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TITLE: Assessment of the Validity and Predictive Performance of Nutritional Risk Screening (NRS 2002) tool in Adult Patients Admitted to Intensive Care Units in Hospitals in Addis Ababa, Ethiopia, 2024 GC: A Facility-Based Prospective Cohort Study

PREPARED BY:

Sihawe Derese Feyisa (MD)

ADVISORS

1. Primary advisor: Bilal Shikur (MD, MPH, PhD)
2. Secondary advisor: Yakob Desalegn (MD, MPH)

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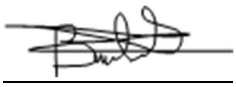
APPROVED BY THE BOARD OF EXAMINERS

This is to certify the thesis prepared by Sihawe Derese entitled "Assessment of the Validity and Predictive Performance of Nutritional Risk Screening (NRS 2002) tool in Adult Patients Admitted to Intensive Care Units in hospitals in Addis Ababa, Ethiopia, 2024 GC: A Facility-Based Prospective Cohort Study" submitted in partial fulfillment of the requirements for the Degree of Masters in Public Health Nutrition complies with regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee:

ADVISOR

Dr. Bilal Shikur	Assistant Professor		30 Nov 2024
Full name	Rank	Signature	Date

EXTERNAL EXAMINER

Dr. Amare Worku	Assistant Professor		Nov 01, 2024
Full name	Rank	Signature	Date

INTERNAL EXAMINER

Dr. Tefera Darge	Assistant Professor		30 Nov 2024
Full name	Rank	Signature	Date

CHAIRMAN, DEPARTMENT GRADUATE COMMITTEE

Full name	Rank	Signature	Date

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For from him, through him, and to him are all things - to God be the glory forever.

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ACRONYMS AND ABBREVIATIONS

AAU – Addis Ababa University

ASPEN – American Society of Parenteral and Enteral Nutrition/Academy of Nutrition and Dietetics

AUC – Area Under the Curve

BMI – Body Mass Index

ESPEN – European Society of Parenteral and Enteral Nutrition

FNA – Full Nutritional Assessment

ICU – Intensive Care Unit

MUAC – Mid-Upper Arm Circumference

MOH – Ministry of Health

NPV – Negative Predictive Value

NRS 2002 – Nutritional Screening Tool 2002

NUTRIC Score – Nutritional Risk in Critically Ill Score

PPV – Positive Predictive Value

ROC – Receiver Operating Characteristic

SGA – Subjective Global Assessment

SPHMMC – Saint Paul's Hospital Millennium Medical College

TASH – Tikur Anbessa Specialized Hospital

TSF – Triceps Skinfold Thickness

OPD – Out Patient Department

EOPD – Emergency Out Patient Department

SCCM – Society of Critical Care Medicine

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ABSTRACT

BACKGROUND: Malnutrition is a major concern for patients admitted to Intensive Care Units both globally and in developing countries, and is associated with poor clinical outcomes such as prolonged length of hospital stay, increased mortality, and complications. Quick and simple nutrition screening methods can help to direct nutrition therapy in the intensive care unit. Ethiopia currently lacks validated tools for conducting nutritional screening among critically ill patients. The need for a validated tool to assess malnutrition risk, and the potential benefits it offers among critically ill patients in Ethiopia are the driving forces behind this study.

OBJECTIVE: This study aims to assess the validity and predictive performance of the nutritional risk screening 2002 tool – NRS 2002 among patients admitted to Intensive Care Units of tertiary hospitals in Addis Ababa, Ethiopia in 2024.

METHOD: A facility-based prospective cohort study was conducted using a structured questionnaire in Intensive Care Units of two tertiary public hospitals in Addis Ababa, Ethiopia for admitted patients aged ≥18 years from March 12 to May 20. A total sample size of 126 was used for the study. The results from the Full Nutritional Assessment were considered the gold standard and the results from the Nutritional Risk Screening 2002 tool – NRS 2002 the test tool. Sensitivity, specificity, Negative and Positive predictive values, Receiver Operating Characteristic analysis, and multiple binary logistic regression have been computed.

RESULT: A total of 122 patients, predominantly male (54.1%), were included. 27% of the study participants died and 22.1% developed complications in the ICU during the study period. The NRS tool was found to have a sensitivity and specificity of 95.8% and 68.4% respectively; and a Cronbach's alpha value of 0.868. This malnutrition screening tool is a significant predictor of death; AOR = 2.206 (95% CI: 1.496, 3.251; $p < 0.05$), and complications; AOR = 1.874 (95% CI: 1.265, 2.776; $p < 0.05$) but not prolonged length of ICU stay; 1.17 (95% CI: 0.821, 1.668; $p > 0.05$).

CONCLUSION: The NRS 2002 tool is a valid nutritional screening tool with high sensitivity. It is also a significant predictor of death and complications during their ICU stay.

KEYWORDS: NRS 2002; Full Nutritional Assessment; Intensive Care Unit; Malnutrition; Validity; Predictive Performance

1. INTRODUCTION

1.1 BACKGROUND

Despite numerous advancements in nutrition support, malnutrition is still a common problem among hospitalized patients, and it is particularly noticeable for those admitted to critical care units.(1–3)

Globally, the prevalence of malnutrition among patients admitted to critical care units ranges from 13 – 78 %. (2,4–6) Another meta-analysis study reported the pooled proportion of malnutrition among patients admitted to the ICU to be 51%. This proportion is reported to be as high as 64% in sub-Saharan Africa.(7) A study carried out in Malawi found that 62% of patients admitted to critical care units had moderate-to-severe malnutrition.(8) According to reports of a cross-sectional study conducted at a Rwandan referral hospital, Malnutrition was identified among 22% of patients upon ICU admission. (9)

Nutrition is a standard of care for critically ill patients who are expected to stay in the Intensive Care Unit (ICU) for longer than 48 hours because it is both a supportive therapy and a moderator of severe diseases.(10,11)

Nutrition screening is the process of identifying people who are malnourished or at risk of malnutrition using a validated screening procedure to see if a thorough nutritional assessment is warranted.(12,13) The aim is to identify patients who do not yet demonstrate signs and symptoms of malnutrition but are at high nutritional risk in the absence of nutritional intervention. Such patients will benefit from nutrition support. (14–16) Nutritional assessment is the thorough assessment of nutritional status utilizing anthropometric measurements, biochemical data, physical examination, and medical and dietary history with the aim of identifying or following up the progress of clinically relevant malnutrition. (12,15) Following a nutrition screening, all patients classified as "nutritionally at risk" should have a nutrition assessment completed, documenting factors relevant to the delivery of nutritional support therapy. (13)

A nutritional screening tool is a series of questions focused on elements presumed to represent nutritional status that yield a qualitative or quantitative score that indicates nutritional risk. (12) Expensive measurements or complex procedures should be avoided when screening for

malnourished patients who need further nutritional assessment and therapy for a screening tool to be acceptable. (17)

It is imperative to detect malnutrition using validated, quick, and simple nutrition screening methods to direct nutrition therapy in the intensive care unit, given that malnutrition can result in complications, readmissions, prolonged hospital stays, and even death. (2,18)

1.2 STATEMENT OF THE PROBLEM

The use of nutritional screening tools, to determine whether a patient is malnourished or at risk of malnutrition, is typical in high-resource settings. However, this is not typical in the absence of formal, informal, or recorded documented nutrition screening protocols or in settings with limited resources. (8,19)

The traditional screening tools used to identify malnutrition in hospital wards are not adequate for use in the ICU making the identification of critical patients who would benefit from an earlier and more aggressive initiation of nutrition therapy a challenge. This is because many of the screening tools generally consider critically ill patients to be at high nutritional risk as they have not been specifically designed for such patients. Other contributing factors include the inability of ICU patients to communicate verbally to provide diet histories, the presence of edema, and the inability to walk. (10,18,20)

Although there are societies and scientific associations that have formulated guidelines on nutritional therapies for ICU patients, there is not enough evidence about the nutritional status in developing countries. (3)

One of the primary reasons patients do not receive nutritional support at the outset is the lack of an appropriate screening instrument. (21) The absence of a structured and validated tool for our country's patient population could be one of the hindrances to accurately assessing nutritional status. (2,21) Patients are missing out on targeted nutritional support because there is no practice of using a validated screening instrument with an adequate understanding of how efficiently it determines the clinical outcomes of patients.

In Ethiopia, despite the indisputable need to have a well-established protocol in place, there are limited to no validated tools for the nutritional screening of critically ill patients. A guideline on ICU nutrition support and therapy was prepared by the Ministry of Health (MOH) Ethiopia in 2022 which comprises screening and assessment as one of four elements in the nutritional care plan and suggests that screening be done within 24 hours of admission to determine each patient's nutritional status. However, the suggested nutritional screening tool, Subjective Global Assessment - SGA, has not been validated to work in the country's intensive care units. (22)

In the absence of an outcomes-validated tool, guidelines support MOH's suggestion to employ SGA as a screening tool for ICU patients. (21,23)

Nevertheless, SGA is not one of the recommended nutritional screening methods for patients admitted to intensive care units because it overlooks metabolic stress caused by the severity of the disease and because its subjectivity limits its application in routine care, especially in teaching hospitals where its accuracy depends on the observer's skills and expertise in recognizing nutritional changes. (24) There is also no clear link between the observations and patient classification, making it less targeted than is ideal for quick screening. (23) According to studies, SGA also has a poor sensitivity and detects existing malnutrition more accurately than nutritional risk. (25)

Whereas NRS 2002 is an effective and simple nutritional screening technique that has consistent application and does not require specially trained healthcare staff. It is also rapid to administer as it takes approximately 3-4 minutes. (26–28)

The use of Nutritional Risk Screening (NRS) 2002 and Nutrition Risk in Critically Ill (NUTRIC) assessment tools are recommended to be used for critically ill patients by the Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (ASPEN) as these tools take disease severity into account.(29)

Therefore, this study aims to validate the NRS 2002 nutrition screening tool and determine its predictive performance of clinical outcomes.

1.3 RATIONALE AND SIGNIFICANCE OF THE STUDY

The need for a validated tool to assess malnutrition risk, the potential benefits it offers, and the pressing need to close the knowledge gap about nutritional status and malnutrition risk among critically ill patients in Ethiopia are the driving forces behind this study.

The goal of carrying out this research is to close the knowledge gap that hinders the development of targeted interventions and establish a reliable and effective means of identifying malnutrition risk in our specific critical care population. It will yield important information about the nutritional status and risk of malnutrition among critically ill patients in Addis Ababa, which will be of great value to policymakers, healthcare providers, patients, and researchers.

The validation of the NRS 2002 tool would help healthcare providers by providing access to a validated tool that has been specially tested for ICU patients. It would also have a direct implication for patients admitted to the ICU as it will contribute to the development of individualized nutrition care plans.

The findings will provide insight into the prevalence of malnutrition, enabling policymakers to create targeted nutritional intervention plans and efficient resource allocation.

By providing a standardized method for nutritional assessment, this validated tool will allow researchers to collect data consistently and comparably across studies in the future. Additionally, it adds to the scant body of research on the nutrition of patients admitted to the ICU in Ethiopia, paving the way for more studies into the improvement of critically ill patients' nutritional status.

