Original

Sensitivity of Malnutrition Screening Tool to Provide Individualized Nutrition Care for Surgical Patients by Dietitians

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ABSTRACT *Background and Purpose*: Malnourished surgical patients face elevated risks of complications, mortality, extended hospitalization, readmissions, and increased costs. Malnutrition screening is an important initial step to enable patient-centered individualized nutrition care. The study aimed to validate the Malnutrition Screening Tool (MST) in planned surgical procedures in Sri Lanka compared with a registered dietitian malnutrition assessment to support individualized nutrition care. This cross-sectional study, conducted at a private surgical hospital in Colombo, Sri Lanka, was part of a broader initiative to enhance healthcare quality and meet international accreditation standards. *Methods:* The sample size of 100 subjects was determined based on the prevalence of malnutrition, with sensitivity and specificity considerations. All patients admitted for planned invasive surgical procedures underwent malnutrition screening by the admitting medical officer using the MST. Within 48 hours of admission, enrolled patients were assessed, independent of MST score, for malnutrition by a Registered Dietitian using the 7-point Subjective Global Assessment (7PSGA) tool. *Results*: In comparison to the 7-Point Subjective Global Assessment (7PSGA), the Malnutrition Screening Tool (MST) demonstrated a sensitivity of 78.1% and specificity of 95.6%. The positive predictive value (PPV) was 89.3%, the negative predictive value (NPV) was 90.3%, and the receiver operating characteristic (ROC) area was 0.869, suggesting good agreement between MST and 7PSGA. *Conclusion*: These results suggest that the Malnutrition Screening Tool effectively identifies malnutrition risk in patients undergoing planned invasive surgical procedures, showing a high level of agreement with the 7PSGA tool. Implementing the validated Malnutrition Screening Tool (MST) in hospitalized surgical patients will support individualized nutrition care by dietitians.

Keywords: Malnutrition, Surgical patients, Screening tools, Individualized Nutrition Care

INTRODUCTION

Individualized nutrition care is a key aspect of a patient-centered quality health care delivery system. Individualized nutrition care is tailored to a patient's specific needs, preferences, and goals. It considers key pillars including what matters to patients, shared decision-making, evidence-informed multi-modal nutritional care, and monitoring outcomes (1). Malnutrition in hospitalized patients is common(2), and often a combination of cachexia (disease-related) and malnutrition (inadequate consumption of nutrients) as opposed to malnutrition alone (3). Malnutrition in surgery wards is prevalent. A study in Vietnam (n=679) found that 51.3% of patients admitted to the surgery ward were malnourished (4). Perioperative malnutrition is an independent predictor of poor postoperative outcomes. Malnourished patients have a higher risk of postoperative mortality, and morbidity, longer hospital stays, higher readmission rates, and elevated healthcare costs (5). Randomized trials have demonstrated that preoperative nutritional therapy reduces morbidity and surgical complications (6). Screening for malnutrition is the initial step in tailoring nutritional care, enabling early detection of individuals who are malnourished or at risk of malnutrition. This facilitates the application of the nutrition care process to those patients who are most likely to benefit.

Consequently, screening for malnutrition preoperatively is crucial to identify patients who will benefit from preoperative nutritional therapy

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and improve outcomes in malnourished individuals undergoing surgery (7).

A screening tool needs to be quick and simple, as they are most often administered by busy nursing staff, and must accurately identify patients at risk of malnutrition (8).There is no gold standard for nutritional screening and as such numerous nutritional screening tools are described in the literature. The most commonly used tools are the Malnutrition Universal Screening Tool, Nutritional Risk Screening 2002, and Malnutrition Screening Tool (9). Many of these tools are validated in specific populations and care contexts therefore, may not be appropriate to use in other clinical contexts. Before adopting a tool, clinicians should for which populations they were designed, and assess whether the tool aligns with the needs of their institution(10).

