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ORIGINAL ARTICLE

Association of Nutritional Status using the Short Nutritional Assessment Questionnaire (SNAQ) and Malnutrition Risk using the Malnutrition Screening Tool (MST) with In-Hospital Mortality and Intensive Care Unit Admission Among Non-Critically-Ill Patients: A Single Center, Prospective Cohort Study

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Abstract

Background and Objective. Although nutritional assessment tools have been available internationally, local data for their use in foreseeing adverse outcomes among admitted patients are currently unavailable. The primary objective of this study was to determine the association of nutritional status using Short Nutritional Assessment Questionnaire (SNAQ) and malnutrition risk using the Malnutrition Screening Tool (MST) with intensive care unit (ICU) admission and in-hospital mortality.

Methodology. This was a prospective-cohort study which included 122 purposively-selected adult participants who were non-intubated, admitted for medical and surgical management, stayed for at least 24 hours, had no COVID-19 infection, and were not admitted in any critical care unit. The SNAQ and MST questionnaires, which are validated tools and consists of two to three easy-to-answer questions, were used among the participants and their scores were tallied in order to get their nutritional status and malnutrition risk. Primary endpoints measured were the length of hospital stay, incidence of mortality, and ICU admission rate. Comorbidities were taken into account using the Charlson Comorbidity Index.

Results. Categorizing the SNAQ scores showed 33.61% were severely malnourished, which was similar when using the MST classification, wherein 34.43% were at risk of malnutrition. None of the participants were admitted to the ICU. Malnutrition risk and nutritional status was not significantly associated with 30-day in-hospital mortality ($p > 0.05$). On the other hand, results of the Cox proportional hazards showed that SNAQ and MST significantly predicted the hazard of 30-day in-hospital mortality, increasing the hazard of mortality by 2.58 times and 3.67 times, respectively, for every 1-unit increase in SNAQ and MST scores. Similarly, nutritional status using the SNAQ classification indicated the severely malnourished category significantly predicted the hazard of mortality, increasing it by 9.22 times for those who are severely malnourished. Also, malnutrition risk using the MST classification indicated that those who were at risk of malnutrition were 9.80 times greater hazard of mortality than those who were not at risk of malnutrition.

Conclusion. The MST and SNAQ classification are screening tools for nutritional status (SNAQ) and malnutrition risk (MST) that can be administered at the onset of the patient's hospital course and have been demonstrated in this study to predict 30-day in-hospital mortality. It is important to note that none of the patients included in this study required intensive care unit admission.

Key words: malnutrition, surveys and questionnaires, mortality, ICU

INTRODUCTION

An optimal dietary intake of the required nutrients contributes to the person's immune system leading to a conclusion that a person must strengthen his or her own immune system in order to achieve a sustainable way to survive. In order to determine one's nutritional status, various tools have been developed and one of which is the Short Nutritional Assessment Questionnaire (SNAQ). This is a nutrition assessment tool that has been validated by Kruizenga et al.,[1] and has been stated to be among the validated tools in the Netherlands for use among hospitalized patients. Another tool available to determine the risk of malnutrition among patients is the Malnutrition

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Screening Tool (MST). This is a simple and quick nutrition screening tool that is based on weight loss and appetite changes and is validated in the acute hospital setting.[2,3] Both of these tools are easy and fast to use and involve only 2 questions for the MST and 3 questions for the SNAQ. This study determined the association of nutritional status using the SNAQ and malnutrition risk using the MST scoring when used for ICU admission rate and in-hospital mortality among non-critically ill patients. This helped us better identify patients who would benefit from more aggressive nutritional intervention. In a study by Barker et al.,[4] it was said that along with the adverse outcomes associated with malnutrition, referrals and assessment of malnutrition per se is in fact suboptimal. This therefore increases the risk of hospitalized patients for more occurrences of muscle wasting, impaired wound healing, and higher treatment costs. Furthermore, malnutrition prevalence in the acute hospital setting has been reported to be as high as 20-50% and as high as 23% among randomly assessed patients on admission indicating the prevalence of malnutrition in the hospital;[5,6] however, identification of these cases is at the minimum. In another study,[7] referrals for malnutrition to dietitians also were noted at only 15% among an identified malnutrition rate of 42%. Among these studies, malnutrition rates were associated with a longer length of hospital stay, higher incidence of complications, and higher mortality rates as also seen in the study by Braunschweig et al.[8]

OBJECTIVE

The primary objective of this study was to determine the association of nutritional status using the SNAQ and malnutrition risk using the MST with in-hospital mortality and ICU admission among non-critically ill patients.

