ mlitsilmɔ kɛ kwɔlɛ, abaa kwɛ gbomɔ tso lɛ kɛ tawo boni o mlitsilmɔ eba shi eha.

- It should not take more than 45 minutes of your time to obtain all the information.
  This will be repeated again before you are discharged.
  Wokɛ bei nishɛɛ '45 minutes' ni baabua sajii nɛɛ naa woba bi bo nɛkɛ sajii nɛɛ eko dani ajie bo OR/ Wo fiteŋ obee ni baashɛ '45 minutes' ni wokɛ nitsumɔ baaba naagbee.

- We may also contact you telephonically 1-month after you have been discharged to ask you a few questions.
  Wɔ baatswa bo yɛ nyɔŋ kome sɛɛ ni ajie bo lɛ koni wo bi bo sajii fioo ko.

Why have you been invited to participate? <u>**Mɛni bewo wo mli fo nine kɛ tɛɛobo lɛ?**</u>

- You have been invited to participate because you are an adult-inpatient that has been admitted to this study department within the last 48 hours and you meet our inclusion criteria:

  Wofobo nine kɛ tɛɛ bo koni okɛ ohe abawo nikasemonɛɛ mli ejaakɛ onukpa ji bon i ahobo efo ni helatsamɔ he lɛ mli yɛ gbii enyɔ ni eho nɛɛ.

What will your responsibilities be? <u>**Mɛni baafee o nitsumo**</u>

Should you agree to be part of this study, you will be expected to: **Kɛji okpɛnɛ ni ofata nikasemɔ nɛɛ he lɛ, wo baasumɔ ni ofee:**

1. *Carefully read the information provided by the researcher about the study or have the information read to you and to ask questions about any uncertainties you may have. To then provide your written approval to participate if you are comfortable to do so.*

   Kanemɔ niŋmaa ni niamli kwɛlɔl lɛ kɛha bo lɛ jogbaŋ alo moko ba kane aha bo ni obi sajii ni onuushishi ojogbaŋ lɛ koni oha wolo nitsoo akɛ okpɛnɛ ni okɛ ohe baawo nitsumɔ nɛɛ mli kɛji oosumɔ lɛ.

2. To keep a copy of the consent form for your own record keeping.
Esani ohiɛ ohe sajii ni abaaŋma awo wojlaŋ mli lɛ eko.

3

3. To provide information that is accurate and honest during the interviews which will be conducted at admission, discharge and one-month post discharge.
Esani oha **sajii ni ja** ni **eji anukwale yɛ bei** mli ni **wonii** bi **bo sane** lɛ **bei** ni **ahe bo afa** bie lɛ **kɛ nyɔŋ kome sɛɛ ni ajie bo** lɛ.

4. To speak to the researcher if you want to stop your participation any time during the study or to contact the researcher or research ethics committee if you have any queries, concerns or complaints.

Esani okɛ niamli kwɛlɔi lɛ awie kɛji eshɔ heko ni **eotawo ni ojie oho yɛ nikasemɔ nɛɛ mli** lɛ.
Obaanyɛ hu ni okɛ niamli kwɛlɔi lɛ aloo niamli kwemɔi amla nokwɛlɔi lɛ awie kɛji oyɛ naagba ko.

Will you benefit from taking part in this research? Ani obaaŋa niamli kwemɔ nɛɛ sɛɛ kɛji okɛ ohe wo mli?

There will be no direct benefits for you as a participant, but you will have the opportunity to help researchers answer the question about the nutritional status and health of Ghanaians that are admitted to hospital.
Onaŋ sɛɛnamɔ kpakpa ko moŋ shi ohe kɛ niamli kwemɔ nɛɛ mli woo lɛ baawa ni ana hetoo kɛha sajii ni koo Ghana bii a niyenii mli hewalɛ kɛ amɛ hewalɛ he sajii amli kɛji ahe ame afa helatsamɔhe lɛ.

Are there risks involved in your taking part in this research? Ani nifaŋ ko baanyɛ aniŋa bo kɛji okɛ ohe wo niamli kwemɔ nɛɛ mli lo?

- *None of the procedures in this study will harm you.*
Gbɛjii anotoo ni wo baatsɔ nɔ yɛ nikasemɔ nɛɛ lɛ eko gbaŋ onaa.

The weight and height measurements we will take are routinely done in the hospital as they are standard practice of care
Mlitslimɔ kɛ nɔkwɔlɛ ni wo baasusu lɛ ji noko ni **yaanɔ yɛ helatsamɔhe lɛ akɛ eji noko ni esa** ni afee.

The weight and height measurements will not cause you any discomfort.
Nibii ni **wɔ kɛ baasusu bo lɛ haŋ ni** ohe ahia **bo.**

Depending on your health condition however, getting undressed into minimal clothing and walking to the scale and stadiometer may be a discomfort.
Moŋ ebaaje ohewalɛ naa lɛ wo baaha ni otsake otaade ni owo nokɔ ni baahani ofee krɛkrɛ kɛ nyiemɔ ni obaanyiɛ kɛya damɔ "scale" lɛ nɔ ji nɔni baaha oho ohiabolioo.

- *We will also record some of the information as already mentioned from your hospital file.*
Tamɔ bɔni wɔ kɛɛ bo momo lɛ wɔ baaŋma ohe sajii lɛ ni wɔ baajie yɛ helatsamɔ wolo lɛ mli lɛ wɔ shwe shi.

Some of your privacy might be lost during this study but your name will never be made known and your data will be handled confidentially.
Oteemɔ nibii komɛi baajekpo shi moŋ ogbɔi ejeŋkpo.

Only the team of researchers will work with the information that you shared.
Niamli kwɛbi lɛ pɛ ni kɛ sajii ni amɛ baabue kɛjɛ naa odeŋ lɛ batsunii.

All sensitive information will be protected by locking it up and storing it on a password protected computer.
Saji ni he hia ni esaa ni also lɛ, **wɔkɛ baawo "computer" no** ni **wɔkɛ "password" baaŋmɛ mli.**

What will happen in the unlikely event of some harm/form of discomfort occurring as a direct result of your taking part in this research study?
Mɛni baaba kɛji nɔkɔ ni baagba onaa loo nɔkɔ ni haŋni **ohe ajɔ bɔ, yɛ bɛi ni akɛ ohe ewo** <u>**niamlikwɛmɔ nikasemɔ nɛɛ mli?**</u>

There is an opportunity for compensation in the event of some form of harm.
Kɛji sane kɔ ba hina **bɔ yɛ** bɛi ni **akɛ ohe ewo nikasemɔ nɛɛ mli lɛ, abaa wabɔ ni ojie ohe kɛje nakaiŋ sane le mli.**

Who will have access to the data? <u>**Nɛmɔ ji mɛni baana ohe saji lɛ ahɛɛbɛ?**</u>
Only the research team that is involved in data collection will have access to your medical files therefore protecting confidentiality.
Niamli kwɛbi lɛ ni **buae sajii lɛ anaa ji mɛi** ni baana **hegbɛ kɛ bote ohelatsamohe wɔlɔ lɛ mli shi moŋ amɛ baabu he jogbaŋ.**

From time to time, sponsors of the study, study monitors or research auditors or members of the Health Research Ethics committee may also need to inspect the research records.
Ye bɛi komɛi ho mɛi ni kɛ shika woɔ niamli **kwɛmɔ nɛɛ kɛ niamli kwɛbi** ni yɔɔ **Health Research Ethics Committee kpee lɛ mli baa somɔ** ni **amɛ baakwɛ nɔkɛ niamli kwɛmɔ nɛɛ wɔjihaa mli.**

Anonymity will be ensured by giving unique codes to each study participant rather than using names on the questionnaire.
Reporting of findings will be anonymous by using these unique codes.
A ŋmaa mɛi ni **kɛ amɛ he ewo niamli kwɛmɔ nikasemɔ nɛɛ mli maa gbɛi shi abaa ha mɔfiaamɔ 'number'** ni **akɛ baa le lɛ bani afe** ni **a kaayono.**

Data will be kept safe and secure by locking hard copies in locked cupboards in the researcher's office at the Dietetics Department of the university of Ghana and for electronic data, it will be password-protected.
Akɛ ohe sajii wɔlɔi fɛɛŋ baa wo adeka mli ni **akɛ krado a ŋmɛ he aloo a kɛ baa wo "computer" mli ni "password" e ŋmɛ naa yɛ dietetics bii atsumli ni yɔɔ 'University of Ghana".**

What will happen with the data? <u>**Mɛni baa fee niamli kwɛmɔ aajii ni abua naa?**</u>
This is a once off collection and the data (questionnaires) will be flown to South Africa and kept in a locked drawer at the Department of Nutrition, North-West-University, Potchefstroom Campus after which questionnaires will be discarded after 5 years.
Kɛji a bua sajii lɛ fɛɛ naa lɛ akɛ baaya wo adeka ni krado e ŋmɛ naa yɛ "nutrition department" ni yɔɔ "North West University,Potchefstroom Campus ni yɔɔ South Africa maŋ mli.