2. LITERATURE REVIEW

There is confusion and a lack of agreement regarding the definition of adult malnutrition because various definitions of it can be found in different literature. Both overnutrition and undernutrition are considered as forms of malnutrition. However, undernutrition, a condition in which there are not enough nutrients in the body to meet requirements, will be referred to as malnutrition for the purposes of this review. (12)

The combination of acute or chronic inflammation and reduced biological function is the pathophysiology of malnutrition that is linked to disease or injury. This results in a changed body composition. (30)

When admitted to the ICU, even well-nourished patients face a decline in their nutritional status, which increases their risk of acute malnourishment demonstrating how the primary factor determining whether or not an ICU patient receives nutrition support is their metabolic state, not their nutritional status, even though they are well-fed. (31) Inadequate intake or substantial metabolic stress may also have an impact on how quickly a person achieves the crucial level of nutritional risk status. ICU patients quickly deteriorate due to inflammatory processes that prevent the body from adapting to semi-starvation, interfering with its adaptive mechanisms. (32)

According to a study, depending on how long they stay in the intensive care unit, 40% of critically ill patients lose more than 10 kg of body weight. (33) Due to their high catabolic state, all ICU patients are at risk of developing malnutrition if not fed adequately. (10,34) Patients in critical care lose twice as much body protein as healthy people do when following a protein-free diet; one classic study found that patients in critical care could lose 1-2 kg of body protein in 10 days, or 10-15% of their starting total protein content. This is relative to healthy people consuming an equivalent amount of protein. (31,32) This is explained by the fact that acute inflammation in critically ill patients causes "acute disease/injury-related malnutrition," distinguishing ICU patients from most other hospitalized patients. In the latter group, disease-related malnutrition is brought on by a combination of reduced food intake that results in both classical undernutrition and varying degrees of inflammation. (30) The substantial prevalence of malnutrition among patients in critical care is caused by a range of factors, including the severity of the disease and disease-associated inflammatory conditions that raise the metabolism rate and energy expenditure,

decreased food/fluid intake, the complexity of the therapy, and the practices of the healthcare system. (1–3,8,35)

A low nutritional status in critically ill patients is linked to a high risk of mortality, indicating that improving nutritional status may be a modifiable risk factor for improved results in this situation. (36) For critically ill patients, malnutrition is independently associated with poor outcomes, including higher rates of infections, reduced immune function, poor wound healing, muscle atrophy, longer hospital stays, more complications, prolonged mechanical ventilation, multiple organ failure, and expensive medical care. (2,8,34,35,37,38) Furthermore, the interaction between illness conditions and nutrition may exacerbate the effects of malnutrition. (2) On the other hand, optimal nutrition leads to better overall outcomes, including fewer complications, less time spent on a mechanical ventilator, and a shorter recovery period for ICU patients. (34,35,38)

2.1 NUTRITION CARE PLAN IN THE ICU

Nutritional care and the administration of nutritional support are guided by a set of recommended steps with feedback loops including nutrition screening, formal nutrition assessment, creation of a nutrition care plan, etc. (14)

Nutritional risk can be described as the possibility of unfavorable consequences that could have been avoided with optimum nutrition support, should it be neglected. It is neither the risk nor likelihood of having the diagnosis of 'malnutrition'. (14,31) Every critically sick patient who stays in the ICU for longer than 48 hours should be evaluated for malnutrition, per the recently substantially amended ESPEN guideline. (39)

Nutritional screening techniques utilized in the ICU should incorporate factors that indicate the patients' metabolic condition, according to Kondrup et al. (31) The NRS 2002 or the NUTRIC score should be used to assess nutrition risk, according to the American Society of Parenteral and Enteral Nutrition/Academy of Nutrition and Dietetics – ASPEN's 2016 guidance on nutrition in the ICU. Since only these two instruments can assess the severity of a disease and its nutritional status. (29) European Society of Parenteral and Enteral Nutrition – ESPEN's guideline on ICU nutrition recommends a pragmatic approach to be taken into consideration for patients at risk, such as those staying in the ICU for more than 48 hours, requiring mechanical ventilation, having an infection, being underfed for more than five days, and/or presenting with a severe chronic disease.

This is because there are no specific nutritional scores that have been standardized and validated for use in the ICU. (39,40) Of all the screening instruments, NRS 2002 and Malnutrition Universal Screening Tool (MUST) are the most easily and quickly calculated, and they offer the highest predictive value for mortality. (39)

2.2 THE NEED FOR VALIDATION OF NUTRITION ASSESSMENT TOOLS

Nutritional screening tools should be simple to use and comprehend, adaptable, economical, valid, and dependable across a range of critical care patient groups. They ought to support medical professionals in creating nutritional care plans as well. (12,41) A commonly agreed upon screening method is lacking even though there are many published nutritional screening and assessment tools that can be utilized to assess a patient's nutritional status. This is because many of these tools have not undergone extensive testing. (12,21)

Further research is required to compare the screening methods' efficacy with the results of a comprehensive nutritional review to assess their effectiveness objectively. (17)

2.3 NRS 2002

Accredited by the European Society for Clinical Nutrition and Metabolism, the Nutritional Risk Screening 2002 (NRS 2002) detects nutrition risk in hospital patients, particularly in intensive care units. (5,42) The degree of undernutrition and the increase in nutritional demands as a result of the illness were the initial assumptions behind the development of the NRS 2002 as a screening tool. This approach went on to become a highly regarded instrument for the inpatient patient group. (21,43) NRS 2002 is an effective, quick, and simple nutritional screening technique (5,44) that also considers the stage of the disease. (26–28)

The NRS-2002 score consists of four variables: BMI, decreased food intake within the past week, weight loss within the last three months, illness severity, and an extra score for patients above the age of seventy. (45) Three categories are used to categorize patients: absent, moderate, and severe. Its components, undernutrition, and illness severity, are each given a score between 0 and 3, adding up to a total score between 0 and 6. If a patient receives three or more points overall, they are considered to be at nutritional risk. Three measures are used to evaluate the first component, undernutrition: body mass index (BMI), percentage of recent weight loss, and recent

changes in food intake. The most compromised of these three features is used to classify the patient. (21)

NRS 2002 has been compared in several studies with other nutritional screening instruments to evaluate the risk of malnutrition and nutritional status in various populations, especially in critically ill and hospitalized adult patients.

A cross-sectional comparative study found that NRS 2002 had the highest positive screening rate compared to different assessment tools for patients in ICUs. (44) Research conducted in Vietnam likewise indicated that the NRS 2002 was a valid and reliable instrument with a sensitivity and specificity of 80.3% and 79.8%, making it feasible for clinicians to use for nutrition screening in hospitals with limited resources. (46) Another prospective study that compared the use of different nutritional screening tools for critically ill veterans found that NRS (87.8%) had the highest sensitivity while NUTRIC (92.1%) had the highest specificity. (47,48)

The Nutritional Risk in Critically Ill Score – NUTRIC score has been shown to be more accurate than the NRS 2002 in some situations (49) and in other settings, it was discovered to have a weak correlation with objective measures of nutritional status, NRS-2002 had the highest positive screening rate and was thus suitable for individuals with mild illnesses. (44) In terms of clinical practice in the intensive care unit, NUTRIC and NRS 2002 did not perform similarly, according to study data. (18) It has been determined, however, that among the four nutritional assessment instruments used in another retrospective cohort analysis, NRS is the most useful method for detecting severe malnutrition in critically ill patients, with the highest sensitivity (79.1%), specificity (94.8%), and greater PPV and NPV suggesting NUTRIC scored lowest overall in diagnosing severe malnutrition in an ICU setting. (50)

A literature review by Pinho et al., and several other studies suggest that the 2002 NRS is a good predictor of clinical outcomes in hospitalized patients, especially concerning the length of stay and death including increased economic cost; in different settings. (45,51–58) Higher NRS ratings have been linked to unfavorable patient outcomes such as higher morbidity and mortality. (59)

In comparison to several other instruments, NRS 2002 has been shown to be an effective, suitable, and practical indicator for predicting clinical outcomes. It was discovered to be a strong predictor of death and longer duration of stay. (27,28,42)

Fatemeh et al., (60) found that Length of stay in the ICU and mortality were higher in those with NRS scores ≥ 5 followed by the group with NRS scores ≥ 3 and < 5. It has also been found to be associated with complications during their hospital stay. In line with these findings, Chen et al. found that, per a 1-point increase in the NRS score, there was an associated 30% higher risk of Non–Ventilator Hospital Acquired Pneumonia. (61)

The NRS-2002 high-risk cut-off point suggested for the ICU context has been linked to poor clinical outcomes and is a predictor of ICU death, despite the fact that NRS-2002 was not created for ICU patients. (28,62) It has also been found to be a reliable and effective risk score for mortality linked to malnutrition and unfavorable outcomes over a 180-day period. (43)

mNUTRIC and NRS-2002 were found to outperform other instruments in predicting clinical outcomes in critically sick patients as other techniques overestimated the risk of malnutrition in the ICU and were unable to accurately predict clinical outcomes. (63) According to some studies, NRS 2002 was found to predict ICU mortality better than the mNUTRIC score (64,65) while another study concludes that both scores were significant independent risk and predictive indicators. (66) The in-hospital mortality risk for patients with a high nutritional risk based on the NRS-2002 score (score ≥5) was twofold greater as opposed to the threefold greater risk based on the mNUTRIC score (score ≥5), according to a Turkish study. (67) Nevertheless, NRS-2002 is the 'alternative instrument' recommended for use as a nutritional risk and prognosis indicator of critically sick patients when mNUTRIC cannot be used. (28)

Stello et al. propose using NRS 2002 ratings in ICU situations since it has the highest predictive validity. (68) Most studies indicate NRS to be an effective and practical technique for identifying malnutrition risk and predicting prognostic values in people who are critically ill.

2.4 FULL NUTRITIONAL ASSESSMENT

The Full Nutritional Assessment is an instrument that examines the nutritional status of patients using both anthropometric and biochemical parameters including BMI, Triceps skin fold, Mid-arm muscle circumference, history of unintentional weight loss of more than 5% within the preceding month or 10% or more within the previous 6 months (69), albumin, pre-albumin, and transferrin levels. (17,69–72) These parameters are accepted as nutritional status indicators as they are associated with malnutrition and clinical results as well as duration of hospitalization and mortality. (70,71)

When at least three of the seven indicators fall below reference levels, patients will be classified as malnourished. Malnutrition has been defined using the same set of three parameters under reference level in situations where specific parameters cannot be measured. (70,71)

The use of FNA without the pre-albumin level calls its validity into skepticism. The FNA will be calculated using the same thresholds and point systems as previously defined, with the exception of the pre-albumin level. As a result, the FNA score will be measured on a scale of 6 rather than 7.

The absence of pre-albumin level is not expected to have a significant impact on the nutritional assessment validity of the FNA score. This is reinforced by studies that demonstrate that serum protein markers, notably albumin, and pre-albumin levels, reflect the acute phase response rather than an accurate depiction of nutritional status in the ICU context.(29,73) A systematic review study indicated that serum visceral protein levels should not be used to guide nutritional therapy for some groups of individuals who are nutrient-deprived but otherwise healthy. (74,75) These visceral protein levels do not reflect a patient's nutritional state, as FNA seeks to accomplish, but may be useful as a component of nutrition risk screening. (16)

In addition to this, serum pre-albumin level is not one of the FNA parameters that contribute the most to the diagnosis of malnutrition. According to THORSDOTTIR et al.,(72) of the seven parameters used in FNA, serum albumin level, total lymphocyte count, triceps skinfold thickness, and body mass index were found to have the highest sensitivity (exceeding 0.5) and negative predictive values, and to contribute most to the diagnosis of malnutrition. Serum albumin (44%) and total lymphocyte count (50%) exhibited higher misclassification rates than TSF and BMI (18% and 21%, respectively).

2.5 USE OF ALTERNATIVE MEASUREMENTS – MUAC AS AN ALTERNATIVE FOR BMI

In cases where weight and height are found to be not feasible to measure due to clinical reasons, which is usually the case for ICU patients, Mid Upper Arm Circumference (MUAC) will be used as an alternative measure. Based on several studies, a close relationship has been found between BMI and MUAC as indices of undernutrition for adult patients suggesting the possibility of the use of MUAC as an alternative screening tool. (76–81) Similar studies conducted on South African and East African adult populations (81,82) also indicate the statistically significant relationship between MUAC and BMI in detecting malnutrition or malnutrition risk. Although the studies suggest different cut points in close ranges, Kondrup et al (21) indicate that MUAC of < 25 cm may correspond to a BMI < 20.5 Kg/m^2. Thus, a MUAC value of < 25 cm will be used as an alternative to BMI < 20.5 Kg/m^2 for patients whose BMI is difficult to measure due to clinical reasons since MUAC has the advantage of being measurable in many more patients than weight and height.

3. CONCEPTUAL FRAMEWORK

Even though a conceptual framework is not typically used in validation studies, this is included here to provide a summary of the context and help explain the theoretical basis for the need for a screening tool being validated.

