The prevalence of malnutrition in hospitalized adult patients at the Aga Khan University Hospital in Nairobi, Kenya.

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DECLARATION

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ABSTRACT

Rationale: The prevalence of adult malnutrition upon hospital admission varies between 10-60%. Knowing the extent of the problem and identifying at-risk patients should be a priority task as the consequences of malnutrition has been shown to negatively impact the working of every organ in the human body system and delayed recuperation from illness. There are a limited number of studies conducted on malnutrition in hospitalized patients in Africa and in Kenya: hence, the aim of this study was to determine the prevalence of malnutrition risk in hospitalized adult patients at the Aga Khan University Hospital in Nairobi, Kenya.

Methods: This was part of a multi-country, multicentre, descriptive cross-sectional study with an analytical component. Adult patients (n=413) were screened (NRS-2002) upon admission and at discharge (if length of hospital stay was more than seven days), and relevant outcomes on the prevalence of malnutrition were charted. Nutritionally at-risk patients were indicated if the NRS-2002 score was ≥3. Summary statistics, appropriate analysis of variance (ANOVA) and non-parametric methods were used. The statistical significance was set at 95%.

Results: 413 hospitalized adult patients (42.4 ± 13.84 years old; 51% female) were screened on admission. 64% of these patients were admitted in the medical ward, followed by 34% in the surgical ward. The mean BMI was 27.07 ± 5.43 kg/m^2 upon admission. Out of the study population, 45.5% (n=188) of these patients were at risk of malnutrition. The mean length of the hospitalization of these patients were 4.4 days (±5.99 SD). Upon discharge, n=48 were assessed. It was found that nutritionally at-risk patients upon discharge were 61%. Despite the high prevalence of malnutrition, only 4% of the total population (n=18) were referred for nutritional therapy upon admission. Only 6.4% (n=12) of nutritionally at-risk patients were referred for nutritionl support.

Conclusions: With 45% of all patients being nutritionally at risk upon admission to the hospital, there is a need, now more than ever, to reinforce nutritional screening and timely referral. With this data, more studies on the prevalence of adult hospital malnutrition need to be conducted in Kenya and other developing countries, applying the same screening tools. This will allow for comparisons of the prevalence of hospital malnutrition, outcomes and validity. Less strict exclusion criteria needs to be applied to obtain a more accurate reflection of the true prevalence of at-risk and malnourished patients.

ABSTRAK

Rationaal: Die prevalensie van volwasse wanvoeding met hospitaal toelating wissel tussen 10-60%. 'n Kennis van die omvang van die probleem en identifikasie van pasiënte met 'n risiko tot wanvoeding behoort 'n prioriteit te wees, aangesien die gevolge van wanvoeding 'n negatiewe impak het op elke orgaan in die liggaam en herstel vertraag. Daar is 'n beperkte aantal studies gedoen rakende wanvoeding in gehospitaliseerde pasiënte in Afrika en Kenia. Gevolglik was die doel van die studie om die prevalensie van die risiko vir wanvoeding in gehospitaliseerde volwasse pasiënte in Aga Khan Universiteit Hospitaal in Nairobi, Kenia te bepaal.

Metodes: Hierdie dwarssnit beskrywende studie met 'n analitiese komponent, was deel van 'n multi-sentrum studie in verskeie lande. Volwasse pasiënte (n=413) het 'n siftingstoets (NRS-2002) ondergaan met toelating en ontslag (indien lengte van hospitalisasie meer as sewe dae was) en relevante uitkomste rakende die prevalensie van wanvoeding is aangeteken. 'n NRS-2002 telling van ≥3 het 'n risiko vir wanvoeding aangetoon. Beskrywende statistiek, gepaste analise van variansie (ANOVA) en nie-parametriese metodes is gebruik. Statistiese beduidenheid is gestel op 95%.

Resulate: 413 Gehospitaliseerde volwasse pasiënte (42.4 ± 13.84 jaar oud; 51% vroulik) het toelating sifting ondergaan. Die meerderheid (64%) is toegelaat tot die mediese saal, gevolg deur 34% in die chirurgiese saal. Die gemiddelde liggaamsmasse indeks was $27.07 ± 5.43$ kg/m^2 met toelating. 'n Totaal van 45.5% (n=188) pasiënte het 'n risiko tot wanvoeding getoon met toelating. Die gemiddelde lengte van hospitalisasie was 4.4 (± 5.99 SD) dae. Met ontslag is 48 pasiënte evalueer, waarvan 61% 'n risiko tot wanvoeding getoon het. Ondanks die hoë prevalensie van wanvoeding is slegs 4% (n=18) van die totale populasie verwys vir voedingondersteuning met toelating. Slegs 6.4% (n=12) van diegene met 'n risiko tot wanvoeding was verwys vir voedingondersteuning.

Gevolgtrekking: Met 45% van alle pasiënte wat 'n risiko tot wanvoeding getoon het met toelating tot die hospitaal is die behoefte nou, meer as ooit, om voedingsifting en tydige verwysing te beklemtoon. Meer studies om die prevalensie van volwasse hospitaal wanvoeding te bepaal is nodig in Kenia en ander ontwikkelende lande, deur gebruik te maak van dieselfde siftingshulpmiddels. Dit sal vergelykings van die prevalensie van hospitaal wanvoeding, uitkomste en geldigheid moontlik maak. Minder streng uitsluitingskriteria moet toegepas word om 'n meer akkurate refleksie te kry van die werklike prevalensie van pasiënte met 'n risiko tot wanvoeding.

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CONTRIBUTIONS BY PRINCIPAL RESEARCHER AND FELLOW RESEARCHERS

The principal researcher, Faith Wanja Munyi, together with Prof Renée Blaauw and Mrs Janicke Visser, developed the protocol for this study. Data collection was done by the principal researcher and a fieldworker, both qualified dietitians. The data was captured by the principal researcher and analysed with the assistance of Prof. R. Renée Blaauw and Prof Daan Nel from Stellenbosch University. Lastly, the data was interpreted by the principal researcher, but was edited and revised at all stages of the research based on the input provided by the supervisors, namely Prof Renée Blaauw, Mrs Janicke Visser and Dr Peter Waweru Munyu.

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LIST OF ABBREVIATIONS

ESPEN: European Society for Clinical Nutrition and Metabolism

ASPEN: American Society of Parenteral and Enteral Nutrition

WHO: World Health Organization

Kg: Kilogram

M: Meter

BMI: Body Mass Index

US: United States

NRS-2002: Nutritional Risk Screening 2002

MUST: Malnutrition Universal Screening Tool

MNA-SF: Mini Nutrition Assessment Short-Form

SNAQ: Short Nutritional Assessment Questionnaire

MST: Malnutrition Screening Tool

NRI: Nutritional Risk Index

SGA: Subjective Global Assessment

AMDT: ASPEN Malnutrition Diagnostic Tool

LOS: Length of Stay

MUAC: Mid-Upper Arm Circumference

AKUH: Aga Khan University Hospital

IQR: Interquartile Range

CHAPTER 1: REVIEW OF THE LITERATURE

1.1 Introduction

The need to address malnutrition is now more evident than ever, especially in developing countries such as Kenya where the problem of increased length of hospitalization may cause serious financial deprivation and reduced productivity to the majority of Kenyan citizens. In most cases geriatric patients often rely on their family members for financial medical assistance and for home care upon discharge. If malnutrition in these hospitalized patients is not detected early, it most likely burdens the patient and the family members. Therefore, malnutrition needs to be combated, not only at community-level, but also in the hospitalized patient where the causes may not be attributed to food security. There are a limited number of studies done on malnutrition in hospitalized patients in Africa and in Kenya; for this reason, the aim of this study was to determine the prevalence of malnutrition in hospitalized adult patients at the Aga Khan University Hospital. This was part of a multi-country, multicentre, descriptive cross-sectional study with an analytical component.

In the literature review on this topic, the scope of malnutrition is discussed, including proposed diagnostic criteria and definition of hospital malnutrition, the prevalence of malnutrition from previous studies carried out in different parts of this world. The aetiology and consequences of malnutrition are explored under this topic. This is followed by literature on documentation and referral of malnourished patients in the hospital system, the nutritional screening, its obstacles, and the routine practices. Lastly, there is a review of some of the various nutritional screening tools available. A brief description of four of the commonly used tools is given, namely the – Nutritional Risk Screening 2002 (NRS-2002; the tool used in this study), the Subjective Global Assessment (SGA), and the American Malnutrition Diagnostic Tool (AMDT) Malnutrition Universal Screening Tool (MUST), It include their origin and validation, components, viability and use in clinical practice.

The conclusion of this review is a brief note on the motivation of this study, especially in a developing country such as Kenya, where health care is still a major concern of citizens.

1.2 Hospital malnutrition

1.2.1 Background information

For quite a long time, malnutrition (undernutrition) has been associated with prolonged lack of food in drought-stricken regions which is often seen among children and women and are referred to as marasmus or kwashiorkor. These conditions are different from the malnutrition that is evident in hospitalized patients, due to the fact that it refers to a disease state and not necessarily due to lack of food. This often goes undiagnosed or unnoticed by health care professionals. This aspect has led to an attempt to reassess malnutrition in the hospital or health care setting in the 21st century, from the usual definition of starvation-related malnutrition, to disease-related malnutrition[1].

Malnutrition in hospitalized patients is a critical condition which has high morbidity and mortality rates[2-4]. The effect of malnutrition in hospitalized adult patients in developing countries in Sub-Saharan Africa (SSA) is not well defined[5]. The number of malnourished people in Sub-Saharan Africa are reckoned at 212 million, with a rate of 37% in Southern Africa and 35% in Eastern Africa[6].

1.2.2 Definition and diagnostic criteria of hospital malnutrition

Several approaches have been applied in an attempt to define malnutrition (undernutrition or disease-related malnutrition[1]). Although different useful epidemiological indicators have been used, there still exists a challenge in having a commonly accepted international definition of malnutrition[7-10] for use by all health care profession[4] which would ease the issue of late recognition of malnutrition in the hospital setting. The definition of malnutrition has been noted to differ from one institution, culture, scholars and discipline [8](see Table 1). A cross-sectional, observational study by Keller, in long-term care patients in Canada[11] pointed out that the term "malnutrition" include undernutrition which is a result of inadequate food intake, lack of particular nutrients, and a disparity in intake proportion.

Further reviews of previous studies show that a number of factors have been considered in identifying and diagnosing malnutrition; some of them include food consumption level, anthropometric measure of patients, and biological markers[12]. Other studies have based it on objective measurements of nutritional status, including assessments of oral energy intake, weight loss, and determination of cell-mediated immunity, biochemical parameters, and body composition analysis[10]. One or more of these factors have been used to define malnutrition by some scholars. Nutritional screening tools include these factors along with other clinical indicators, such as anorexia or weight loss[13]. The European

Society for Parenteral and Enteral Nutrition (ESPEN) have also defined malnutrition to emphasise the differences between cachexia, sarcopenia (loss of muscle mass and function) and malnutrition[14]. The recent diagnostic criteria for malnutrition by ESPEN recommend two diagnostic options for diagnosing malnutrition; the first one needs a body mass index (BMI) of less than $18.5 kg/m^2$ to define malnutrition, the second one requires compulsory investigations on involuntary weight loss with either a low BMI of less than 20 and 22 kg/m^2, or a low fat-free mass index (FFMI) of less than 15 and 17 $kg/m^{2(15)}$. Although the term malnutrition can be used to denote both under- and overnutrition, the term will be used to refer to undernutrition in this study.

Table 1: Definition of hospital malnutrition by different institutions and scholars

Institutions/organizations/scholars	Definition of malnutrition
Stratton *et al* [7] + European Society of Clinical Nutrition and Metabolism (ESPEN)[16]	"State of nutrition in which a deficiency or excess/imbalance of energy, protein and other nutrients causes measurable adverse effect on tissue/body form and function, and clinical outcome"[7].
Council of Europe Alliance on Nutritional Care	Undernutrition condition of patients upon admission[17].
American Society on Parenteral and Enteral Nutrition (ASPEN)	"acute, sub-acute or chronic state of nutrition, whereby different level of overnutrition or undernutrition with or without inflammatory activity causes composition and diminished change"[18-19].
ASPEN + the Academy of Nutrition and Dietetics	Use specific characteristic for the diagnostic criteria for adult malnutrition; these include the presence of two of the following: insufficient energy intake, weight loss, loss of muscle mass, loss of subcutaneous fat, localized or generalized fluid accumulation, and diminished functional capacity[12, 20].

ESPEN	ESPEN recommend two diagnostic options for diagnosing malnutrition: i. Body mass index (BMI) of less than 18.5 kg/m^2 to define malnutrition. ii. Investigations on involuntary weight loss with either: • a low BMI of less than 20 and 22 kg/m^2 or • a low fat-free mass index (FFMI) of less than 15 and17 kg/m^{2,} [15].
Sobotka,[21]	"a state resulting from lack of uptake or intake of nutrition leading to altered body composition (decreased fat free mass) and body cell mass leading to diminished physical and mental function and impaired clinical outcome from disease."
	Diagnostic criteria of malnutrition
The International Classification of Diseases (Tenth Revision), Australian Modification (ICD-10-AM)	"BMI <18.5 kg/m2 or unintentional weight loss of at least 5% in presence of sub-optimal intake due to subcutaneous fat loss and/or muscle wasting"[22].
World Health Organization (WHO)	Classification of body mass index - weight in kilogram divided by the square of the height in meters (kg/m^2) - of 17.0 kg/m^2 to 18.49 kg/m^2 to refer to malnutrition in adults[5].

1.2.3 Prevalence of malnutrition in hospitalized adult patients

1.2.3.1 General prevalence

The prevalence of malnutrition has not changed significantly from the time of studies by Bistrian and Blackburn in the 1970s where the prevalence of protein-calorie malnutrition was 44% in hospitalized

patients in general medical wards, and more than 50% in general surgical wards[23-24]. Recent studies around the world have estimated that the prevalence of hospitalized adult malnutrition to range from 10–69%, depending on the patient population and criteria used to identify its occurrence[25-38]. Other studies indicate that hospital malnutrition prevalence worldwide range between   20–50% [2,7,39].

In a study conducted in Spain on 1707 adult patients, 11.4% were undernourished (BMI < 18.5 kg/m^2) upon admission and at discharge the figure increased to 13.3%. The malnutrition prevalence was associated with increasing age and longer periods of hospitalization[40]. In sub-Saharan Africa, 212 million free-living persons were estimated to be malnourished in 2005, with a prevalence of 37% and 35% occurring in Southern and Eastern Africa respectively[41, 42]. A prospective cross-sectional study carried out in Burundi among 226 adult inpatients to determine their nutritional status, showed that the prevalence of malnutrition was higher at 47.3%, among the patients investigated[43]. A more recent cohort study conducted in Southwestern Uganda indicated that the prevalence of malnutrition was 25–59% depending on the measure used[34]. This study was conducted among adult patients admitted in a medical ward at Mbarara Regional Referral Hospital.

Studies conducted involving participants in the United States (US) during 1976 to 2013 using different nutritional assessment to diagnose malnutrition, found that 50–75% of participants admitted in the hospital were undernourished. Out of those participants who had a good nutritional status upon admission, 38% acquired hospital malnutrition during their admission period[35]. This was a higher rate than the study reported previously from Spain. Malnutrition is a common condition in most hospitals all over the world. In Latin America the prevalence studies conducted from the year 2000 indicate a percentage of 50% of patients who were undernourished when admitted to the hospital[44].

1.2.3.2 Prevalence of malnutrition from studies on age and diagnostic category en route of admission

From the literature, there is a noted difference in the reported malnutrition prevalence between studies in different parts of the world. It may be due to the method applied in diagnosing malnutrition and the category of the participants in the study such as medical, surgical, oncology, etc [45]. Some studies have been conducted on the association between the kind of hospital admission and at risk of malnution[45]. In their study, Burgos *et al* concluded that malnutrition is a condition that is often present in those patients admitted to hospital through emergency or medical units. Other researchers who have shared

similar findings, include Planas *et al*[46] and Lobo *et al*[47]; who all observed a high prevalence of malnutrition. These findings show 51.5% and 52% respectively in patients admitted through the emergency route, versus 44% and 33% respectively of scheduled hospital admission. A study conducted in Australia found a similar malnutrition prevalence of 42.3% to what has been reported by other studies internationally and in local major teaching hospitals[48].

Other studies have reported a higher rate of malnutrition in the older adults. This is probably due to poor food intake and oral health problems, gastrointestinal diseases, age, declined functional capacity, and poor vision, among others[49]. Unfortunately, this often goes undiagnosed, affecting the patients' ability to eat or overcome the disease[50]. A study carried out in Germany observed a 30–85% prevalence of malnutrition in hospitalized elderly patients[50].This is similar to a study carried out in China that found a prevalence rate of 76.9% in older adults who were 90 years and older[49]. Therefore, the majority of geriatrics patients admitted in hospitals are at risk of malnutrition, or they are already malnourished. This leads to increased length of hospitalization.

In the United States (US), a study on the prevalence of malnutrition in older adults admitted at the emergency departments, showed a high rate of malnutrition that was not detected by clinicians[51]. As concluded from this study, there was no difference between the rate of malnutrition in males and females[51].

High prevalence of malnutrition has also been reported in certain diagnostic categories[52-58]. Surgical inpatients — especially those who had abdominal procedures and different intestinal failures — are more at nutritional risk[27]. Gastrointestinal surgical patients have also shown a high nutritional at-risk rate, ranging from 57–82% and an increase rate of deterioration in their nutritional status[7,59]. Other groups, such as haemato-oncology patients who undergo chemotherapy and/or radiotherapy, suffer damage from this treatment affecting their dietary intake, hence they are at nutritional risk[60].

1.2.3.3 Prevalence of malnutrition according to screening tools

The rate of malnutrition in hospitalized patients differ based on the kind of screening tool used[61]. In hospitalized adult patients, the rate of malnutrition has been reported to be between 10–41%[62-71] this is according to the MUST. The MNA-SF has showed the rates of 28–73% reported by several studies[72-78], while the NRS-2002 has reported a range of 6–42% in hospitalized adult patients[67,79-80]. SNAQ, another commonly used tool, classified 5–14% of hospitalized patients as at risk of

malnutrition, and 7–29% as malnourished[67,81-84]. The SGA tool has reported a prevalence rate of between 0–42% [62,85-97], in comparison to the MUST that found 18–55% in literature [67,96]. The NRI tool has shown rates of 24–68%[63,97-99].

1.2.3.4 Prevalence of malnutrition from studies done in Africa

Despite the fact that Sub Saharan Africa has a high rate of malnutrition, infectious and critical diseases, studies from this area on how they interact in hospitalized adult patients are scarce[100-101].

In South Africa, few studies have been conducted on the prevalence of malnutrition in hospitalized adult patients. One study done at Tygerberg Hospital among medical ward patients reported that 17% of participants were undernourished while 77% showed subclinical symptoms of undernutrition[102]. Dannhauser and Nel[80], in their study at Pelonomi Universitas and National Hospitals in Bloemfonteinin South Africa, report a prevalence of malnutrition in hospitalized adult patients age 18 years and older of between 40–60%.

In Kenya, a study was conducted by BK Nyanchama to assess the nutritional status of patients undergoing abdominal surgery upon admission and after surgery, comparing it to the postoperative outcome in 2011 at the Kenyatta National Hospital (KNH) — the largest public referral hospital in Kenya. The study found that half of the study participants were malnourished upon admission and that the prevalence increased by 16% after surgery[103]. Another more recent Kenyan cross-sectional, descriptive and observational study by Francis[104] observed a prevalence of >50% in adult patients admitted in medical wards in Embu, a Level 5 Hospital located in Embu Country. Both Kenyan studies indicate a prevalence of 16% and >50% in surgical and medical patients respectively; this falls in the range as reported by other studies carried in other regions of the world. This may also be predictive of malnutrition prevalence in other Kenyan hospitals where data on hospital adult malnutrition does not exist.