METHODOLOGY

Study design and setting

This was a prospective cohort study conducted at the non-COVID wards of Chinese General Hospital and Medical Center from May 2022 to December 2022.

Participants of the study

Patients included in the study were all adult patients of age 19 years and above, both males and females, non-intubated and admitted for medical and surgical management.

Patients excluded from the study were patients with hospital stay of less than 24 hours, with COVID-19 infection, and patients admitted at the ICU/CCU/NICU.

Data collection

Data and informed consent were solely collected by the primary investigator. Age and sex data were obtained from the patients' charts and by interviewing the patients. The primary investigator was also the one to administer the tests to the patients. Collection started with the approval of the protocol and was done for 8 months (May 2022 to December 2022). The primary investigator collected the responses of the patients included in the study from the forms provided (using the SNAQ and MST tools) by total enumeration from the start of approval until 7 months after the start of the study. Patients included in the study were all medical and surgical patients. Data collected included data that were part of the questionnaires used (SNAQ and MST). The Charlson Comorbidity Index (CCI) was used to assess and document the participant's current comorbidities. The SNAQ and MST scoring sheets were used and were retrieved thereafter, with their scores being tallied. Their outcomes were followed up until the date of their discharge. For those patients who were still at the wards once the study was terminated, they were classified as still admitted and were still included in the study and considered as non-ICU/non-mortality data as an outcome assessment. The data was encoded and compiled using Microsoft Excel in only one laptop of the primary investigator. Data protection was done by ensuring password protection on the file before access which was only known by the primary investigator and their co-author. The compiled data that was garnered through the interview was only accessed by the primary investigator and their co-author. Data privacy and confidentiality were reiterated to the patients. Data sheets, questionnaires, and files will be destroyed once no longer needed for the study.

Sample size

A sample size computation for binary logistic regression analysis was conducted using GPower version 3.1.9.4. According to the study of Bernardino and Llido,[9] the odds ratio of mortality for patients with an mSGA score of >5.00 (high risk malnutrition) was 2.98 with a confidence interval of 2.01 to 4.45. The lowest limit of the odds ratio (2.01) was utilized. In addition, the odds ratio for admission in critical care units was 2.986. Furthermore, in the same study above,[9] the prevalence of mortality was 20.60% while ICU admission had a prevalence of 23.89%. With these parameters and with a minimum power of 80% at a significance level of 5% (two-tailed), a minimum of 109 respondents was necessary for the analyses for mortality and 50 participants was needed for the analyses for ICU admission. From these two estimates, the largest sample size was inflated by 10% to account for possible attrition. Hence, the final sample size for the study was a total of 122 respondents.

External validation

The MST and the SNAQ tool were translated from English to Tagalog by three (3) physicians who were fluent in English and Tagalog. This was further verified by a Filipino Language Expert to determine the appropriateness of the translation. The tools subsequently underwent a pilot study among 10-15 participants that were not included in the study. This then underwent validation using one-sample *t*-test and Spearman correlation to determine the difference and association, respectively, of the items in English and Filipino languages. There were no significant differences in all items between the two languages and the correlations were high to excellent (r_s = 0.764 to 1.000), hence they were used in the study. The tools obtained rights for usage via Elsevier website using Rights Link for use in the study.

Nutritional status and malnutrition risk

The Short Nutritional Assessment Questionnaire (SNAQ) is a nutrition screening tool created by the Dutch Malnutrition Screening Group to identify risk for malnutrition in hospitalized patients which consists of three questions namely: presence and degree of unintentional weight loss, changes in appetite and use of supplemental drinks or tube feeding. Scores are from zero to three based on severity and patients with a score of two or more are classified as moderately malnourished and patients with a score of three or more are identified as severely malnourished.[1]

The Malnutrition Screening Tool (MST) is a simple and valid tool developed for use in adult hospitalized patients and consists of two items namely: Decreased intake due to poor appetite and amount of recent unintentional weight loss. The sum obtained in this tool results in a score between zero and five and patients are considered to be at risk for malnutrition if they receive a score of two or more.[2]

Mortality assessment and ICU admission

Administration of the two tools was conducted within 48 hours of admission. Their in-hospital course was monitored for the outcomes (in-hospital mortality and ICU admission rate). The comorbidities of the target population were taken into account using the Charlson Comorbidity Index. Participants were followed up on the hospital electronic medical record system at the time of termination of the study in order to record mortality outcomes and ICU admission rates. All deaths and ICU admissions from the time of hospitalization until the date of discharge or mortality were recorded as binary outcome.