The Malnutrition Screening Tool (MST) is a simple, quick, valid, and reliable tool that can be used to identify patients at risk of malnutrition (11). MST has been validated for diverse patient populations, including hospitalized adults, the elderly, community-dwelling adults, cancer patients, and surgical patients [(12), (13), (14), (15). MST was originally validated against subjective global assessment (SGA), which is considered a gold standard for diagnosing malnutrition (16). Malnutrition screening tools need to be evaluated for reliability. Only the MST and the Malnutrition Universal Screening Tool (MUST) screening techniques have demonstrated reliability in acute and hospital-based ambulatory care settings (17). To the best of our knowledge, malnutrition screening using the MST is not routinely conducted in surgical patients preoperatively in public hospitals in Sri Lanka. To support the implementation of individualized nutrition care for surgical patients in Sri Lanka, this study aimed to assess the sensitivity of the MST in patients undergoing planned invasive surgical procedures in Sri Lanka, compared to a registered dietitian assessment of nutritional status.

MATERIALS AND METHODS

This cross-sectional study was undertaken at a private surgical hospital in Colombo, Sri Lanka. The study was conducted as part of a broader initiative to improve healthcare quality to meet international accreditation standards. Ethical approval was obtained from Wayamba University of Sri Lanka (application number 202011HI122).

From the 1st to the 7th of September 2023, all patients admitted for planned invasive surgical procedures were considered to participate in the study. Inclusion criteria were patients who underwent routine malnutrition screening using the MST by the admitting medical officer. The Malnutrition Screening Tool (MST) screening questions were in English but for patients who may not understand English, they were translated into local Sri Lankan languages Sinhala or Tamil. Exclusion criteria comprised terminally ill patients, psychiatric patients, lactating or pregnant mothers, individuals under 18 years old, and patients or accompanying individuals who were unable to recall their previous weight or had no documented previous weight in their medical records for the last six months, or could not have their weight measured. Patients who met the inclusion and exclusion criteria and provided informed consent were enrolled in the study. Patients who provided informed consent were assessed by a Sri Lankan Registered Dietitian within 48 hours of admission using the 7-point Subjective Global Assessment (7PSGA) nutrition assessment tool to diagnose malnutrition. This assessment was completed independent of the MST score. The 7PSGA was used because it better reflects time-sensitive changes to nutrition interventions than the SGA (18). The 7PSGA component scores were summed and the following cut-off scores were used to classify the severity of malnutrition: a score of 6-7 as “well-nourished”, a score of 3-5 as “mild to moderately malnourished” and a score of 1-2 as “severely malnourished”(19).

Patient characteristics including demographics, health and medical history, and number of co-morbidities, were obtained from medical records and case notes. Anthropometry measurements of weight and height were measured following the standard protocols and utilizing a “Charder” stand-on-floor scale (model MS 3450) available on the hospital ward. Body mass index (BMI) was calculated using weight and height data. The primary admission surgery type was categorized as per the NOMESCO Classification of Surgical Procedures(20) Comorbidities scores were calculated by the Charlson co-morbidity index (CCI).

The study sample size was determined using a published table derived from PASS software, considering a 50% prevalence of malnutrition, and specifying sensitivity and specificity between 0.5 to 0.8. The minimum required sample size was calculated to be 40 patients(21)

All statistical analyses were conducted using IBM SPSS software version 29.0 using data from eligible patients with complete datasets. To test the agreement between the Malnutrition Screening Tool (MST) and 7-point Subjective Global Assessment (7PSGA) tools, the scores of each tool were normalized by scaling the rating values between 0 and 1. Patients with a 7PSGA score ≤ 5

were classified as “malnourished” and those with a 7PSGA score ≥ 6 as “well-nourished”. Similarly, patients with an MST score of ≤ 1 were classified as “not at risk of malnutrition” and those with a score ≥2 as “at risk of malnutrition”. Reliability was evaluated using kappa values and sensitivity, specificity, positive and negative predictive values (PPV/NPV), and precision was calculated. Pearson’s regression was used to compare the likelihood of detecting a change between the 7PSGA and the MST. A receiver-operating characteristic curve (ROC) curve was used to determine whether the MST score predicts malnutrition based on the 7PSGA and the area under the curve (AUROC) was calculated. Results with a $p < 0.05$ were considered statistically significant.