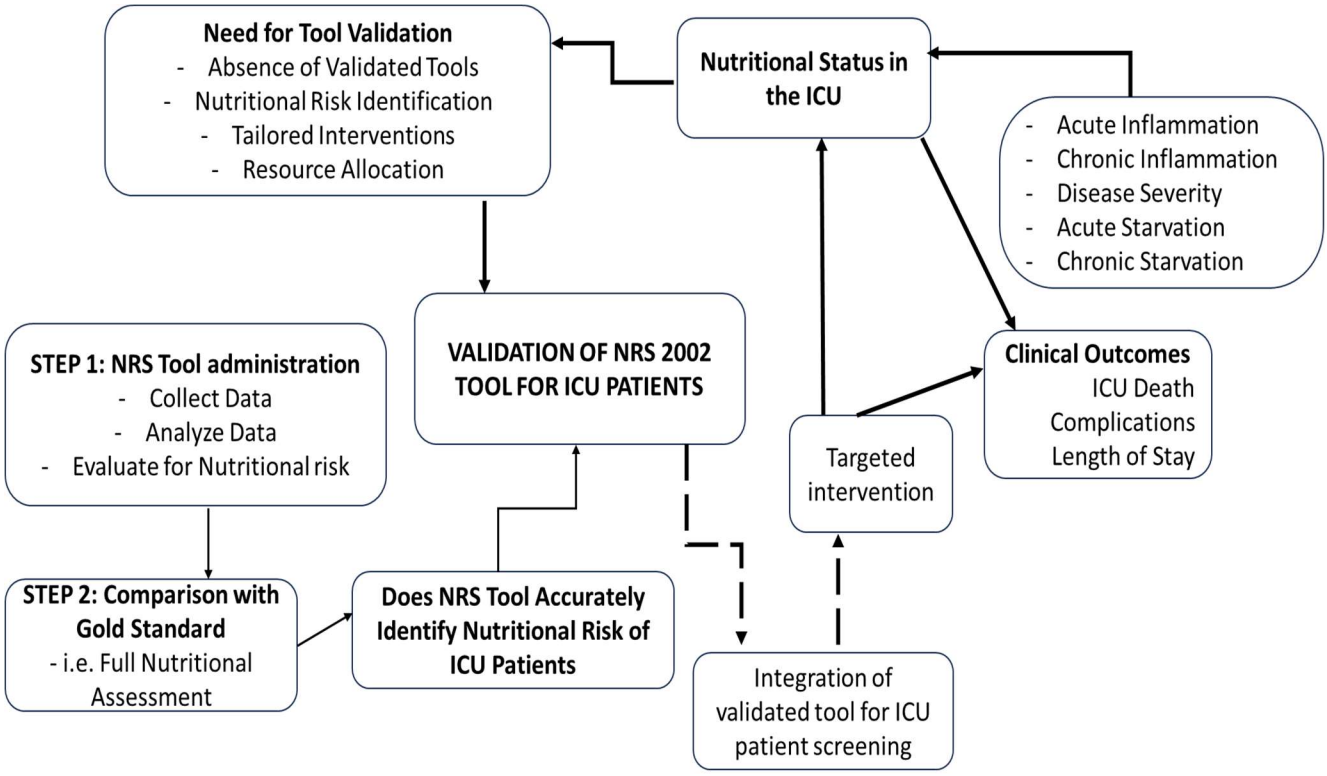

FIGURE 1: Summarizing the need for a validated nutrition screening tool, its implementation strategy, and expected outcomes – developed based on different literature.

4. OBJECTIVES

GENERAL OBJECTIVE

- To assess the validity and predictive performance of the nutritional risk screening tool – NRS 2002, in identifying patients at risk of malnutrition and predicting clinical outcomes among adult patients admitted to Intensive Care Units of public hospitals in Addis Ababa, Ethiopia in 2024 GC

SPECIFIC OBJECTIVES

- To determine the validity of the nutritional risk screening tool – NRS 2002 in identifying critically ill adult patients at risk of malnutrition in hospitals of Addis Ababa, Ethiopia in 2024 GC

- To evaluate the predictive performance of the nutritional risk screening tool – NRS 2002 in predicting clinical outcomes among critically ill adult patients admitted to public hospitals in Addis Ababa, Ethiopia in 2024 GC

5. METHODS AND MATERIALS

5.1 STUDY SETTING

This study was conducted in Addis Ababa, Ethiopia in Intensive Care Units under selected referral hospitals. In Ethiopia, there are now 53 Intensive Care Units and 23 more are under development, with an approximate bed capacity of 620 beds, the majority of which are General ICUs. (22)

Addis Ababa, the nation's capital, has a population of 5.461 million people. (82) In this city, there are 11 public hospitals with ICUs, each with at least one. Nine of these are referral hospitals, with seven of them linked with a medical school. In the 11 public hospitals, there are 15 intensive care units. (83) The annual patient capacity in the intensive care units (ICUs) of these public hospitals ranges from 127 to 480.

The data collection period was March 12 to May 20, 2024

5.2 STUDY DESIGN

This study was a facility-based prospective cohort study. The test tool, the NRS 2002, was compared with criterion instrument (FNA) scores in a concurrent validation study.

5.3 STUDY POPULATION

SOURCE POPULATION: All patients aged ≥18 years admitted to Intensive Care Units of hospitals located in Addis Ababa

STUDY POPULATION: Patients aged ≥18 years who are admitted to the selected hospitals' Intensive Care Unit during the study period.

ELIGIBILITY CRITERIAS

Adult patients i.e. 18 years or older; who were admitted to the Intensive Care Unit were considered eligible for the study given that they were able to communicate or have attendants who could give consent and medical history. Patients already admitted to the ICU by the start of data collection

were found to be eligible only if they were within 48 hours of admission; In accordance to ESPEN guideline. (14)

Consequently, patients without means of communication, including attendants, those below the age of 18 years, and those who were admitted to the ICU more than 48 hours ago were excluded from the study.

5.4 SAMPLE SIZE DETERMINATION

For validity

Optimum sample size was estimated separately for sensitivity, specificity, and area under the curve using Buderer's formula. (84–86)

FORMULA:

For sensitivity:

$$n = \frac{Z^2_{\frac{\alpha}{2}}\, SN(1-SN)}{\in^2 Prev} \quad \ldots\ldots \text{ Formula 1}$$

For specificity

$$n = \frac{Z^2_{\frac{\alpha}{2}}\, SP(1-S\ )}{\in^2 (1-Pre\ )} \quad \ldots\ldots\ldots\ldots \text{ Formula 2}$$

Where:

n – required sample size

$Z^2_{\frac{\alpha}{2}}$ – a standard normal value at α and confidence level

SN – sensitivity SP – sensitivity

∈ – absolute precision desired of sensitivity or specificity

Prev. – prevalence of malnutrition among critically ill patients

In Malawi, research revealed that moderate-to-severe malnutrition affected 62% of patients admitted to critical care units. (8) We used this value to estimate sample size as the populations are found to be comparable. According to Haldun Akoglu (2022), the determination of sensitivity and specificity values might be based on clinical judgment or already published data. (87) The sensitivity and specificity of the NRS tool were estimated to be 74.6 and 80.6, respectively, based on a study that compared nutritional screening tools—the NUTRIC score, SGA, and NRS 2002 – against two diagnostic criteria for malnutrition that were suggested by ESPEN and ASPEN to assess malnutrition in critically ill patients. (50) A 10% desired precision was employed to allow for a higher level of statistical power and to account for data variability as it helps ensure that the

sample size is adequate to detect differences within the data. These values will be used for this study's sample size estimation.

ASSUMPTIONS:

- $Z_{\alpha/2}$ is a standard normal value at α level of 5% and 95% confidence level,
- 10 % desired precision
- SN – 79.1 %; SP – 94.8 % (50)
- Prevalence of malnutrition in critically ill patients – 62% (8)

Based on these assumptions calculated Sample Size

- For sensitivity: $n = \frac{Z_{\frac{\alpha}{2}}^2 SN(1-SN)}{\epsilon^2 Prev} = \frac{(1.96^2)(0.79)(1-0.79)}{(0.1^2)(0.62)} = 102.79 = 103$
-
- For specificity: $n = \frac{Z_{\frac{\alpha}{2}}^2 SP(1-SP)}{\epsilon^2 (1-Pre)} = \frac{(1.96^2)(0.95)(1-0.95)}{(0.1^2)(1-0.62)} = 49.83 = 50$

For predictive performance

The sample size for estimating the diagnostic accuracy 86) of NRS 2002 was estimated using the calculation as follows, using the binomial-based variance of the area under the curve (AUC), equal sample size (n1=n2), and the assumptions, 95% confidence interval, with α level of 5%, and 0.07 being the required precision on either side of the AUC.

$$\frac{Z_{\alpha/2}^2 V(AUC)}{\epsilon^2} \quad \text{..... Formula 3}$$

Where:

- n is the minimum sample required,
- 2V(AUC) is the variance of the AUC calculated based on the formula
- V(AUC) = (0.0099) (e−α/2) (6α + 16)
- α = ϕ −1 (AUC) X 1:414 and ϕ−1 is the inverse of standard cumulative normal distribution
- α = ϕ −1 (0.70) X 1:414 = 0.741502

V(AUC) = (0.0099) ($e^{-0.741502}$) (6 × 0.7415022) + 16) = 0.145136

Substituting the above empirical evidence to the equation → $\frac{Z_{\alpha/2}^2 V(AUC)}{\epsilon^2} = 114$

In order to accurately determine the diagnostic accuracy of the test, the estimated sample size of becomes 114. According to Zaidi et al.; if sensitivity and specificity are equally important for the

study, the sample size shall be determined for both sensitivity and specificity, and diagnostic accuracy separately and the final sample size of the study would be the larger of these. (84)

In this case, it will be 114. Adding a 10% nonresponse rate to the bigger sample size, a total of 126 patients admitted to the ICU will be required.

5.5 SAMPLING METHOD

Two tertiary-level hospitals, i.e., Saint Paul's Hospital Millennium Medical College (SPHMMC) and Tikur Anbessa Specialized Hospital (TASH) were purposively selected for inclusion in this study due to their high patient flow and heterogeneity in patient diagnoses.

A total sample size of 126 was used for the study and it was proportionally allocated to each ICU center of selected hospitals.

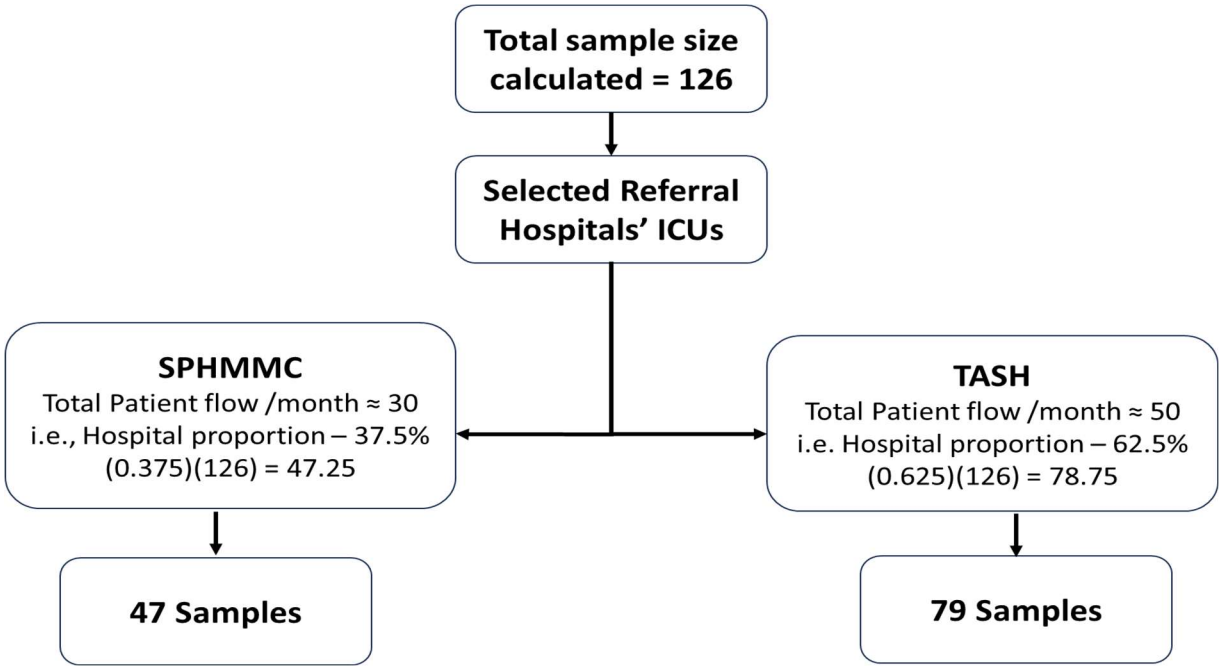

Figure 2: Schematic representation of sample allocation of sample size (n=126) to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

All eligible patients admitted to selected hospitals' ICUs within the study period were included in the study until the predetermined sample size was met.

5.6 STUDY VARIABLES

The test variable of this study was the NRS 2002 score.

Whereas the index variable was the gold standard FNA Score.