Statistical analysis

Statistical analyses were conducted using STATA Statistical Software, Version 13, College Station, TX: StataCorp LP. A *p*-value of 0.05 was considered statistically significant. Missing data were imputed using variable mean imputation; however, variables with more than 10% missing data were excluded. Data normality was analyzed using Shapiro-Wilk's Test.

Descriptive statistics involved mean and standard deviation for normally distributed, continuous data; median and interquartile range (IQR) for ordinal and non-normally distributed, continuous data; and frequency and percentage for categorical data.[10] The incidence rate of 30-day in-hospital mortality, alongside its 95% confidence intervals, was also estimated. Comparative analyses of the different demographic and clinical characteristics according to malnutrition risk, using both the SNAQ and MST classifications, were performed using independent *t*-test and one-way Analysis of Variance (ANOVA) for normally-distributed, continuous data; Mann-Whitney U Test and Kruskall-Wallis H Test for ordinal and non-normally-distributed, continuous data; and, Chi-Square Test of Homogeneity or Fisher's Exact test, if the assumption of at least 5 expected observations per cell was not met, for categorical data.[10]

To address the questions and hypotheses on the associations of nutritional status using the SNAQ and malnutrition risk using MST with ICU admission and in-hospital mortality, binary logistic regression analyses were performed. In addition, Kaplan-Meier survival curve analyses were utilized to determine the survival rates or estimates according to nutritional status using the SNAQ and malnutrition risk using the MST. Moreover, Cox proportional hazards regression analyses were employed to determine the hazards of 30-day in-hospital mortality. Data were censored at the time participants were discharged or expired. Crude estimates were initially determined (crude odds ratios and hazards ratio). Afterwards, the estimates were adjusted after controlling confounders or covariates using a 10% change-in-estimate criterion and were represented as adjusted odds ratio (aOR) or adjusted hazards ratio (aHR).[11] Finally, survival estimates according to malnutrition risk, using both SNAQ and MST classifications, were compared using the log-rank test.[12]

Ethical considerations

There was strict adherence to ethical considerations set in relevant guidelines such as the Declaration of Helsinki, data privacy act, voluntary participation, informed consent, anonymity, confidentiality, potential for harm, and results communication. Ethical approval was granted by the Ethics Review Board of the Chinese General Hospital and Medical Center with RERB Protocol No. 2022 F-16.

RESULTS

Demographic characteristics

The comparative analyses of the demographic and clinical characteristics according to malnutrition risk are depicted in Table 1. The mean age of the participants was 55.08 years old (SD =16.43), with most of them being <50 years old (36.89%). In addition, majority of the participants were females (57.38%), and the most prevalent comorbidities were uncomplicated diabetes mellitus (31.97%), congestive heart failure (10.66%), and hemiplegia (9.84%). Results also showed that the mean Charlson Comorbidity Index (CCI) was 2.84 (SD = 2.37). Comparative analyses of the demographic characteristics according to malnutrition risk using the SNAQ classification showed that age, sex, and all comorbidities were not significantly different (*p*

Table 1. Comparative analyses of the demographic and clinical characteristics according to Malnutrition Risk, using the Short Nutritional Assessment Questionnaire (SNAQ) and the Malnutrition Screening Tool (MST), among the participants (N = 122)