1.2.4 Etiology of malnutrition in hospitalized patients

The cause of hospital malnutrition is multifactorial and includes poor appetite, physical disabilities, swallowing impairments, increased metabolic demands for nutrients, and nutrient losses due to vomiting and diarrhoea[105]. Inadequate nutritional knowledge among nursing and medical staff, partly because of the low emphasis given to nutrition education in medical training[32-33,35], and the inability

to identify and treat patients in need of specialized nutrition support timeously[26], have led to a lack of awareness and poor recognition and monitoring of the nutritional status of hospitalized patients[31,105-106]. Schueren conducted a study, proposed that doctors and nurses were unaware of the importance of screening and treating malnutrition, or it could be that malnourished patients present themselves with a variety of non-typical symptoms that pass by undetected, and make the diagnosis of malnutrition easy to miss[107].

Reduced food intake is often the most essential etiology of malnutrition. It arises from a multiple of factors like age, depression, illness or injury whereby there is a significant deterioration in appetite due to modified secretion of cytokines, glucocorticoids, peptides, insulin and insulin-like growth factors[60].

Hospital malnutrition etiology is complicated as the disease or condition the patient is hospitalized with is a crucial factor in presentation of malnutrition. Elia *et al* in their study further state that is wrong to look at malnutrition as an attribute feature of the disease, and that it is equally not reversible when treated[108].

1.2.5 Consequences of hospital malnutrition

Malnutrition has been shown to negatively impact the working of every organ in the human body systems and delayed recuperation from illness[7,109]. This leads to deleterious metabolic, physiologic and psychologic changes[7].

Stratton *et al*[7] expound the impact of malnutrition in detail at cellular level; malnutrition has been shown to cause prolonged wound healing and a very high risk of developing bed sores and infection of the wound. It also leads to a poor body immunity causing an ineffective respond to systemic infections. In malnourished patients, the gut-barrier function is reduced, increasing bacterial translocation, systemic inflammation, and risk of sepsis[7]. Thermoregulation is also impaired in malnourished patients leading to low body temperature[7]. Physiologically, malnutrition causes loss of muscle mass and functional capacity which affects skeletal, cardiac and respiratory muscles. Malnutrition also affects the psychology of the body by causing depression, stress, anxiety, and compromises the cognitive levels of the individual[7].

Malnutrition leads to increased hospital-related complications and infections (morbidity) [2-4, 37,44] as well as longer length of hospitalization[17,33-34,37-40]. This eventually leads to higher cost-related treatments and a high mortality rate[2-4,35,37,39,44] which reduce the quality of life of the patient. Post discharged, malnourished patients have also been associated with more frequent readmissions, higher morbidity, and mortality[39].

The economic impact of malnutrition has been shown to be very high[33]; in fact, patients at nutritional risk have been shown to incur higher cost, compared to patients not at risk[110]. This is partly due to a prolonged length of stay (LOS) that ranges between 2.4–7.2 days as compared to those not at nutritional risk[2], increased medical attention in terms of extra care, medication, and other surgical intervention. Tappenden *et al* explains that the prolonged LOS is caused by the effect of malnutrition on suppressing most of the body systems, for instance the muscular and immunity systems[26].

1.2.6 Documentation of malnutrition and referral for nutritional therapy

It is quite evident that the degree of malnutrition in hospitals is high and often malnutrition goes undocumented or even untreated in hospitals. Several studies have indicated a lower rate of malnutrition being documented in the patients' medical records[27,38,44,59]. The United States Department of Health and Human Services (HHS) shows that only 3% of admitted patients had malnutrition as a diagnosis in their records[12].

Usually patients should undergo nutritional risk screening and be referred for nutritional therapy on time. Those identified to be at risk during their stay in the hospital should also be referred. A nutritional assessment by a qualified nutritional professional should then be carried out on those referred for nutritional therapy, and the nutrition care process must be implemented accordingly. Often this seems not to be the trend in most cases as studies show the contrary. On average, one in ten patients get to have the nutritional care plan implemented on them[27,44,59]. Furthermore, less than a third of patients nutritionally at risk are monitored and evaluated during their hospitalization period[38]. Kondrup also noted that only a quarter of those patients nutritionally at risk received optimal calories and proteins[38]. Barker *et al* noted that 7–36% of nutritionally at-risk patients had a referral for nutritional therapy[25]. This is the estimated prevalence of malnutrition stated in this literature review of 20–59%.

Several studies have indicated poor documentation of the patient's nutritional status by the medical staff by 8%, 19%, 23% and 60%[27,38,44,59]. Evidence show that malnutrition in hospitalized patients is poorly managed; there is a poor nutritional status reported in patients during their hospitalization period. In their study report, Valero *et al* reported 42% of inpatients had more than 5% weight loss, while 39% reported a lower dietary intake[111]. Another study by Kondrup reported that 31% of those patients at nutritional risk had further reduction in their weight and more than half of them showed more than 5% weight loss[38]. Another study supporting this has shown that nutritional status has deteriorated from admission during the hospitalized period[63].

There are many reasons put forward as to why malnutrition has remained untreated. Despite the existence of malnutrition in hospitals, a major reason can be attributed to the low nutritional risk awareness[112,38,59], because to treat malnutrition, it must be recognized first[25]. As a matter of fact, malnutrition could be treated when recognized and lead to the patient's improved outcome in terms of mortality and morbidity[108].

1.3 Nutritional screening

The process of nutritional screening has been used along with nutritional assessment and often taken to mean the same thing in practice and in writing. In real sense, nutritional screening should be carried out by other non-nutritional/dietetic professionals who refers the patient screened to be at nutritional risk for nutritional assessment by nutritional experts[113,38]. The American Society of Parenteral and Enteral Nutrition (ASPEN) defines nutrition screening as "a process to identify an individual who is malnourished or who is at risk for malnutrition to determine if a detailed nutritional assessment is indicated"[114]. It contains guidelines on detecting nutritional risk, which includes weight loss, chronic illnesses, high metabolic demands, modified diets and insufficient nutritional intake[114].

ESPEN adds that this should be a very fast and basic process carried out on admission by the admitting staff member[16]. They have stated three results of the nutritional screening process and their action courses. The first result is "not at risk" — this calls for periodic rescreening, the second result is "at risk" where a nutrition plan is developed, and the third result is those "at risk" but this could hinder the execution of a set nutritional action point.

. due to metabolically or functional-related complications[11]. A nutritional screening process is the first step to detecting a nutritional problem and a primary mechanism for patients' referral for nutritional

consult for further assessment, diagnosis and intervention[115-116]. The ESPEN recommends that all patients must be screened for nutritional risk upon admission[15]. An ideal nutrition screening tool should be simple, quick, and easy, completed by nursing staff or other non-professionally trained staff when admitting patients to hospital [114],[117]. Due to lack of an universal definition of malnutrition and a reference method to diagnose malnutrition, most screening tools have been generated over time.

1.3.1 Obstacles to nutritional screening

In most cases hospital malnutrition goes unrecognized due to lack of formal screening policies set by the hospital. Therefore, patients at risk of developing malnutrition in a hospital setting are not identified or referred timely for nutritional therapy. A universally accepted malnutrition screening tool for screening patients upon admission to hospitals is lacking; this has been identified as one of the causes of failing to detect and treat malnutrition in hospitalized patients[38,118]. In addition to poor knowledge, the training offered to staff and the lack of time and staffing, is reported to be a great barrier to the screening of patient for nutritional risk upon admission[99]. A screening tool in use during admission has been proposed to be better in identifying those patients at risk of malnutrition from 50–80%, consequently reducing a patient's length of hospitalization[119].

To carry out a nutritional screening procedure, it is essential to have a uniform and validated tool[9] which is simple to conduct.

1.3.2 Routine nutritional screening practice

Several scientific studies carried out in the previous years have demonstrated the negative consequence of disease-related malnutrition as illustrated in this review. Despite this report, the identification and treatment of malnourished patients are still poor in most health care settings[119]. Regular screening is said to be inclusive in the initial primary disease management of a patient; it's therefore erroneous when nutritional issues leading to critical clinic risks are missed initially[38]. Consequently, identifying the patients at risk of becoming malnourished during hospitalization and thus needing specialized nutrition support, should be of the highest priority. Despite the presence of these policies, recommendations and clinical guidelines have been adopted by most health care settings, but this does not translate to practice in most cases. Nutritional screening at the initial stages of admission is the beginning of better nutritional care and does not improve a patient's outcome if further assessment by a nutritional professional is not carried out. At the Aga Khan University

Hospital in Nairobi, a section of nutritional screening is included in the initial nursing assessment form; all patients are screened by the nurses upon hospital admission.

This section contains a table which includes three columns. The first column is the nutritional indicators and contain four indicators: food intake, weight loss, mode of feeding, and diet-related condition. These four indicators are matched against the third column which contains details on the patients' status. The last column is the change of status, whereby the admitting nurse ticks a "yes" for those with a positive response to the questions. Patients who scored two or more "yeses", are referred for nutritional therapy by a hospital dietitian. See Figure 1.1.

Nutritional Screening			
Nutritional Indicators	**Status**	**Change in Status**	
		Yes	No
Food Intake	Decreased over the last 3 months due to loss of appetite, digestive problems, e.g. vomiting, chewing or swallowing difficulties, etc.	☐	☐
Weight Loss	Weight loss greater than 3 kg (6.6 lbs) during the last 3 months	☐	☐
Mode of Feeding	Tube Feeding	☐	☐
Diet-related Condition (May tick more than one)	Wound/Pressure Sores	☐	☐
	Pre-/Post-Major Surgery	☐	☐
	Multiple Trauma/Fracture	☐	☐
	Sepsis/Infection	☐	☐
	Signs of Muscle Wasting/Cachexia	☐	☐
	Cancer	☐	☐
	Diabetes Mellitus	☐	☐
	Renal Failure	☐	☐
Number of Yeses Scored			

If ≥2 yeses, inform doctor regarding referral to dietician Document nursing progress note Comments: ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

Figure 1.1: Nutritional indicators in the initial nursing assessment form from the AKUH

1.4 Nutritional screening tools

Nutritional screening tools are categorized as quick and easy-to-use tools which are used quickly for the screening process during admission. These tools have questions which can foretell the patient's nutritional status. There are other, more detailed malnutrition screen tools which are thorough and take a long period of time in taking the anthropometry measurement, disease severity evaluation, and the extent of weight loss[38,120]. It is important to mention that, the main challenge in comparing the rate of malnutrition in a health care setting on different groups of patients with different diagnostics, is complicated by the fact that a commonly agreed tool and criteria is missing. The debate on the most ideal nutritional screening tool to apply to different patient groups, is still on going. A systematic review by Van Bokhorst *et al*[120] concluded that there is not a particular tool sufficient enough in predicting nutritional status. This research team further caution on the use of a sole nutritional screening or assessment tool as most of tools have a poor diagnostic and predictive validity[120]. Quite a number of validated nutritional screening and assessment tools for the evaluation of at-risk patients are available. These have been tested under different conditions yielding different results. A full description of all the available nutritional screening tools may be beyond the scope of this study. The commonly used tools include: the Malnutrition Universal Screening Tool (MUST), the Nutritional Risk Screening 2002 (NRS-2002), the Malnutrition Screening Tool (MST), the Mini-Nutritional Assessment Short-Form (MNA-SF), the Subjective Global Assessment (SGA), the Nutritional Risk Index (NRI), and the Mini-Nutritional Assessment (MNA). The majority of these nutritional screening tools which are in existence have been developed, studied extensively, and validated in developed countries. However, no universal nutritional screening tool has yet been developed and the above-mentioned tools are yet to be validated in populations from developing African countries[121] such as Kenya.

1.4.1 Nutritional Risk Screening 2002 (NRS-2002)

1.4.1.1 Origin and validation

This tool was developed in 2001–2002 by Kondrup *et al* and the ESPEN working group with an objective of generating a nutritional screening tool that would detect both the status of malnutrition and disease severity in 2002[36,122]. The group's school of thought was that the state of disease severity and increased nutritional demands from the disease plays a crucial role in the manifestation of malnutrition and hence included in the screening tool to enable recognition of those patients who were at risk of becoming undernourished too[122]. This tool was therefore designed to measure potential undernutrition and severity of the disease state. This tool is recommended by ESPEN as the preferred screening tool for malnutrition in hospitals in Europe[36,123].

This tool uses the following parameters to measure the nutritional risk status of the patient: BMI, weight loss which is expressed as a percentage, and food intake changes. These are among the commonly used parameter in nutritional risk screening tools and have been linked to clinical and functional outcomes. The NRS-2002 classified the disease state as mild, moderate and severe[122].

The NRS-2002 was the first screening tool validated against 128 randomized controlled trials (RCTs) with respect to clinical outcomes[36,122]. The participants in the RCTs were grouped according to this tool, followed by a study of clinical outcomes to verify if the NRS-2002 could predict them. An adjustment score for older patients aged 70 years and older was added to the screening tool after it was analysed. The ESPEN working group also participated in the study to ensure content validity[122].

A prospective, controlled trial with 212 hospitalized patients was also carried out using the NRS-2002. It showed that patients who received nutritional intervention had a high nutritional intake, however, it did not show any statistical significance in the patient's length of hospitalization to those who had nutritional intervention and control. It also did not show any improvement in the patient's quality of life[122]. According to Kondrup *et al*[38], its feasibility has been shown by the screening of 99% of 750 newly admitted patients, giving the frequency of the at-risk patients to be 20%.

Kondrup *et al*[36], have shown a good reliability of the NRS-2002 with a kappa value of 0.67 in clinicians-nurses, doctors and clinical nutritionists, and a value of 0.76 between 28 doctors[41]. Despite the original objective at its developmental stage, it has been applied in assessment of a patient's nutritional status[122].

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1.4.1.2 Components of the NRS-2002

The NRS-2002 comprises of two screening tables. The initial screening part (Table 1) consists of four questions on BMI, reduced dietary intake, recent weight loss, and severity of illness. If the answer is "yes" to any of these questions, then the second part of screening is administered. Patients who answered "no" to all four questions are to be rescreened on a weekly basis.

Table 2 comprises of scoring the patient on two aspects: the patient's nutritional status, and disease state. Nutritional status is scored on dietary intake, BMI, and recent weight loss. The patient's disease state is scored based on their illness, for example, if a patient requires intensive therapy in critical care, a "yes" will be scored. If the illness of the patient is missing among the stated one, then clinical intuition is applied. Usually those with chronic diseases along with one or two complications, will be scored under the "mild" category. The "moderate" category includes patients such as those who are incapacitated and bedridden, with increased protein requirements due to the nature of their illness and may require artificial feeding. The "severe" category includes patients who are in intensive care, ventilated, or on inotropic support, and those with high levels of protein requirements in such a way that its provision is a challenge. For patients 70 years and older, an age adjustment score of 1 is added[122]. A nutritional care plan is indicated in all patients who are: severely undernourished (score=3), severely ill (score=3), moderately undernourished and mildly ill (score 2 +1), or mildly undernourished and moderately ill (score 1+2)[34,122].

Table 2 Final screening

	Impaired nutritional status		Severity of disease ($\approx$ increase in requirements)	
Absent Score 0	Normal nutritional status	Absent Score 0		Normal nutritional requirements
Mild Score 1	Wt loss >5% in 3 mths or Food intake below 50–75% of normal requirement in preceding week	Mild Score 1		Hip fracture* Chronic patients, in particular with acute complications: cirrhosis*, COPD*. *Chronic hemodialysis, diabetes, oncology*
Moderate Score 2	Wt loss >5% in 2 mths or BMI 18.5 – 20.5 + impaired general condition or Food intake 25–60% of normal requirement in preceding week	Moderate Score 2		Major abdominal surgery* Stroke* *Severe pneumonia, hematologic malignancy*
Severe Score 3	Wt loss >5% in 1 mth (>15% in 3 mths) or BMI <18.5 + impaired general condition or Food intake 0-25% of normal requirement in preceding week in preceding week.	Severe Score 3		Head injury* Bone marrow transplantation* *Intensive care patients (APACHE>10).*
Score:	+	**Score:**	=**Total score**	
Age	if ≥70 years: add 1 to total score above	=**age-adjusted total score**		
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 preventive nutritional care plan is considered to avoid the associated risk status.				

Nutritional Risk Screening (NRS 2002)

Table 1	Initial screening		Yes	No
1	Is BMI <20.5?			
2	Has the patient lost weight within the last 3 months?			
3	Has the patient had a reduced dietary intake in the last week?			
4	Is the patient severely ill ? (e.g. in intensive therapy)			
Yes: If the answer is 'Yes' to any question, the screening in Table 2 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 preventive nutritional care plan is considered to avoid the associated risk status.				

Figure 1.2: Nutritional Risk Screening 2002 (NRS-2002)[122]

1.4.1.3 Pros and cons

The NRS-2002 is easy-to-use and can be completed faster. It is also advantageous as it does not call for calculation of BMI, the weight change is adequate, and it does not need the severity of illness to be assessed subjectively. One unique aspect of the NRS-2002 is the combination of the patient's disease state, age and nutritional status[36,122,125].

A retrospective analysis of controlled trials was performed to determine which medical condition or illness was significantly linked to improved impact from nutritional therapy[80,82]. The NRS-2002 has been shown to accurately identify those patients at risk and those requiring additional nutritional support[72,120]. It also predicts the mortality and complications in patients[126], the cost of hospitalization[103], and the length of hospital stay[35].

The NRS-2002 has been criticized for the way it includes certain disease examples in the grading of disease severity, which obviously is not all-inclusive, causing differences in the scoring assessment. It is also reported to be challenging and complex for routine administration by clinicians[127]. The NRS-2002 seems to overestimate risk in older patients, probably due to added points for age in the scoring system, regardless of the nutritional or disease state[128].

A recent evaluation of 11 screening tools on their ability to detect malnutrition in patients, from acute care to hospital-based ambulatory care settings, reported the NRS-2002 as the only tool to receive a grade 1 recommendation, whereas the SGA received a grade 2 recommendation[129]. The NRS-2002 tool is also the only tool validated for use in surgical patients[130]. It includes disease grading and certain scores for abdominal surgery. The NRS-2002 has further been shown to have a higher sensitivity and

specificity than the MUST[130]. It is because of these unique features that the NRS-2002 was chosen to be used in this study.

1.4.2 Subjective Global Assessment (SGA)

The Subjective Global Assessment (SGA) was described by Baker *et al*[131] in 1982, and later Detsky *et al*[132] described it extensively in an article in 1987. It is one of the nutritional assessment tools that has been widely used to determine the nutritional status of patients. This tool was initially designed to assess bedside surgical patients for malnutrition, thus those who did not need a precise body composition analysis, anthropometric assessment, and biochemical values (total lymphocyte count and albumin), which was the traditional approach at the time[131]. It is a systematic mode of assessing patients' nutritional status, defined as well-nourished, moderately malnourished, or severely malnourished[133].

 Despite its suggestive name as a type of assessment[18], the SGA is a screening tool which actually has been considered as one of the best in screening. It is centred on the patient, including the medical history and the physical examination, and it has been linked to patient outcome, including the length of stay in hospital, medical complications, infections and poor wound healing[130]. The final ranking of the SGA is not linked to nutritional interventions[134].

The validation of the SGA has been conducted between two clinicians on 109 gastrointestinal surgical patients. The validation study indicated a very good correlation between the subjective and objectives parameters. Despite significant variation between rater-pairs, it had a strong inter-rater reproducibility (k=0.784)[134]. Fischer *et al* have proposed the SGA as the gold standard for nutritional screening[135], while the ESPEN have recommended it for further nutritional assessment[130].