Table 1: Baseline Characteristics of Study Population

Characteristics	Study Population (n=100) % or mean (range) or mean (SD)
Age (years)	62.4 (18 - 87)
Gender	
Male	70
Female	30
Employment Status	
Employed	52
Unemployed	48
Charlson co-morbidity index	1.76 (2.5)
Comorbidities	
Ischemic Heart Disease	31
Diabetes Mellitus	45
Chronic KidneyDisease	4
Cancer	26
Body mass index (Asian Cut offs) (kg/m^2)	
Underweight (<18.5)	5
Normal weight (18.522.9)	31
Overweight (23-26.9)	36
Obese (>27)	28

RESULTS

During the study period, there were 190 admissions. Of these, 100 patients consented to participate in the research. Among the 90 patients who were excluded, 40 older adults were unable to recall their weight. Table 1 describes the baseline characteristics of the study population. In this study, the mean age of participants was 62.4 years (SD 12.7), ranging from 18 to 87 years, and the majority (70%) were male. Additionally, 56% of the participants were over 60 years old, The mean (SD) CCI was 1.76 (2.5) and 24% of patients had another admission to the hospital within the previous two weeks. The majority of participants presented to undergo digestive tract (17%) or cardiothoracic (15%) surgeries. Table 2 summarizes the percentage of patients according to the NOMESCO surgery classification.

According to 7-point Subjective Global Assessment (7PSGA) most (68%) patients were classified as well-nourished (7PSGA score ≥6) and 32.0% of patients were classified as malnourished (7PSGA score ≤5), and the Malnutrition Screening Tool classified 28% of patients at risk of malnutrition (MST score ≥2) while 72 patients (72%) were classified as "not at risk of malnutrition" (MST score < 2). (Table 3).

Table 2: Percentage of patients according to NOMESCO surgery classification

Surgery Type	Study Population (n=100) (%)
Chest wall, pleura, mediastinum, diaphragm, trachea, bronchus and lung	5
Digestive system and spleen	17
Ear, nose, and larynx	1
Endocrine system	5
Enteral feeding procedures	5
Female genital organs	1
Heart and major thoracic vessels	15
Investigative procedures connected with surgery	15
Mammary gland	4
Minor surgical procedures	6
Musculoskeletal system	9
Peripheral vessels and lymphatic system	1
Procurement of organs or tissue for transplantation	1
Nervous system	1
Teeth, jaws, mouth, and pharynx	8
Urinary system, male genital organs, and retroperitoneal space	6

Table 3: Nutrition status according to 7PSGA and MST

		At Risk of Malnutrition > 2 score	Not at risk of Malnutrition <2 score	Total
			MST	
7PSGA	Severely Malnourished (1-2 ratings)	2	0	2
	Mild to Moderately Malnourished (3-5 ratings)	24	6	30
	Well Nourished (6-7 ratings)	2	66	68
	Total	28	72	100

Abbreviations: 7PSGA, 7 point subjective global assessment; MST, malnutrition screening tool

In the study, The MST accurately identified 25 of the 32 patients (78.1%) who were malnourished (true positive), and 65 of the 68 patients (95.6%) were correctly classified as well-nourished (true negative) In contrast, three patients (4.4%) of the 68 who were well nourished were classified as at risk of malnutrition (false positive) and 7 patients (21.9%) were classified as well nourished (false negative), despite being identified as malnourished using 7PSGA. When compared with 7PSGA, MST had a sensitivity of 78.1% and specificity of 95.6% with a positive predictive value of 89.3% a negative predictive value of 90.3%, and an ROC area of 0.869, indicating good agreement (Figure 1). Kappa statistics showed k=0.762, p<0.001 indicating good agreement between the MST and 7PSGA.

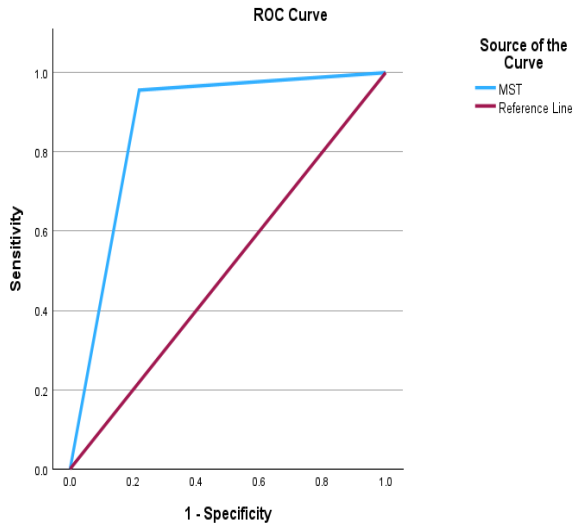

Figure 1: Receiver operator curve for identification of Malnutrition by the malnutrition screening tool.