5.7 DATA COLLECTION METHOD

Data were collected by four data collectors prospectively from patients during their ICU stay. Data collection was conducted from March 12 to May 20. It was a 2-month prospective cohort study. Patients were followed starting from within 48 hours of admission to the ICU until discharge/transfer or death, whichever occurred first within the study period. The NRS 2002 tool and FNA were administered to all patients within 48 hours of admission to the ICU. Data was collected through interviews of the patients/ attendants, physical examination, and laboratory investigations. This was done through a structured questionnaire, through the KOBO data collection tool, prepared to assess important variables which was initially prepared in English and later translated to a local language, Amharic. The Questionnaire assesses socio-demographics, anthropometric, biochemical, clinical, and outcome data incorporating components of both NRS 2002 and FNA. To avoid repetition, components common to both tools were assessed only once.

Anthropometric data was taken through the use of calibrated instruments. In cases where weight and height were not feasible to measure due to clinical reasons, which is usually the case for ICU patients, Mid Upper Arm Circumference (MUAC) was used as an alternative measure. Triceps skin-fold was measured using a skinfold caliper following standard procedure.

Trained phlebotomists drew 4 milliliters of blood into each of two different blood collection tubes to measure albumin and lymphocyte count/ CBC. The investigation was carried out at the hospitals' laboratories and reference values of these laboratories were used. Following the completion of the blood sample analyses for these tests, samples were discarded. Pre-albumin level, which is originally part of the FNA, was not assessed for this study as it is almost entirely unavailable in the country.

5.8 OPERATIONAL DEFINITIONS

- NRS 2002 classification: Patients are scored in each of the two components i.e. undernutrition and disease severity, according to whether they are absent, moderate, or severe, giving a total score of 0–6. For those aged 70 years and greater, a score of one will be added to correct for the elderly. Patients with a total score of > 3 are classified as nutritionally at risk, with NRS > 3 to < 5 being a moderate risk of malnutrition, and NRS ≥ 5 being a severe risk of malnutrition. (21)
- In determining percent weight loss
  - Estimated weight loss of 5 % corresponds to a small or minimal change of cloth tightness which will be identified as 'slightly looser'
  - Estimated weight loss of 10 % corresponds to a noticeable or moderate change of cloth tightness which will be identified as 'moderately looser'
  - Estimated weight loss of > 10 % corresponds to a substantial or considerable change of cloth tightness which will be identified as 'significantly looser'
- To assess the sub-component 'food intake decrement' - A decrease in the size of plates/ portion size or frequency of meal or both
  - by half or less – corresponds to 50 - 75 % of the normal requirement
  - by more than half – corresponds to 25 - 60 % of the normal requirement
  - to a very small amount/ few 'gurshas' throughout the day – corresponds to 0 - 25 % of the normal requirement

- FNA classification: Patients are defined as malnourished when at least three of the six parameters are below reference values. (70)
- Outcome: In this case, it is defined as clinical outcomes during the ICU stay – including death, disease complication, and prolonged length of stay in the ICU.
- Length of stay: was determined from the date of ICU admission to the date of discharge, transfer, or death; and is stated in days.
- Adult patients – Adult patients are patients who are 18 years of age or older.

5.9 DATA QUALITY MANAGEMENT

There were four data collectors. They were experienced General Practitioners selected and trained by the principal investigator. They were given a two-day thorough training on the general and specific objectives of the study, data collection techniques, how to properly administer the assessment tools, and the standard way of measuring weight, height, MUAC, and TSF. The data collectors were clinicians who had previous anthropometric data collection experience. Two data collectors were assigned at each ICU to ensure standard practice of anthropometric measurement and minimize error. There has been ongoing supervision during the data collection process including visits to the data collection sites to oversee the process. Measurement pieces of equipment were calibrated every morning during the data collection time. A structured questionnaire including the full NRS 2002 tool, FNA components, and other important variables has been used to collect data. This tool has first been prepared in English and translated into a local language, Amharic. Part of the questionnaire has been pretested on 5% of samples on similar study subjects for the standardization of the study tool in the Ethiopian context.

Data Cleaning: Data was first cleaned manually, checked & cleaned for consistency and any missing values.

5.10 DATA ANALYSIS

After data were exported from the KOBO toolbox into an Excel sheet, SPSS version 27 was used to code and analyze the data. The results have been summarized and descriptive statistics have been used to assess the frequency and percentages of the study variables. The results from FNA were considered the gold standard and the results from NRS the test tool.

As a measure of the reliability of the NRS 2002, Cronbach's α has been used to compute homogeneity. A Cronbach's α value of 0.60, 0.70, and 0.80 were considered acceptable, adequate, and good, respectively. (87) Sensitivity, specificity, Negative and Positive predictive values, and Receiver Operating Characteristic (ROC) of NRS 2002 have been computed. Multiple binary logistic regression was used to evaluate the predictive performance of NRS – 2002. This statistical technique allowed for the evaluation of the relationships between NRS scores and the likelihood of specific clinical outcomes while accounting for potential confounding variables. A p-value below 5% has been used to declare the statistical significance level. Multiple logistic regression analysis has been used to analyze the prediction performance of various NRS scores for different clinical outcomes.

The NRS score results were divided into three subgroups. These subgroups are i.e., NRS ≤ 3 – no risk of malnutrition, NRS > 3 to < 5 – moderate risk of malnutrition, and NRS ≥ 5 – severe risk of malnutrition. The selected outcomes for which NRS Scores' predictive value were computed include in–ICU mortality, prolonged length of ICU stay, and disease complication.

For the purpose of this study, 10 days of ICU stay was used as the cut-point to identify prolonged length of stay. This is based on studies that have found 10 days to be the point of illness-shifting to chronic critical illness resulting in poor outcomes.

For BMI the participants whose weight and height were assessable, BMI was calculated using these measurements. For the cases where this was not clinically possible, BMI was estimated using MUAC.

5.11 ETHICAL CONSIDERATION

The study was conducted in accordance with the Helsinki Declaration and local ethical guidelines. Ethical clearance was obtained from the Research Ethics Committee of the School of Public Health, Addis Ababa University – AAU. A formal letter obtained from AAU was used for communication with the various hospital officers. In-depth information about the objectives of the study and the procedures and tests to be conducted has been provided. Informed written consent has been obtained from all patients or their legal representatives prior to study participation. (Annex 4,5) Participants or their legal representatives were informed that their participation is on a voluntarism basis only and consent could be withdrawn at any time without facing any consequence or harm. Patient confidentiality has been maintained throughout the study, and all data is stored securely and anonymously. To guarantee that no harm was done throughout this investigation, extensive precautions have been put in place. Patients who were determined to be "at risk" of malnutrition during the trial period were identified and notified to the responsible physicians and nurses for nutritional intervention. The blood samples collected and transported to the hospital's laboratory were discarded following the completion of the analyses.

5.12 DISSEMINATION OF RESULTS

Following the study's completion, the thesis report will be delivered to the Department of Nutrition at Addis Ababa University's School of Public Health, College of Health Science. The findings will also be published in peer-reviewed scholarly journals specializing in critical care, nutrition, and healthcare. This is to reach a broad number of health professionals, researchers, and policymakers. There is a plan to present the study results at relevant professional conferences linked to critical care, nutrition, and healthcare quality improvement if the opportunity arises.

6. RESULT

The response rate of this study was 96.8% as 122 of the total 126 eligible patients admitted to the Intensive Care Units of SPHMMC and TASH have participated.

6.1 SOCIODEMOGRAPHIC CHARACTERISTICS

The majority (54.1%) of the 122 study subjects were male. The participants' age ranges from 18 years old (the minimum age of eligibility) to 80 years old, with a median age of 45 years. To aid with the NRS scoring, the age was grouped into 2 sets; under 70 years old and 70 years and older. 45.9% of the study participants were from Addis Ababa, and another 45.9% of them were from Oromia Region with the remaining being from several different parts of the country. 11.5% of the study participants could not read and write while the remaining 88.5% had an education of different levels. 36.1% of the study participants are unemployed, 31.1% are employed and 11.5% are students. The sociodemographic characteristics of the study participants are summarized in Table 1.

TABLE 1: Socio-demographic characteristics of the study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethio**pia, 2024**

VARIABLES	FREQUENCY	PERCENT
Gender		
Male	66	54.1
Female	56	45.9
Age		
> 70 years	4	3.3
< 70 years	118	96.7
Marital status		
Divorced	2	1.6
Married	63	51..6
Single	40	32.8
Unknown	1	0.8
Widowed	16	13.1
Region of Residence		
Addis Ababa	56	45.9
Afar	1	0.8
Amhara	5	4.1
Dire Dawa	1	0.8
Gambella	1	0.8
Harrari	1	0.8
Oromia	56	45.9
Somali	1	0.8

Highest level of education		
Able to read and write	16	13.1
Diploma	6	4.9
Primary level (1-8)	19	15.6
Secondary level (9-12)	32	26.2
Technical/ Vocational	6	4.9
Unable to read and write	14	11.5
University graduate or postgraduate degree	26	21.3
Unknown	3	2.5
Employment Status		
Employed	38	31.1
Other	1	0.8
Private	20	16.4
Student	19	15.6
Unemployed	44	36.1

6.2 ADMISSION RELATED CHARACTERISTICS

6.2.1 Admission characteristics

Transfer from the emergency OPD comprised the majority of admissions (71.3%) while 5.5% were direct admissions to the ICU from triage. The remaining 23% were transferred from other wards. Other than the emergency ward, most of the ward transfers were from the surgical ward (12.3%), followed by the cardiac (8%), GynObs (4.1%), and Medical (3.3%) wards. Refer to Table 2 for a summarized overview of admission characteristics of the study participants.

The duration of stay prior to ICU admission ranges from 0 to 12 days, with a mean duration of 1.2 days. 40.2% of patients were transferred to the ICU after 1 day of stay in their previous respective wards while 36.1% were transferred on the day of their admission.

90.2% (110) of the admitted patients had no history of previous admission to the ICU.

6.2.2 Admission diagnoses

Respiratory disease was part of the admission diagnosis of 40.2% of the patients, followed by cardiovascular (14.8%) and neurological (16.4%) diseases. 31.1% and 35.2% of the patients had infection and sepsis respectively as part of their diagnosis. 37.7% (46) of the patients had a history of chronic Illness. Table 2 outlines the admission diagnoses of the study participants.

6.2.3 Current Intervention

Depending on their different diagnosis, the study participants were receiving several kinds of interventions as part of their management in the ICUs. These interventions include Fluid

resuscitation (75.4%), Antibiotics (68.9%), Mechanical Ventilation (52.5%), Nutrition therapy (57.4%), Other medications (13.1%), and Different surgical procedures (11.5%). The current interventions the study participants were receiving are presented in Table 2.

TABLE 2: Admission-related characteristics of the study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

VARIABLE	*FREQUENCY*	*PERCENT*
ADMISSION TYPE		
Direct admission to the ICU	7	5.7
Transferred from Emergency ward	87	71.3
Transferred from other wards	28	23
ADMISSION DIAGNOSIS		
Cardiovascular disease	18	14.8
Respiratory disease	49	40.2
Metabolic disease	6	4.9
Gastrointestinal disease	17	13.9
Genitourinary disease	15	12.3
Neurological disease	20	16.4
Musculoskeletal disease	4	3.3
Hematologic disease	9	7.4
Trauma	2	1.6
Other	10	8.2
Infection as part of the diagnosis	38	31.1
Sepsis as part of the diagnosis	43	35.2
History of chronic illness	46	37.7
CURRENT INTERVENTION		
Mechanical Ventilation	64	52.5
Nutrition therapy	70	57.4
Fluid resuscitation	92	75.4
Antibiotics	84	68.9
Other medications	16	13.1
Surgical procedures	14	11.5

Footnote: More than one component of admission diagnosis and current intervention are found in a single study subject

6.3 ANTHROPOMETRIC MEASUREMENTS

Due to clinical reasons, Weight and Height were not assessed in 63.9% (78) patients. For the remaining 36.1% of patients whose weight and height were able to be measured, weight ranges from 41 to 89 kg. 3.3% of patients have lost > 5% of their body weight within the past 1 month.

MUAC measurements range from 11 – 31 cm. 39.28% of the female participants had a MUAC level of < 22.9 cm while 57.6% of the male participants had a MUAC level of < 23.6 cm. BMI calculated using weight and height measurement was used for the 44 patients whose measurements could be taken and BMI estimated using MUAC was used for the participants whose weight and height measurements could not be taken. Table 3 summarizes anthropometric measurements of the study participants.