1.4.2.1 Components of the SGA

The SGA consists of seven sections (see Figure 1.3). These sections are classified into two categories: medical and physical assessment. The medical section deals with a patient's assessment on five significant features. The first feature is recent changes in weight in the past six months and two weeks. This change in weight is recorded in kilograms and expressed as a percentage. The second feature is dietary changes from the usual routine and includes the duration of the changes in weeks and the extent of the unusual meal intake. The third feature is the presence (if applicable), of any

gastrointestinal symptoms that have been persistent for more than two weeks, which includes anorexia, diarrhoea, vomiting, and nausea. The fourth feature is any changes in the functional capacity of the patient (if applicable), ranging from full capacity to bedridden. The last feature is on metabolic demand (stress) experienced by the patient due to the medical condition they suffer from[132]. The physical assessment section is the last feature of the SGA tool. A subjective rating is assigned by assessing the patient physically for loss of subcutaneous fat (triceps), presence of muscle wasting (quadriceps and deltoids), presence of ankle oedema, sacral oedema or ascites. A score is allocated for each, ranging from 0-3, (0) normal, (1) mild, (2) moderate, and (3) severe, based on a subjective impression[152]. The final SGA score is not based on numerical scoring, but on a subjective rating of either A, B or C. Based on these ratings, a final score is subjectively assigned as overall (A) normally nourished, (B) moderately malnourished (at risk of malnutrition), or (C) severely malnourished (poor nutritional status)[132,136]. Detsky *et al* state that the SGA classification is often determined by loss in weight and presence of muscle or fat loss and it does not have any nutritional care process in the outcome of the assessment[132].

Features of subjective global assessment (SGA)

(Select appropriate category with a checkmark, or enter numerical value where indicated by "#.")

A. History
    1. Weight change
        Overall loss in past 6 months: amount = # _____ kg; % loss = # _____
        Change in past 2 weeks: _____ increase,
                                 _____ no change,
                                 _____ decrease.
    2. Dietary intake change (relative to normal)
        _____ No change,
        _____ Change _____ duration = # _____ weeks
                            _____ type: _____ suboptimal liquid diet, _____ full liquid diet
                                                _____ hypocaloric liquids,   _____ starvation.
    3. Gastrointestinal symptoms (that persisted for >2 weeks)
        _____ none, _____ nausea, _____ vomiting, _____ diarrhea, _____ anorexia.
    4. Functional capacity
        _____ No dysfunction (e.g., full capacity),
        _____ Dysfunction _____ duration = # _____ weeks.
                                _____ type: _____ working suboptimally,
                                                   _____ ambulatory,
                                                   _____ bedridden.
    5. Disease and its relation to nutritional requirements
        Primary diagnosis (specify) _____
        Metabolic demand (stress) : _____ no stress,   _____ low stress,
                                     _____ moderate stress, _____ high stress.
B. Physical (for each trait specify: 0 = normal, 1+ = mild, 2+ = moderate, 3+ = severe).
        # _____ loss of subcutaneous fat (triceps, chest)
        # _____ muscle wasting (quadriceps, deltoids)
        # _____ ankle edema
        # _____ sacral edema
        # _____ ascites
C. SGA rating (select one)
        _____ A = Well nourished
        _____ B = Moderately (or suspected of being) malnourished
        _____ C = Severely malnourished

Figure 1.3: Subjective Global Assessment Sheet (SGA) [132]

The subjective criteria applied in the SGA questions correspond with objective measures of at nutritional risk showing convergent validity. It can anticipate the development of infections after an operation[129]. From the time the SGA was developed, it has been applied in several different populations in a number of clinical studies, including both surgical and oncological patients[131]. Detsky *et al*[137] carried out a study on surgical patients. The result showed that 69% of the population (n=202) was assessed with the SGA scored A, 21% scored B and 10% scored C. The SGA has shown to be a useful tool in determining the disease prognosis[138]. Studies whereby the SGA has been used to assess the patient's nutritional status in preoperative surgical patient's, has yielded fair validity compared to pre-albumin as a biochemical test. The SGA can be used to predict the clinical outcome[120]. In this study, the SGA was compared to the NRS-2002 in an elderly population and a fair validity.

The fact that the SGA is subjective, is that it allows clinicians to identify subtle patterns of change in clinical variables, for instance weight change pattern instead of the overall amount of weight lost[132]. The SGA has been found by most clinician to be an appealing method of nutritional status assessment since it is easy to learn and apply[132].

1.4.3 American Malnutrition Diagnostic Tool (AMDT)

The consensus statement of the American Society for Parenteral and Enteral Nutrition (ASPEN) recommends a diagnosis of malnutrition in the presence of six features, i.e. inadequate energy intake, loss of either weight, muscle mass or subcutaneous fat, fluid retention — whether localized or generalized — and reduced functional capability as measured by hand-grip strength. The presence of any two or more of these features indicates malnutrition[12]. These features are to be assessed when a patient is admitted, as well as regularly during the patient's stay in the hospital as some are already in use by the clinicians in their routine care[12]. To be able to collect this information requires a systematic approach, starting with a review of the patient's medical record, by holding a session with the patient or/and caregivers along with a physical examination[20].

Out of the six features recommended by ASPEN, muscle mass or subcutaneous fat, and fluid retention require a physical assessment to be determined. This provides adequate information in order to diagnose malnutrition.

To obtain the weight loss history of a patient, it is necessary to obtain their usual body weight and their current weight. The weight is often taken upon admission for the patients who can stand, either on a weigh bed or by verbal report. It is essential to be cautious when taking weight of patients who are dehydrated or with fluid retention, as an additional detailed evaluation by the clinician is necessary before arriving at a certain weight. Other factors such as technical issues with the measuring tools and the patient's inability to recall their previous weight can cause difficulty in accuracy of the information recorded[20]. Inadequate energy intake of the patient can be obtained from holding a discussion with the patient or caretakers to explore how well the patient has been able to consume their meals. Reduced functional capability is measured by hand-grip strength using a dynamometer. Illnesses such as rheumatoid arthritis and neuromuscular disorder may hinder the effectively of the performance of this measurement[20].

1.4.4 Malnutrition Universal Screening Tool (MUST)

The Malnutrition Universal Screening Tool (MUST) was developed and published by the Malnutrition Advisory Group of the British Association for Parenteral and Enteral Nutrition (BAPEN) in 2003. This tool which is validated and scientifically evidence-based, was developed to aid in the identification of malnourished (both under- and overnutrition) adult patients. The MUST has face validity, content validity and concurrent validity with a number of other nutritional screening tools. Its content validity was assured by including professionals from different health care disciplines in the development phase. Face validity was ensured by having components that are relevant to the identification of malnutrition risk[64,139]. Concurrent validity with another measure of nutritional risk (dietician's assessment) was excellent[65]. The MUST has been used in both hospital and community settings to screen for malnutrition[64]. In the hospital, the MUST has shown to be able to predict the hospitalization period, when patients will be finally discharged, and mortality rates after age has been controlled. This tool is developed in such a way to be able to assess any weight changes that may impact the dietary intake and illness of the patient[64,139]. According to the developer of this tool, it can be used in all adult patients across all health care facilities. They have also reported it as a simple nutritional risk screening tool that is user-friendly for a wide spectrum of health care workers[139].

1.4.4.1 Components of the MUST

The criteria included in this tool for at risk of nutritional screening include BMI, unintentional weight loss in percentage in the last 3–6 months, and the presence of an acute disease effect with poor food

intake for more than five days[64]. The BMI categories in this tool are according to the ranges of the United Kingdom, as well as worldwide guidelines. The MUST is a five-step screening tool with processes for nutritional rescreening, and management as the last step.

See Figure 1.4 which represents these steps.

The MUST also describes alternative measurements that can be used to the mentioned screening criteria. For instance, in cases where weight and height cannot be taken, clinical judgment can be used to determine BMI by assessing wasting, or if the patient is of normal weight for their height. Another way to estimate the BMI is by use of mid-upper arm circumference, whereby a MUAC of <23.5cm shows a BMI of less than 20 kg/m^2. Patients may be asked for their weight and height. The other commonly used alternative method to measure the height of patients unable to stand upright, includes the use of ulna length, knee height and demi-span length. Those patients not certain of their recent unintentional weight loss may be asked if they have noted loose fitting of clothes or jewellery. A self-reported change in dietary intake and any underlying disease states, dysphagia or other disabilities that may have led to a reduced food intake and weight loss can be done[64]. Some scholars have reported that there is an overestimation on the classification of patients with acute disease as having a high risk of malnutrition[72,130].
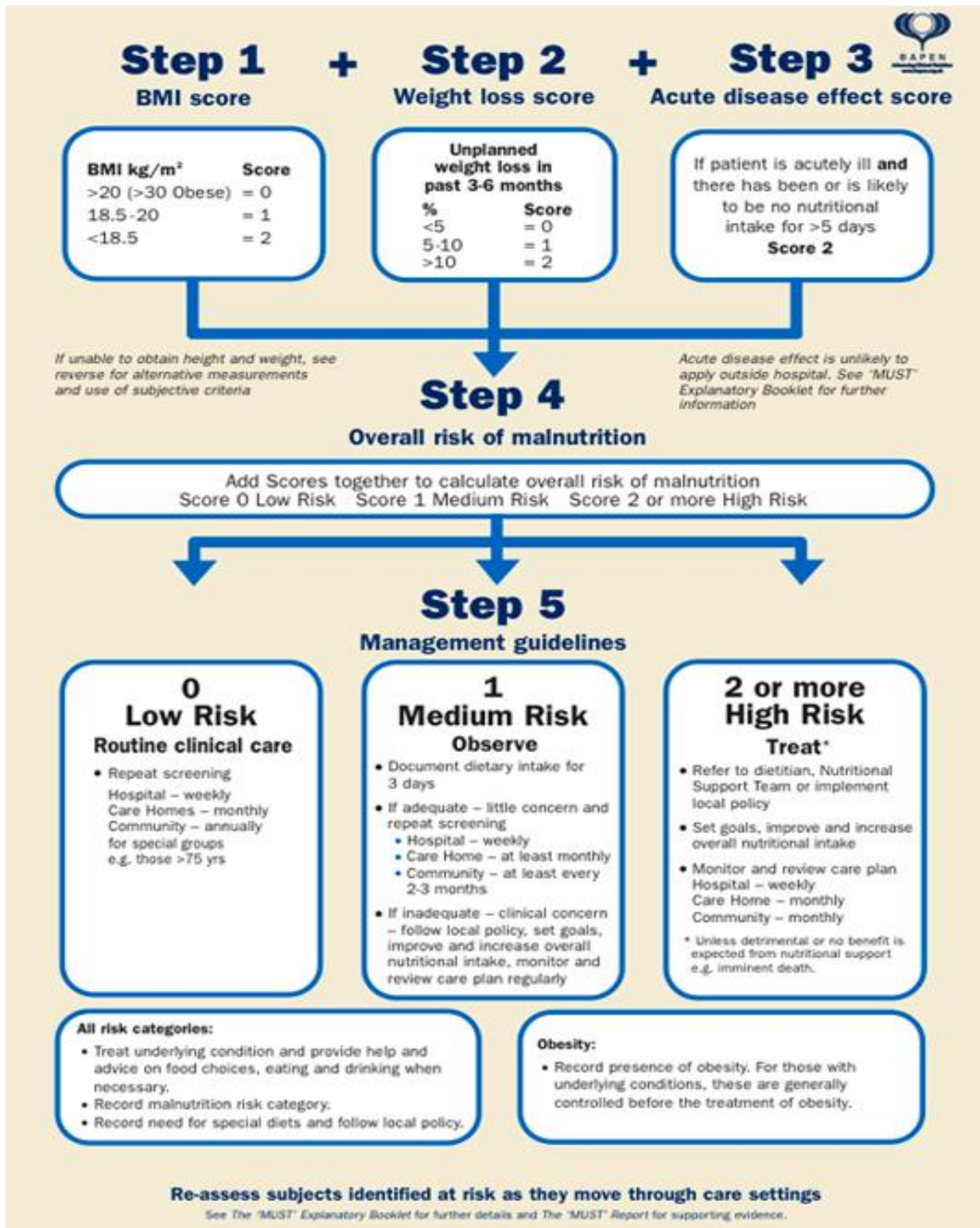
Figure 1.4: Malnutrition Universal Screening Tool[64]

Based on the result of the screening, the MUST has a nutritional care plan. Patient's nutritionally at risk need a weekly rescreening. Patients with a moderate risk need close monitoring for three days for dietary assessment, and the necessary action is taken according to protocol. Patients found to be nutritionally at risk are referred to a nutritionist expert for specialized support and monitoring[64].

1.4.4.2 Clinical studies

There are several clinical studies conducted on the MUST to prove its ability to predict clinical outcomes in older patients[50] hospitalized in both medical and surgical units[65]. The MUST predicted the mortality and length of hospitalization of these patients[62,65-66,139-141]. Scholars like Velasco *et al*[62] and Stratton *et al*[65] have reported that the MUST can predict complications in surgical and internal medicine patients and the need to discharge to a health care facility, compared to home discharges respectively. This has not been found in another study by Raslan *et al*[72]. They found that the MUST could not predict the length of hospital stay, complications and mortality.

1.4.5 Conclusion and motivation of this study

The high burden of malnutrition, critical illness, and infectious diseases in Sub-Saharan Africa has not been well studied in adult population[100,142]. The prevalence reported from literature continues to vary as new studies emerge with different populations being studied, but the conclusion of the rates of malnutrition is similar and quite worrying. The prevalence of hospital malnutrition is persistently high despite the criteria used to diagnose malnutrition. In spite of this, the clinicians' awareness of malnutrition is low[37]. The high reported rate of malnutrition is partly because preventive and curative nutritional interventions are difficult to implement in limited-resource countries of Sub-Saharan Africa. Health care in Kenya is expensive and this may contribute to patients' seeking health services in their advance stages of diseases and malnutrition and thereby, significant benefits may not be achieved. It is unfortunate that, even those seeking health care attention at an early stage, are prone to malnutrition during hospitalization, mainly due to the non-existence of nutritional screening protocol. As a result, malnutrition goes undetected because of the inadequate knowledge of practitioners on nutritional therapy, and delay or failure of referring patients for nutrition support, along with the unavailability of food supplementation and enteral and parenteral formulations. This leads to the use of hypocaloric locally available foods for nourishment. Knowing the prevalence of malnutrition and identifying the at-risk patients, especially in Kenya, should be a priority task.

CHAPTER 2: METHODOLOGY

2.1 Research questions

The study aims to answer the following research questions:

a) In hospitalized adult patients, what was the prevalence of at risk for malnutrition (undernutrition) upon admission and discharge?

b) Did the nutritional status of hospitalized adult patients relate to their diagnosis during the hospitalization period?

c) Is there a difference in the nutritional status of patients upon admission and discharge?

d) In hospitalized adult patients, what proportion of undernourished patients were referred for nutritional support during the period of their hospital stay?

2.2 Aims and objectives

The aims and objectives of this study were:

a) To determine the prevalence of at risk for malnutrition in hospitalized adult patients upon admission and discharge at the Aga Khan University Hospital;

b) To determine the relationship between hospitalized patient's nutritional status and diagnosis;

c) To determine the difference in the prevalence of at risk for malnutrition of hospitalized adult inpatients between admission and discharge;

d) To investigate the association between at risk for malnutrition and in-hospital nutritional/medical indicators;

e) To determine the proportion of patients at risk of malnutrition referred for nutritional support.

2.3 Hypotheses

a) There is no difference in the prevalence of at risk for malnutrition of hospitalized inpatients upon admission and discharge.

b) There is no difference in the prevalence of at risk for malnutrition between the different disease classifications.

2.4 Study plan

2.4.1 Study design

The study was part of a multi-country, multi-centre, descriptive, cross-sectional study with an analytical component. The study was carried out in three hospitals in South Africa: Tygerberg Academic Hospital (Cape Town), Groote Schuur Academic Hospital (Cape Town), and Chris Hani Baragwanath Hospital (Johannesburg). The study was also conducted in two hospitals in Kenya: the Aga Khan University Hospital (Nairobi) and Mbagathi District Hospital (Nairobi), and one hospital in Ghana: Korle Bu Teaching Hospital (Accra).This report only covers the study conducted at the Aga Khan University Hospital in Nairobi.

2.4.2 Study population

The study participants were adult patients admitted at the Aga Khan University Hospital in Nairobi between February and July 2015. The Aga Khan University Hospital admits on average 2 330 adult inpatients per year, excluding the units such as ICU, paediatrics, and maternity. During the study, 413 patients were selected to participate. Eligible patients were selected consecutively based on the selection criteria that were set. Consecutive sampling methods which allow cases to be selected until a certain number, has been achieved and was applied in this study (see Figure 2).In each of the above-mentioned hospitals, 400 adult patients participated, resulting in a total of 2 400 patients that were included in the bigger study. This number was selected based on the available time to perform the study, and represented about 33% of all the patients meeting the inclusion criteria.

2.4.2.1 Selection criteria

Selection criteria included:

  a) Adult inpatients, both male and female
  b) All patients who were 18 years and older
  c) Patients admitted to hospital within the past 48 hours
  d) Conscious patients
  e) Patients consenting to participate in the research study

The following group of patients were excluded from the study:

  a) Patients admitted in ICU

25

b) Patient on dialysis

c) Patients with advance directives and on palliative care

d) Medical conditions that cause excessive fluid retention: edema, ascites and pleural effusion

e) Paediatric patients younger than 18 years

f) Pregnant and lactating women

g) Patients with burns >5% burn surface area (BSA)

h) The patients who did not want to take part in the study

```
┌─────────────────────────────┐
│ Admission: medical or        │
│ surgical ward                │
└─────────────────────────────┘
              │
┌─────────────────────────────┐
│ Eligible patient is          │
│ approached for               │
│ participation in the study   │
│ within 24–48 hours of        │
│ admission                    │
└─────────────────────────────┘
              │
┌─────────────────────────────┐
│ Signing of participant       │
│ consent form                 │
└─────────────────────────────┘
              │
┌─────────────────────────────┐
│ Administration of the        │
│ questionnaire and taking     │
│ anthropometry measurement    │
└─────────────────────────────┘
              │
      ┌───────────────┐
      │ On discharge  │
      └───────────────┘
              │
┌─────────────────────────────┐
│ Administration of the        │
│ discharge questionnaire and  │
│ taking anthropometry         │
│ measurement                  │
└─────────────────────────────┘
```

Exclusion criteria of patients

1. Patients in ICU, maternity ward
2. Patients with advance directives and on palliative care
3. Patients with a LOS ≤ 2 days
4. Patients with medical conditions causing fluid retention
5. Patients who decline to participation
6. Patients <18 years of age
7. Patients that are pregnant and lactating
8. Patients with burns and dialysis

Figure 2: Study flow chart

2.5 Methods of data collection

2.5.1 Operational matters

The principal investigator put the necessary collaborations in place and appointed facility-coordinators (sub-investigators) to take responsibility for the data gathering. The research assistants were BSc students in Food, Nutrition and Dietetics who have completed their fourth-year studies at the Dietetic Department at the Aga Khan University Hospital in Nairobi. The principal investigator guided the students in the process of data collection. The statistician, Prof Daan Nel, conducted the data analysis.

A questionnaire was administered to the patients at the patient's bedside or hospital room. The data that was collected included anthropometric measurements, weight, height and nutritional data using the NRS-2002 tool. Eligible patients were approached and informed about the aims of the study and if they agreed, were included in the study after impeding their signature and that of one witness.

2.5.2 Measurements

The following measurements were obtained from the patients.