AUROC =0.869

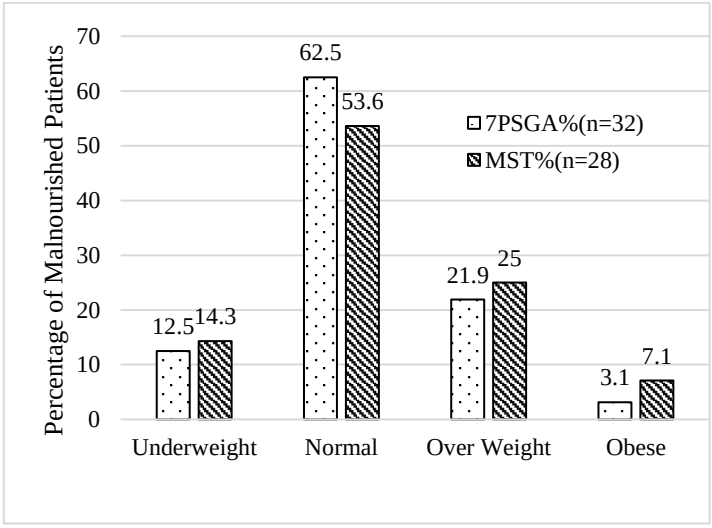

Figure 2: Percentage of Malnourished patients as per BMI category according to 7PSGA and MST

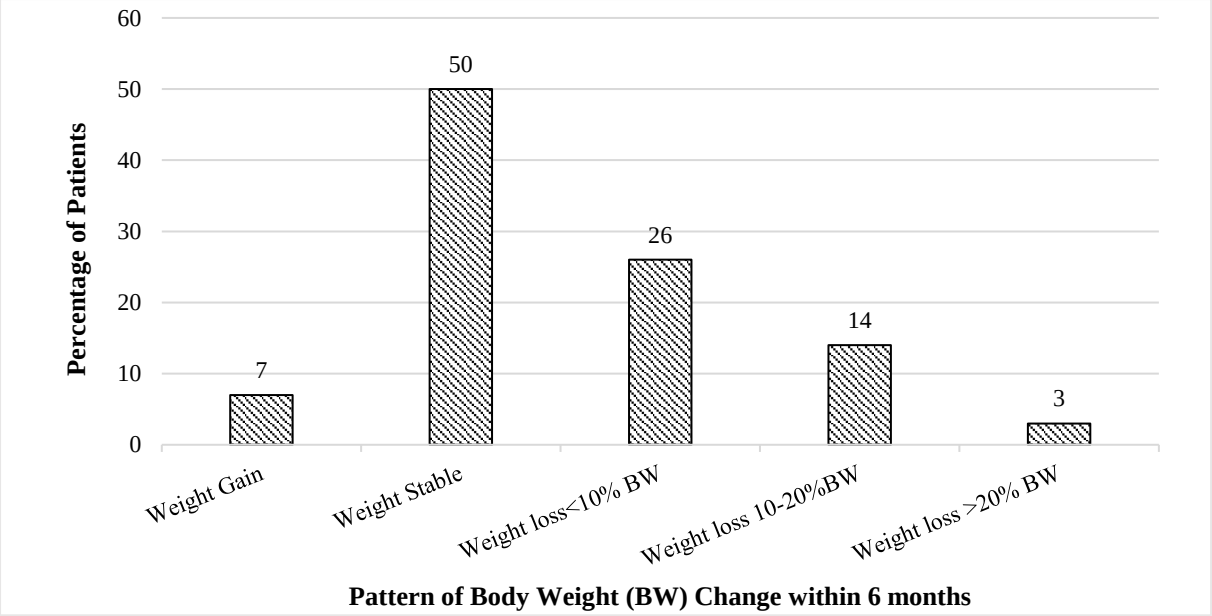

Figure 3: Reported weight change in the 6 months prior to hospital admission.