For the participants whose weight could be measured, both BMI calculated using weight and BMI estimated using MUAC measurements were calculated and Chi-square analysis was done resulting in a Pearson's Chi-square value of 29.622 ($p<0.001$; $df=4$).

TABLE 3: Summary of Anthropometric measurements of the study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

WEIGHT	
MINIMUM	41 Kg
MAXIMUM	89 Kg
HEIGHT	
MINIMUM	152 cm
MAXIMUM	184 cm
MUAC	
MINIMUM	11 cm
MAXIMUM	31 cm
TSF	
MINIMUM	10 mm
MAXIMUM	32 mm

6.4 MALNUTRITION

According to FNA results, 19.7% of the patients were malnourished while the remaining 80.3% were identified as not malnourished.

Whereas NRS identified 44.3% of the admitted patients to be at risk for malnutrition while the remaining 55.7% were classified as 'not at risk' group. When graded in terms of severity, 16.4% of the at-risk group had a moderate risk of malnutrition and 27.9% had a severe risk of malnutrition. Figure 3 displays the NRS score grading of the study participants.

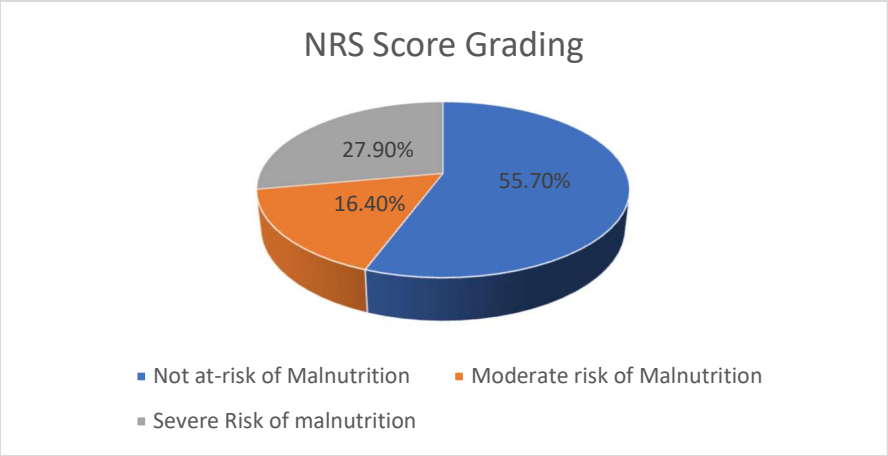

FIGURE 3: Magnitude of malnutrition risk according to NRS 2002 among the study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

When stratified by gender, female patients comprised 50% of the malnourished patients according to FNA and 44.45% of the nutritionally at-risk patients according to the NRS score. Patients above the age of 70 years comprised 4.2% and 7.4% of the malnourished patients according to FNA and the nutritionally at-risk patients according to NRS respectively.

6.5 OUTCOMES

Different spectrums of outcomes were documented during the data collection process from March 12 to May 20, as displayed in Figure 4.

Refer to Figure 6 for a graphical representation of the prevalence of selected patient outcomes.

Within the study period, 27% (33) of the study participants died during their ICU stay. Refer to Figure 4. The mean duration of stay at the ICU prior to death was 9.12 days. 14.8% of the deaths happened within the first 4 days of admission. 3 main immediate causes of death were identified. Namely, Septic shock (18.8%), Cardiorespiratory failure (12.02%), and Multiorgan failure (6.06%).

30.3% (37) of participants were discharged home from the ICU within the study period. Refer to Figure 4. The mean length of stay prior to discharge from the ICU was 8 days.

29.5% of the study participants were transferred from the ICU during the study period. Refer to Figure 4. Of the 36 who had been transferred, 94.4 % (34) were to another ward within the hospital, and the remaining 5.9 % (2) were referrals to other health institutes for better care.

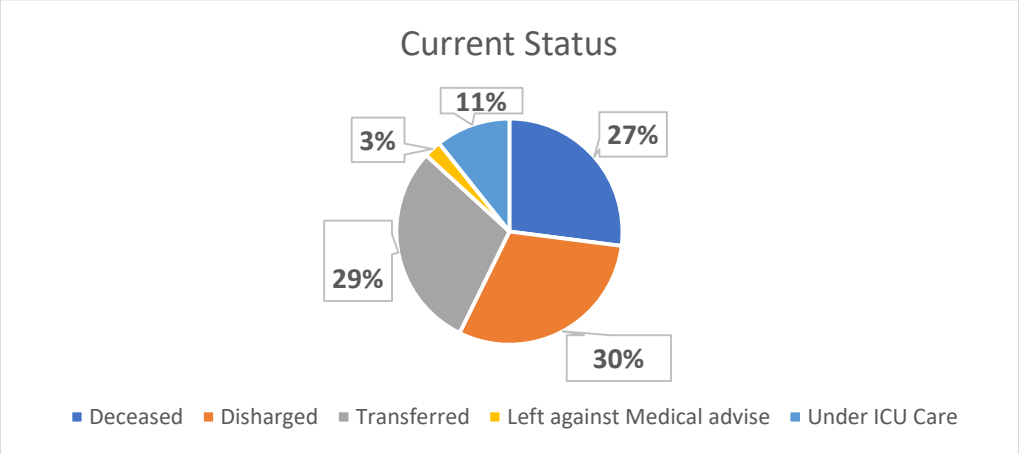

FIGURE 4: Clinical outcomes of study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

22.1 % of patients had developed complications during their ICU stay. The spectrum of complications is illustrated in Figure 5.

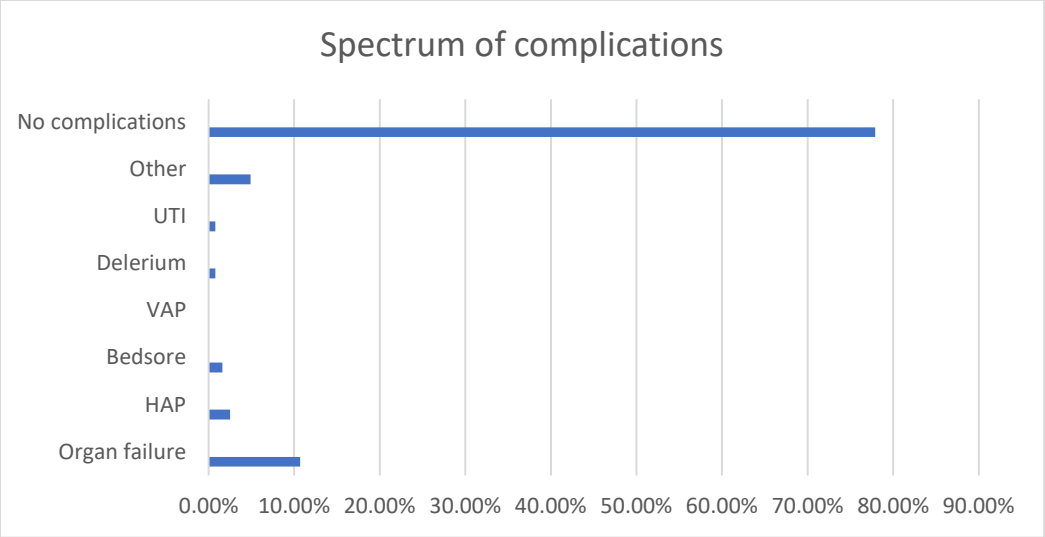

FIGURE 5: Spectrum of complications outcomes among study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

KEY: HAP: Hospital Acquired Pneumonia; VAP: Ventilator Associated Pneumonia; UTI: Urinary Tract Infection

The total length of ICU stay ranges from 1 day to 40 days, with a mean stay of 7.18 days. Using the 10-day cut-point, 17.2% (21) participants had a prolonged duration of stay at the ICU. This Is summarized in Table 4.

TABLE 4: Total Length of ICU stay characteristics of the study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

TOTAL LENGTH OF ICU STAY	
Minimum	1 day
Maximum	40 days
Mean	7.18 days
Median	5 days
Stayed longer than 10 days	COUNT – 21
	PERCENT – 17.2%

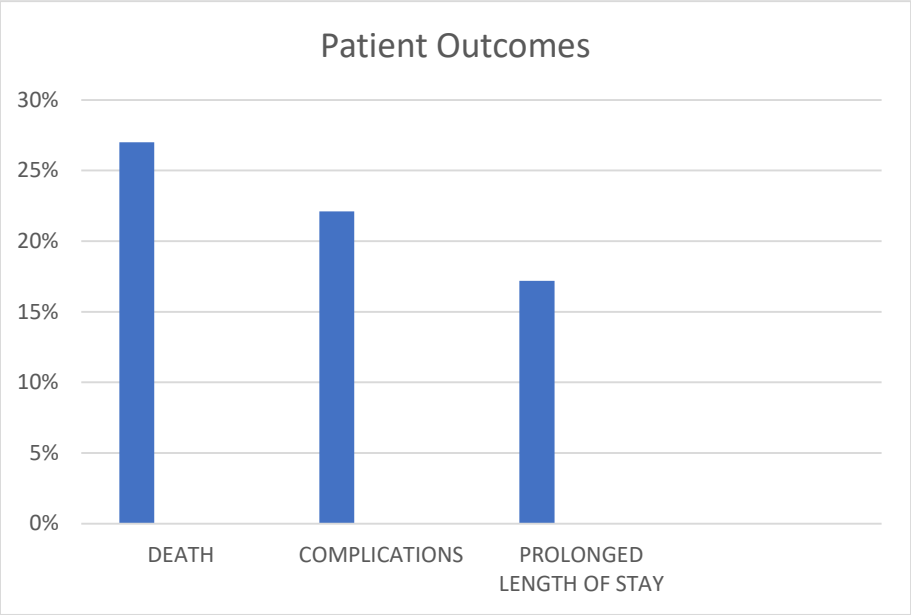

FIGURE 6: Prevalence of selected patient outcomes among study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

Of the malnourished patients according to FNA, within the study period, 37.5 % were deceased, 29.1 % were discharged home, 8.33 % were Transferred, 25 % were under ICU care and 16.67% of the malnourished patients stayed for 10 or more days in the ICU.

Of the nutritionally at-risk patients according to the NRS score, within the study period, 29.62% were deceased, 35.18% were discharged home, 1.85% left against medical advice, 22.2% were transferred, 11.12% were under ICU care, and 20% stayed for 10 or more days in the ICU. Table 5 summarizes these characteristics and outcomes of the study participants that were ‘malnourished’ and ‘at risk of malnutrition’.

TABLE 5: Prevalence of malnutrition and its characteristics according to Full Nutritional Assessment (FNA) and Nutritional Risk Screening (NRS) Score for the study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024;

VARIABLES	**Malnourished According to FNA**		**Malnourished According to NRS**	
	COUNT	**PERCENT**	**COUNT**	**PERCENT**
SEX				
MALE	12	50%	24	44.5%
FEMALE	12	50%	30	55.5%
AGE				
Age < 70	1	4.16%	50	92.6%
Age > 70	23	95.83%	4	7.4%
OUTCOME				
Deceased	9	37.5%	16	29.62%
Discharged Home	7	29.1%	19	35.18%
Left against medical advice	0	0	1	1.85%
Transferred	2	8.33%	12	22.2%
Under ICU Care	6	25%	6	11.12%
LENGTH OF STAY				
Longer than 10 days	4	16.67%	9	16.7%

6.6 RELIABILITY AND CONCURRENT VALIDITY OF NRS - 2002

Cronbach's alpha coefficient was used to analyze the internal consistency of the NRS tool and found an overall consistency of $\alpha = 0.868$. Inter-item correlation findings show that the impaired nutrition score had the highest correlation to the final NRS score (0.992), while the age score had the lowest correlation (0.178). Omitting the impaired nutrition score dropped the reliability of the tool to 0.757. Age score had a negative correlation with food intake decrement score. Refer Table 6 for inter-item correlation findings.

TABLE 6: Cronbach's Alpha coefficient of NRS 2002 study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

Cronbach`s Alpha = 0.868		
	Corrected Item-Total Correlation	Cronbach`s Alpha if Item deleted
Age Score	0.067	0.926
BMI Score	0.864	0.793
Food Intake Decrement Score	0.537	0.875
NRS Score	0.971	0.758
Impaired Nutrition Score	0.973	0.757

Using FNA as the gold standard, the concurrent validity of NRS was computed. It was found to have a 95.8% sensitivity, 68.4% specificity, a positive predictive value of 42.6%, and a negative predictive value of 98.5%. These results are depicted in Table 7.