2.5.2.1 Demographic Data

The following information of patients was obtained from the medical record/attending doctor or nurse. The patients were monitored daily to ensure accurate data:

    a) Socio-demographic data

    b) Age and gender

    c) Admission and discharge dates

2.5.2.2 Medical Information

This was obtained similarly to the demographic data:

    a) Number of hospital admissions in the past six months

    b) Diagnosis

    c) Discharge destination

    d) Ward category

e) Reasons for hospitalization and medical diagnosis

f) Referral to dietitian for specialized nutritional support

g) Development of any complications requiring medical intervention during hospitalization

h) Presence of gastrointestinal side-effects such as diarrhoea and vomiting

i) Mortality data

2.5.3 Nutritional Risk Screening

The Nutritional Risk Screening Tool was implemented in this study. The following measurements were needed to calculate the NRS-2002 score: weight and height for BMI, weight changes, changes in food intake, illness severity, and age. More details on the NRS-2002 can be found in the literature review section of this thesis. The result section of this report includes the interpretation of these measurements in this tool. All measurements taken at baseline were taken within the first 48 hours upon hospital admission. Measurements taken at discharge were taken at actual discharge or on day 28 of hospitalization for those with a longer length of hospital stay.

The patient's anthropometrical status was assessed through weight and height measurements. It was performed on all patients upon admission to the hospital and on those patients who qualified upon discharge. The validity and reliability of the measuring instruments was ensured by the calibration of the weighing scale before weighing the patient. The patients were weighed barefoot and in one lightweight garment. This was done at the patient's bedside by the principal investigator or the research assistants. If anthropometry measures were feasible for patients who could not stand, recently documented or reported weights and heights were used instead. The anthropometry data was carried out in accordance with the internationally recommended procedure by the National Health and Nutrition Examination Survey III[143] and a set standard of operations.

Weight: The patients' weight was assessed to the nearest 0.5 kg by using an electronic weighing scale. The same electronic scale was used for all measurements and was calibrated with known weights on a daily basis[144].

Method: The patients were weighed dressed in minimal clothing, barefoot, or with light stockings on. An electronic weighing scale was used by placing it on the floor and was activated by lightly touching the surface. Verification of the measuring unit was checked to ensure it was in the kilogram

setting. Weight was taken after the display read 0.0 kg.

Height: The patient's height was determined by a stadiometer if the patient could stand upright, or recumbent height was obtained from those patients unable to stand[144].

Method: The standing height of patients requires a stadiometer — a vertical board with an attached metric rule and a horizontal headboard. That can be brought into contact with the uppermost point of the head. The patient was barefoot or in thin socks, wearing lightweight clothing to ensure the positioning of the body could be seen. The patient stood on a flat surface, the arms hanged freely by the sides, and the head, neck, back, buttocks and heels were in contact with the vertical board. Patients were asked to inhale deeply and maintain a fully erect position. The movable headboard of the stadiometer was brought onto the uppermost point of the patient's head with sufficient pressure to compress the hair, and height was recorded to the nearest 0.1 cm[144].

Recumbent height method: This method was conducted using a non-stretch measuring tape for those patients whoe were unable to stand upright. The patient was asked to lie in a supine position on a flat-levelled bed, and a wooden block was placed against the top of the patient's head. The tape was placed along the right side of the patient's body, from the tip of the wooden block to the base of the feet. Measurements were recorded to the nearest 1 cm.

Changes in body weight: All patients were asked about recent changes in their body weight. If they were unable to accurately describe their weight loss in kilogram, they were asked whether their clothes or jewellery fit more loosely or in the case of male patients, if they had to adjust their belt setting. If any of these questions were answered positively, it was assumed that considerable weight loss took place and was indicated as >5% weight loss. A weight loss of >5% in the past month is indicative of malnutrition[144-145].

Dietary intake: Dietary data was collected by using a pictorial food plate, fruit and a cup (see addendum 4). Patients were asked about changes in their appetite/food intake in the week prior to hospitalization. The decreased food intake was recorded as[145]:

a) an intake of less than ¾ of food served on the plate, recorded as 75% of usual intake for >7 days;

b) an intake of less than ½ of the food served on the plate, recorded as 50% of usual intake for ≥5 days. This was interpreted as severe malnutrition.

Patients were asked to choose one image, which represents their previous food intake and their current food intake.

Gastrointestinal side-effects: Five gastrointestinal side-effects were investigated, including: vomiting, diarrhoea, anorexia, constipation and nausea. This was investigated by asking the patients if they experienced any of the gastrointestinal side-effects and the frequency of occurrence. The frequencies investigated were: almost daily for one week, almost daily for two weeks, and none at all.

Referral for nutritional support: This was obtained from the patients' medical files, whereby either the doctors, nurses or dietitians had instructed patients to be seen by a dietitian while in the hospital. The dietitian note in the medical report indicated a nutritional consult in cases where documentation of referral was missing.

Severity of disease screening: This is classified in the NRS-2002 tool as mild-score 1, moderate-score 2, and severe-score 3. Based on the NRS-diagnosis scoring, severely ill participants were not included entirely but a score of disease severity was assigned to all the patients that participated. The score increases with the extent of nutritional requirement and the disease of the patient. The mild-score 1 includes diagnostic categories like orthopaedic illnesses (e.g. septic limb, hip and knee replacements, bone fractures and breaks), chronic diseases (e.g. hypertension, diabetes, chronic kidney diseases), general medicine categories (e.g. dermatology, pemphigus vulgaris,) oncology cases (e.g. cancer, not on active treatment, mycosis fungoides (T-cell lymphoma) not active treat), and lastly surgical cases (e.g. hernia repair, stoma closures, facial abscess removal). The moderate-score 2 included diagnostic categories of chronic diseases complicated or on treatment (retrovirus disease with tuberculosis and lymphoma, Crohn's disease), oncology cases on active treatment, surgery (e.g. major abdominal surgery, oesophagostomy and gastric pull-up), autoimmune diseases (e.g. rheumatoid arthritis, lupus), nutritional deficiencies and anaemias, and neurology (e.g. stroke with hemiparesis/hemiplegia).The severe-score 3 includes patients with conditions such as head injuries, bone marrow transplants and patients in intensive care.

2.6 Pilot study

The questionnaire was piloted on 10 patients for validity and reliability of its use. The purpose of pretesting was to standardize data collection, minimize variation in data collection procedures that could result in biases, check for ambiguity and to assess the utility of the different responses categories. Two dietitian interns who assisted in the data collection were trained and a practical session was included.

2.6.1 Quality control during data collection

The extent of the final suggestions to be included in the final questionnaire was minimal. Refresher training was provided to the research assistants after the pilot study. This was done and scheduled weekly, but whenever the research assistant needed a clarification, the principal investigator provided assistance immediately.

2.7 Analysis of data

Data was captured in Microsoft Excel and in Statistics (version 12, 2014). A descriptive and comparative analysis was included. Weight and height was used to determine BMI. BMI=weight (kg)/[height (m)^2]. A normal BMI (corrected for fluid status) ranges within 18.5–24.9kg/m^2 and a value <18.5 indicates undernutrition, whereas a value of >25 indicates overnutrition[5]. The BMI was then interpreted by the WHO cut-off points (see Table 2).

Table 2: The international classification of adult underweight, overweight and obesity according to BMI[5]

Classification	BMI (kg/m²)	
	Principal cut-off points	**Additional cut-off points**
Underweight	**<18.50**	**<18.50**
Severe thinness	**<16.00**	**<16.00**
Moderate thinness	**16.00 – 16.99**	**16.00 – 16.99**
Mild thinness	**17.00 – 18.49**	**17.00 – 18.49**
Normal range	**18.50 – 24.99**	**18.50 – 22.99**
		23.00 – 24.99
Overweight	**≥25.00**	**≥25.00**
Pre-obese	**25.00 – 29.99**	**25.00 – 27.49**
		27.50 – 29.99
Obese	**≥30.00**	**≥30.00**
Obese class I	**30.00 – 34.99**	**30.00 – 32.49**
		32.50 – 34.99
Obese class II	**35.00 – 39.99**	**35.00 – 37.49**
		37.50 – 39.99
Obese class III	**≥40.00**	**≥40.00**

2.7.1 Descriptive statistics

For continuous/numerical data, means and standard deviations was used if data was normally distributed, together with 95% confidence for population means. Medians and interquartile ranges (IQRs) were also used if data was non-normally distributed. The data was presented graphically using histograms. Ordinal variables, medians and interquartile ranges were used if data was non-normally distributed. Data was presented graphically using histograms.

For nominal variables, data was presented using frequency distributions and graphical presentation s by means of bar charts. A 95% confidence for binary proportions was presented.

2.7.2 Comparative analysis

When comparing two continuous variables, the Pearson correlation was used if both variables were normally distributed. However, Spearman's rank correlation was used if both variables were not normally distributed. When comparing two nominal variables, Pearson's chi-squared test for independent proportions was used, and McNemar's chi-squared test was used for dependent proportions. Where the expected frequencies of cells were <5, exact tests were used.

Comparing one continuous and one binary variable, a student's t-test was used if the continuous variable were normally distributed, but the Mann-Whitney U test was used if the continuous variable was not normally distributed. Comparing one continuous and one nominal variable, ANOVA was used if the continuous variables are normally distributed, and the Kruskal-Wallis ANOVA was used if the continuous variable were non-normally distributed. In general, a 5% significance level was applied throughout for all the data analyses and hypothesis testing.

2.8 Data management

Participant confidentiality was to be ensured. The privacy and confidentiality of the participant will be held by omitting participant identification information such as names, hospital numbers, and personal contact from the study. Curtains were drawn before the anthropometry measure was taken for patients in general wards, and in enclosure for those in rooms set up, Information obtained will only be used for study purposes, and will not be used for any other purposes. Data was entered into password-protected spread sheets. Only the principal investigator, statistician, supervisors and co-supervisors have access to the data.

2.8.1 Ethical and legal consideration

An ethical approval for the "mother" study was granted from the Health Research Ethics Committee (HREC) at Stellenbosch University (project number N14/06/061). This study was reviewed by the Aga Khan University Ethics Review Committee and ethical approval was granted (project number 2014/REC-62) before the study could be undertaken. An informed consent was also obtained from the patients before they joined the study.

The patients and/or their relatives were given all the relevant information regarding the purpose and aims of the study in order to make an informed decision on whether to participate or not. A promise

statement was made on the consent, that the personal information would be withheld. Patients received a copy of the signed consent form to take home. All information was and were to be handled with confidentiality. Participants received an identification number, which was used on study material and documentation. They were informed that the information collected by the researchers was regarded as confidential.

2.8.2 Time schedule

The piloting of the questionnaire was conducted during February 2015, the research project begun in March 2015, and data collection continued until July 2015. Data was therefore collected over a period of five months.

2.8.3 Budget

All the expenses related to the researcher's thesis were covered by the researcher.

CHAPTER 3: RESULTS

3.1 Introduction

The aim of this study was to determine the prevalence of at risk for malnutrition in hospitalized adult patients at the Aga Khan University Hospital in Nairobi upon admission and at discharge. This study is part of a larger multi-country, multi-centre study with a descriptive cross-sectional design (with an analytical component) using quantitative methods of data collection. The results mentioned here only apply to the study done at the Aga Khan University Hospital in Nairobi. Quantitative data were collected by means of questionnaires to obtain information about the participant's nutritional information.

3.2 Study population

This study involved adult patients who met the study inclusion criteria stated in the methodology section of this report. The patients were admitted at the Aga Khan University Hospital Nairobi during the months of January 2015 to July 2015. The total number of patients screened for participation in the study was 3 978, but only 1 632 patients qualified for participation and were approached for consent, while 413 patients consented and agreed to participate in this study. The main reason why quite a number of participants did not consent to the study was that the majority felt they needed to be approached after 48 hours of their stay, in order to get treated and obtain a diagnosis. The rest needed the presence of their relatives in order to participate, while some — even after several explanations — felt their doctor needed to agree first in order for them to participate.

Out of the study participants, 365 patients had less than seven days' stay in hospital and therefore, did not qualify for follow-up upon discharge. 48 patients were followed-up on upon discharge; out of these, 45 patients were discharged home, one patient was discharged to another hospital, one patient was discharged to a ward that fell outside of the study criteria, while one patient was still in the ward (see Figure 3.1).
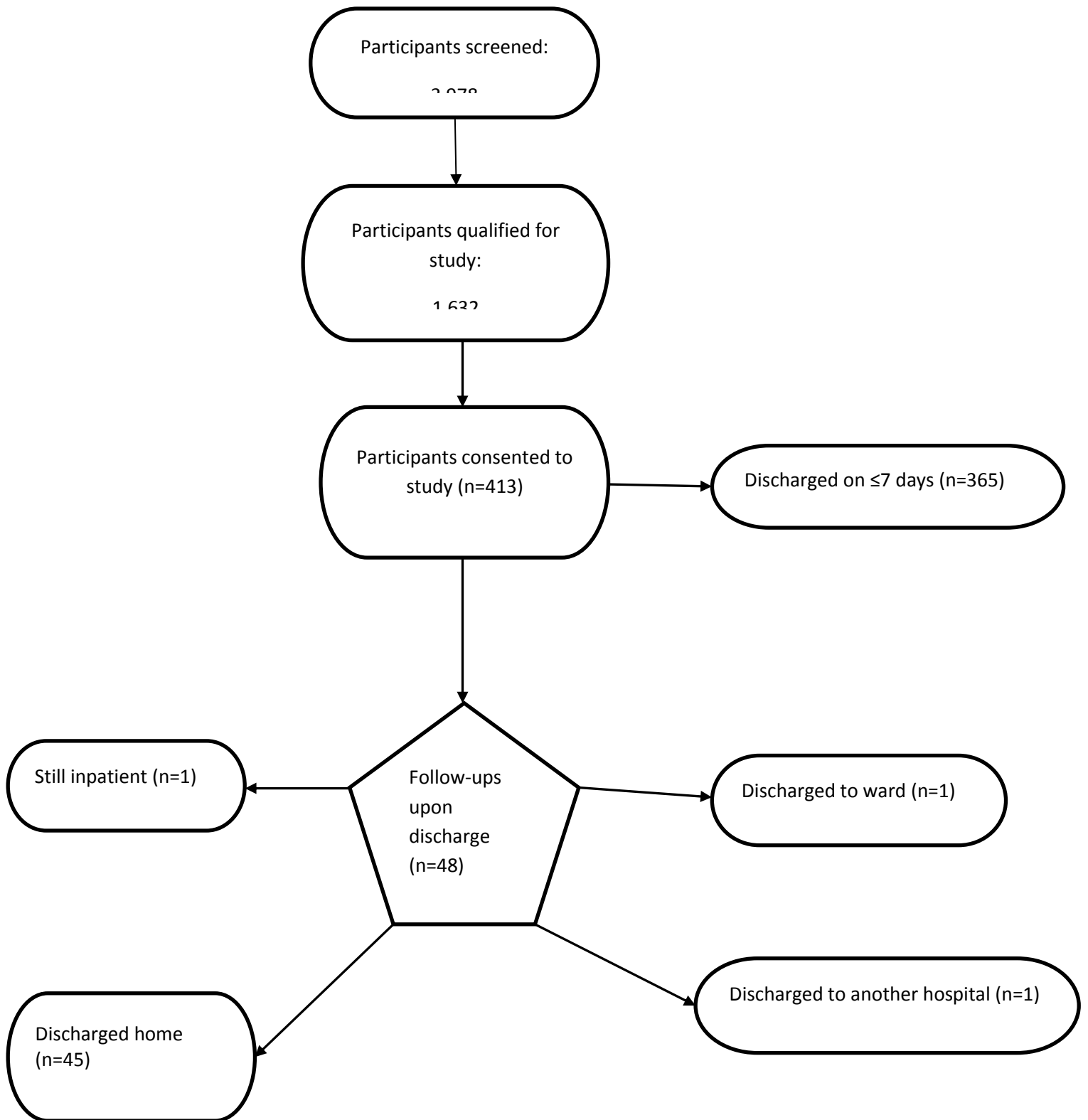
Figure 3.1: Flow chart of study population

3.3 Data upon admission

This sub-section provides a profile of the patients from the general medical and surgical wards at the Aga Khan University Hospital who were enrolled for the study. The medical information of the study participants upon admission, such as the ward category, and the presence of GI side effects, is mentioned.

3.3.1 Patients' demographic and medical information

The demographic characteristics of the patients who participated in the study are discussed in this section. Out of the 413 patients, 49% (n=204) were male and 51% (n=209) were female. The mean age of the participants were 42.36 ± 13.84 years, with a range of patients between 18.2 to 90.8 years.

The ward category (this is not determined by the diagnostic category) of the study participants was as follows: 64% (n=261) were admitted to the general medical ward, 34% (n=142) were admitted to the surgical ward, and the remaining 2% (n=7) and 1% (n=3) were admitted to the gynecology and oncology wards respectively.

The study participants in the gynecology diagnostic category were 8.7% (n=36), participants in the general medicine category were 34.5% (n=14), participants in the surgical category were 23.8% (n=98), and participants in the oncology category were 5.1% (n=21) respectively. The patients who did not fall into any of the diagnostic categories were grouped in the category of "others", for instance patients for instance, patients found to have urological, autoimmune, and lower back pain conditions, and depression were 27.9% (n=115)**.** The diagnostic category used in this study is a grouping of related medical conditions.

3.3.2 Gastrointestinal side-effects and frequency of occurrence upon admission

The graph below (Figure 3.2) presents the frequencies of occurrence of the gastrointestinal side-effects that patients experienced in the last two weeks prior to admission. The following five gastrointestinal side-effects were investigated in this study: nausea, vomiting, diarrhoea, anorexia and constipation. Gastrointestinal side-effects occurred almost daily for two weeks during admission, though in varying percentages, i.e. nausea (3.6%), vomiting (1%), diarrhoea (1.9%), anorexia (6.3%), and constipation (5.3%).
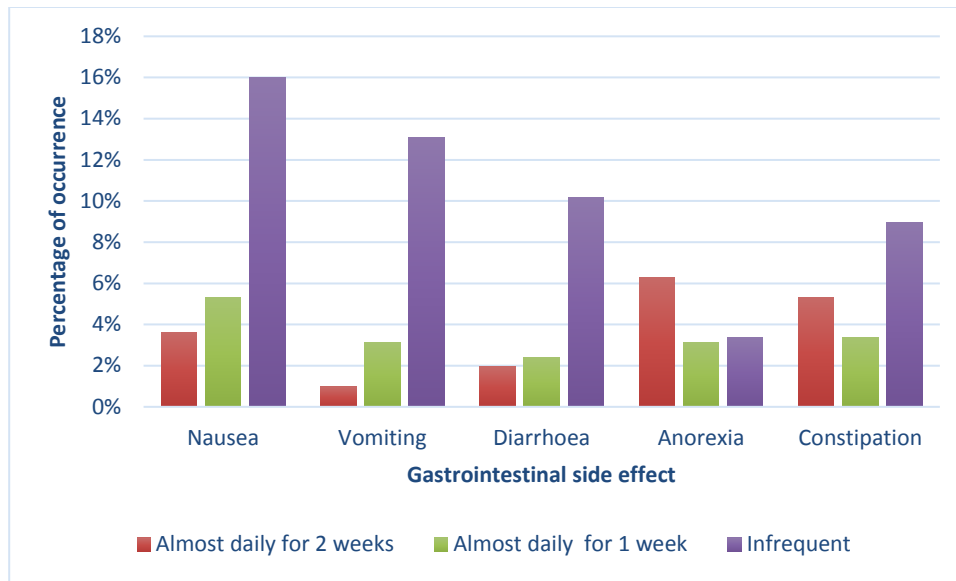
Figure 3:2: Gastrointestinal side-effect occurrence upon admission

3.4 Body mass index (BMI) of study population

This section includes the BMI calculated for all the study participants upon admission. The measurements of weights and heights were carried out as per the procedures set forth in the methodology chapter of this report.

BMI is a commonly used parameter to measure the severity of malnutrition. The results of the 413 patients analysed showed that the mean BMI of the study population was 27.05 ± 5.43 upon admission. There was no significant difference in BMI between males and females, although the female participants had a slightly higher average BMI value of 27.9 kg/m^2, in comparison to the male participants' BMI of 26.2 kg/m^2.