According to South Asian BMI cut-off values(22), 5% of patients were classified as underweight (BMI < 18.5 kg/m^2) whereas 31% were normal weight, 36% were overweight, and 28% were classified as obese. In this population, BMI did not reliably predict whether a patient was well-nourished or malnourished before surgery. Despite only 5% of the patients being underweight in this population, screening with the Malnutrition Screening Tool(MST) indicated that 28% of all patients were at risk of malnutrition. Additionally, according to the 7-point Subjective Global Assessment (7PSGA), 32% were classified as mildly to moderately malnourished. Figure 2 illustrates the percentage of malnourished patients categorized by BMI according to the results of MST and 7PSGA screenings.

The 7PSGA assesses unintentional weight loss in the last six months. Half (50%) of the study population did not experience any weight changes within six months. However, within the study group, 43% of patients experienced weight loss ranging from less than 10% to more than 10% of present body weight within 6 months. Three patients were found to have unintentionally lost more than 20% of weight within the same timeframe. Figure 3 depicts the pattern of weight changes within this study population.

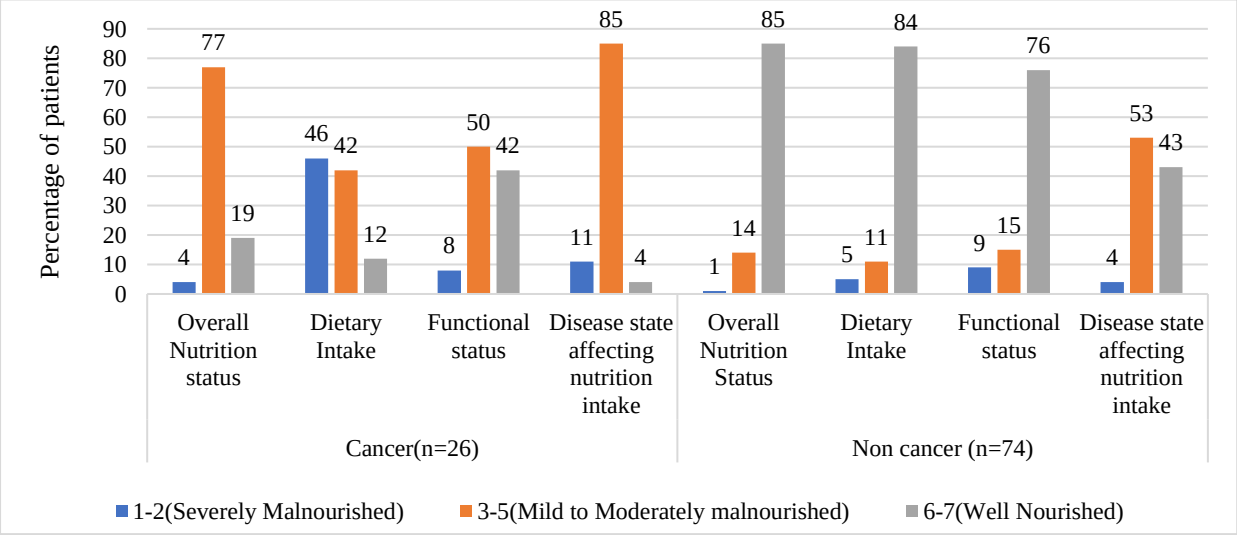

Figure 4: Nutrition Status comparison among patients with and without cancer

Malnutrition was more prevalent in patients admitted for cancer-related surgery (Figure 4). Mild to moderately malnutrition was present in 77% of patients with cancer, with 46% having poor dietary intake and disease state impacted nutrition intake for 85% of patients. Whereas Malnutrition Screening Tool (MST) identified 77% of cancer patients were at risk of malnutrition and 23% were not at risk of malnutrition. In contrast, most non-cancer patients were well-nourished and had better functional status compared to cancer patients. Also, all patients with cancer reported unintentional weight loss within the last six months (Figure 5). The median weight change for cancer patients was -7.3 kg, whereas for non-cancer patients, it was around -1.8 kg.