Will you be paid to take part in this study and are there any costs involved?

Anl abaa ha bo shika kɛji ekɛ ohe wo **nlamli kwɛmɔ nɛɛ mli** aloo nyɔmɔ ko baaba?

You will not be paid to take part in the study. Neither will you incur any costs from the study.
Ahaabo shika kɛ o kɛ ohe wo **nlamli kwɛmɔ nɛɛ mli** ni nyɔmɔ ko hu baa o nɔ.
Is there anything else that you should know or do? Anl noko yɛ nl esani ole aloo ofe?

You can contact Miss Dzifa Nyatefe (0243978997), Dr Matilda Asante (0540683892), Mrs Anna Amoako Mensah (0208411904) or Dr Robin Dolman (+27828597053) if you have any further queries or encounter any problems.
Obaa nyɛ o tswa Dzifa Nyatefe (0243978997), Dr Matilda Asante (0540683892), Mrs Anna Amoako Mensah (0208411904) a loo Dr Robin Dolman (+27828597053).
Kɛjl oyɛ sajli bimɔ aloo noko ni gba onaa.

- You may contact the administrative secretary of the Ghana Health Service Ethics Review Committee via Mrs Hannah Frimpong at 0507041223 or the Health Research Ethics Committee of the North-West University via Mrs Carolien van Zyl at 018 299 2089; carolien.vanzyl@nwu.ac.za if you have any concerns or complaints that have not been adequately addressed by the researcher.

Oba nyɛ ni okɛ secretary biaa onukpa ni yɔɔ Ghana Health Service a gba sane kɛ tsɔ Mrs Hannah Frimpong yɛ 0507041223 aloo Health Research Ethics Committee ni yɔɔ North-West University kɛ tsɔ Mrs Carolien Van Zyl yɛ 0182992089 aloo Carolien.vanzyl@nwu.ac.za kɛ jl oyɛ noko wiemɔ aloo noko ni obaa bl.

- You will receive a copy of this information and consent form for your own records.

Esani ohlɛ ohe sajii ni abaaŋma awo wojiaŋ mli lɛ eko

How will you know about the findings? Tɛ o baa fɛ tɛŋ o nine baa shɛ susumɔi ni [ɛɔ nlamli kwɛmɔ nɛɛ mli?

- Your weight and height measurements will be communicated to you at the point of data collection unless you decide otherwise.
  O nine baa shɛ o mlitsiimɔ kɛ o nukalɛ he susumɔ yɛ bei ni a susu bo lɛ ja bo dichitsɛ o sumɔɔ.

The overall findings of the research will be ready from next year May 2016.
Niamli kwɛmɔ susumɔi kɛ sajli lɛ fiɛŋ naa buamɔ baaba naagbe yɛ afi ni baa nɛɛ 'May 2016'.

You may place a phone call to either Dzifa Nyatefe (0243978997), Dr Matilda Asante (0540683892), Anna Dedei Kuevi (0208411904) or Dr Robin Dolman (+27828597053) for these findings.
Obaa nyɛ otswa Dzifa Nyatefe (0243978997),Dr Matilda Asante (0540683892), Mrs Amoako Mensah (0208411904) aloo Dr Robin Dolman (+27828597053).

Declaration by participant (Helatsɛ Kpɛnɛmɔ)

By signing below, I ..... agree to take part in a research study entitled Adult hospital malnutrition: prevalence and consequences on malnutrition- associated outcomes at a teaching hospital in Ghana.
Mi ŋma mi gbɛi yɛ wolo nɛɛ mli kɛ tsɔɔ akɛ mihe miwomli akɛ mi kɛ mihe baa wo niamli kwɛmɔ nɛɛ ni yitso ji "Adult hospital malnutrition: prevalence and consequences on malnutrition-associated outcomes at Korle-Bu teaching hospital.

I declare that: Mi he mi womli akɛ:

- I have read this information and consent form and it is written in a language with which I am fluent and comfortable.
  Mi kane niamli kwɛmɔ nɛɛ mli gbalama wolo lɛ ni afŋma yɛ Ga weimɔ lɛ mli ni yɛ shishinumɔ kɛ hejoolɛ.

- I have had a chance to ask questions and all my questions have been adequately answered.
  Mi na hegbɛ kɛ bi sajii ni niamli kwɛlɔl lɛ gbala mli ojogbaŋ kɛ tsɔɔ mi.

- I understand that taking part in this study is voluntary and I have not been pressurised to take part.
  Mi nushishi akɛ ejɛ mi diehiɛ mi suomɔ naa ni mi kɛ mi wo nikasemɔ nɛɛ mli.

- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
  Kɛ ji mi sumɔ ma nyɛ ma shi nikasemɔ lɛ yɛ bei fɛɛ bei ni naagba ko bɛ.

- I may be asked to leave the study before it has finished. if the researcher feels it is in my best interests, or if I do not follow the study pl as agreed to.
  Abaa nyɛ ajɔi mi yɛ nikasemɔ lɛ mli kɛji niamli kwɛlɔ is na akɛ ekɛ naagba baa ba.

Signed at (place) ..... on (date) ..... 20....

he ni mi ŋma mi gbɛi gbii ni mi ŋma mi gbɛi.....

.....
Signature of participant

.....
Signature of witness

helatsɛ gbɛi.....

odasifɔ nyo gbɛi.....

7

Declaration by investigator/fieldworker (Niamli kwɛlɔ kɔɔnɛmɔ)

I *(name)* ..... declare that:
Mi.....he mi womli akɛ.

- I explained the information in this document to .....
  Mi gbala wolo nɛɛ mli sajii kɛ tsɔɔ.....
- I encouraged him/her to ask questions and took adequate time to answer them.
  Mi ha hegbɛ ni e bi sajii ni mi gbala naa jeimɔ ojogbaŋ.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
  Mi he mi ye akɛ enu niamli kwɛmɔ lɛ sajii ojogbaŋ tomɔ boni a gbala mli yɛ wolo lɛ mli.
- I did/did not use a interpreter.
  Mi haaŋ ni weimɔ shishinu tsɔɔlɔ awa mi.

Signed at (place) ..... **on (date)** ..... **20....**
He ni mi fɔma mi gbɛi..... **gbii ni mi fɔma mi gbɛi**.....

.....
Signature of investigator/fieldworker

Niamli kwɛlɔ gbɛi

.....
Signature of witness

Niamlikwɛlɔ lɛ odasifonyo gbɛi

ANNEXURE E: PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM PARTICIPANTS (TWI)

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

Health Research Ethics Committee
Faculty of Health Sciences
NORTH-WEST University
(Potchefstroom Campus)
2015 -10- 0 2

HREC Stamp

10.3 FORM 3-PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM FOR PARTICIPANTS

TITLE OF THE RESEARCH PROJECT: Adult hospital malnutrition: prevalence and consequences on malnutrition- associated outcomes at a teaching hospital in Ghana

REFERENCE NUMBERS:

PRINCIPAL INVESTIGATOR: Dzifa Nyatefe

ADDRESS: P.O. BOX CE 11488, COMMUNITY 11, TEMA, GHANA.

CONTACT NUMBER: +233243078997

You are being invited to take part in a research project that forms part of my Masters' thesis titled the Adult Hospital Malnutrition Study.
Yɛ to nsa aferɛɔ ama wo abɛka nhwehwɛmuyi a yɛsɔyɛ afa mpanyinfo a wo da ayaresabea yi adidiemu.

Please take some time to read the information presented here, which will explain the details of this project.
Meserɛɔ wo, nya mmre kenkan krataa yi mu nsem a efa nhwehwɛmuyi yɛ be yɛ yi.