From the analysis, most females were overweight, with a BMI of ≥25 kg/m^2 [39.7% (n=83)] while most males had a normal BMI ranging between 18.5–24.99 kg/m^2 [41.2 % (n=84)]. The underweight category of patients was equally shared between the two gender groups. The chi-squared test showed there is an association between a patient's gender and the BMI category upon admission. This implies that female patients are more likely to be overweight and obese than male patients (chi-square (df=3) =11.20, p=0.01). See Figure 3.3.
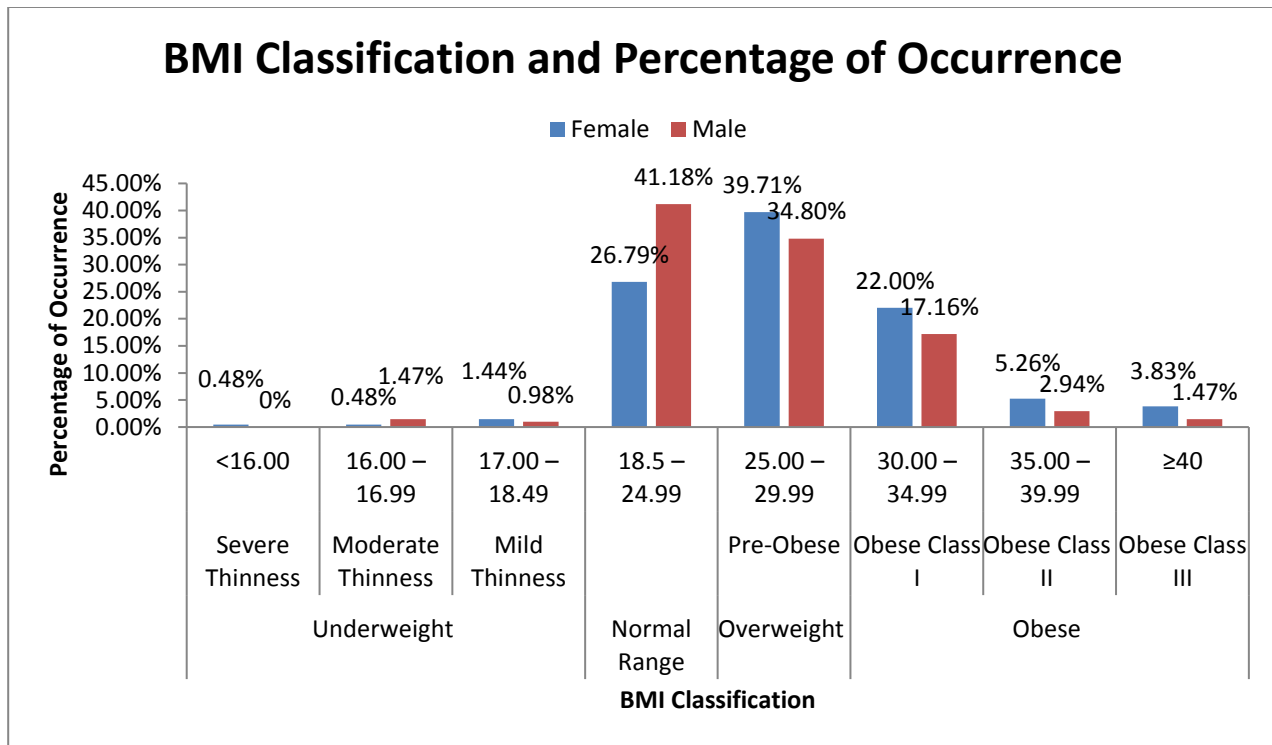
Figure 3.3: Body mass index categories of study population

3.3.3 Nutritional risk profile

This section includes the analysis of the questions found in the Nutritional Risk Screening 2002 tool for the admission data, as the tool was used to determine the prevalence of malnutrition in this study. Those study participants who entered the final screening phase, were 282 patients out of the total study population of 413 patients.

3.3.3.1 Initial screening phase

According to the NRS-2002 tool, the first question to screen a patient is a BMI less than 20.5 kg/m². Out of the specified participants, 282 (11%, n=31) patients had a BMI less than 20.5 kg/m² in their initial screening phase, they included 9% (n=17) that were at nutritional risk and 15% (n=14) that were not at nutritional risk. The rest of the patients (89%, n=251) had a BMI greater than 20.5 kg/m². No association was found between patients' nutritional risk status and a BMI <20.5 kg/m² (chi-square (df=1) =2.11, p=0.15). Patients with a BMI <20.5 kg/m² were as likely to be at nutritional risk as those with BMI values greater than 20.5 kg/m². The summary is presented in the histogram shown below (Table 3.1).

Table 3.1: Nutritional status of patients with a BMI > and <20.5 kg/m^2 upon admission

At Nutritional Risk	BMI <20.5 kg/m^2 Yes (n%)	BMI >20.5 kg/m^2 No (n%)	Total
Yes	171 (91%)	17 (9%)	188
No	80 (85%)	14 (15%)	94
Total	251	31	282

3.3.3.1.1 Weight loss in the last three months

This was captured by asking patients their usual body weight and if they experienced loose-fitting clothing or other accessories like rings, watches or belts, or if they were unable to quantify their usual body weight. Upon admission, 180 patients reported weight loss based on usual weight were while 133 patients reported weight loss based on loose-fitting clothes. A weighted mean test was run on the 282 patients (qualified for the NRS-2002 assessment) to determine if there was a difference in participant's current weight and usual weight, for patients at nutritional risk (n=188) and those not at nutritional risk (n=94). The results of the weighted mean test showed that the difference in weight changes of participants at nutritional risk and participants not at nutritional risk, is statistically significant (p=0.03). Those patients nutritionally at risk had lost more weight (usual body weight minus current weight) as shown in Figure 3.5. Therefore, patients' current weight significantly determines their nutritional status.
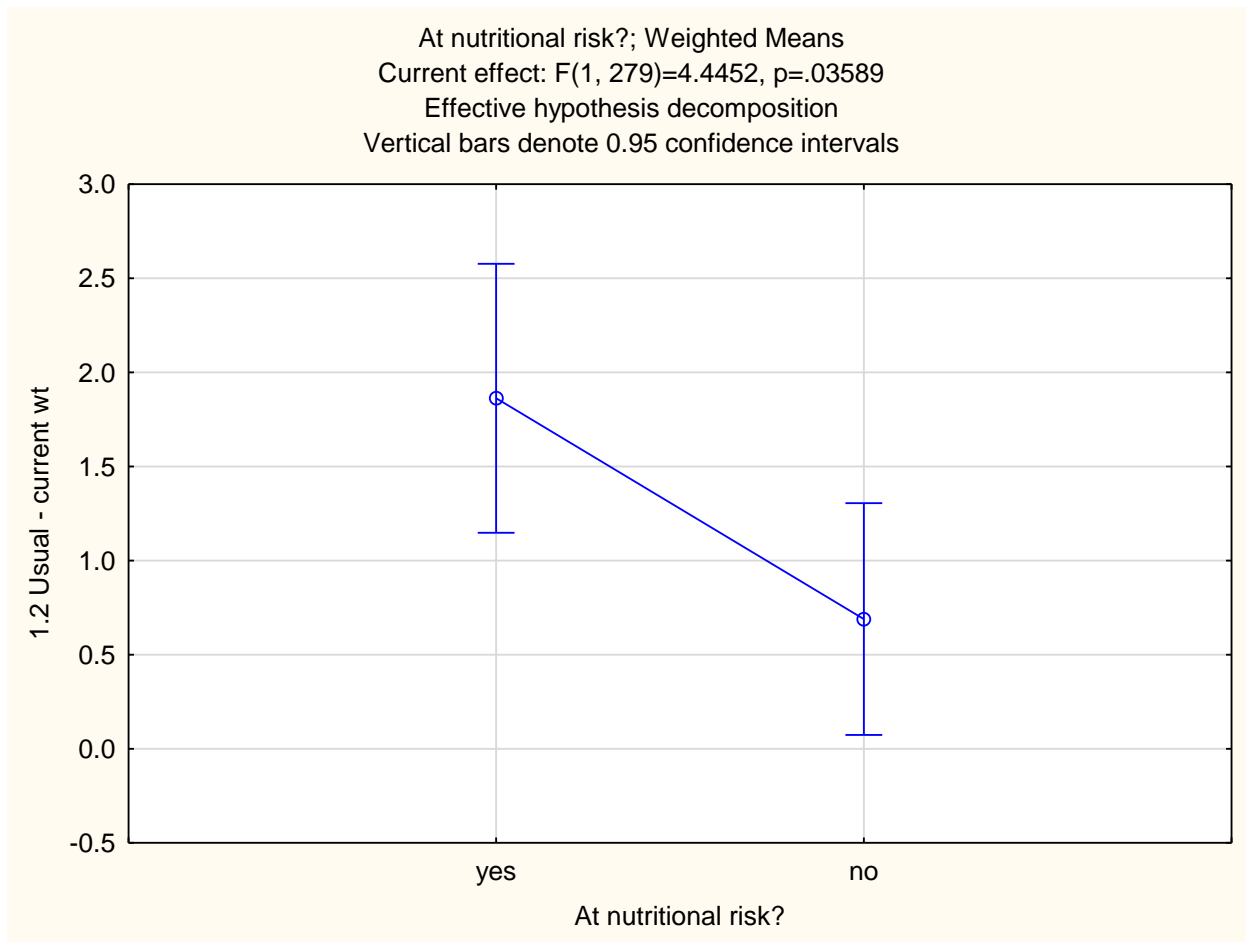
Figure 3.4: **Weight difference and nutritional risk status**

3.3.3.1.2 Reduced dietary intake in the last week

Patients who reported reduced food intake were 38.3% (n=158), while 61.7% (n=255) of patients had no changes in their food intake prior to admission. Chi-square test shown there was a significant difference noted in reduced food intake in the last week as shown with a p=0.00129

The breakdown of the dietary assessment per the diagnostic categories had shown that oncology patients reported the highest number of decreased food intake in the last week, followed by patients in the general medicine categories, and lastly the surgical patients. See Figure 3.5.
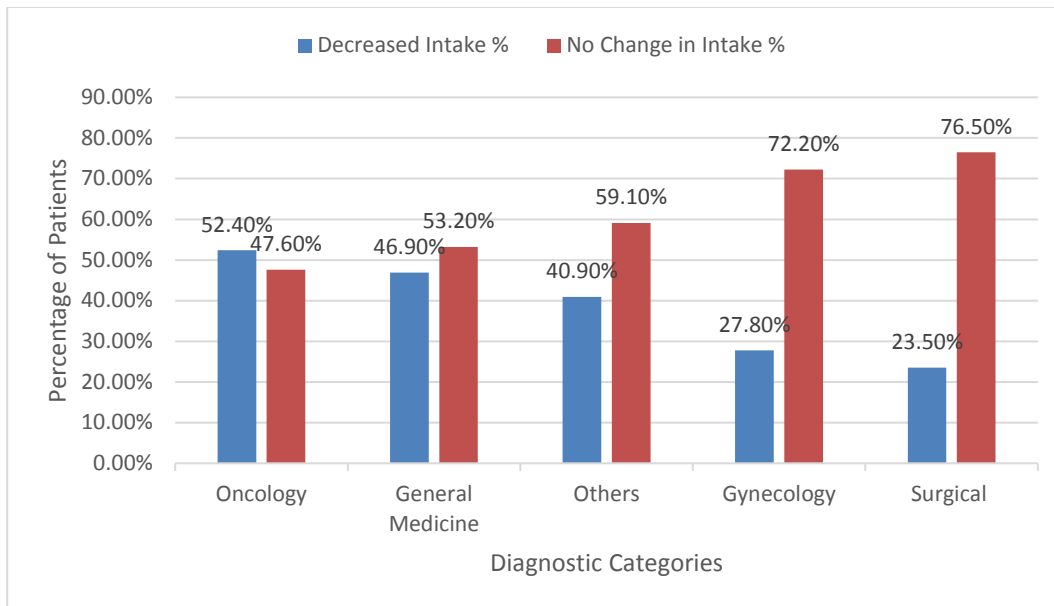
Figure 3.5: **Changes in dietary intake of patients in different diagnostic categories**

Out of the 282 patients who qualified for the final NRS-2002 tool, 74% (n=140) were nutritionally at risk with reported reduced food intake in the last week, while 26% (n=48) were nutritionally at risk but with no changes in their food intake in the last week. 19% (n=18) were not at nutritional risk, and indicated no reduced food intake in the last week. Significantly, more patients who were at nutritional risk reported a reduced food intake in the last week (chi-square=80.4; p=0.001). See Figure 3.6.

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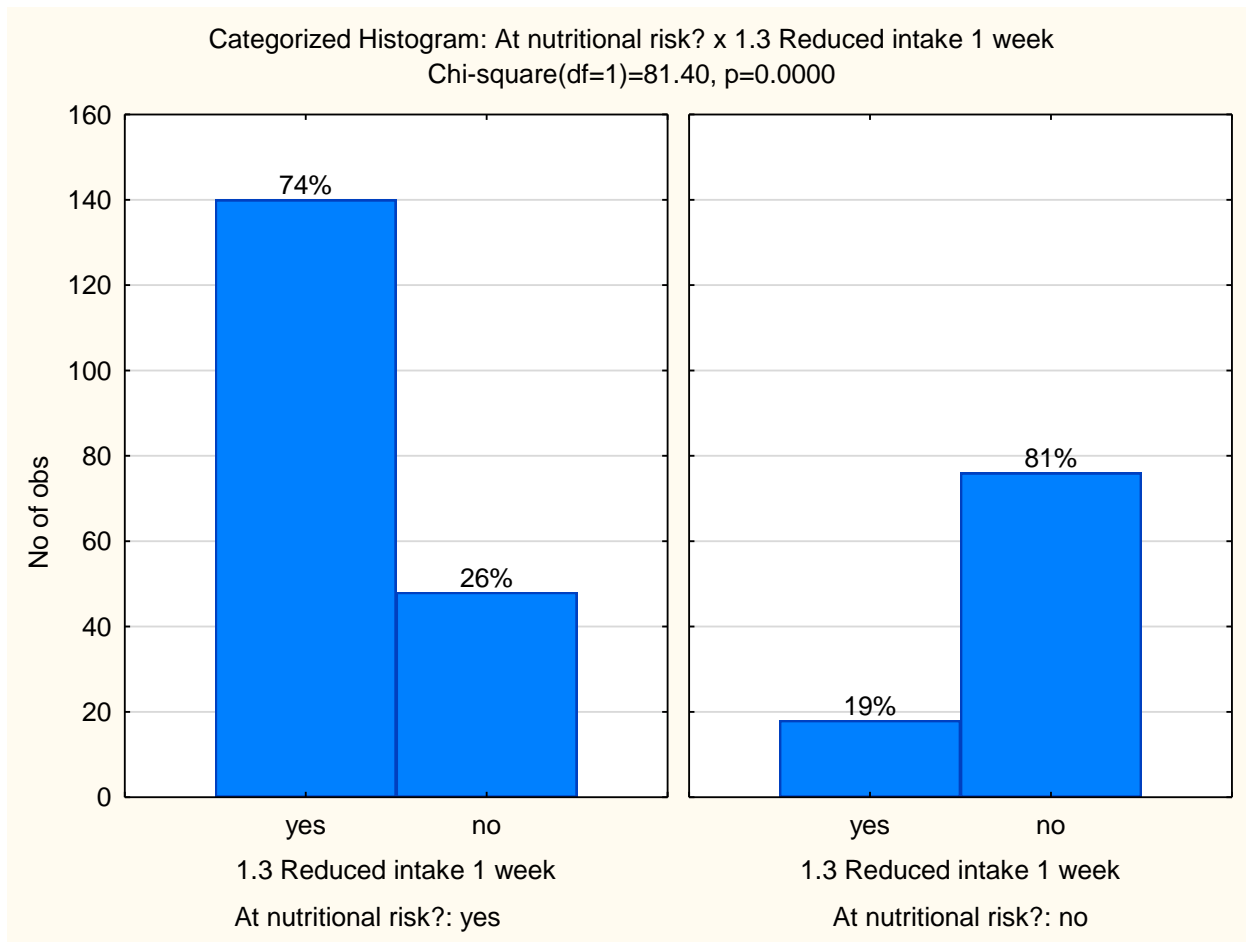
Figure 3.6: Nutritional status and dietary assessment upon admission

*3.3.3.1.**3** Disease severity score*

Data analysis upon admission showed that 94.2% (n=389) of patients had a mild disease severity score while 5.8% (n=24) had a moderate-score. The Mann-Whitney U test was applied to determine whether there is a difference in the severity of diseases between patients at nutritional risk and those that are not at nutritional risk. The result of the test showed that, even though the severity of illnesses was higher in patients at nutritional risk compared to those not at nutritional risk, the difference was not statistically significant (p=0.37).Figure 3.7 illustrates the difference.

At nutritional risk?; LS Means
Current effect: $F_{(1, 31)}=1.9727$, $p=0.17$ Mann-Whitney U $p=0.37$
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals
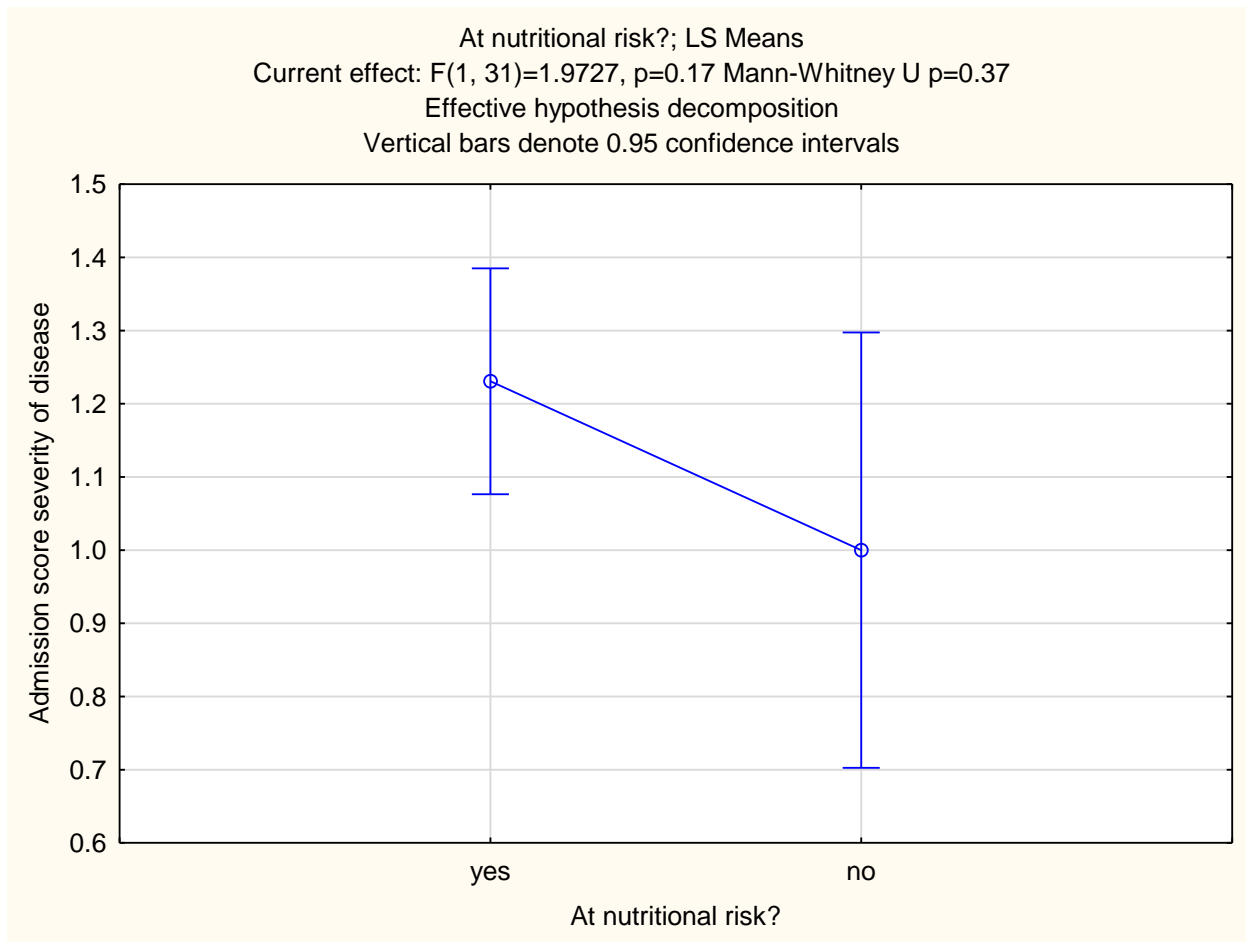
Figure 3.7: The severity of disease score upon admission

3.3.3.2 Final screening phase

This section included 282 patients who scored "yes" in the initial screening phase. A nutrition assessment was further done

3.3.3.2.1 Weight loss of >5% in 3 months or food intake below 50–75% of normal requirements in proceeding weeks

Those who reported a >5% weight loss with nutritional risk were 91% (n=49), while 9% (n=5) had a >5% weight loss but were not at nutritional risk. On the other hand, 61% (n=138) at nutritional risk reported less than 5% weight reduction, and 39% (n=89) not at risk of undernutrition reported a >5% weight loss. P=0.00 showed a significant reduction in the food intake in both groups of patients (chi-square=20.8).