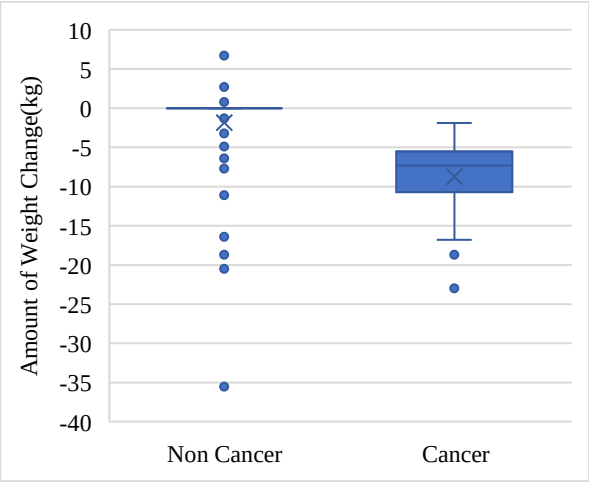

Figure 5: Body weight change in the last six monthsamong patients with cancer (n=26) and non-cancer (n=74)

DISCUSSION

This study assessed the sensitivity of The Malnutrition Screening Tool (MST), compared to the widely used 7-point Subjective Global Assessment (7PSGA), to identify malnutrition risk among surgical patients in Sri Lanka. The MST demonstrated good agreement with the 7PSGA in identifying patients at risk of malnutrition, with a sensitivity of 78.1% and a specificity of 95.6%. This indicates that approximately 21.9% of malnourished patients identified by the 7PSGA might be missed by the MST. However, the MST accurately identifies well-nourished patients in 95.6% of cases, minimizing the risk of over diagnosing malnutrition.

Furthermore, the MST's high positive predictive value indicates that most patients identified by the MST as at risk of malnutrition truly are malnourished. Similarly, the high negative predictive value suggests that patients identified as not at risk by the MST are likely to be well-nourished. These findings underscore the MST's practical utility in clinical settings, as it effectively balances sensitivity and specificity, reducing the likelihood of unnecessary interventions while ensuring that most at-risk patients are appropriately identified. Moreover, measures of agreement such as kappa statistics and Pearson's correlation revealed good agreement between MST and 7PSGA. Assessment of diagnostic accuracy using the area under the receiver operating characteristic curve (AUROC) showed the strongest performance between MST and 7PSGA. This study suggests that MST could be used in hospitalized surgical patients with multiple comorbidities in Sri Lanka to screen for the risk of malnutrition and subsequent referral to a registered dietitian for an individualized nutritional assessment.

Screening patients for malnutrition upon hospital admission should be considered standard practice. Nutritional status has a significant impact on surgical outcomes(23) , therefore nutrition screening is a crucial initial step to assess the suitability of a patient for an operation (24). The Feed M.E. Northeast Asia Study Group recommends routine nutrition screening across various healthcare settings, including in the surgical setting, with the MST(25). The MST questionnaire has been validated in numerous countries; however, there is a lack of published data in South Asian countries. Determining whether its use effectively improves patient outcomes remains an ongoing challenge. This study was conducted in a private hospital in Sri Lanka, which may limit the generalizability of the findings to public hospital settings. Private and public healthcare environments in Sri Lanka often differ in terms of available resources, patient demographics, and healthcare delivery systems. For instance, public hospitals typically serve a broader socioeconomic population, which may include individuals with greater nutritional challenges due to limited access to healthcare and support services. These differences could impact the prevalence of malnutrition and the applicability or performance of the malnutrition screening tool in such settings. Currently, public hospitals in Sri Lanka do not routinely screen patients for malnutrition, whether they are undergoing preoperative evaluation or receiving other medical treatments. Introducing a validated malnutrition screening tool into these settings could address this gap, enabling systematic identification and management of malnutrition. Additionally, further validation of the tool in a larger population would enhance its reliability and applicability in diverse clinical settings Future research should aim to validate this tool across diverse healthcare environments, including public hospitals, in Sri

Lanka and potentially extend nutrition screening to the broader South Asian region.

In this study, although the minimum required sample size was 40 participants, 100 patients were recruited to account for potential participant dropout or incomplete data, ensuring the study maintained sufficient statistical power. Additional participants were included to allow for subgroup analyses or exploratory investigations that were not part of the initial study plan.