Please ask the researcher any questions about any part of this project that you do not fully understand.
Woti mi bisa asɛm bia ɛkyiri w'adwen.

It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved.
Ɛho be hia sɛ wo bɛ ti nhwehwɛmuyi asi yie ɛne ahofama a ɛhia wo wɔ nhwehwɛmuyi.

Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.
Nhwehwɛmuyi nyɛ ɔhyɛ,wo tumi gyae mmbre bia wo pɛ a ɛnfa nsunsuansuo bio mmbre wo.

1

This study has been approved by the Health Research Ethics Committee of the Faculty of Health Sciences of the North-West University (NWU, Potchefstroom) and the Ghana Health Service Ethics Review Committee. It will be conducted according to the ethical guidelines and principles of the International Declaration of Helsinki and the ethical guidelines of the National Health Research Ethics Council.
Health Research Ethics Committee of the Faculty of Health Sciences of the North-West University (NWU,Potchefstroom) ne Ghana Health Service agye nhwehwɛmuyi ato mu. Nhyehyɛmuyi a yeyɛ bɛ fa 'International Declaration of Helsinki' ne National Health Research Ethics Council akwankyerɛ ne nhyehyɛe.

It might be necessary for the research ethics committee members or relevant authorities to inspect the research records.
Afei nso ɛbɛtumi abanɛɛ wɔ bɛnya ehunumu afa nea yɛɛ yɛ yi ho.

What is this research study all about? Nhwehyɛmuyi afa dɛn ho

- It is known that people that are underweight (weigh less than what they used to in the past) take longer to recover from illness or surgery and are more likely to develop infections. These result in a longer stay in hospital and extra costs.

  Nhwehwɛmu kyerɛɛ wɔn a wɔn so ate, ɛkyɛwo ayaresabea ansaa na wɔn ho ato wɔn na wɔ sɛl sika bebree.

- This study aims to get information on the number of people that are underweight when they are admitted to hospital and when they are discharged.

  Nhwehwɛmuyi botae ne sɛ yɛ bɛ hu won a wɔsoate bre a wɔ da ayaresabea ni bre a yeyi won.

- It will be conducted at Korle Bu Teaching hospital during the period December 2015 to March 2016 or until the desired number of study participants have been reached.

  Nhwehwɛmuyi bɛ shɛ asi efiri December 2015 akosi March 2016 ɛwɔ Korle Bu ayaresabea anasɛ kosi sɛ ye benya nipa dodoɔ a yɛpɛ nyinaa.

- A total of 400 participants 18 years and above are needed for the study to provide meaningful results.
  Nhwehwɛmuyi bɛ hia nnipa dodoɔ 400 (ɔha anan) a w'adi mfi 18 (duwɔtwe)reko ama ye nya anoyi a edimu.

- In order to conduct this study, the researcher will first explain the study and ask your approval to participate.

  Wobenya nkyerɛkyerɛmu afa nhwehwɛmuyi ho ne wo nimuse ansaana ya hyɛ aseɛ.

The information to be obtained include: asking you questions about your appetite, determining your weight and height, performing a clinical examination on you to assess for signs of weight loss.
Nɛɛm a yɛbɛ bisa wo bi ne; w'anum nto yɛ, wo tenten, wo mu duru ne nhwehwɛmu a ɛkyerɛɛ woso ate.

- It should not take more than 45 minutes of your time to obtain all the information.

  This will be repeated again before you are discharged.

  Ɛnkitahodie yi mmɔ so sɛmaa '45' (aduanan-num).
  Ɛyɛɛ sɛn ne wo abedi nkitaho biom ansaana ɛe yi wo.

- We may also contact you telephonically 1-month after you have been discharged to ask you a few questions.

  Ɛyɛɛfrɛ wo bosome baako akyi, abisa wo nsɛm kakrabi.

Why have you been invited to participate? Adɛn enti na yato nsa afrɛ wo sɛ bɛka ho?

- You have been invited to participate because you are an adult-inpatient that has been admitted to this study department within the last 48 hours.
  Yafrɛ wo aka saa nhwenwɛmuyi ho efisɛ,woɛe opanyin na afei nso a'ada ha nna mmienu ntem.

What will your responsibilities be? W'asɛdeɛ nɛ sɛn?

Should you agree to be part of this study, you will be expected to:
Sɛ wopene so sɛ wobeyɛ nhwehwɛmuyi a,

1. Carefully read the information provided by the researcher about the study or have the information read to you and to ask questions about any uncertainties you may have. To then provide your written approval to participate if you are comfortable to do so.
   Ɛyɛɛ pɛ sɛ wo bɛkan kratɛa a ɛɛde bɛmawo no ana sɛ obin kenkan nsɛm a ɛwo kratɛamuyi akyerɛ wo, na sɛ wo wo nsɛm bi a ɛkyere w'adwen a, na w'abisa. Sɛ ɛbɛkyerɛ sɛ w'apene so no, wobɛtɪm krata yi so.

2. To keep a copy of the consent form for your own record keeping.
   Ɛyɛɛma wo kratɛa yi a w'ɛtim so baako.

3. To provide information that is accurate and honest during the interviews which will be conducted at admission, discharge and one-month post discharge.
   Ɛyɛɛsɛ sɛ, woɛema ɛɛn mmuae a ɛdi mu.
   Sɛnea ɛɛdi kan kia ɛɛ no,ɛɛne wo benya nkitahodie mmiensa;mmere a woda ha, sɛ ɛɛbeyi wo a, ɛna bosome baako a ɛdi da a ɛɛyii wo no akyi.

4. To speak to the researcher if you want to stop your participation any time during the study or to contact the researcher or research ethics committee if you have any queries, concerns or complaints.

   Ebere biara biribi kyere wadwen, anaa biribi ha wo, anaasɛ wopɛ sɛ wofrɪ nhwehwɛmuyi, ma ɛɛn **nhu.**

Will you benefit from taking part in this research? Mfaso bɛn na wobenya afi nhwehwɛmuyi?

- There will be no direct benefits for you as a participant, but you will have the opportunity to help researchers answer the question about the nutritional status and health of Ghanaians that are admitted to hospital.

Wonya mfaso biara ewo adesuamuyi nanso, wobenya akwanya aboa nhwehwɛmu a ɛfa aduanedi ne apomuden ho.

Are there risks involved in your taking part in this research? Nsusuansoo bi wo nhwehwɛmuyi anaa?

- *None of the procedures in this study will harm you.*
  Nsusuansoo biara nni nhwehwɛmuyi ho.

The weight and height measurements we will take are routinely done in the hospital as they are standard practice of care. The weight and height measurements will not cause you any discomfort. Depending on your health condition however, getting undressed into minimal clothing and walking to the scale and stadiometer may be a discomfort.
Ɛbɛ susu wo mu dɔrɔ ne wo tenten sɛnea ɛyɛɛ no wɔ ha nanso ɛmfa nsusuansoo biara mmrɛ wo. Ɔhaw kakra a ɛwo nhwehwɛmuyi ne sɛ wobɛ nante ama yɛsusu wo na w'ayi ade duruduru biara a ɛwo wo ho.

- *We will also record some of the information as already mentioned from your hospital file.*
  Yɛbɛnya nsɛmmisa mo mmuae no bi afi wo 'folder' no mu.

Some of your privacy might be lost during this study but your name will never be made known and your data will be handled confidentially.
Only the team of researchers will work with the information that you shared. All sensitive information will be protected by locking it up and storing it on a password protected computer.
Mmuae biara wode bɛma yɛn no, ɛbɛda yɛne won tem, na ɛyɛde besie yie.

What will happen in the unlikely event of some harm/form of discomfort occurring as a direct result of your taking part in this research study? Sɛ biribi yɛ wo ɛnam nhwehwɛmuyi a, ɛdɛn ne ɛbaɛi?

There is an opportunity for compensation in the event of some form of harm.
Mmoa kakra bi wo ho me wo.

Who will have access to the data? <u>Obi nsa betumi aka nsɛmmisayi ho mmuae anaa?</u>
Only the research team that is involved in data collection will have access to your medical files therefore protecting confidentiality.
Obiara nsa entumi nka wɔnsɛmisa mmuae no agye won a wɔne wo adi nkitahodie yi ɛne mpanyinfoɔ a edi nhwehwɛmuyi anim.