Based on the diagnostic categories, the oncology category had the most patients (31.6%) with weight loss above 5%, followed by the general medicine (21.8%) category, and lastly the gynecology category with 11.1%. See Figure 3.8.
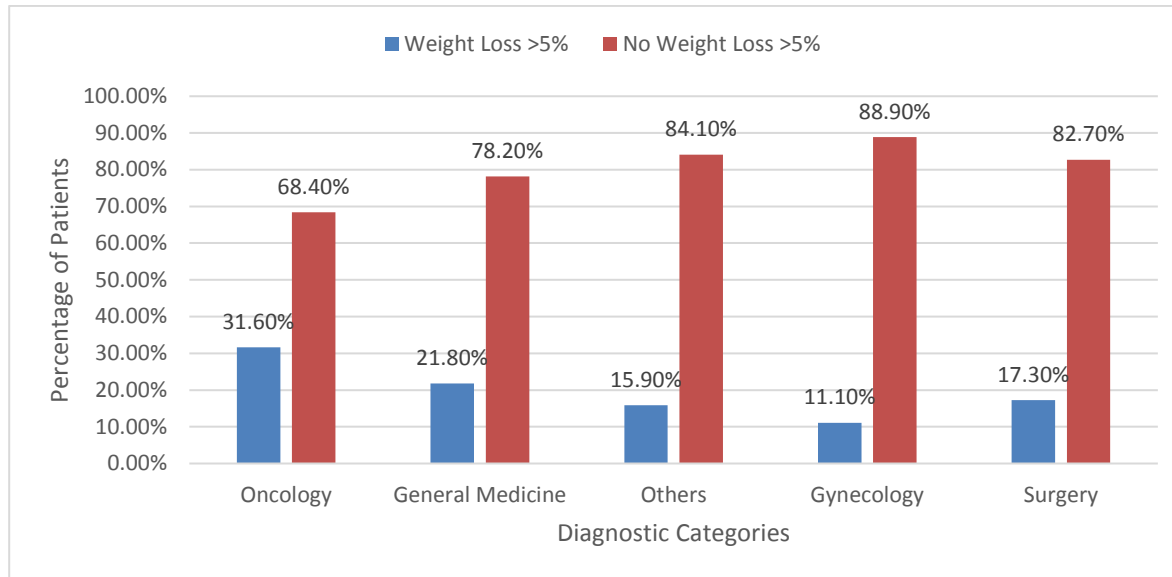
Figure 3.8: Diagnostic categories and weight loss >5%

Changes in food intake from the normal intake requirement was reported in terms of a percentage, 61.7% (n=255) reported no change in their food intake, 9.2% (n=38) reported to manage only 75% of their normal requirement, 14.3% (n=59) reported an intake of 50% of their normal requirement, while 14.3% (n=59) reported 25% intake. Those patients who had more than 5% weight loss and reduced intake below 50–75% were scored on the NRS-2002 tool.

3.3.3.3 Patients at risk of malnutrition (NRS) upon admission

The assessment of patients at risk of malnutrition upon admission was done using the NRS-2002 screening tool. The study population of 413 patients entered the initial screening phase on the NRS-2002 form; from these, 282 patients qualified for the final screening phase (one or more "yeses" were answered in the initial phase). This was indicative of the presence of a component putting them at nutritional risk. Out of the 282 patients that qualified for nutritional risk, a final screening on the NRS-2002 tool was done, and 66.7% (n=188) of patients were found to be at nutritional risk while 33.3% (n=94) of patients were not at nutritional risk. The patients at nutritional risk were 48.40% (n= 91) male, while 51.6% (n=97) were female. Patients not at nutritional risk were 53.19% (n=50) male,

while 46.81% (n=44) were female. Therefore, out of the total study population, 45.5% were found to be nutritionally at risk upon admission.

The diagnostic categories of those patients found to be at nutritional risk, included: general medicine with 39.4% (n=74), surgical with 18.6% (n=35), gynecology with 5.3% (n=10), and oncology with 6.4% (n=12). Other diagnostics which fell out of the stated diagnostic categories were 30.5% (n=57). Those patients not at nutritional risk, included: general medicine with 38.3% (n=36), surgical with 19.2% (n=18), gynecology with 8.5% (n=8), and oncology with 7.5% (n=7). Other diagnostic categories were 26.6% (n=25).The chi-square test found that there is not enough evidence to conclude that the diagnostic categories determine a patient's nutritional risk status (chi-square (df =4) =1.38, p=0.848). See Figure 3.9.
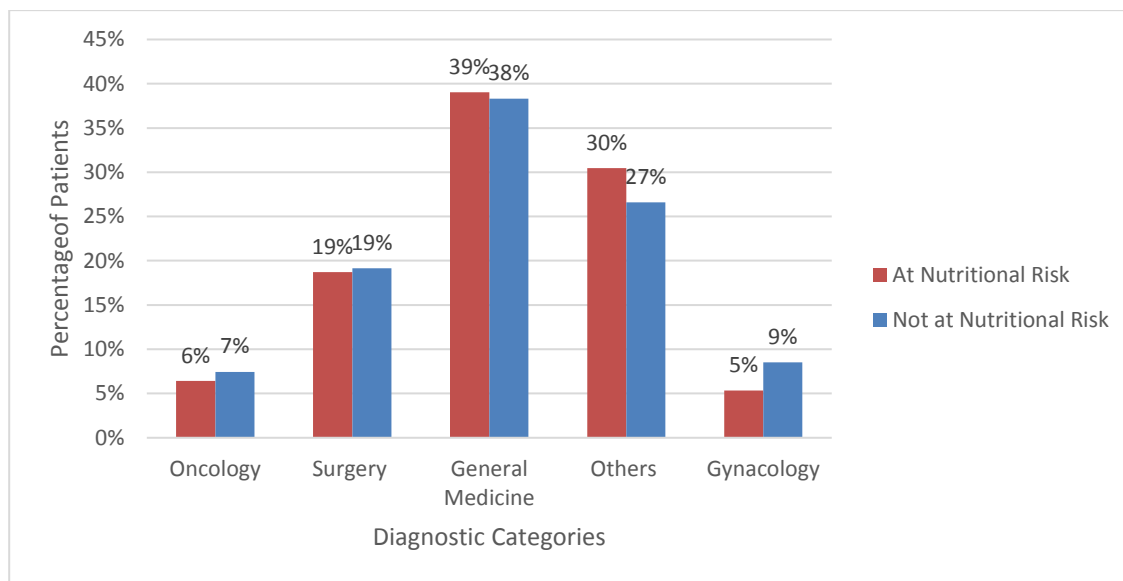
Figure 3.9: Diagnostic categories and nutritional risk status upon admission (NRS-2002)

3.3.3.4 Nutrition Risk Screening (NRS-2002) score

The study further sought to establish the relationship between patients' nutritional risk status and the diagnostic categories. The NRS scores were obtained and used to measure patients' nutritional risk level. To asses the exent of the malnutritional level,a preliminary test for normality was done on the scores obtained, and then classified into five diagnostic categories. Levene's test for homogeneity of

variance (p=0.85 >0.05) was also done to test the variance of the data under the five diagnostic categories. The data of both the preliminary test for normality and Levene's test qualify for parametric tests of relationships." Given that dependent variables under investigation were more than two, the ANOVA test was applied. A set of 282 records were tested under five diagnostic categories, namely: oncology, surgery, general medical ward, gynecology, and others. The mean NRS score for the five categories are summarized in Table 3.2. Oncology has the highest mean NRS score of 3.105 and gynecology has the least mean NRS score of 2.50. The ANOVA test result showed that there is no statistically significant difference (p=0.46). This suggests that there is no significant difference between patients' NRS for the various diagnostic categories. The study aims to find the difference in the prevalence of at risk for malnutrition of hospitalized adult inpatients between admission and discharge. The average admission NRS was 3.30 ± 1.23 and the discharge score was 3.03 ± 1.33 (p=0.02). This shows that there is a significant difference in hospitalized adult inpatients' prevalence of at risk for malnutrition between admission and discharge.

Table 3.2: Nutritional Risk Screening 2002 score and the diagnostic categories

Diagnostic category	Total NRS-2002 score	n
Oncology	3.1	19
General medicine	2.9	110
Others	2.9	82
Surgery	2.8	53
Gynecology	2.5	18

Abbreviation: NRS-2002: Nutritional Risk Screening 2002

3.3.3.5 *Referrals for nutritional support*

During admission, 4% (n=18) of the participants were referred for nutritional support while most of the participants (n=395) were not referred. The referral sources of the 18 patients were: 10 by the doctors, 7 by nurses, and one by a dietitian. Out of the patients that are nutritionally at risk, only 6.4% (n=12) were referred for nutritional support, while 4.3% (n=4) were not nutritionally at risk, but were also referred for nutritional support. See Table 3.3.

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Table 3.3: Referrals for nutritional support

Referrals	Upon admission [n (%)]	Nutritional status [n (%)]	
		At risk	Not at risk
Not referred	395 (96.1%)	176 (93.6%)	89 (95.7%)
Referred	18 (3.9%)	12 (6.4%)	4 (4.3%)
Total	413	188	93

3.4 Discharge data

3.4.1 Patients' demographic and medical information

48 patients included in this study were followed up on, about seven days after admission. Out of these 48 patients, 45 patients were discharged home, and the remaining patients were either transferred to a different ward (that falls outside the study conclusion criteria), or transferred to another hospital. Out of the 45 patients that were discharged home, 92% (n=23) were from the general medical ward, while 95.7% (n=22) were from the surgical ward. The mean age of the discharged patients was 46.21 ± 16.24 years. The average length of hospitalization for the study participants (n = 413), from admission to discharge, was 4.4 ± 5.99 days.

3.4.2 Gastrointestinal side-effects and frequency of occurrence upon discharge

The five gastrointestinal side-effects analyzed from the discharged patients (n=45), showed that most patients did not experience any of the side effects during their hospital stay. Some patients experienced infrequent episodes of gastrointestinal side-effects, including: nausea (14.6%), vomiting (12.5%), diarrhoea (8.3%), anorexia (8.3%), and constipation (6.3%). There were few reports of gastrointestinal side-effects daily in one week, and almost daily in two weeks. Constipation was high

at 12.5% almost daily for 2 weeks, compared to other gastrointestinal side-effects during the same period. See Figure 3.10.
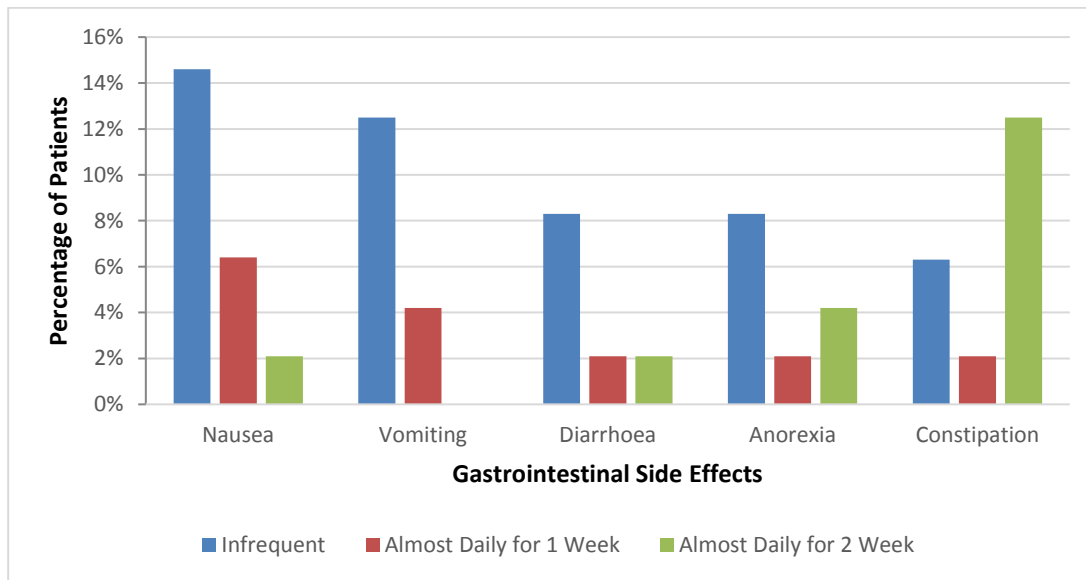
Figure 3.10: Occurrence of gastrointestinal side effects in nutritionally at-risk patients

3.4.3 Nutritional risk profile

This section includes the analysis of the questions found in the Nutritional Risk Screening 2002 tool for the discharge data.

3.4.3.1 Initial screening phase

This includes the assessment of three parameters. The first one is a BMI of less than 20.5 kg/m^2. Upon discharge, 87.5% (n=42) of patients did not report a BMI of less than 20.5 kg/m^2, while 12.5% (n=6) of patients had a BMI of less than 20.5 kg/m^2. The second one is the assessment of weight loss in the last three months; this was reported in 83.3% (n=40) of patients, while 16.7% (n=8) of patients did not have any weight reduction in their last three months. The last one is reduced dietary intake in the last week, whereby there was a reduction in food intake in 34% (n=16) of patients, while 66% (n=31) of the patients did not report any changes in their dietary intake in the last week in the hospital.

3.4.3.2 Final screening phase

This section included 41 patients who scored a "yes" in the initial screening phase. These were assessed further.

3.4.3.2.1 Weight loss of >5 % in 3 months in proceeding weeks

Most of the patients (83.3%, n=40) experienced more than 5% weight loss during hospitalization. There was, however, no difference between the diagnostic categories (p=0.18).

3.4.4 Nutritional status upon discharge

Out of the 48 patient follow-ups, 41 patients qualified for a final nutritional risk screening on the NRS-2002 tool. 61% (n=25) of these patients were found to be nutritionally at risk. See Table 3.4.

The chi-square test indicated that gender did not play a role in patients' malnutrition risk upon discharge, as the result was not statistically significant (chi-square (df=1) =1.99, p=0.15).

Table 3.4: Nutritional profile upon discharge

Nutritionally at risk	n (%)		
		Male	Female
At nutritional risk	25 (61%)	10 (50%)	15 (71.4%)
Not at nutritional risk	16 (39%)	10 (50%)	6 (28.6%)
Total	41	20	21

The diagnostic categories of patients upon discharge included the following: surgical ward patients were nutritionally at risk with 61.5% (n=8), general medical ward patients were nutritionally at risk with 75% (n=9), and patients from the oncology category and the "other" category were nutritionally at risk with 66.7% (n=2) and 54.6% respectively. No significant difference was found between the disease category and risk of malnutrition (chi-square (df=4) =5.05, p=0.29). Figure 4.13 shows the diagnostic categories of the patients upon discharge and their nutritional status.
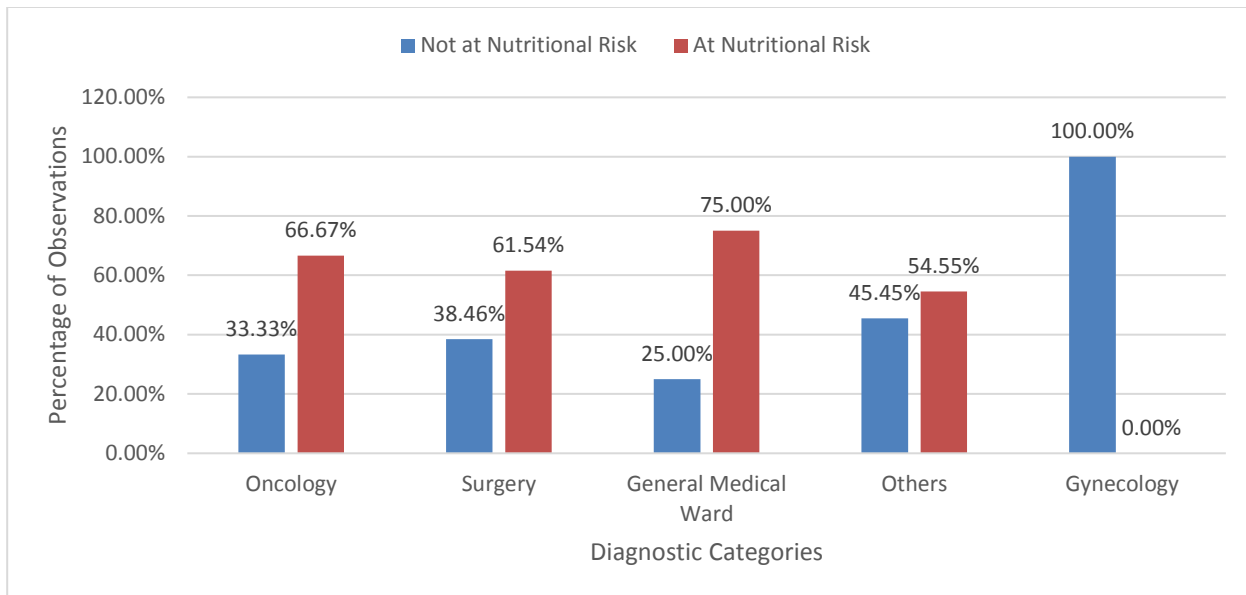
Figure 3.11: Nutritional status per diagnostic categories upon discharge

Abbreviations: General Medicine (GENMED), Surgery (SURG), Oncology (ONC), Gynecology (GYN), Others (OTH).

3.4.4.1 Weight changes during hospitalization

For the 41 participants, an unpaired test was done on the score for weight loss between patients nutritionally at risk (61%, n=25) and patients not at risk (39%, n=16) and indicated a statistically significant difference in weight loss between patients at nutritional risk and patients not at nutritional risk (F (1,39)=36.26, p=0.00). Participants at nutritional risk had an average weight loss of 1.8 kg ± 0.19 SE.