In this study population of 100 patients, only 5% of patients had a BMI less than 18.5 kg/m², indicating they were underweight. In patients admitted for surgical procedures, the prevalence of underweight was lower than the prevalence of nutritional risk. Low BMI has been utilized to assess the severity of malnutrition, categorizing it as moderate or severe, according to the Global Leadership Initiative on Malnutrition (GLIM)criteria (26). In 2019, Maeda et al. established BMI cut-off values for grading malnutrition severity in Asian populations. Their findings indicated that the thresholds for moderately or severely low BMI were 17.0 kg/m² for individuals under 70 years of age and 17.8 kg/m² for those aged 70 years and older(27). The use of BMI in hospital clinical practice has several limitations. BMI is effective in diagnosing well-nourished patients; however, its use in identifying malnutrition may result in a high rate of false negatives(28). This is concerning, as it can lead to inadequate care and oversight of at-risk individuals. It does not distinguish between muscle and fat tissue, can be affected by fluid retention, and may conceal malnutrition in individuals with excess fat mass(29). Also, malnourished obese patients may experience significant weight loss without meeting the criteria for underweight classification based on BMI(30). Even among patients with a normal BMI, 62.5% were identified as malnourished according to the 7PSGA tool, while 53.6% were identified as at risk of malnutrition according to the MST tool. Furthermore, BMI fails to account for a history and pattern of body weight loss, which is a critical factor in diagnosing malnutrition(31). Interestingly, 42% of the study population experienced unintentional weight loss, but the prevalence of malnutrition, as determined by the 7-point Subjective Global Assessment (7PSGA), only 2% of patients were classified as severely malnourished, while 30% were identified as mildly to moderately malnourished. In contrast, the Malnutrition Screening Tool (MST) indicated that 28% of patients were at risk of malnutrition and required nutritional interventions. This suggests that while a significant portion of the population may have experienced weight loss, not all of them may be classified as malnourished or at risk of malnutrition according to these assessment tools. Body weight change measurements serve as an indirect indicator of undernutrition. Body fat and skeletal muscle tend to diminish in the later stages of malnourishment meaning that body weight changes may not effectively detect marginal malnutrition or acute changes in nutritional status(32). Consequently, relying solely on basic anthropometric parameters may underestimate the nutritional risk among hospitalized patients, potentially overlooking individuals who require nutritional support(33).It is important to assess factors such as muscle mass depletion, micronutrient deficiencies, and functional status to provide a more comprehensive evaluation of nutritional health and identify potential malnutrition(34).

Conversely, significant body weight changes do indicate chronic alterations in the nutritional well-being. In this study, the median weight change of oncological patients was -7.3kg within the last 6 months

A major strength of our study was that the research dietitian, who conducted the 7-point Subjective Global Assessment (including the subjective component of 7PSGA), was blinded to the MST scores and therefore unbiased by prior knowledge. Another strength was the completion of the 7PSGA within 48 hours of admission, as per best practice guidelines (35)

A major limitation of our study is that the 40 older adults who could not recall their weight or have it measured were excluded. This was not an unexpected finding as a previous Sri Lankan study found that less than a quarter of free-living Sri Lankan adults could accurately report their body weight [36] The exclusion as these older adults may have inadvertently excluded a high-risk of malnutrition subgroup of patients that could have skewed the findings. However, the study population did include a substantial number (56 participants) of adults over 60 years old, mitigating some concerns about representation. A future Sri Lankan educational campaign, targeting both healthcare providers and patients, that focuses on highlighting the crucial role of precise weight reporting and monitoring in healthcare environments could help address this shortcoming.

To facilitate the implementation of the MST in clinical practice, practical steps should be considered. These include training healthcare staff, such as nurses and dietitians, on accurate administration and interpretation of the MST, ensuring consistency and accuracy. Additionally, integrating the MST into hospital workflows, such as incorporating it into preoperative checklists or electronic health records, would streamline the

screening process and ensure timely nutritional interventions. Establishing clear referral pathways for patients identified as at risk would further enhance the effectiveness of this tool in improving patient care in surgical settings in Sri Lanka.

In conclusion, this study demonstrated that the Malnutrition Screening Tool (MST) is a sufficiently sensitive tool, compared to a registered dietitian's assessment, for identifying patients at risk of malnutrition among those undergoing planned invasive surgical procedures in Sri Lanka. The findings suggest that adopting the MST in surgical settings could provide a reliable means of early malnutrition risk detection, enabling healthcare providers, particularly dietitians, to implement individualized nutritional care. This, in turn, has the potential to reduce malnutrition-related surgical complications and improve overall patient outcomes.

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