TABLE 7: Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value of NRS 2002 compared to FNA among study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

TOOL	**Sensitivity**	**Specificity**	**Positive Predictive Value**	**Negative Predictive Value**
NRS 2002	95.8%	68.4%	42.6%	98.5%

To figure the overall performance of the model, Area Under the curve was computed resulting in a value of 0.997 (95% CI: 0.99, 1) with a standard error of 0.003 and 0.00 asymptotic sig. This is illustrated in Figure 7.

Youden Index was calculated to identify the optimal threshold that maximizes the sum of sensitivity and specificity. A 3.5 cut-off point was identified as the optimal threshold as it corresponds to the point on the ROC curve where the Youden index is maximized, as this would maximize the overall accuracy of the NRS -2002 tool. The coordinates of the Receiver Operating Curve of NRS 2002 and Youden Index are displayed in Table 8.

TABLE 8: Coordinates of the Receiver Operating Curve of NRS 2002 and Youden Index among study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

Positive if Greater than or equal to	*Sensitivity*	*1 - specificity*	*Youden's Index*
2.00	1.000	1.000	0
3.50	1.000	0.015	0.985
4.50	0.963	0.015	0.948
5.50	0.630	0.000	0.63
6.50	0.037	0.000	0.037
8	0.000	0.000	0

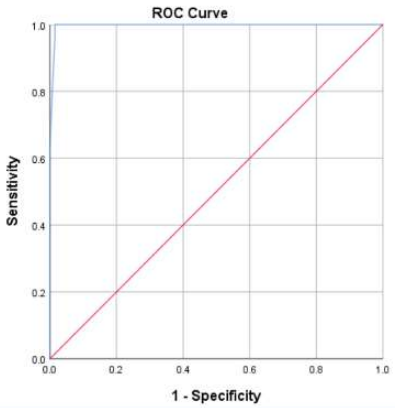

FIGURE 7: Receiver Operating Curve of NRS 2002 showing the graphical representation of the binary classification model among study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024;

X-axis: False Positive Rate (FPR) and Y-axis: True Positive Rate (TPR) or Sensitivity

6.7 PREDICTIVE PERFORMANCE OF NRS 2002

Adjusted for nutritional therapy, binary multiple regression was used to determine the predictive performance of NRS scores on the likelihood of selected outcomes; i.e. Death, prolonged length of stay, and complication, and the Adjusted Odds Ratio was found to be 2.206 (95% CI: 1.496, 3.251; $p< 0.05$), 1.17 (95% CI: 0.821, 1.668; $p > 0.05$), and 1.874 (95% CI: 1.265, 2.776; $p< 0.05$) respectively for each. The logistic regression analysis also revealed an overall percentage of 77%, 82.8%, and 75.4% for death, prolonged length of stay, and complications respectively. Other statistical details, such as model fit indices, were also obtained. The results of the regression analysis are depicted in Table 9.

TABLE 9: Predictive performance of NRS 2002 on selected outcome variables, adjusted for confounders, using logistic regression for association for study participants (n=122) admitted to the Intensive Care Units of SPHMMC and TASH, Addis Ababa, Ethiopia, 2024

OUTCOME VARIABLES	AOR	p-value	95% CI		Cox and Snell R^2	Nagelkerke R^2
			Lower Value	Upper Value		
Death	2.206	0.00	1.496	3.251	0.176	0.255
Complication	1.874	0.02	1.265	2.776	0.152	0.233
Prolonged length of stay	1.17	0.385	0.821	1.668	0.08	0.013

7. DISCUSSION

This study aimed to evaluate the malnutrition risk identification capacity and outcome-predictive performance of the NRS 2002 tool for patients admitted to the ICU. The traditional screening tools being used in hospitals to identify malnutrition are not ideal for ICU use. (10,18) A facility-based study was done in 2 of the largest tertiary hospitals in Ethiopia to study the concurrent validity of the NRS tool using the FNA score as the gold standard. The predictive performance of the NRS 2002 tool was also assessed for the likelihood of selected outcomes; i.e. Death, prolonged length of stay, and complication.

Of the patients admitted to the ICU, 19.7% were found to be malnourished according to FNA, and 44.3% were identified to be at risk of malnutrition according to the NRS 2002. Using FNA as the gold standard, the validity of NRS was found to have a 95.8% sensitivity, 68.4% specificity, a positive predictive value of 42.6%, and a negative predictive value of 98.5%. Cronbach's alpha coefficient was used to analyze the internal consistency of the NRS tool and found an overall consistency of $\alpha = 0.868$. 22.1 % of patients had developed complications, 17.2% had a prolonged duration of stay, and 27% of the study participants died within the study period during their ICU stay. The odds ratios indicating the predictive performance of the NRS tool were 2.206 ($p < 0.005$) for death, 1.17 ($p > 0.05$) for prolonged length of stay, and 1.874 ($p < 0.05$) for complications.

The majority, 55.7%, and the remaining 44.3% of the admitted patients were found to be 'not at-risk of malnutrition' and 'at-risk of malnutrition' respectively based on the NRS tool. This prevalence of malnutrition (44.3%) is lower than the findings of studies that state it to be as high as 64% in Sub-Saharan countries and 62% of patients in Malawi but is higher than the 22% prevalence reports from a Rwandan study. (9) It is consistent with works of global literature whose findings indicate a prevalence of 13 – 78% and 38 – 78% of malnutrition among patients admitted to critical care. (2,4,5,7–9) These variations in results can be explained by the inconsistent definitions of malnutrition throughout studies, variances in nutrition screening instruments, and specific study methodologies used i.e. study designs and different screening tools. BMI, Controlling Nutritional Status, Adductor Pollicis Muscle Thickness, Malnutrition Screening Tool, NUTRIC, mNUTRIC, NRS 2002, and SGA are among the different malnutrition screening tools used.

The homogeneity analysis found a Cronbach's alpha = 0.868 indicating good internal consistency. (87) All the items, with the exception of age score, resulted in a drop of Cronbach's alpha if they were to be removed from the list of the screening tool. The impaired nutrition score had the highest correlation to the final NRS score (0.992), while the age score had the lowest correlation (0.178). Omitting the impaired nutrition score dropped the reliability of the tool to 0.757, while the Age score resulted in a Cronbach alpha increment to 0.926 from 0.868 if it were to be removed. The negative correlation between age score and food intake decrement score suggests they are measuring different unrelated concepts. This might be explained by the fact that only 3.3% of the study subjects were above the age of 70.

The sensitivity and specificity of this screening tool, 95.8%, and 68.4% respectively, suggest that out of all the patients who are truly at risk of malnutrition, the NRS tool correctly identifies 95.8% of them, and correctly identifies the patients who are not at risk of malnutrition 68.4% of the time. The disparity between the sensitivity and specificity of the tool can be explained by the inverse relationship between the two.(88) The high sensitivity implies its efficiency as a screening tool, whereas a high specificity is expected from follow-up confirmatory tests. The PPV and NPV were 42.6% and 98.5% respectively, indicating that among the positive/at-risk results, 42.6% are actual positive cases, and among the negative/ 'not at-risk' results, 98.5% are true 'not at-risk' results.

These findings indicate that the NRS tool has a high ability to accurately rule out patients who are not at risk of malnutrition but may need further confirmatory assessments for those identified to be at risk of malnutrition as certain patients may be classified as at risk of malnutrition while being well-nourished - a high likelihood of false positives. NRS 2002 is found to have good discriminant accuracy according to Plante and Vance's criteria of 90% to 100% for sensitivity and/or specificity to be deemed "good" and 80% to 89% for sensitivity and/or specificity to be deemed "fair." (89) According to Power et al., a test must have a sum of sensitivity and specificity of at least 1.5 in order to be considered helpful, whereas Fynn et al. define an acceptable accuracy in practical application as an average of sensitivity and specificity above 75%. (90,91)

This study's findings indicate that the NRS 2002 tool is a valid tool to screen for nutritional risk among patients admitted to intensive care units (ICUs), with a 1.64 sum, and an 82.1 average of sensitivity and specificity, and a sensitivity of 95.8%.

This is similar to the findings of a prospective comparative study that found NRS to have high sensitivity (87.8 %) and low specificity; with PPV of 41.7% and NPV of 87.2%. (92) The sensitivity of the NRS tool in this study was higher than the findings of a Brazilian retrospective cohort study evaluating the performance of NRS 2002 (49) with a sensitivity of 79.1% and a study conducted in Vietnam with a sensitivity of 74.6% (93). On the other hand, the specificity (68.4%) and PPV (42.6%) are lower than the findings in the above-stated studies which were 80.6% and 94.8% respectively. The PPV computed in this study (42.6%) was lower than the PPV values (64.9%) of the Vietnam study and the NPV of this study (98.5%) was higher than the Vietnam study NPV (84.4%). The variations could be explained by differences in using gold standards and differences in disease spectrum.

The AUC is 0.997 ($p< 0.001$) indicating that the model has excellent discriminatory power with a standard error of 0.003 suggesting a precise and reliable estimate. The 3.5 cut-off point identified by the highest Youden Index maximizes the NRS's discriminatory power as it attains an optimal balance between sensitivity and specificity and results in an improvement in diagnostic accuracy.

The mortality prevalence in this finding is higher than the 18.2% ICU mortality prevalence reported by an international study and lower than Africa's ICU mortality rate which ranges from 32.9 to 54%, and the pooled Ethiopia's prevalence of adult intensive care unit mortality which was 39.70%. (94–99) A study states that all ICU-admitted patients had at least one problem during their stay. (100)

Our findings indicate a lower incidence of complications than a Rwandan study that found 59% of patients admitted to the ICU to experience complications.(101)

Low nutritional status and high nutritional risk are linked unfavorable outcomes. (36) A statistically significant relationship was found between the NRS Score and death and complications, with higher scores being associated with increased odds of these outcomes. The odds of developing complications increase 1.874 times for each unit increase in NRS score, adjusted for receiving nutritional therapy. Similarly, the odds of death occurrence increase 2.206 times for each unit increase in NRS score. The model was found to explain 15.2% – 23.3% of the variance in complications and 17.6% - 25.5% of the variance in death. The probability of having complications and death, or not was correctly predicted in 75.4% and 77% of cases respectively.

The significant association between NRS 2002 score and mortality based on this study is similar to other studies' findings that state NRS 2002 as an effective mortality predictor for patients admitted to ICUs. (27,28,57,64–66,102) Majari et al. found a 75 % increase (OR 1.75; 95% CI, 1.42–2.16; P < .001) in death probability for each unit increase in NRS score for critically ill patients (45) while Ahmadi et al. reported a 354% increase in the odds of death linked to each unit increase in score. (55) The strong association between ICU mortality and nutritional risk in the ICU is further supported by the significant relationship between NUTRIC score and mortality in the ICU. (103)

Several studies report a statistically significant association between NRS scores and prolonged length of stay (45,62,68) On the other hand, this study's results indicate that there is no statistically significant relationship between NRS score and the likelihood of a prolonged stay (AOR:1.17: 95% CI: 0.821, 1.668; p>0.05). Our findings are similar to a New Zealand study that showed no significant association between NRS 2002 and prolonged length of stay. (104) Likewise, among patients at nutrition risk, Maciel et al. (62) and Mohammadi et al. (56) did not find any changes in the length of stay in the intensive care unit or hospital. Variations in the study population and their clinical characteristics could be among the factors that contributed to the discrepancy. Most studies' study populations included general hospitalized patients in addition to critical patients. Other factors could be unaccounted confounding factors i.e., interventions other than nutritional therapy, differences in sample size, and statistical methodology used in different studies.

7.1 LIMITATIONS

Due to its unavailability in Ethiopia, serum pre-albumin level was not assessed as part of the FNA (Full Nutritional Assessment) questionnaire, and this might have compromised the gold standard and impacted the result interpretations. The possibility of its minimum significance impact is discussed in the literature review.

Baseline weight of patients, history of food intake reduction, and history of weight loss were recalled from memory with estimation and could contribute to recall bias. Attempts to remedy this limitation, operational definitions of food intake reduction and history of weight loss, were pretested and used to guide their responses.

The lack of appropriate weighing apparatus for patients admitted to the ICU has made it difficult to assess BMI. This issue was remedied by the use of alternate measures discussed in the methodology.

Among the study subjects, only 3.3% were above the age of 70 and this might have contributed to the negative inter-item correlation test of NRS's age score.