From time to time, sponsors of the study, study monitors or research auditors or members of the Health Research Ethics committee may also need to inspect the research records. Anonymity will be ensured by giving unique codes to each study participant rather than using names on the questionnaire.
Ɛmfa wo din mmata wo mmuae no ano.

Reporting of findings will be anonymous by using these unique codes.
Data will be kept safe and secure by locking hard copies in locked cupboards in the researcher's office at the Dietetics Department of the university of Ghana and for electronic data, it will be password-protected.
Ɛde wanoyi kratɔa yi besie adaka a krado da ano ɛwɔ University of Ghana suapon mu.

What will happen with the data? <u>Ɛdɛn na ɛde wo mmuae yi bɛyɛ?</u>

4

This is a once off collection and the data (questionnaires) will be flown to South Africa and kept in a locked drawer at the Department of Nutrition, North-West-University, Potchefstroom Campus after which questionnaires will be discarded after 5 years.
Yede wanoyi krataa yi bema nhwehwɛmu mpanyinfo a wowɔ Department of Nutrition, North-West University, Potchefstroom Campus a ewɔ South Africa. Mfie anum akyi no, yebesɛi no.

Will you be paid to take part in this study and are there any costs involved? **Akatua anaa ɛka bi wɔ nhwehwɛmuyi anaa?**

You will not be paid to take part in the study. Neither will you incur any costs from the study.
Akatua anaa ɛka biara nnI mu.

Is there anything else that you should know or do? Biribi wɔ hɔ a, ɛsɛɛ wɔ yɛ anaa wohu?
You can contact Miss Dzifa Nyatefe (0243978997), Dr Matilda Asante (0540683892), Mrs Anna Amoako Mensah (0208411904) or Dr Robin Dolman (+27828597053) if you have any further queries or encounter any problems.
Sɛ wowɔ nsɛmmisa anaa biribi kyere w'adwen a, wobetumi afrɛ Miss Dzifa Nyatefe (0243978997), Dr Matilda Asante (0540683892), Mrs Anna Amoako Mensah (0208411904) or Dr Robin Dolman (+27828597053).

- You may contact the administrative secretary of the Ghana Health Service Ethics Review Committee via Mrs Hannah Frimpong at 0507041223 or the Health Research Ethics Committee of the North-West University via Mrs Carolien van Zyl at 018 299 2089; carolien.vanzyl@nwu.ac.za if you have any concerns or complaints that have not been adequately addressed by the researcher

Wobetumi nso afrɛ kyerefo Panyin a ɔwɔ Ghana Health Service, Mrs Hannah Frimpong ewɔ 0507041223 ana sɛ Mrs Carolien van Zyl ewɔ 018 299 2089 ewɔ carolien.vanzyl@nwu.ac.za.

- You will receive a copy of this information and consent form for your own records.
  Yebema wɔ krataa yi a w'etim so baako.

How will you know about the findings? Wobɛyɛ dɛn ahu nea ebɛfi nhwehwɛmuyi?
- Your weight and height measurements will be communicated to you at the point of data collection unless you decide otherwise
  Yebɛka wɔ tenten ne womuduro akyerɛ wɔ ɛwɔ hɔ a.

The overall findings of the research will be ready from next year May 2016.
Na nea ebefi nhwehwɛmuyi mu aba nyinaa no de, wo nsa betumi aka efi bosome kotonima afe a yebɛwura muyi 2016.

You may place a call to either Dzifa Nyatefe (0243978997), Dr Matilda Asante (0540683892), Mrs Anna Amoako Mensah (0208411904) or Dr Robin Dolman (+27828597053) for these findings.
Wo nsa beka, sɛ wofrɛ Dzifa Nyatefe (0243978997), Dr Matilda Asante (0540683892), Mrs Anna Amoako Mensah (0208411904) or Dr Robin Dolman (+27828597053.

Declaration by participant Mpɛmuka (Me a meyiyi nsɛm no ano)

By signing below, I ..... agree to take part in a research study entitled **Adult hospital malnutrition: prevalence and consequences on malnutrition- associated outcomes at a teaching hospital in Ghana.**

Abɛrɛ a me tim kratayi ,me ..... gye tomu sɛ me ka nhwehwɛmuyi a y'eto din ' **Adult hospital malnutrition: prevalence and consequences on malnutrition- associated outcomes at a teaching hospital in Ghana**'.

I declare that: Me pɛ mu ka sɛ;

- I have read this information and consent form and it is written in a language with which I am fluent and comfortable.
  M'akan krataa yi ate asɛɛ wɔ me kasa mu na m'akoma atɔ me yɛm.

- I have had a chance to ask questions and all my questions have been adequately answered.
  M'anya akwanya abisa nsɛm, na m'anya ɛho mmuae nyinaa.

- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
  Mate asɛɛ sɛ nhwehwɛmuyi nyɛ ɔhyɛ.

- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
  Metumi agyae mmere biara a mepɛ, na ɛnya nsunsuansoɔ biara wɔ meso.

- I may be asked to leave the study before it has finished, if the researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.
  Sɛ ɔba sɛ wan a wɔdi adeɛsua yi anim yi hu sɛ nhwehwɛmu yi betumi aha me ɔkwan bi so a, anɔa sɔ me nni nhwehwɛmuyi nhyehyɛeɛyi a, ɛbetumi ama m'agyae.

Signed at (*place*) ..... on (*date*) ..... 20....
Me tim ewɔ **da**

.....
Signature of participant
Tim so wɔ ha

.....
Signature of witness
Adanseni ntimso

Declaration by investigator/fieldworker (Ɔsɛmmisafo Mpɛmuka)

I *(name)* ..... declare that:
Me .....**pɛmuka sɛ**,

- I explained the information in this document to .....

  Makyerɛkyerɛ nsɛm a ɛwɔ krataa yi mu akyerɛ.....

- I encouraged him/her to ask questions and took adequate time to answer them.

  Me hyɛɛ no nkuran sɛ ɔmmisa asɛm biara a akyerɛ n'adwen na me too mebo yii n'ano.

- I am satisfied that he/she adequately understands all aspects of the research, as discussed above

  Me gyidi sɛ wate biribiara a ɛwɔ nhwehwɛmuyɛ mu **yie**.

- I did/did not use a interpreter.
  Me faa yɛ/Manfa obi a obɛkyerɛkyerɛ nsɛmmisa no mu.

Signed at *(place)* ..... on *(date)* ..... 20...
Me tim ɛwɔ **da**

.....
Signature of investigator/fieldworker
Tim sɔ wɔ ha

.....
Signature of witness
Adanseni ntimso

ANNEXURE F: STELLENBOSCH ETHICS APPROVAL

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

Approval Notice
New Application

03-Oct-2014
Blaauw, Renee R

Ethics Reference #: N14/06/061

Title: **Prevalence and Impact of Hospital malnutrition on associated outcomes.**

Dear Professor Renee Blaauw,

The New Application received on 27-Aug-2014, was reviewed by members of Health Research Ethics Committee 1 via Expedited review procedures on 03-Oct-2014 and was approved.
Please note the following information about your approved research protocol:

Protocol Approval Period: **03-Oct-2014 -03-Oct-2015**

Please remember to use your protocol number (N14/06/061) on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review:
Please note a template of the progress report is obtainable on www.sun.ac.za/rds and should be submitted to the Committee before the year has expired. The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.
Translation of the consent document to the language applicable to the study participants should be submitted.

Federal Wide Assurance Number: 00001372
Institutional Review Board (IRB) Number: IRB0005239

The Health Research Ethics Committee complies with the SA National Health Act No.61 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health).

Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Contact persons are Ms Claudette Abrahams at Western Cape Department of Health (healthres@pgwc.gov.za Tel: +27 21 483 9907) and Dr Helene Visser at City Health (Helene.Visser@capetown.gov.za Tel: +27 21 400 3981). Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.
For standard HREC forms and documents please visit: www.sun.ac.za/rds

If you have any questions or need further assistance, please contact the HREC office at 0219389657.