The likelihood of malnutrition risk between patients with a BMI of <20.5 kg/m^2 and those with a BMI of >20.5 kg/m^2 remained the same for patients upon discharge. The chi-square test indicates that the malnutrition risk was not significantly different between patients with a BMI of less than 20.5 kg/m^2 and those with a BMI greater than 20.5 kg/m^2. See Figure 3.14 below.
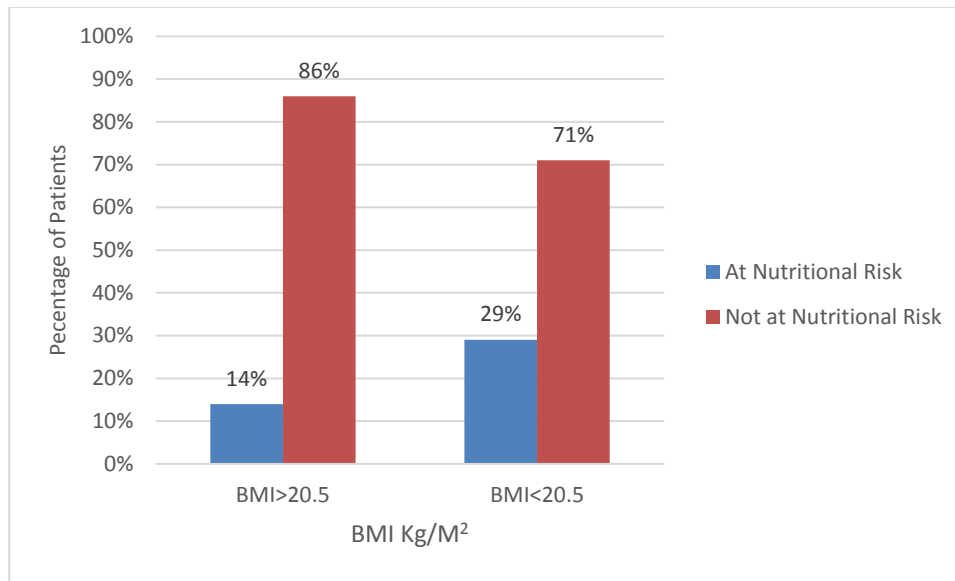
Figure 3.12: Nutritional status of patients with a BMI > and <20.5 kg/m² upon discharge

3.4.4.2 Occurrence of gastrointestinal side-effects of nutritionally at-risk patients upon discharge

The gastrointestinal side-effects of the 25 patients nutritionally at risk upon discharge, showed that most of the patients did not experience any gastrointestinal side-effects during hospitalization. The occurrence of nausea, vomiting, diarrhoea, anorexia, and constipation are outlined in Table 3.5.

Table 3.5: occurrence of gastrointestinal side-effects in nutritionally at-risk patients upon discharge

GI side-effects	GI side-effect occurrence			
	None	**Infrequent**	**AD1WK**	**AD2WKS**
Nausea	64% (n=16)	24% (n=6)	8% (n=2)	4 % (n=1)
Vomiting	72% (n=18)	20% (n=5)	0	8% (n=2)
Diarrhoea	80% (n=20)	12% (n=3)	4% (n=1)	4% (n=1)
Anorexia	76% (n=19)	12% (n=3)	4% (n=1)	8% (n=2)
Constipation	76% (n=19)	12% (n=3)	12% (n=3)	0

Abbreviations: Gastrointestinal (GI), Almost Daily for One Week (AD1WK), Almost Daily for Two Weeks (AD2WKS).

3.4.4.3 Number of complications developed upon discharge

The numbers of medical complications the patients may have developed during hospitalization which required medical intervention were studied upon discharge. Most patients, 54.2% (n=26), did not show any new medical complications. Fifteen (31.3%) patients had only one complication, four (8.3%) patients had two complications, and three (6.3%) patients developed three complications during hospitalization.

3.5 Comparative analysis

This section explores data on the comparison of study participants upon admission and discharge.

3.5.1 Participants at nutritional risk

The report of the comparative analysis done on patients' state of nutritional risk against gender, showed more females were at nutritional risk compared to males (52% vs. 48%) upon admission, although not significant (p=0.45). Upon discharge, 71% females, compared to 50% males, were at nutritional risk (p=0.28). The study shows consistency in independence of patients' nutritional risk status and gender as confirmed by chi-square tests carried out upon admission and discharge. The chi-square test indicated that gender differences on patients' malnutrition risk was not statistically significant (chi-square (df=1) =1.99, p=0.16).

When comparing the age of patients at nutritional risk (n=188) with those not at nutritional risk (n=94), there is no statistically significant difference in the age of the two categories of patients (p=0.54). Though the mean age of patients at nutritional risk (41.4 ± 14.5 years) was slightly lower than that of patients not at nutritional risk (42.5 ± 13 years), age seems to play an insignificant role in patients' nutritional risk status.

CHAPTER 4: DISCUSSION

4.1. Introduction

The prevalence of malnutrition has been shown to range from 10–69%[25-38,41-42-48,50-51,62-78,97-98,102-103] from the literature discussed in this study. This depends on the measure used to diagnose malnutrition, the population, the route of admission, and the hospital settings. The presence of inflammations due to diseases tends to make hospital malnutrition worse, thus raising the risk of malnutrition in such patients[146]. It is well-known that hospital malnutrition is associated with hospital-related complications and infections (morbidity), increased cost of health care related to medical intervention needed, increased length of hospitalization, mortality, and a decrease of patients' quality of life compared to the well-nourished patients[2-4,33,35,37-40,44]. It appears that there are a limited number of studies conducted in Kenya on the prevalence of malnutrition in the hospital setting. Two studies conducted in public health care in Kenya report a prevalence rate of 50%[103-104]. To the best of the researchers' knowledge, this is the first study to be conducted on malnutrition in hospitalized adult patients in a private hospital, at Aga Khan University Hospital, in Kenya. The aim of this study was to gain insight into the prevalence of hospital malnutrition in Kenya, as there is currently very limited data available on this.

4.2 Patients' demographic

This study presented a higher number of females than males upon admission with a mean age of 42.4 ± 13.84 years. The mean age upon discharge was 46.2 ± 16.24 years. Patient's nutritionally at risk upon admission had a mean age of 41.37 ± 1.2 years SE. Other studies among hospitalized adult patients have included a higher percentage of females than males in their studies[104], although the majority of the studies have reported more male than female participants.

The average length of hospital stay in this study was 4.4 ± 5.99 days. This was almost similar to another study by Asiimwe *et al* carried out in the Mbarara Regional Referral Hospital in Uganda where the median length of hospital stay was six days[34]. This long period of hospitalization has been suggested in another study to be due to poor clinical outcomes associated with malnutrition[26]. Nutritional interventions have been shown to be beneficial in reducing the length of hospital stay significantly. In a prospective study conducted at the Johns Hopkins Hospital, in Baltimore,

Maryland-United States nutritional interventions reduced the length of hospitalization by an average of 3.2 days in severely malnourished patients[148].

4.3 Prevalence of malnutrition on admission,discharge, gender and diagnostic categories

Despite the high estimated degree of malnutrition in hospital patients, it varies based on the screening tools used, the study settings, and the subgroup. The prevalence of hospital malnutrition is worrying. The rates reported in the neighbouring countries of Uganda and Burundi is startling, whereby the studies show that more than half of the participants were at risk of malnutrition[34,43].

The prevalence of malnutrition found in this study, according to the NRS-2002, was 45.5% upon admission and 61% upon discharge. This is within the prevalence ranges reported for the studies that have been carried out, that used the same tool, showing a prevalence of between 7–57%[72,149-153]. The slight variation may be explained by the hospital setting used in these studies, different population size, and the duration of the study period. A study by Paulia *et al* to evaluate the efficacy of six nutritional screening tools to predict malnutrition in older patients, found the rate of malnutrition upon admission according to the combined index applied in this study to be 66.9%[147].

The female participants were found to be at a higher nutritional risk than the male participants, clearly because they formed the majority of the study population. The majority of nutritionally at-risk patients were from the general medicine diagnostic category. This is similar to the result of a recent study conducted by Tangvik *et al* on the nutritional risk profile of hospitalized patients[154].

The highest prevalence, based on the diagnostic categories, was from the general medicine wards, with 39.4% upon admission and 75% upon discharge. This may be explained by the accompanying disease conditions in these categories, such as gastrointestinal disorders. The gastrointestinal disorders may present with gastrointestinal side-effects, malabsorption, reduced food intake, and higher changes of unintended weight loss[155]. The oncology category reported the highest mean NRS score, with the highest number of patients who reported reduced food intake as well as high cases of weight loss above 5%. This is in line with the well-known literature that oncology patients are most likely to experience side effects of cancer treatments and suffer weight loss[155]. In their recent study, Nasrah *et al* state that most cancer patients may suffer from changes in normal food intake due to changes in appetite and signals of satiety, the treatment affecting their taste acuity, and symptoms which are not easily managed, such as pain and nausea[156].

Poor food intake has been said to be one major cause of malnutrition in hospitalized patients, as a result of several factors, such as the disease prognosis, poor oral health, and inadequate meal provision[33,49,60]. This study had a high number of nutritionally at-risk patients reporting a decreased food intake. This adds to the existing evidence that poor dietary intake is associated with mortality[157].

4.4 Nutritional status of patients based on Body mass index

Body mass index is one of the commonly used parameters in the assessment of nutritional status. Fewer patients at nutritional risk had a BMI of less than 20.5 kg/m^2 compared to those who are at nutritional risk with a BMI greater than 20.5 kg/m^2. The mean BMI upon admission was 27.05 ± 5.43 kg/m^2 when the patient's nutritional status was classified per BMI. This is similar to the upper range reported in the literature of 23–26 kg/m^2 [157]. According to BMI, only 10% of the study participants were found to be undernourished (BMI <18.5 kg/m^2) upon admission. This was far below the rate classified by the NRS-2002. Zhou *et al* also found that the BMI reported a lower rate of 17%, compared to the 45%, and 38% of the MNA-SF and the NRS-2002 respectively. Malnutrition is also underdiagnosed when BMI is used as the only criteria[158]. Malnutrition can be present in patients with a normal or higher BMI, but can be masked by a high fat mass; hence, the BMI alone may fail to detect the changes in nutritional status in overweight and obese patients[12,159-161]. Tangvik *et al[154]* had similar findings in their study. Another study proposed a possible reason for under diagnosis when BMI was used: it is likely due to fluid and electrolyte accumulation, causing an overestimation of the patient's correct weight.[162]. BMI can be misleading as the growing obesity epidemic causes quite a number of severely malnourished patients to be in the normal BMI range, although they may have lost a significant and clinically relevant amount of body mass[15].

The WHO advocates a BMI of <18.5 kg/m^2 as a general cut-off for underweight[5], but its relevance in clinical and health care settings has been challenged[15]. There is a general trend worldwide of a BMI increase in all populations. This makes the BMI cut-off unsuitable in defining malnutrition. Additional argument epidemiologically is that older populations show higher BMI ranges than younger populations[15]. When the BMI was classified as per the cut-offs of the World Health Organization, the majority of the patients were overweight with a mean BMI of 27.05 kg/m^2, with most of the patients being women. This is in line with studies done by Ng *et al* that showed a gradual increase of the population with a BMI >25 kg/m^2 from 1980 to 2013[163]. Another study conducted by Ziraba *et al[164]* showed a high rate of overweight and obesity among Kenyan women and among the wealthiest

population included in the study. This is part of the population who seek admission in private hospitals in Kenya, such as the Aga Khan University Hospital in Nairobi, which is the study site of this study.This study showed no association between the patients' BMI and their nutritional status.

4.5 Referral for nutritional support on admission and at discharge

Despite the high prevalence of malnutrition noted, only 6.45% of nutritional at-risk patients were referred for nutritional therapy by the dietitian upon admission, but the majority of these referrals were done by the doctors. The referrals upon discharge were equally limited. These findings are similar to those mentioned in the literature[25,27,38,44,59]. This was noted during admission and upon discharge. The rate of referral for nutritional assessment has been found to be substandard. As a result, there is a high chance of malnutrition progression [24,38] Despite a mandatory nutritional risk screening for all patients upon admission, the reason for poor referrals can be contributed to the lack of recognizing the risk of malnutrition at an early stage, since most of the at-risk patients do not show any visible symptoms of undernutrition. Other reasons for poor referrals are due to a lack of knowledge of nutritional screening, and seeing it as a low priority[38]. There is also no evidence of documentation of malnutrition as a medical diagnosis in the patient's files. By the time this is done, the patient is usually in the severe stage of visible wasting[165]. A retrospective chart review of 50 records showed that 42% of these records had no indication of any nutritional issues. This review supports the existing finding that patients at nutritional risk, or patients who are already malnourished, remains unrecognized[166].

This adds up to existing pieces of evidence that at least 50% of malnourished patients go unrecognized[82, 167,168]. It is further estimated that, in developing countries, at least one-third of the patients are malnourished and without early nutritional intervention, and around two-thirds of these patients are likely to deteriorate further[148]. Another study found that, although doctors routinely perform physical assessments on all patients, nutritional assessments are only performed on 15.3% of patients. This was similar among the nurses who carried out patients' examination in 80% of the patients, but only did a nutritional assessment on 29% of those patients[169].

At the study site —   the Aga Khan University hospital in Kenya — where all services are charged, the patients, doctors, and the nurses fail to include the dietitian in patient management due to the cost of the hospital nutritional charges and the cost incurred as a result of nutritional intervention such as

enteral nutrition and oral nutritional supplements. In addition, some of the medical schemes in Kenya do not pay for the nutrition services if offered to the patient under such schemes.

4.6 Study limits and strengths

This study gives insight on the prevalence of hospital malnutrition in a private hospital in Kenya, but it is not without limitation. The study design and the methodology applied did have limitations which could have influenced the results obtained. The study missed to assess the patients who were admitted on Friday evenings, as the study took place from Mondays to Friday evenings. As a result, some of the patients who could have been screened and included, were missed.

There is uncertainty of the number and proportion of patients who did not participate because they were unavailable (e.g. gone for tests or long procedures like surgery), which affects the generalizability of our results in terms of the prevalence of malnutrition. This study was conducted in a private hospital in Kenya, and the clientele there had to pay for most services. This aspect could be a limiting factor, which will affect the generalization of the result to the public hospital sector in Kenya.

The lower mean age (<18 years) of patients included in this study and the lower disease scores may have been influenced by the exclusion criteria. The exclusion criteria include patients with dementia, especially older patients, and critically ill patients admitted to the ICU, patients who are unconscious, ventilated, or on dialysis. The prevalence of patients at risk of malnutrition may have, therefore, been underestimated, as these patients are known to be at higher risk of malnutrition[40, 27,167].

With regards to anthropometrics measurements, some of the patients with reduced functional capacity measurements could not always be obtained. In such cases, their anthropometrics measurements had to be estimated; this is a subjective method and depends on the data collector's clinical judgement and experience. Despite this being a common method, fortunately most of the participants had good knowledge of their body mass, while the majority of patients had their parameters recorded in the medical file. To the best of my knowledge this is the first study on adult malnutrition to be carried out in a private health facility in Kenya. The prevalence rate reported here is not different from that reported in the public health facilities indicating the need for addressing nutritional issues in the provision of health services across all categories of facilitis. This study findings can therefore be generalised to both the private ad public health facilities populations.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Adult malnutrition is prevalent around the world and is a heavy burden, not only to the patients and their relatives, but also to the hospitals even with existing evidence from several studies worldwide and the advancement of medical technology in this era, the simple diagnosis of malnutrition seems to be overlooked and not prioritized, as seen by the few nutritional referrals made during the time of the study. The rate of malnutrition at the Aga Khan University Hospital in Kenya was considerably higher than reported in other parts of the world. The doctors and the nurses seem not to identify and refer patients in need of nutritional therapy on admission,despite the evidence of a screening tool in the nurse's initial assessment form. A holistic and interdisciplinary approach in addressing hospital malnutrition in the hospital is lacking. All the clinician team members – the nurses, doctors, dietitians, administrators and health care assistants seem not to be in team on patients nutitional therapy.

This study has shown that patients who had reported weight loss in the last three months were more likely to be at nutritional risk than those who had no history of weight loss. Patients nutritionally at risk had a high mean weight based on the weighted mean test. This clearly indicates weight loss as one of the indicators to changes in the nutritional status of hospitalized patients, and should therefore be included in the screening process as is recommended and monitored regulary[15, 38,120].

There seem to be an awareness of nutrition screening as evidence by the presence of a screening tool in the initial nursing assessment form in the institution.There is no regular rescreening of patients during hospitalisation,the study found out that patients are more likely to lose weight and develop gastrointestinal side-effects during their hospitalization period.

The study found that there was no statistically significant difference (p=0.46) in the nutritional risk among the different disease categories, hence the null hypothesis, which was that there is no difference in the prevalence of risk for malnutrition between the different disease classifications, is accepted.

Further, when considering the prevalence of at risk for malnutrition of hospitalized inpatients on admission and discharge, the study found that the average admission NRS was 3.30±1.23 and the discharge score 3.03 ±1.33, P=0.02. This showed that there was a significant difference between patient's prevalence of at risk for malnutrition of hospitalized adult in-patients between admission

and discharge. Thus the null hypothesis, there is no difference in the prevalence of at risk for malnutrition of hospitalised in-patients on admission and at discharge, was rejected

5.2 Recommendations

This study gives the following recommendations:

a) There is a need for timely documentation and referral of patients who are identified to be at nutritional risk upon admission by the admitting nurses and doctors, There is now, more than ever, a need to reinforce the nutritional screening and referral polices to ensure that all patients are screened, and that a nutritional referral is timely attended to since few patients were referred for nutritional support upon admission and discharge.The is also a need for rescreening of patients weekly as recommended by the ESPEN[36] to capture any nutrional changes occurring during hospitalisation.

b) There is a need for more studies using the other nutritional assessment tools stated in this study, especially in Kenya, to aid in the generation of a specific nutritional screening tool in Kenyan hospitals.

c) More studies on the prevalence of adult hospital malnutrition need to be conducted in Kenya and other developing countries, applying the same screening tools to allow for comparisons of the prevalence of hospital malnutrition, outcomes and validity, with perhaps lesser constricted exclusion criteria to obtain a more accurate reflection of the true prevalence of patients at risk of malnutrition, and malnourished patients.

d) A research with nursing staff and resident doctors on nutrition support and intervention would be recommended, to establish why there is no referral, despite the presence of a screening tool in place, so that the root cause of this problem may be addressed in the institution.

e) Future studies could also include a cost-effective analysis to provide statistics on the extra health care costs that are associated with the malnourished patient.

f) There is a need for the institution to work hand in hand with the nutrition department to put at work the existing policies and procedures on nutritional intervention for all the clinician team members to ensure their executed on ground level.

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LIST OF ADDENDA

ADDENDUM 1: Form 3E: Participant Information Leaflet and Consent Form

ADDENDUM 2: Form 4: Admission Data Collection Form

ADDENDUM 2: Form 5: Discharge Data Collection Form

ADDENDUM 3: Standard Operating Procedures

ADDENDUM 4: Pictorial presentation of the dietary assessment

FORM 3E

PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM

TITLE OF THE RESEARCH PROJECT:

The prevalence of malnutrition in hospitalized adult patients at the Aga Khan University Hospital in Nairobi, Kenya.

REFERENCE NUMBER: N14/06/061

PRINCIPAL INVESTIGATOR: Ms. **Munyi** Faith Wanja (Registered Dietitian AKUH, N)

ADDRESS: PO BOX 30270-0100 GPO, NAIROBI

CONTACT NUMBER: Tel:+254-725-708-046

INTRODUCTION:

I am Munyi Faith Wanja (hospital dietician/nutritionist), and I am currently doing my postgraduate training at Stellenbosch University (South Africa) to specialize in clinical nutrition. As a requirement for my degree course, I am required to conduct a research project. My research project involves determining the nutritional status in hospitalized adult patients.