8. CONCLUSION AND RECOMMENDATION

8.1 CONCLUSION

The NRS 2002 tool is a reliable and valid nutritional screening method. With high sensitivity and an acceptable level of specificity, the NRS 2002 screening tool was found to be highly sensitive to be used as a screening tool for patients admitted to the ICU since a screening test ought be be highly sensitive .It measures similar underlying constructs and has good internal consistency. The already established cutoff points can predict the nutritional status of patients admitted to the ICU and a 3.5 cut-off point identified by the highest Youden Index maximizes the NRS's discriminatory power improving in diagnostic accuracy. It is also a significant predictor of death and complications during their ICU stay. Higher NRS scores are associated with an increased likelihood of death and complications.

8.2 RECOMMENDATION

Healthcare policy makers and clinicians in ICU facilities should integrate the use of validated nutritional screening instruments in a consistent manner to enhance comprehensive patient care. Healthcare professionals should be trained on the importance of early identification of malnutrition risk, the proper utilization of the validated screening tool, and the customization of nutritional treatments according to individual risk.

It is recommended that health care providers administer nutrition risk screening tools in emergency rooms as findings indicate that the majority of patients admitted to ICUs are transferred from emergency departments.

With the expertise of hospital administration and Digital health team, the NRS screening tool may be integrated into the Electronic Medical Records system, in ICUs where the system is in use, such as the ICUs of the 2 selected hospitals, so that it can automatically determine the risk of malnutrition based on the data there.

Furthermore, researchers can investigate additional pathways for future research drawing on this study's findings and limitations. For instance, Validating Cronbach's alpha results will require more research with a more evenly distributed age group sample. Following that, the cut-off point of the Age score could be reset, for Ethiopia's setting, to a different value that can assess a similar construct with the rest of the NRS components. A different "disease severity assessment" criteria that apply to Ethiopia's ICU setup and can distinguish the severity of critical illness could also be investigated and set to improve the tool's predicted performance. As some of the components of the "food intake impairment" score are subjective, a standardized quantifier that will be used across all ICUs should be set.

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10.ANNEXES

ANNEX 1: ASSURANCE OF PRINCIPAL INVESTIGATOR

I, the undersigned agree to accept all responsibilities for the scientific and ethical conduct of the research project. I will provide a timely progress report to my advisor and seek the necessary advice and approval from my primary advisors in the course of the research. I will communicate timely to my advisors all stakeholders involved in the study including any source of funding for this research.

Name of the student: _____

Date: _____

Signature: _____

Approval of the primary Advisor

Name of the primary advisor: _____

Date: _____

Signature: _____

ANNEX 2: NRS 2002 TOOL

2.1 NRS INITIAL SCREENING

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?		

KEY:

If the answer is 'YES' to any of the questions, proceed to the Final screening table.

If the answer is 'NO' to all questions, re-screen the patient at weekly intervals.

2.2 NRS FINAL SCREENING

FINAL SCREENING			
IMPAIRED NUTRITIONAL STATUS		SEVERITY OF DISEASE	
ABSENT (SCORE 0)	Normal Nutritional Status	ABSENT (SCORE 0)	None
MILD (SCORE 1)	Wt. loss > 5% in 3 months Or Food intake below 50-75% of normal requirement in the preceding week	MILD (SCORE 1)	**Mild stress metabolism** Patient is mobile Increased protein requirement can be covered with oral nutrition Hip fracture, chronic disease especially with complications e.g., liver cirrhosis, COPD, diabetes, cancer, chronic hemodialysis
MODERATE (SCORE 2)	Wt. loss > 5% in 2 months Or BMI 18.5 – 20.5 Or Food intake below 50-25 – 60 % of normal requirement in the preceding week	MODERATE (SCORE 2)	**Moderate stress metabolism** Patient is bedridden due to illness Highly increased protein requirement, may be covered with Oral Nutritional Support Stroke, hematologic cancer, severe pneumonia, extended abdominal surgery
SEVERE (SCORE 3)	Wt. loss > 5% in 1 month Or Wt. loss > 15% in 3 months Or BMI < 18.5 AND reduced General Condition Or Food intake below 0-25% of normal requirement in the preceding week	SEVERE (SCORE 3)	**Severe stress metabolism** Patient is critically ill (intensive care unit) Very strongly increased protein requirement can only be achieved with (par)enteral nutrition APACHE-II >10, bone marrow transplantation, head traumas
TOTAL SCORE (A)		TOTAL SCORE (B)	

AGE: <70 years: 0 pt ≥70 years: 1 pt

TOTAL NRS SCORE = (A) + (B) + Age

≥3 points: the patient is at nutritional risk.

SOURCE: (23,105)

ANNEX 3: FULL NUTRITIONAL ASSESSMENT

	REFERENCE VALUES
Albumin level	3.5 – 5.5 g/dL
Total lymphocyte count	1000 – 4000 / mm^3
BMI	18.5 - 24.9 kg/m^2
TSF	M: >12.8 mm F: >19.3 mm
Mid -Arm Muscle circumference	M: >23.6 cm F: >22.9 cm
Unintentional weight loss in the preceding month	< 5 %

Patients will be defined as malnourished when at least three of the seven parameters are below reference values

SOURCE: (70,71)

ANNEX 4: INFORMATION SHEET - ENGLISH

Questionnaire number: _____

INFORMATION SHEET

Study on the validation and predictive performance of the NRS-2002 tool for patients admitted to the ICUs in Addis Ababa, Ethiopia:

This is a study being conducted on validation and predictive performance of the NRS-2002 tool for patients admitted to the ICUs in Addis Ababa, Ethiopia. It is a study being conducted in multiple hospitals in Addis Ababa on patients admitted to ICU. The purpose of this study is to validate the use of a simple nutrition assessment tool for patients admitted to the ICU of Ethiopia in order to detect the risk of malnutrition and intervene with the aim of improving outcomes.

The Addis Ababa University Ethical Clearance committee has granted authorization to carry out this study.

You are selected to be part of this study because you have been admitted to one of the Intensive Care Units of the selected hospitals for this research during the study period and fulfill the study's eligibility criteria. Your participation in this study is based solely on your willingness to participate. You have the right to not take part and once you begin the interview, you can withdraw at any time without facing any consequences or harm. There will be no repercussions for your decision to participate or not. Your name or any other personally identifying information will not be recorded or used. The questionnaires will be securely stored and coded anonymously for analysis. Should it be determined at the conclusion of the interview that you are at risk for malnourishment, you will be linked to the responsible physicians and nurses for further intervention and follow-up.

If you consent to participate in this research, you will be measured for height and weight, have a blood sample taken to assess lymphocytes and serum albumin level and answer interview questions. Trained phlebotomists will collect 4 ml of blood sample in each of two blood collection tubes; which will be transported to the hospital's laboratory where they will be analyzed and will then be discarded afterwards.

The overall time burden of this study is estimated to be 20 minutes.

ANNEX 5: CONSENT FORM - ENGLISH

CONSENT FORM

Based on the information provided above, are you willing to be part of the study?

[__] YES [__] NO

If no, can you please provide a reason for refusal?

_____

Respondent

Signature: _____

Data collector:

Name: _____

Signature: _____

Date: _____

Hospital: _____

Data collection completeness – PLEASE TICK IN THE BOX

Refused	
Complete response	
Incomplete response	

If need arises, feel free to communicate with the primary investigator.

Contact Information:

Dr. Sihawe Derese

+251912010682

sihawederese@gmail.com

ANNEX 6: QUESTIONNAIRE - ENGLISH

QUESTIONNAIRE

1. SOCIODEMOGRAPHIC DATA

Age: _____ (in complete years)
Sex:
[___] Male
[___] Female
Marital status?
[___] Single
[___] Married
[___] Divorced
[___] Widowed
[___] Other:
Specify - _____

Region of residence?
[___] Addis Ababa
[___] Oromia Region
[___] Dire Dawa
[___] Harrari Region
[___] Tigray Region
[___] Amhara Region
[___] Sidama Region
[___] Afar Region
[___] Somali Region
[___] Benshangul – Gumuz Region
[___] Central Ethiopian Regional State
[___] Gambella Region
[___] South Ethiopian Regional State
[___] South West Ethiopia People's Region

Highest level of Educational completed
[___] Unable to read and write
[___] Able to read and write
[___] Primary level (1-8)
[___] Secondary level (9-12)
[___] Technical/Vocational
[___] Diploma
[___] University graduate or postgraduate degree
Occupation
[___] Student
[___] Employed
[___] Private
Specify: _____

[__] Unemployed
[__] Other
Specify: _____

Religion
[__] Protestant
[__] Muslim
[__] Orthodox
[__] Catholic
[__] Other
specify: _____

2. ANTHROPOMETRIC DATA

Current weight (in kilogram): _____

Baseline weight (in kilogram): _____

Height (in centimeters): _____

Mid arm circumference (in centimeters): _____

Triceps skin fold (TSF) thickness (in centimeters): _____

3. BIOCHEMICAL DATA

Serum albumin level: _____

Total White Blood Cell count: _____

Serum % lymphocyte count: _____

4. BASELINE CLINICAL DATA

Date of admission: _____

Number of days post Admission (DOA): _____

Admission Type
[__] Transferred from the emergency ward
[__] Transferred from other wards
Specify: _____
[__] Direct admission to the ICU
Duration of stay at the hospital prior to ICU admission (in days): _____

- Admission diagnosis (select)
[__] Cardiovascular
[__] Respiratory

[__] Metabolic
[__] Gastrointestinal
[__] Genitourinary
[__] Neurology
[__] Musculoskeletal
[__] Hematology
[__] Trauma
[__] Others
Specify: _____

- Full admission diagnosis
  _____
  _____

- GCS - _____ (In number)

- Edema
  [__] YES
  If yes, Grade of edema: _____
  [__] NO

- Was infection part of the clinical diagnosis at the time of admission?

  [__] YES

  [__] NO

- Was Sepsis part of the the clinical diagnosis at the time of admission?

  [__] YES

  [__] NO

- Is there previous history of ICU admission?

  [__] YES

  [__] NO

- Do you have a history of chronic illnesses?

  [__] YES
  If yes, specify diagnosis: _____
  specify medication: _____

  [__] NO

- Current intervention being administered at the ICU
  [__] Mechanical ventilation
  [__] Nutrition therapy
  [__] Enteral
  [__] Parenteral

[__] Fluid resuscitation
[__] Antibiotics
[__] Surgical procedure
If yes, specify – type of surgery: _____
number of days post surgery: _____

[__] Other medications?
Specify: _____

- Was there unintended weight loss anytime within the past three months

[__] NO
[__] YES
If yes, does your clothing feel like it fits loose?

[__] NO
[__] YES

I. If yes, was it
[__] Slightly looser (small or minimal change)

[__] Moderately looser (noticeable or moderate change)

[__] Significantly looser (substantial or considerable change)

II. If yes, when did you notice this happen?
[__] in the past one month

[__] in the past 2 months

[__] in the past 3 months

- Was there a reduction in dietary intake i.e. size of plates/ portion size or frequency of meal or both within the last week?

[__] NO
[__] YES

- If yes, did the food intake (portion size / frequency)
[__] Decrease by by half or less
[__] Decrease by more than half
[__] Decrease to a very small amount (only having few small 'gurshas' throughout the day)

5. OUTCOME DATA
Complication
[__] None
[__] Urinary tract infection
[__] Delirium
[__] Organ failure
[__] Hospital-acquired pneumonia
[__] Ventilator-related pneumonia

[__] Bedsore
[__] Esophageal fistula
[__] Other
Specify: _____

[__] Discharged home

Date of discharge: _____
Day of discharge post admission: _____

[__] Discharged with improvement
[__] discharged without improvement

[__] Transferred to another ward

[__] Deceased
Date of death: _____
Day of Death post admission: _____
Immediate cause of death: _____
_____

[__] Referred
Specify the reason for referral: _____

[__] Left against medical advice?