Included Documents:
Checklist
Declaration - Dr M Asante
CV - Mrs J Visser
Participant information leaflet & informed consent

ANNEXURE G: NORTH WEST UNIVERSITY HREC APPROVAL

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

Ethics Office
Tel: 018-299 2092
Fax: 018-299 2088
Email: Minrie.Greeff@nwu.ac.za

02 October 2015

Dr R Dolman
Nutrition

Dear Dr Dolman

HREC APPROVAL OF YOUR APPLICATION

Ethics number: NWU-00091-15-A1/N14/06/061 (Prevalence and Impact of Hospital malnutrition on associated outcomes)

Kindly use the ethics reference number provided above in all correspondence or documents submitted to the Health Research Ethics Committee (HREC) secretariat.

Project title: Adult hospital malnutrition-associated outcomes at a teaching hospital in Ghana

Project leader/supervisor: Dr R Dolman

Student: D Nyatefe

Application type: Sub-study

Risk level descriptor: Minimal

You are kindly informed that at the meeting held on 14/05/2015 of the HREC, Faculty of Health Sciences, the aforementioned was approved.

The period of approval for this project is from 02/10/2015 to 30/10/2016.

After ethical review:

Translation of the informed consent document to the languages applicable to the study participants should be submitted to the HREC (if applicable).

The HREC requires immediate reporting of any aspects that warrants a change of ethical approval. Any amendments, extensions or other modifications to the protocol or other associated documentation must be submitted to the HREC prior to implementing these changes. Any adverse/unexpected/unforeseen events or incidents must be reported on either an adverse event report form or incident report form.

A progress report should be submitted within one year of approval of this study and before the year has expired, to ensure timely renewal of the study. A final report must be provided at completion of the study or the HREC must be notified if the study is temporarily suspended

or terminated. The progress report template is obtainable from Carolien van Zyl at Carolien.VanZyl@nwu.ac.za. Annually a number of projects may be randomly selected for an external audit.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process.

Please note that for any research at governmental or private institutions, permission must still be obtained from relevant authorities and provided to the HREC. Ethics approval is required BEFORE approval can be obtained from these authorities.

The HREC complies with the South African National Health Act 61 (2003), the regulations on Research with Human Participants of 2014 of the Department of Health and Principles, the Declaration of Helsinki, 2013, the Belmont Report and the Ethics in Health Research: Principles, Structures and Processes (SANS document).

We wish you the best as you conduct your research. If you have any questions or need further assistance, please contact the Ethics Office at Carolien.VanZyl@nwu.ac.za or 018 299 2089.

Yours sincerely

Prof Minrie Greeff
HREC Chairperson

Current details: (13210572) C:\Users\13210572\Documents\HREC\HREC - Applications\2015 Applications\Applications 04 - 14 May 2015\NWU-00091-15-S1 (R Dolman-D Nyatefe)\NWU-00091-15-S1 (R Dolman-D Nyatefe) - AL\NWU-00091-15-S1 (R Dolman-D Nyatefe) - AL.docm
2 October 2015

File reference: 9.1.5.3

ANNEXURE H: GHANA HEALTH SERVICE ETHICS ARROVAL

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted

My Ref. :GHS-ERC: 3
Your Ref. No.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Tel: +233-302-681109
Fax + 233-302-685424
Email: Hannah. Frimpong@ghsmail.org

6th August, 2015

Nyatefe Dzifa Esi
P. O. Box CE 11488
Community 11
Tema

ETHICS APPROVAL - ID NO: GHS-ERC: 06/06/15

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol titled:

"Adult Hospital Malnutrition: Prevalence and Consequences on Malnutrition-Associated Outcomes at a Teaching Hospital in Ghana"

This approval requires that you inform the Ethics Review Committee (ERC) when the study begins and provide Mid-term reports of the study to the Ethics Review Committee (ERC) for continuous review. The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Please note that any modification without ERC approval is rendered invalid.

You are also required to report all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.

You are requested to submit a final report on the study to assure the ERC that the project was implemented as per approved protocol. You are also to inform the ERC and your sponsor before any publication of the research findings.

Please note that this approval is given for a period of 4 months, beginning August 6th 2015 to December 6th 2015.

However, you are required to request for renewal of your study if it lasts for more than 4 months.

Please always quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

1

ANNEXURE I: GHANA HEALTH SERVICE ETHICS RENEWAL

GHANA HEALTH SERVICE ETHICAL REVIEW COMMITTEE

In case of reply the number and date of this letter should be quoted.

My Ref: ERC-
Your Ref. No.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra.

Tel: +233-0302681169
233-0302679522

Fax: 233-0302685424
ghsres@gmail.com

Hannah.Frempong@ghsmail.org
233 0507041223

10th December 2015

Nyutefe Dzifa Esi
P. O. Box CE11488
Community 11
Tema

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE APPROVAL FOR PROTOCOL AMENDMENT AND RENEWAL LETTER (1) OF INITIAL APPROVAL CERTIFICATE - (dated 6th August 2015)

RE: REQUEST FOR PROTOCOL AMENDMENT AND RENEWAL OF INITIAL ETHICAL APPORVAL

RE: Protocol titled: "Adult Hospital Malnutrition: Prevalence and Consequences on Malnutrition-Associated Outcomes at a Teaching Hospital in Ghana- ID NO: 06/06/15

Reference is made to your letter dated 1st December, 2015 requesting for amendment to your study Protocol and renewal of the ERC initial approval letter for the above-mentioned subject.

Please be informed that the Committee has reviewed the request and is satisfied with the explanation thereof. We therefore wish to inform you that approval is hereby granted for renewal of the initial ERC approval and implementation of the amended version of the protocol.

This approval requires that you submit periodic report of the study to the Committee for continues review and a final full report to the Committee on completion of the study. The Committee may observe or cause to be observed procedures and records of the study during and after implementation.

1

ANNEXURE J: KORLE BU SCIENTIFIC AND TECHNICAL COMMITTEE APPROVAL

In case of reply the number
And the date of this
Letter should be quoted
My Ref. No. KBTH-Inv/163/15
Your Ref. No.....

KORLE BU TEACHING HOSPITAL
P. O. BOX KB 77,
KORLE BU, ACCRA.

Tel: +233 302 667759/673034-6
Fax: +233 302 667759
Email: Info@kbth.gov.gh
pr@kbth.gov.gh
Website: www.kbth.gov.gh

20th October, 2015

NYATEFE DZIFA ESI
P. O. BOX CE 11488
COMMUNITY 11
TEMA

SCIENTIFIC AND TECHNICAL COMMITTEE APPROVAL:
- ID NO. (KBTH-STC) 001/2015

The Korle Bu Teaching Hospital Scientific and Technical Committee (KBTH-STC), at its meeting held on 16th October, 2015, reviewed and approved your study protocol titled: "**Adult Hospital Malnutrition: Prevalence and consequences on Malnutrition –Associated Out comes at a Teaching Hospital in Ghana**.

This approval requires that you **forward your document to Korle Bu Teaching Hospital – Institutional Review Board (KBTH-IRB) for Ethical Clearance before the project can be initiated.**

This approval has been granted for a period of four (4) months, beginning 19th October, 2015 to 29th January, 2016. You may, however, request extension of the approval period, or renewal as the case may be, should the study extend beyond the stated period.

Upon completion, you are required to submit a final report on the study to the STC. This is to enable the STC ensure among others that, the project has been implemented as per the approved protocol. You are also required to inform the KBTH-STC and Research Directorate of any publications that may emanate from the research findings.

Kindly note that, should the need arise, the KBTH-STC or IRB may institute appropriate measures to satisfy itself that study is being conducted according to the highest scientific and ethical standards.

Please note that any modification to the study protocol without Scientific Technical Committee (STC) approval renders this approval invalid.

Sincere regards,

Prof. Obeng Adjei
Chairman, KBTH-STC

Cc: The Chairman, KBTH-IRB

ANNEXURE K: KORLE BU INSTITUTIONAL REVIEW BOARD APPROVAL

In case of reply the number
And the date of this
Letter should be quoted

My Ref. No.....
Your Ref. No.....

P. O. BOX KB 77,
KORLE BU, ACCRA.

Tel: +233 302 667759/673034-6
Fax: +233 302 667759
Email: info@kbth.gov.gh
pr@kbth.gov.gh
Website: www.kbth.gov.gh

4th November, 2015

NYATEFE DZIFA ESI
P. O. BOX CE 11488
COMMUNITY 11
TEMA

ADULT HOSPITAL MALNUTRITION: PREVALENCE AND CONSEQUENCES ON MALNUTRITION ASSOCIATED OUTCOME AT A TEACHING HOSPITAL IN GHANA

KBTH – IRB /001/2015

Investigator :Ms Nyatefe Dzifa Esi

On 3rd November 2015 the Korle-Bu Teaching Hospital Institutional review Board (KBTH IRB) reviewed and granted approval to the study entitled ***"Adult Hospital malnutrition: prevalence and consequences on malnutrition associated outcome at a teaching hospital in Ghana"***

Please note that the Board requires you to submit a final review report on completion of this study to the KBTH IRB.