I am going to provide you with information and invite you to be part of this research. I will explain the details of this project to you. Please ask me to stop as we go through the information and I will take time to explain it to you. If you have any questions during our interview or at a later stage, please feel free to either ask me, the study staff, or the nurse who is attending to you. It is very important that you are fully satisfied and that you clearly understand what this research entails and how you could be involved. Also, your participation is **entirely voluntary**. It is your choice whether to participate or not. Whether you choose to participate or not, all the hospital services you receive in this ward will continue and nothing will change i n any way whatsoever. You may change your mind at a later stage and stop participating, even if you agreed to participate earlier.

This study has been reviewed and approved by both the **Health Research Ethics Committee (HREC) at Stellenbosch University** and the **Aga Khan University hospital   Ethics Review Committee, which is a committee whose task it is to make sure that research participants are protected from harm in any way.** This research will be conducted according to the ethical guidelines and principles of   the   international   Declaration   of   Helsinki,   *South   African   (SA) Good   Clinical*

Practice (*GCP*) *guidelines*, and the South African Medical Research Council's Guidelines on Ethics for Medical Research

What is this research study all about?

It is known that people who are underweight (weighing less than the normal amount for one's age, height, and build) take longer to recover from illness or surgery and are more likely to develop infections. This results in longer hospitalization 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.

The study will be conducted at the Aga Khan University Hospital in Nairobi (Kenya) during the period of January to December 2015, or until the desired number of study participants have been included.

A total of 400 participants older than 18 years are needed for the study to provide meaningful results.

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

The information obtained include: asking you questions about your appetite, determining your weight, height and muscle-strength, and 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 process will be repeated when you are discharged.

Few studies have been conducted in Africa and Kenya to provide data on the nutritional status of adult patients during hospitalization. This research that we are undertaking will serve to contribute to the existing body of knowledge and provide vital recommendations that will improve nutrition practises and protocol in Kenyan hospitals.

Procedure and protocol

We will enroll patients who are eligible for this study from the inpatient adult wards. The patients will be approached and requested to participate in the study. An extensive explanatory statement will be made on the study aims, objectives and the use of result obtained. Those who agree to participate will be issued with a participant information leaflet and consent form.

We will then proceed to administer a questionnaire to the patients to ascertain the demographic status, nutritional status and medical information, and weight and height will be taken to establish the patient's body mass index (BMI).

A sample of 400 participants will be picked randomly and contacted via phone for a follow-up on their nutritional progress three months after discharge. This will be done to determine if their nutritional status have changed or not.

Why have you been invited to participate?

You have been asked to participate as you are a patient that has been newly admitted to hospital within the last 48 hours, and also meet our inclusion criteria.

What will your responsibilities be?

- To carefully read the information provided by the researcher about the study and to ask questions about any uncertainties you may have. You then have to provide your written approval to participate in this study if you are comfortable to do so.
- To speak to the researcher if you want to stop your participation any time during the study or to contact the researcher or The Health Research Ethics Committee if you have any queries, concerns or complaints.
- To provide information that is accurate and honest.
- To keep a copy of the consent form for your own record keeping

Will you benefit from taking part in this research?

There are no benefits. The results of this study will be used to determine the nutritional status of hospitalized adult patients and to make recommendations that will improve nutrition practise and protocol in Kenyan hospitals.

Are there in risks involved if you partake in this research?

There are no risks involved by participating in this study. Depending on your health condition, getting undressed into minimal clothing and walking to the weighing scale and height metre may be a discomfort.

If you do not agree to partake in the study, what alternatives do you have?

To take part in this study is your choice. You may say that you do not want to partake in this study, and even if you agreed in the beginning, you may stop participating at any time.

Who will have access to your medical records?

Only the research team that is involved in the data collection will have access to your medical files. Even though some of the information may be recorded, your identity will be kept anonymous by using coding rather than names on the questionnaires.

The data will be stored by the researcher for five years, after which it will be destroyed.

The sponsors, study monitors or research auditors, or members of the Health Research Ethics Committee of this study may need to inspect the research records.

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

No, you will not be paid to take part in the study. There will be no costs involved, even if you do take part in this study.

Is there anything else that you should know or do?

Should you, at any time during this study, require any further information with regards to the study, please contact Ms. Faith Munyi at +254-725-708-046.

You can contact the **Stellenbosch University Health Research Ethics Committee** at +27 21 938 9207 or **the Aga Khan University Research Ethics Committee** 020-366-2148 if you have any concerns or complaints that have not been adequately addressed by your study team. You will receive a copy of this information and consent form for your own records

Declaration by participant

By signing below, I …………………………………..…………. agree to take part in a research study entitled: The prevalence of adult malnutrition in hospitalized adult patients at the Aga Khan University Hospital in Nairobi, Kenya.

I declare that:

- I have read or had read to me this information and consent form and it is written in a language in 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 pressurized to take part.
- I may choose to leave the study at any time and will not be penalized or prejudiced in any way.
- I may be asked to leave the study before it has finished or if the researcher feels it is in my best interest.

Signed at (*place*) ....…….......………….. on (*date*) …………...……….. 2015.

....
Signature of participant   Signature of witness

Declaration by investigator

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 an interpreter (if an interpreter is used, the interpreter must sign the declaration below).

Signed at (*place*) ....….........…………….. on (*date*) …………...………….. 2015.

....
Signature of investigator

....
Signature of witness

Declaration by interpreter

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

- I assisted the investigator (*name*) ………………………………………. to explain the

  information in this document to (*name of participant*)

  ……………..…………………………….. using the language medium of

  ………………………... .

- We encouraged him/her to ask questions and took adequate time to answer them.
- I conveyed a factually correct version of what was related to me.
- I am satisfied that the participant fully understands the content of this informed consent document and had all his/her question satisfactorily answered.

Signed at (*place*) ....….........…………….. on (*date*) …………...……………….2015.

....
Signature of interpreter

....
Signature of witness

FORM 4

Participant number	

ADMISSION DATA COLLECTION FORM			
Date of interview			
Date of admission			
Hospital code		Hospital name	
Ward category	3.1 Medical		
	3.2 Surgical		
	3.3 CCU		
	3.4 MSW		
	3.5 P/WING		
	3.6 HDU		
	3.7 PZP		

DEMOGRAPHIC INFORMATION

Gender	Male		Female	

Date of birth of patient

Day   Month   Year

MEDICAL INFORMATION

What is the patient's primary diagnosis on admission (Indicate only one)		
	Present (x)	**Provide details of specific medical condition**
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)		

Indicate the presence of gastrointestinal side-effects.

Indicate the appropriate options below.

		YES	NO	If YES to any, please indicate the frequency		
Side-effect				Almost daily for 2 weeks	Between the 2 options	Minor / infrequent
7.1	Nausea					
7.2	Vomiting					
7.3	Diarrhoea					
7.4	Anorexia					
7.5	Constipation					

DIETARY INFORMATION

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 plate / usual intake	
8.3	Decreased intake: consumes only ½ plate / usual intake	
8.4	Decreased intake: consumes only ¼ plate / usual intake	
8.5	Unable to consume anything	
If a decreased food intake occurred (8.2 – 8.5 above), determine the duration.		

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9.1	< 1 month	
9.2	> 1 month - < 3 months	
9.3	> 3 months	

Was the patient referred for specialized nutritional support?		
10.1	Yes	
10.2	No	
If YES to question 10, which health care professional made the referral?		
11.1	Doctor	
11.2	Dietitian	
11.3	Registered nurse	
11.4	Other (specify)	

ANTHROPOMETRY

How was the anthropometric measurements taken? **Indicate the appropriate options below.**		
Measurement	Measured	Estimated
12.1 Weight		
12.2 Height		
Indicate the measurements as determined		
13.1	Weight measurement (kg)	
13.2	Height measurement (cm)	Standing height (cm)	
		Bed length height (cm)	

		Half arm-span reading (cm)	

Were there any factors affecting the weight measurement e.g. casts, external fixing devices etc.			
14.1	Yes		Specify:
14.2	No		

Assessment / Determination of usual weight measurement.		
15.1	Usual weight (kg)	
15.2	Date of last weight measurement	
15.3	Reading unknown	

Determination of weight history

Ask the patient to indicate their weight readings at the following time periods. 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
16.1	2 weeks ago								
16.2	1 month ago								
16.3	2 months ago								
16.4	3 months ago								
16.5	6 months ago								

	Determine whether clothes / jewellery fit more loosely or adjustment of belt setting made	
17.1	Yes	
17.2	No	
17.3	N/A	

	If YES to question 17 above, determine the duration.	
18.1	< 1 month	
18.2	> 1 month - < 3 months	
18.3	> 3 months	

FUNCTIONAL CAPACITY

	Indicate the patient's dominant arm	
19.1	Right	
19.2	Left	

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

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					

CLINICAL EXAMINATION

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Test around the following areas for the presence of <u>oedema</u>: ankle, orbital, sacral. Please follow the SOP.

Indicate the appropriate option below.

	Clinical finding	Category	Indicate option
22.1	No depression	No edema	
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	

Test around the <u>orbital area</u> (under the eyes) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP.

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

	Clinical finding	Category	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	Hollow look, depressions, dark circles, loose skin	Severe	1	2	

Test around the <u>upper arm area</u> (triceps / biceps) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP.

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	

Test around the <u>thoracic/lumbar region</u> (ribs / mid-axillary line) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP.

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	

Test around the <u>temple region</u> (temporalis muscle) for the presence of <u>muscle wasting</u>. Please follow the SOP.

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 malnutrition	3	4	5
26.3	Hollowing, scooping, depression	Severe	1	2	

Test around the <u>clavicle bone region</u> for the presence of <u>muscle wasting</u>. Please follow the SOP.

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, visible but not prominent	Normal / well nourished	6	7	
27.2	Some protrusion	Mild-moderate malnutrition	3	4	5
27.3	Protruding, prominent bone	Severe	1	2	

Test around the <u>clavicle and acromion bone region</u> (shoulder) for the presence of <u>muscle wasting</u>. Please follow the SOP.

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	Normal / well nourished	6	7	
28.2	Acromion process may protrude slightly	Mild-moderate malnutrition	3	4	5
28.3	Shoulder to arm joint looks square	Severe	1	2	

Test around the <u>scapular bone region</u> for the presence of <u>muscle wasting</u>. Please follow the SOP.

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	

Test around the <u>dorsal hand</u> (Interosseous muscle) for the presence of <u>muscle wasting</u>. Please follow the SOP.

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	

Test around the <u>patellar region</u> (knee) for the presence of <u>muscle wasting</u>. Please follow the SOP.

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	

Test around the <u>anterior thigh region</u> (quadriceps) for the presence of <u>muscle wasting</u>. Please follow the SOP.

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	

Test around the <u>posterior calf region</u> for the presence of <u>muscle wasting</u>. Please follow the SOP.

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

	Clinical finding	Category	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	Well-developed bulb of muscle	Severe	1	2	

Please double-check that all sections are fully completed!

Completed by:

Checked by:

Date:

ADDENDUM 3: FORM 5: DISCHARGE DATA COLLECTION FORM

Participant number	D

DISCHARGE DATA COLLECTION FORM

Date of interview	
Date of admission	
Hospital	D

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

GENERAL INFORMATION

Please indicate the discharge option most relevant		
3.1	Transferred to another hospital	
3.2	Transferred to another ward (that falls outside the inclusion criteria for this study)	
3.3	Discharged to own residential home	
3.4	Discharged to nursing home / hospice	
3.5	Discharged to relatives home	
3.6	Other (specify)	

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

4.1	Deceased in hospital	
4.2	Unexpected discharge	
4.3	Refuse to participate	
4.4	Other (specify)	

If the patient is deceased, indicate the following:		
15.1	Date of death	
15.2	Cause	
15.3	Cause of death unknown	

MEDICAL INFORMATION

Indicate the presence of gastrointestinal side-effects. Indicate the appropriate options below.					
			If YES to any, please indicate the frequency		
Side-effect	YES	NO	Almost daily for 2 weeks	Between the 2 options	Minor / infrequent
6.1 Nausea					
6.2 Vomiting					
6.3 Diarrhoea					
6.4 Anorexia					
6.5 Constipation					

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)	
7.1	Complication 1
Specify complication	
Organ system involved	
Date of diagnosis	
Specify the treatment taken	
Non-invasive treatment	
Pharmacological treatment	
Interventions	
Life-threatening complications	
Death	
7.2	Complication 2
Specify complication	
Organ system involved	
Date of diagnosis	
Specify the treatment taken	
Non-invasive treatment	
Pharmacological treatment	
Interventions	
Life-threatening complications	
Death	
7.3	Complication 3
Specify complication	

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

Pharmacological treatment	
Interventions	
Life-threatening complications	
Death	

DIETARY INFORMATION

	Ask the patient to describe any <u>changes in food intake during the past week in hospital</u>. Indicate the appropriate option below.	
8.1	No change in usual food intake / consumes all food	
8.2	Decreased intake: consumes only ¾ plate / usual intake	
8.3	Decreased intake: consumes only ½ plate / usual intake	
8.4	Decreased intake: consumes only ¼ plate / usual intake	
8.5	Unable to consume anything	

	Was the patient referred for specialized nutritional support?	
9.1	Yes	
9.2	No	

	Did the patient receive specialized nutritional support?	
10.1	Yes	
10.2	No	

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)
11.1	Enteral nutrition			
11.2	Parenteral nutrition			
11.3	Combination therapy			

11.4	Supplementation drinks			
11.5	Other (specify)			

ANTHROPOMETRY

How was the anthropometric measurements taken? Indicate the appropriate options below.		
Measurement	Measured	Estimated
12.1 Weight		
12.2 Height		

Indicate the measurements as determined	
13.1 Weight measurement (kg)	
13.2 Height measurement (cm)	

E. FUNCTIONAL CAPACITY

Indicate the patient's dominant arm	
14.1 Right	
14.2 Left	

Measurement of hand-grip strength

Measurement 1	Measurement 2	Measurement 3

Determine general functional capacity. Indicate the appropriate options below.

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

16.1	Experience difficulty with normal activities / ambulation					
16.2	Bed /chair-ridden					

CLINICAL EXAMINATION

Test around the following areas for the presence of <u>oedema</u>: orbital, ankle, sacral. Please follow the SOP. Indicate the appropriate option below.

	Clinical finding	Category	Indicate option
	Clinical finding	Category	Indicate option
17.1	No depression	No edema	
17.2	2-4mm depression Immediate or few second rebound	Mild	
17.3	6mm deep pit 10-12 second rebound	Moderate	
21.4	8mm very deep pit > 20 second rebound	Severe	

Test around the <u>orbital area</u> (under the eyes) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP. Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

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

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Test around the <u>upper arm area</u> (triceps / biceps) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP. Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

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

Test around the <u>thoracic/lumbar region</u> (ribs / mid-axillary line) for the presence of <u>subcutaneous fat loss</u>. Please follow the SOP. Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

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

Test around the <u>temple region</u> (temporalis muscle) for the presence of <u>muscle wasting</u>. Please follow the SOP. Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

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

21.3	Hollowing, scooping, depression	Severe	1		2	

Test around the clavicle bone region for the presence of muscle wasting. Please follow the SOP. Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	Category	Indicate option (X)		
22.1	Not visible, visible but not prominent	Normal / well nourished	6	7	
22.2	Some protrusion	Mild-moderate malnutrition	3	4	5
22.3	Protruding, prominent bone	Severe	1	2	

Test around the clavicle and acromion bone region (shoulder) for the presence of muscle wasting. Please follow the SOP. Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	Category	Indicate option (X)		
23.1	Lines of bones prominent, no significant depressions	Normal / well nourished	6	7	
23.2	Acromion process may protrude slightly	Mild-moderate malnutrition	3	4	5
23.3	Shoulder to arm joint looks square	Severe	1	2	

Test around the scapular bone region for the presence of muscle wasting. Please follow the SOP. 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 not prominent, no depressions	Normal / well nourished	6	7	
24.2	Mild depression, or bone may show slightly	Mild-moderate malnutrition	3	4	5
24.3	Prominent, visible bones, depressions between ribs/scapula or shoulder/spine	Severe	1	2	

Test around the <u>dorsal hand</u> (Interosseous muscle) for the presence of <u>muscle wasting</u>. Please follow the SOP. Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

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

Test around the <u>patellar region</u> (knee) for the presence of <u>muscle wasting</u>. Please follow the SOP. 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 protrudes, bones not prominent	Normal / well nourished	6	7	
26.2	Knee cap less prominent, more rounded	Mild-moderate malnutrition	3	4	5
26.3	Bones prominent, little sign of musculature around knee cap	Severe	1	2	

Test around the <u>anterior thigh region</u> (quadriceps) for the presence of <u>muscle wasting</u>. Please follow the SOP. Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

	Clinical finding	Category	Indicate option (X)		
27.1	Well rounded, developed	Normal / well nourished	6	7	
27.2	Mild depression on inner thigh	Mild-moderate malnutrition	3	4	5

27.3	Depression on inner thigh, obviously thin	Severe	1	2	

Test around the <u>posterior calf region</u> for the presence of <u>muscle wasting</u>. Please follow the SOP. Indicate the appropriate option below, as well as the relevant scale [1 severe PEM – 7 normal].

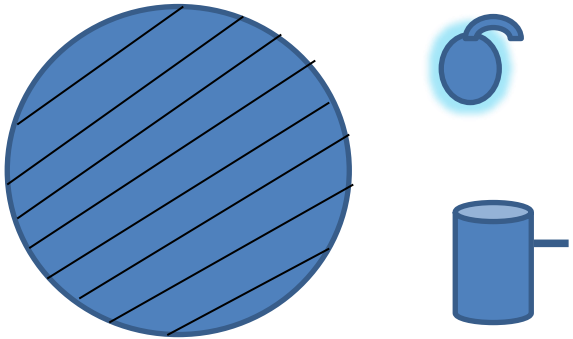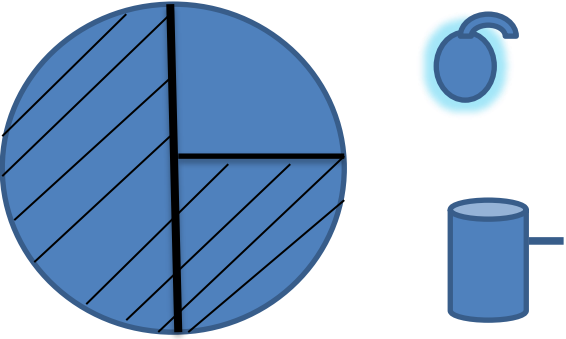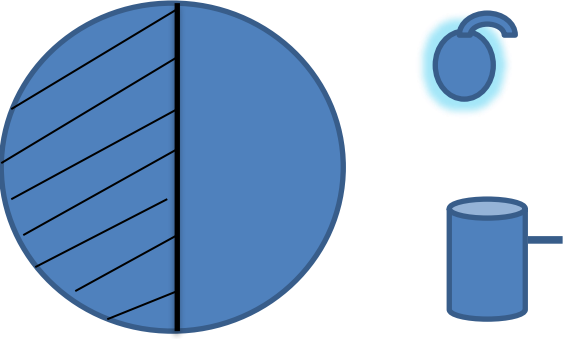|	Clinical finding	Category	Indicate option (X)		
28.1	Well-developed bulb of muscle	Normal / well nourished	6	7	
28.2	Not well developed	Mild-moderate malnutrition	3	4	5
28.3	Well-developed bulb of muscle	Severe	1	2	

Please double-check that all sections are fully completed!

 Completed by:

 Checked by:

 Date:

ADDENDUM 4: Dietary Assessment Pictorial

	Patient is able to complete all the food items served per meal; Food, fruits and fluids (beverages, juice porridge etc.) No complain on loss of appetite Rates as no change
	Patient is able to complete only ¾ of the food served per me including fruits and fluid (beverages, juice porridge etc.) Rates as ¾ plate
	Patient is able to complete only ½ of the food served per meal including some fruits and fluids (beverages, juice porridge etc.) Rates as ½ plate

	Patient is able to complete only ¼ of the food served per meal; some fruits and little fluids (beverages, juice porridge etc.) Rates as ¼ plate