[__] Under care in the ICU

ANNEX 7: INFORMATION SHEET - AMHARIC

የመረጃ ቅፅ

በአዲስ አበባ፣ ኢትዮጵያ ውስጥ የአይሲዩዎች ታካሚዎች የNRS-2002 መሣሪያ ማረጋገጫ እና ትንበያ አፈጻጸም ላይ ጥናት፡-

ይህ በአዲስ አበባ፣ ኢትዮጵያ ውስጥ ወደ አይሲዩዎች ለሚገቡ ታካሚዎች የNRS-2002 መሣሪያን በማረጋገጥ እና በመተንበይ አፈጻጸም ላይ እየተካሄደ ያለ ጥናት ነው። በአዲስ አበባ በሚገኙ በርካታ ሆስፒታሎች በአይሲዩ የተያዙ ህሙማን ላይ እየተደረገ ያለ ጥናት ነው። የዚህ ጥናት አላማ በኢትዮጵያ አይሲዩ ለታካሚዎች ቀላል መመርመሪያ መሳሪያ በመጠቀም የተመጣጠነ ምግብ እጥረትን አደጋ ለመለየት እና ውጤቱን ማሻሻል ነው።

ይህንን ጥናት ለማካሄድ የአዲስ አበባ ዩኒቨርሲቲ የሥነ ምግባር ኮሚቴ ፈቃድ ሰጥቷል ።

እርስዎ የዚህ ጥናት አካል እንዲሆኑ የተመረጡት በጥናቱ ወቅት ለዚህ ጥናት ከተመረጡት ሆስፒታሎች አይሲዩ ክፍል ውስጥ ስለገቡ እና የጥናቱ የብቁነት መስፈርት ስላሟሉ ነው። በዚህ ጥናት ውስጥ ያለዎት ተሳትፎ ባሎት ፍላጎት ላይ ብቻ የተመሰረተ ነው። ያለመሳተፍ መብት ያሎት ሲሆን አንዴ ቃለ መጠይቁን ከጀመሩ በኋላም በማንኛውም ጊዜ ማቋረጥ ይችላሉ። ይህን በማድረግዎም ምንም አይነት አሉታዊ ተጽዕኖ አይከተሎትም። ለመሳተፍ ወይም ላለመሳተፍ ውሳኔዎ ምንም ችግር አይኖረውም ። የእርስዎ ስም ወይም ሌላ ማንኛውም የግል መለያ መረጃ አይመዘገብም ወይም ጥቅም ላይ አይውልም። መጠይቆቹ ድህንነት በተጠበቀ ቦታ ይከማቻሉ። መጠይቆቹን ለመተንተን ኮድ እንጠቀማለን ።

በቃለ መጠይቁ መደምደሚያ ላይ ለተመጣጠነ ምግብ እጦት ስጋት እንዳለዎት ከተረጋገጠ ለቀጣይ ጣልቃገብነት እና ክትትል ከሚመለከታቸው ሐኪሞች እና ነርሶች ጋር ይገናኛሉ ።

በዚህ ጥናት ላይ ለመሳተፍ ከተስማሙ ቁመት እና ክብደት ይለካሉ፣ የነጭ የደም ሴል መጠን እና የደም አልቡሚን መጠንን ለመገምገም የደም ናሙና ይወሰዳል። 4 ml የደም ናሙና በሰለጠኑ ፍሌቦቶሚስቶች በእያንዳንዱ በሁለት የተለያዩ የደም መሰብሰቢያ ትቦዎች ይሰበሰባሉ። የተሰበሰበው የደም ናሙና ምርመራው ከተጠናቀቀ በኋላ ይወገዳሉ። ሌሎች የቃለ መጠይቅ ጥያቄዎችንም ይመልሳሉ።

ይህ ጥናት አጠቃላይ የሚወስደው ጊዜ 20 ደቂቃ እንደሚሆን ይገመታል።

ANNEX 8: CONSENT FORM - AMHARIC

የመጠይቅ ቁጥር: _____

የፍቃድ ፎርም

ከላይ በቀረበው መረጃ መሰረት የጥናቱ አካል ለመሆን ፍቃደኛ ኖት?

[____] አዎ

[____] አይ

ፈቃደኛ ካልሆኑ፣ እባክዎን ምክንያት ይግለጹ -

_____

ምላሽ ሰጪ

ፊርማ፡ _____

መረጃ ሰብሳቢ፡-

ስም፡ _____

ፊርማ፡ _____

ቀን፡- _____

ሆስፒታል፡ _____

የመረጃ አሰባሰብ ምሉእነት - እባክዎን በሳጥኑ ውስጥ ምልክት ያድርጉ

ፈቃደኛ አይደሉም	
የተሟላ ምላሽ	
ያልተሟላ ምላሽ	

አስፈላጊ ከሆነ ከዋናው መርማሪ ጋር ለመገናኘት ነፃነት ይሰማዎ።

ዶ/ር ሲሃዌ ደረሰ

+251912010682

sihawederese@gmail.com

ANNEX 9: QUESTIONNAIRE - AMHARIC

መጠይቅ

1. መሰረታዊ እና የ ስነ-ህዝብ መረጃዎች

ዕድሜ፡ _____ (በሙሉ ዓመታት)

ጾታ

[___] ወንድ

[___] ሴት

የጋብቻ ሁኔታ?

[___] ያገባ/ች
[___] ያላገባ /ች
[___] የተፋታ/ች
[___] የሞተበት/ባት
[___] ሌላ:
ይግለጹ - _____

የመኖሪያ ክልል?

[___] አዲስ አበባ

[___] የኦሮሚያ ክልል

[___] ድሬዳዋ

[___] የሀረሪ ክልል

[___] የትግራይ ክልል

[___] የአማራ ክልል

[___] የሲዳማ ክልል

[___] የአፋር ክልል

[___] ሶማል ክልል

[___] ቤንሻንጉል - ጉሙዝ ክልል

[___] የማዕከላዊ ኢትዮጵያ ክልላዊ ግዛት

[___] ጋምቤላ ክልል

[___] የደቡብ ኢትዮጵያ ክልላዊ ግዛት

[___] የደቡብ ምዕራብ ኢትዮጵያ ህዝቦች ክልል

ከፍተኛ የትምህርት ደረጃ

[___] ማንበብ እና መጻፍ ማይችል

[___] ማንበብ እና መጻፍ የሚችል

[___] የመጀመሪያ ደረጃ (1-8)

[___] ሁለተኛ ደረጃ (9-12)

[___] ቴክኒክ/ሙያ

[___] ዲፕሎማ

[___] የዩኒቨርሲቲ ምሩቅ ወይም የድህረ ምረቃ ዲግሪ

ሥራ

[___] ተማሪ

[___] ተቀጣሪ

[___] የግል

ይግለጹ፡_____

[___] ሥራ የሌለው

[___] ሌላ

ይግለጹ፡_____

ሃይማኖት

[___] ፕሮቴስታንት

[___] ሙስሊም

[___] ኦርቶዶክስ

[___] ካቶሊክ

[___] ሌላ

ይግለጹ፡ _____

2. የሰውነት ልኬት መረጃ

የአሁኑ ክብደት (በኪሎግራም): _____

የመነሻ ክብደት (በኪሎግራም): _____

ቁመት (በሴንቲሜትር): _____

የመሃል ክንድ ዙሪያ (በሴንቲሜትር): _____

የትራይሴፕስ የቆዳ እጥፋት (TSF) ውፍረት (በሴንቲሜትር): _____

3. የደም ምርመራ መረጃ

የደም አልቡሚን መጠን - _____

አጠቃላይ የነጭ የደም ሕዋስ መጠን -_____

የደም % ሊምፎሳይተስ መጠን - _____

4. መሰረታዊ ክሊኒካዊ መረጃ

የገቡበት ቀን ፡- _____

ከገቡበት በኋላ ያለው የቀናት መጠን - _____

ወደ ICU የገቡበት ሁኔታ

[___] ከድንገተኛ ክፍል

[___] ከሌሎች ተኝተው የሚታከሙባቸው ክፍሎች

ይግለጹ፡ _____

[___] ወደ አይሲዩ በቀጥታ

አይሲዩ ከመግባቱ በፊት በሆስፒታል የተቆየበት ጊዜ (በቀናት)፡ _____

የመግቢያ ምርመራ (ምረጥ)

[___] የልብና የደም ሥር

[___] የመተንፈሻ አካላት

[___] ሜታቦሊክ

[___] የሆድ እና አንጀት

[___] የኩላሊት እና የሽንት ቱቦዎች

[___] የነርቭ

[___] የጡንቻ እና የአጥንት

[___] የደም እና ተዛማጅ

[___] የድንገተኛ አደጋ

[___] ሌሎች

ይግለጹ፡ _____

ሲገቡ የነበረው ሙሉ ምርመራ

_____

_____

የንቃተ ህሊና ደረጃ: _____

የሰውነት እብጠት

[___] አይ

[___] አዎ

አዎ ከሆነ፣ የ እብጠት ደረጃ፡ _____

- ኢንፌክሽን በሚገቡበት ጊዜ የክሊኒካዊ ምርመራው አካል ነበር?
  [___] አዎ

  [___] አይ

- ሴፕሲስ በመግቢያው ወቅት የክሊኒካዊ ምርመራው አካል ነበር?
  [___] አዎ

  [___] አይ

- ከዚህ ቀደም ወደ አይሲዩ ገብተዋል?
  [___] አዎ

  [___] አይ

- ሌሎች የቆዩ በሽታዎች አለቦት ?
  [___] አዎ

  አዎ ከሆነ፣ ምርመራውን ይግለጹ፡ _____

  መድሃኒት ይግለጹ፡- _____

  [___] አይ

- አሁን ያለው በICU ውስጥ እየተሰጠ ያለው ሕክምና
  [___] ሜካኒካል መተንፈሻ ማሽን

  [___] የአመጋገብ ሕክምና

  [___] በአፍ የሚሰጥ

  [___] በደም ስር የሚሰጥ

  [___] በደም ስር የሚሰጥ ፈሳሽ

  [___] አንቲባዮቲኮች

[___] የቀዶ ጥገና ሂደት

አዎ ከሆነ፣ ይግለጹ - የቀዶ ጥገና ዓይነት፡ _____

ከቀዶ ጥገናው በኋላ ያሉት ቀናት ብዛት: _____

[___] ሌሎች መድሃኒቶች?

ይግለጹ፡ _____

- ባለፉት ሶስት ወራት ውስጥ ያልታሰበ ክብደት መቀነስ ነበር?

[___] አይ

[___] አዎ

አዎ ከሆነ

አዎ ከሆነ፣ ልብሶት የሰፋዎት ሆኖ ይሰማዎታል?

[___] አይ

[___] አዎ

አዎ ከሆነ፣ ምን ያህል ነው የሰፋዎት

[___] ትንሽ ሰፍቷል

[___] በመጠኑ ሰፍቷል (የሚታወቅ ወይም መጠነኛ ለውጥ)

[___] በጣም ሰፍቷል

ይህን መቼ አስተዋሉ?

[___] ባለፈው አንድ ወር ውስጥ

[___] ባለፉት 2 ወራት ውስጥ

[___] ባለፉት 3 ወራት ውስጥ

- ባለፈው ሳምንት ውስጥ፤ የአመጋገብ መቀነስ ማለትም የምግብ መጠን ወይም የምግብ ድግግሞሽ ወይም ሁለቱም ቀንሷል?

[___] አይ
[___] አዎ

አዎ ከሆነ፣ አመጋገብዎ የምግብ መጠን / ድግግሞሽ) በምን ያህል ቀነሰ?

[___] በግማሽ ወይም ከዚያ ባነሰ ቀንሷል
[___] ከግማሽ በላይ ቀንሷል
[___] ወደ በጣም ትንሽ መጠን ቀንሷል (ቀኑን ሙሉ ጥቂት ትናንሽ 'ጉርሻዎች' ብቻ ነው የምወስደው)

5. የውጤት መረጃ

የምርመራ ውጤት ውስብስብነት

[___] ምንም

[___] የሽንት ቧንቧ ኢንፌክሽን

[___] ደሊሪየም

[___] የአካል ክፍሎች ውድቀት

[___] ከሆስፒታል የተገኘ የሳምባ ምች

[___] ከአየር መተንፈሻ ማሽን ጋር የተያያዘ የሳምባ ምች

[___] የሰውነት መቁሰል

[___] የጉሮሮ ፌስቱላ

[___] ሌላ

ይግለጹ፡ _____

[___] ወደቤት ተልከዋል

የተላኩበት ቀን፡- _____

ከገቡ በስንተኛው ቀን፡ _____

[___] በመሻሻል ተልከዋል

[___] ሳይሻሻል ተልከዋል

[___] ወደ ሌላ ክፍል ተዘዋውረዋል

[___] ሞተዋል

የሞቱበት ቀን፡- _____

ከገቡ በስንተኛው ቀን፡ _____

የሞት መንስኤ: _____

_____

[___] ወደ ሌላ የህክምና ጣቢያ ተልከዋል

ምክንያት ይግለጹ፡- _____

[___] ከህክምና ምክር ውጪ ለቀው ወጥተዋል

[___] በኢይሲዩ ውስጥ እንክብካቤ እየተደረገላቸው ነው