Kindly note that, any modification/amendment to the approved study protocol without approval from KBTH IRB renders this certificate invalid.

Sincere regards,

OKYERE BOATENG (MR)
CHAIR (KBTH-IRB)

Cc: The Chief Executive Officer
Korle Bu Teaching Hospital

The Director of Medical Affairs
Korle Bu Teaching Hospital

ANNEXURE L: ADMISSION DATA COLLECTION FORM

Participant number	

ADMISSION DATA COLLECTION FORM

1. Date of interview						
2.1	**Date of admission to hospital**					
2.2	**Date of admission to ward**					
Hospital code	**A**		**Hospital name**	Korle Bu teaching		
3. Ward category and number	**Ward category**				**Ward number number**	**B**
	3.1	Medical				
	3.2	Surgical				
	3.3	Oncology				
	3.4	Gynaecology				

A. DEMOGRAPHIC INFORMATION

4. Gender	Male		Female	

5. Date of birth of patient

Day		Month		Year			

B. MEDICAL INFORMATION

6. What is the patient's primary diagnosis on admission (Indicate only one)		
	Present (x)	**Provide details of specific medical condition**
6.1 General medicine		
Gastroenterology		
Cardiology		

Respiratory		
Nephrology		
Tuberculosis		
Retroviral Disease		
Endocrine / Diabetes		
Weight control		
Allergies		
Neurology		
Urology		
Nutritional Deficiency		
6.2 Surgery		
Abdominal surgery		
Trauma		
Orthopaedic surgery		
Neurosurgery		
Vascular surgery		
Cardiothoracic surgery		
6.3 Oncology		
6.4 Gynaecology		
6.5 Other (please specify)		

7. Indicate the presence of gastrointestinal side-effects.

Indicate the appropriate options below.

Side-effect	**YES**	**NO**	**If YES to any, please indicate the**

				frequency		
				Almost daily for 2 weeks	**Almost daily for 1 week**	**Infrequent**
7.1	Nausea					
7.2	Vomiting					
7.3	Diarrhoea					
7.4	Anorexia					
7.5	Constipation					

C. DIETARY INFORMATION

8. Ask the patient to describe any <u>changes in food intake during the past week</u>. Indicate the appropriate option below.

8.1	No change in usual food intake / consumes all food	
8.2	Decreased intake: consumes only ¾ of usual intake	
8.3	Decreased intake: consumes only ½ of usual intake	
8.4	Decreased intake: consumes only ¼ of usual intake	
8.5	Unable to consume anything	

9. If a decreased food intake occurred (8.2 – 8.5 above), determine the duration.

9.1	< 1 month	
9.2	> 1 month - < 3 months	
9.3	> 3 months	
9.4	Not applicable	

10. Was the patient referred for specialised nutritional support?

10.1	Yes	
10.2	No	

11. If YES to question 10, which health care professional made the referral?

11.1	Doctor	
11.2	Dietitian	
11.3	Registered nurse	
11.4	Not applicable	
11.5	Other (specify)	

D. ANTHROPOMETRY

12. Assessment / Determination of usual weight measurement.

12.1	Usual weight (kg)	
12.2	How long ago did you last weigh your USUAL weight (kg)?	
12.3	Information unknown	

13. Determination of weight history

Ask the patient to indicate their weight readings at as many of the following time periods as possible. If unable to indicate the actual readings, ask them to compare the weight to what it is currently.

Time frame		Actual measurement (kg)	Same as current	More than current			Less than current		
				Little	Med	Lot	Little	Med	=Lot
13.1	2 weeks								

13.2	1 month								
13.3	2 months								
13.4	3 months								
13.5	6 months								

13.6 If weight loss has occurred in questions 13.1-13.5, was this intentional?		
13.6.1	Yes	
13.6.2	No	
13.6.3	N/A	

14. Determine whether clothes / jewellery fit more loosely or adjustment of belt setting made		
14.1	Yes	
14.2	No	
14.3	N/A	

15. If YES to question 14 above, determine the duration.		
15.1	< 1 month	
15.2	1 month - < 3 months	
15.3	> 3 months	
15.4	Not applicable	

16. How was the anthropometric measurements taken? Indicate the appropriate options below.				
Measurement		**Measured**	**Estimated**	**Calculated**
16.1	Weight			

16.2	Height			

17. Indicate the measurements as determined			
17.1	Weight measurement (kg)		
17.2	Height measurement (cm)	Standing height (cm)	
		Bed length height (cm)	
		Half arm-span reading (cm)	

18. Were there any factors affecting the weight measurement e.g. casts, external fixing devices etc.			
18.1	Yes		**Specify:**
18.2	No		

E. FUNCTIONAL CAPACITY

19. Indicate the patient's dominant arm		
19.1	Right	
19.2	Left	

20. Measurement of hand-grip strength		
Measurement 1	**Measurement 2**	**Measurement 3**

21. Determine general functional capacity.

Indicate the appropriate options below.

Measurement	**YES**	**NO**	**If YES to any, please indicate change over the past 2 weeks**		
			Improved	**No change**	**Regressed**

21.1	Experience difficulty with normal activities / ambulation					
21.2	Bed /chair-ridden					

F. CLINICAL EXAMINATION

22. Test around the following areas for the presence of <u>oedema</u>: ankle, orbital, sacral. Please follow the SOP. *(TIP: Sacral - patient must be in a sitting position).*

Indicate the appropriate option below.

	Clinical finding	**Category**	**Indicate option**
22.1	No depression	No oedema	
22.2	2-4mm depression Immediate or few second rebound	Mild	
22.3	6mm deep pit 10-12 second rebound	Moderate	
22.4	8mm very deep pit > 20 second rebound	Severe	

23. Test around the <u>orbital area</u> (under the eyes) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP. *(TIP: Patient must stand up straight; view patient when standing directly in front of them, touch above the cheekbone)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**1. Category**	**2. Indicate option (X)**		
23.1	Slightly bulged fat pads	Normal / well nourished	6		7
23.2	Slightly dark circles, somewhat hollow look	Mild-moderate malnutrition	3	4	5
23.3	3. Hollow look, depressions, dark circles, loose skin	Severe	1		2

24. Test around the <u>upper arm area</u> (triceps / biceps) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP. *(TIP: patient stand up straight; arm bent,*

roll skin between fingers, do not include muscle in pinch)

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
24.1	Ample fat tissue obvious between folds of skin	Normal / well nourished	6	7	
24.2	Fingers almost touch, some depth to pinch	Mild-moderate malnutrition	3	4	5
24.3	Very little space between folds, fingers touch	Severe	1	2	

25. Test around the <u>thoracic/lumbar region</u> (ribs / midaxillary line) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP. *(TIP: Patient must stand up straight, have patient press hands hard against a solid object)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
25.1	Chest is full. Ribs do not show. Slight to no protrusion of iliac crest.	Normal / well nourished	6	7	
25.2	Ribs apparent. Iliac crest somewhat prominent.	Mild-moderate malnutrition	3	4	5
25.3	Ribs very apparent. Iliac crest very prominent.	Severe	1	2	

26. Test around the <u>temple region</u> (temporalis muscle) for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: patient must stand up straight; view patient when directly standing in front of them, ask patient to turn head side to side)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
26.1	Can see/feel well-defined muscle	Normal / well nourished	6	7	
26.2	Slight depression	Mild-moderate	3	4	5

		malnutrition			
26.3	Hollowing, scooping, depression	Severe	1	2	

27. Test around the clavicle bone region for the presence of muscle wasting. Please follow the SOP. *(TIP: Patient must stand up straight; look for prominent bone. Make sure patient is not hunched forward)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
27.1	Not visible (males), visible but not prominent (females)	Normal / well nourished	6	7	
27.2	Some protrusion	Mild-moderate malnutrition	3	4	5
27.3	Protruding, prominent bone	Severe	1	2	

28. Test around the clavicle and acromion bone region (shoulder) for the presence of muscle wasting. Please follow the SOP. *(TIP: Patient must stand up straight; patient arms at side: observe shape)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
28.1	Lines of bones prominent, no significant depressions / Rounded, curves at arm, shoulder, neck.	Normal / well nourished	6	7	
28.2	Acromion process may protrude slightly	Mild-moderate malnutrition	3	4	5
28.3	4. Shoulder to arm joint looks square, bones prominent; acromion protrusion very prominent	Severe	1	2	

29. Test around the scapular bone region for the presence of muscle wasting. Please follow the SOP. *(TIP: Patient must stand up straight; ask patient to extend hands straight out, push against solid object)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
29.1	Lines of bones not prominent, no depressions	Normal / well nourished	6	7	
29.2	Mild depression, or bone may show slightly	Mild-moderate malnutrition	3	4	5
29.3	Prominent, visible bones, depressions between ribs/scapula or shoulder/spine	Severe	1	2	

30. Test around the <u>dorsal hand</u> (Interosseous muscle) for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: Patient must stand up straight. Look at thumb side of hand; look at pads of thumb when tip of forefinger touching tip of thumb)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
30.1	Muscle bulges, could be flat in well-nourished	Normal / well nourished	6	7	
30.2	Slightly depressed or flat	Mild-moderate malnutrition	3	4	5
30.3	Depressed area between thumb – forefinger	Severe	1	2	

31. Test around the <u>patellar region</u> (knee) for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: Ask patient to sit with leg propped up, bent at knee)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
31.1	Muscle protrudes, bones not prominent	Normal / well nourished	6	7	
31.2	Knee cap less prominent, more rounded	Mild-moderate malnutrition	3	4	5
31.3	Bones prominent, little sign of musculature around knee cap	Severe	1	2	

32. Test around the <u>anterior thigh region</u> (quadriceps) for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: Ask patient to sit prop leg up on lo furniture; grasp quads to differentiate amount of muscle tissue from fat tissue*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
32.1	Well rounded, developed	Normal / well nourished	6	7	
32.2	Mild depression on inner thigh	Mild-moderate malnutrition	3	4	5
32.3	Depression on inner thigh, obviously thin	Severe	1	2	

33. Test around the <u>posterior calf region</u> for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: Patient must stand up straight. Grasp the calf muscle to determine amount of tissue)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	5. Clinical finding	**6. Category**	**7. Indicate option (X)**		
33.1	Well-developed bulb of muscle	Normal / well nourished	6	7	
33.2	Not well developed	Mild-moderate malnutrition	3	4	5
33.3	Thin, minimal to no muscle	Severe	1	2	

If any of the above clinical examinations could not be conducted, specify reason

Please double-check that all sections are fully completed!

Section A,B,C Completed by:	
Section D,E,F	

Completed by:	
Checked by:	
Date:	

At the end of each data collection day the team coordinator needs to hand the completed forms in a survey box and the equipment used to the research assistant. The research assistant will sign and ensure that all completed forms are in the survey box and that all equipment is still in original condition. The survey box will be sealed and together with the equipment it will be stored in the Department of Human Nutrition.

ANNEXURE M: DISCHARGE DATA COLLECTION FORM

Participant number	

DISCHARGE DATA COLLECTION FORM

1. Date of interview			
2. Date of admission to hospital			
3. Date of discharge from hospital			
Hospital code	**F**	**Hospital name**	**Korle-Bu teaching hospital**

<u>This form can only be completed if the patient was in hospital for longer than 7 days.</u>

A. GENERAL INFORMATION

4. Please indicate the discharge option most relevant		
4.1	Transferred to another hospital	
4.2	Transferred to another ward (that falls outside the inclusion criteria for this study)	
4.3	Discharged to own residential home	
4.4	Discharged to nursing home / hospice	
4.5	Discharged to relatives home	
4.6	Other (specify)	

5. If the patient is lost to follow-up, please indicate the appropriate option below.

5.1	Deceased in hospital	0.
5.2	Unexpected discharge	1.
5.3	Refuse to participate	2.
5.4	Other (specify)	3.
5.5	Not applicable	4.

6. If the patient is deceased, indicate the following:

6.1	Date of death	5.
6.2	Cause	6.
6.3	Cause of death unknown	7.

B. MEDICAL INFORMATION

7. Indicate the presence of gastrointestinal side-effects.

Indicate the appropriate options below.

Side-effect		YES	NO	If YES to any, please indicate the frequency		
				Almost daily for 2 weeks	Almost daily for 1 week	Infrequent
7.1	Nausea					
7.2	Vomiting					
7.3	Diarrhoea					
7.4	Anorexia					
7.5	Constipation					

8. Indicate if the patient developed any medical complications during hospitalization and indicate the action taken for each complication listed.

(This information will be used to determine disease severity)

8.1	**Complication 1**
Specify complication	
Organ system involved	
Date of diagnosis	
Specify the treatment taken	
Non-invasive treatment	
Pharmacological treatment	
Interventions	
Life-threatening complications	
Death	
8.2	**Complication 2**
Specify complication	
Organ system involved	
Date of diagnosis	
Specify the treatment taken	
Non-invasive treatment	
Pharmacological treatment	
Interventions	
Life-threatening complications	
Death	
8.3	**Complication 3**

Specify complication	
Organ system involved	
Date of diagnosis	
Specify the treatment taken	
Non-invasive treatment	
Pharmacological treatment	
Interventions	
Life-threatening complications	
Death	
8.4 **Complication 4**	
Specify complication	
Organ system involved	
Date of diagnosis	
Specify the treatment taken	
Non-invasive treatment	
Pharmacological treatment	
Interventions	
Life-threatening complications	
Death	
8.5 **Complication 5**	
Specify complication	
Organ system involved	
Date of diagnosis	

Specify the treatment taken	
Non-invasive treatment	
Pharmacological treatment	
Interventions	
Life-threatening complications	
Death	

C. DIETARY INFORMATION

Ask the patient to describe any changes in food intake during the past week in hospital.

9. **Indicate the appropriate option below.**

9.1	No change in usual food intake / consumes all food	
9.2	Decreased intake: consumes only ¾ of usual intake	
9.3	Decreased intake: consumes only ½ of usual intake	
9.4	Decreased intake: consumes only ¼ of usual intake	
9.5	Unable to consume anything	

10. Was the patient referred for specialised nutritional support?

10.1	Yes	
10.2	No	

11. Did the patient receive specialised nutritional support?

11.1	Yes	
11.2	No	

12. If YES to question 10, what was prescribed? (More than one option can be ticked)				
	Nutrition support option	**YES**	**NO**	**If YES, indicate duration (in days)**
12.1	Enteral nutrition			
12.2	Parenteral nutrition			
12.3	Combination therapy			
12.4	Supplementation drinks			
12.5	Enriched foods			
12.6	Other (specify)			

D. ANTHROPOMETRY

13. How was the anthropometric measurements taken? Indicate the appropriate options below.				
Measurement		**Measured**	**Estimated**	**Calculated**
13.1	Weight			
13.2	Height			

14. Indicate the measurements as determined		
14.1	Weight measurement (kg)	
14.2	Height measurement (cm)	

E. FUNCTIONAL CAPACITY

15. Indicate the patient's dominant arm		
15.1	Right	

15.2	Left	

16. Measurement of hand-grip strength		
Measurement 1	**Measurement 2**	**Measurement 3**

17. Determine general functional capacity.

Indicate the appropriate options below.

	Measurement	**YES**	**NO**	**If YES to any, please indicate change over the past 2 weeks**		
				Improved	**No change**	**Regressed**
17.1	Experience difficulty with normal activities / ambulation					
17.2	Bed /chair-ridden					

F. CLINICAL EXAMINATION

18. Test around the following areas for the presence of <u>oedema</u>: ankle, orbital, sacral. Please follow the SOP. *(TIP: Sacral - patient must be in a sitting position).*

Indicate the appropriate option below.

	Clinical finding	**Category**	**Indicate option**
18.1	No depression	No oedema	
18.2	2-4mm depression Immediate or few second rebound	Mild	
18.3	6mm deep pit 10-12 second rebound	Moderate	
18.4	8mm very deep pit > 20 second rebound	Severe	

19. Test around the <u>orbital area</u> (under the eyes) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP. *(TIP: Patient must stand up straight; view patient when standing directly in front of them, touch above the cheekbone)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
19.1	Slightly bulged fat pads	Normal / well nourished	6	7	
19.2	Slightly dark circles, somewhat hollow look	Mild-moderate malnutrition	3	4	5
19.3	Hollow look, depressions, dark circles, loose skin	Severe	1	2	

20. Test around the <u>upper arm area</u> (triceps / biceps) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP. *(TIP: patient stand up straight; arm bent, roll skin between fingers, do not include muscle in pinch)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
20.1	Ample fat tissue obvious between folds of skin	Normal / well nourished	6	7	
20.2	Fingers almost touch, some depth to pinch	Mild-moderate malnutrition	3	4	5
20.3	Very little space between folds, fingers touch	Severe	1	2	

21. Test around the <u>thoracic/lumbar region</u> (ribs / midaxillary line) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP. *(TIP: Patient must stand up straight, have patient press hands hard against a solid object)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
21.1	Chest is full. Ribs do not show. Slight to no protrusion of iliac crest.	Normal / well nourished	6	7	
21.2	Ribs apparent. Iliac crest somewhat prominent.	Mild-moderate malnutrition	3	4	5

21.3	Ribs very apparent. Iliac crest very prominent.	Severe	1	2

22. Test around the <u>temple region</u> (temporalis muscle) for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: patient must stand up straight; view patient when directly standing in front of them, ask patient to turn head side to side)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
22.1	Can see/feel well-defined muscle	Normal / well nourished	6	7	
22.2	Slight depression	Mild-moderate malnutrition	3	4	5
22.3	Hollowing, scooping, depression	Severe	1	2	

23. Test around the <u>clavicle bone region</u> for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: Patient must stand up straight; look for prominent bone. Make sure patient is not hunched forward)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
23.1	Not visible (males), visible but not prominent (females)	Normal / well nourished	6	7	
23.2	Some protrusion	Mild-moderate malnutrition	3	4	5
23.3	Protruding, prominent bone	Severe	1	2	

24. Test around the <u>clavicle and acromion bone region</u> (shoulder) for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: Patient must stand up straight; patient arms at side: observe shape)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM

– 7 normal].

	Clinical finding	Category	Indicate option (X)		
24.1	Lines of bones prominent, no significant depressions / Rounded, curves at arm, shoulder, neck.	Normal / well nourished	6	7	
24.2	Acromion process may protrude slightly	Mild-moderate malnutrition	3	4	5
24.3	Shoulder to arm joint looks square, bones prominent; acromion protrusion very prominent	Severe	1	2	

25. Test around the <u>scapular bone region</u> for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: Patient must stand up straight; ask patient to extend hands straight out, push against solid object)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	Category	Indicate option (X)		
25.1	Lines of bones not prominent, no depressions	Normal / well nourished	6	7	
25.2	Mild depression, or bone may show slightly	Mild-moderate malnutrition	3	4	5
25.3	Prominent, visible bones, depressions between ribs/scapula or shoulder/spine	Severe	1	2	

26. Test around the <u>dorsal hand</u> (Interosseous muscle) for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: Patient must stand up straight. Look at thumb side of hand; look at pads of thumb when tip of forefinger touching tip of thumb)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	Category	Indicate option (X)		
26.1	Muscle bulges, could be flat in well-nourished	Normal / well nourished	6	7	
26.2	Slightly depressed or flat	Mild-moderate malnutrition	3	4	5

26.3	Depressed area between thumb – forefinger	Severe	1	2

27. Test around the <u>patellar region</u> (knee) for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: Ask patient to sit with leg propped up, bent at knee)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
27.1	Muscle protrudes, bones not prominent	Normal / well nourished	6	7	
27.2	Knee cap less prominent, more rounded	Mild-moderate malnutrition	3	4	5
27.3	Bones prominent, little sign of musculature around knee cap	Severe	1	2	

28. Test around the <u>anterior thigh region</u> (quadriceps) for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: Ask patient to sit prop leg up on lo furniture; grasp quads to differentiate amount of muscle tissue from fat tissue*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	**Category**	**Indicate option (X)**		
28.1	Well rounded, developed	Normal/ well nourished	6	7	
28.2	Mild depression on inner thigh	Mild-moderate malnutrition	3	4	5
28.3	Depression on inner thigh, obviously thin	Severe	1	2	

29. Test around the <u>posterior calf region</u> for the presence of <u>muscle wasting</u>. Please follow the SOP. *(TIP: Patient must stand up straight. Grasp the calf muscle to determine amount of tissue)*

Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	Category	Indicate option (X)		
29.1	Well-developed bulb of muscle	Normal / well nourished	6	7	
29.2	Not well developed	Mild-moderate malnutrition	3	4	5
29.3	Thin, minimal to no muscle	Severe	1	2	

If any of the above clinical examinations could not be conducted, specify reason

Please double-check that all sections are fully completed!

Section A,B,C Completed by:	
Section D,E,F Completed by:	
Checked by:	
Date:	

ANNEXURE N: PARTICIPANT CONTACT DETAILS

FORM 2

Hospital code		Hospital name	

Participant contact details

Nr	Participant Number	Ward	Surname	Name	Contact telephone number 1	Contact telephone number 2
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						

ANNEXURE O: FOLLOWUP-UP DATA COLLECTION FORM

Participant number	

FOLLOW-UP DATA COLLECTION FORM

Date of interview	

1. Please indicate the person with whom this interview was conducted		
1.1	Patient self	
1.2	Spouse	
1.3	Other: (specify)	

2. If the patient is deceased post-discharge, indicate the following:			
2.1	Date of death		
2.2	Cause of death		
2.3	Cause of death unknown / family member refuses to answer this question		

In the event of death, there is no need to complete the rest of the form

A. GENERAL INFORMATION

3. Have you been re-admitted to hospital in the past 3 months?		
3.1	Yes	
3.2	No	

4. If YES to question 3, please indicate		
4.1	Date of admission	
4.2	Reason for admission	

A. MEDICAL INFORMATION

5. Have you developed any medical condition for which you consulted a doctor / received treatment in the past 3 months?		
5.1	Yes	
5.2	No	

6. If YES to question 5, please indicate the following information for each complication..		
6.1	**Complication 1**	
Specify complication		
Organ system involved		
Date of diagnosis		
Specify the treatment taken		
Non-invasive treatment		
Pharmacological treatment		
Interventions		
Life-threatening complications		
6.2	**Complication 2**	
Specify complication		
Organ system involved		
Date of diagnosis		

Specify the treatment taken	
Non-invasive treatment	
Pharmacological treatment	
Interventions	
Life-threatening complications	
6.3	**Complication 3**
Specify complication	
Organ system involved	
Date of diagnosis	
Specify the treatment taken	
Non-invasive treatment	
Pharmacological treatment	
Interventions	
Life-threatening complications	
6.4	**Complication 4**
Specify complication	
Organ system involved	
Date of diagnosis	
Specify the treatment taken	
Non-invasive treatment	
Pharmacological treatment	
Interventions	
Life-threatening complications	

6.5	Complication 5	
Specify complication		
Organ system involved		
Date of diagnosis		
Specify the treatment taken		
Non-invasive treatment		
Pharmacological treatment		
Interventions		
Life-threatening complications		

B. ANTHROPOMETRY

7. Ask the patient if they experienced any changes in weight in the past 1 month

7.1	Weight remained constant	
7.2	Lost weight	
7.3	Gained weight	

8. Ask the patient if they know their current weight?

8.1	Current weight (kg)	
8.2	Date of last weight measurement	

C. DIETARY INFORMATION

9. Ask the patient to describe any changes in food intake during the past 3 months.

Indicate the appropriate option below.

9.1	No change in usual food intake / consumes all food	

9.2	Decreased intake: consumes only ¾ of usual intake	
9.3	Decreased intake: consumes only ½ of usual intake	
9.4	Decreased intake: consumes only ¼ of usual intake	
9.5	Unable to consume anything	

10. If a decreased food intake occurred (9.2 – 9.5 above), determine the duration.

10.1	< 1 month	
10.2	> 1 month - < 2 months	
10.3	> 2 month - <3 months	
10.4	Not applicable	

Please double-check that all sections are fully completed!

Completed by:	
Checked by:	
Date:	