Characteristics	Malnutrition risk							
		SNAQ classification				MST classification		
	Total (N = 122)	Well nourished (n = 70)	Moderately malnourished (n = 11)	Severely malnourished (n = 41)	*p*-value (two-tailed)	Not at risk (n = 80)	At risk (n = 42)	*p*-value (two-tailed)
Age (Years; x̄, SD)	55.08 (16.43)	53.43 (16.50)	49.00 (15.71)	59.54 (15.83)	0.098	51.78 (15.37)	61.38 (16.72)	0.002†
<50 Years Old	45 (36.89%)	28 (40.00%)	6 (54.55%)	11 (26.83%)	0.587	35 (43.75%)	10 (23.81%)	0.029*
50 to 59 Years Old	31 (25.41%)	17 (24.29%)	2 (18.18%)	12 (29.27%)		19 (23.75%)	12 (28.57%)	
60 to 69 Years Old	27 (22.13%)	17 (24.29%)	2 (18.18%)	8 (19.51%)		18 (22.50%)	9 (21.43%)	
70 to 79 Years Old	10 (8.20%)	4 (5.71%)	1 (9.09%)	5 (12.20%)		6 (7.50%)	4 (9.52%)	
≥80 Years Old	9 (7.38%)	4 (5.71%)	0 (0.00%)	5 (12.20%)		2 (2.50%)	7 (16.67%)	
Sex (f, %)					0.512			0.133
Male	52 (42.62%)	33 (47.14%)	4 (36.36%)	15 (36.59%)		38 (47.50%)	14 (33.33%)	
Female	70 (57.38%)	37 (52.86%)	7 (63.64%)	26 (63.41%)		42 (52.50%)	28 (66.67%)	
Comorbidities (f, %)								
Myocardial Infarction	5 (4.10%)	4 (5.71%)	1 (9.09%)	0 (0.00%)	0.195	5 (6.25%)	0 (0.00%)	0.163
Congestive Heart Failure	13 (10.66%)	6 (8.57%)	1 (9.09%)	6 (14.63%)	0.560	7 (8.75%)	6 (14.29%)	0.346
Peripheral Vascular Disease	8 (6.56%)	5 (7.14%)	1 (9.09%)	2 (4.88%)	0.866	5 (6.25%)	3 (7.14%)	1.000
Cerebrovascular Disease	9 (7.38%)	6 (8.57%)	0 (0.00%)	3 (7.32%)	0.884	5 (6.25%)	4 (9.52%)	0.493
Dementia	2 (1.64%)	1 (1.43%)	0 (0.00%)	1 (2.44%)	1.000	1 (1.25%)	1 (2.38%)	1.000
Chronic Obstructive Pulmonary Disease	6 (4.92%)	4 (5.71%)	0 (0.00%)	2 (4.88%)	1.000	4 (5.00%)	2 (4.76%)	1.000
Connective Tissue Disease	5 (4.10%)	3 (4.29%)	0 (0.00%)	2 (4.88%)	1.000	4 (5.00%)	1 (2.38%)	0.659
Peptic Ulcer Disease	5 (4.10%)	1 (1.43%)	0 (0.00%)	4 (9.76%)	0.107	1 (1.25%)	4 (9.52%)	0.047*
Liver Disease					0.495			0.654
None	116 (95.08%)	68 (97.14%)	11 (100.00%)	37 (90.24%)		77 (96.25%)	39 (92.86%)	
Mild	4 (3.28%)	1 (1.43%)	0 (0.00%)	3 (7.32%)		2 (2.50%)	2 (4.76%)	
Moderate to severe	2 (1.64%)	1 (1.43%)	0 (0.00%)	1 (2.44%)		1 (1.25%)	1 (2.38%)	
Diabetes mellitus					0.359			0.206
None or diet-controlled	77 (63.11%)	48 (68.57%)	6 (54.55%)	23 (56.10%)		53 (66.25%)	24 (57.14%)	
Uncomplicated	39 (31.97%)	20 (28.57%)	5 (45.45%)	14 (34.15%)		25 (31.25%)	14 (33.33%)	
End-organ damage	6 (4.92%)	2 (2.86%)	0 (0.00%)	4 (9.76%)		2 (2.50%)	2 (2.50%)	
Hemiplegia	12 (9.84%)	9 (12.86%)	1 (9.09%)	2 (4.88%)	0.330	9 (11.25%)	3 (7.14%)	0.542
Moderate to severe CKD	8 (6.56%)	3 (4.29%)	0 (0.00%)	5 (12.20%)	0.214	3 (3.75%)	5 (11.90%)	0.122
Solid tumor					0.095			0.024*
No tumor	109 (89.34%)	66 (94.29%)	10 (90.91%)	33 (80.49%)		75 (93.75%)	34 (80.95%)	
Localized	10 (8.20%)	4 (5.71%)	1 (9.09%)	5 (12.20%)		5 (6.25%)	5 (11.90%)	
Metastatic	3 (2.46%)	0 (0.00%)	0 (0.00%)	3 (7.32%)		0 (0.00%)	3 (7.14%)	
Leukemia	2 (1.64%)	0 (0.00%)	1 (9.09%)	1 (2.44%)	0.069	1 (1.25%)	1 (2.38%)	1.000
Lymphoma	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	–	0 (0.00%)	0 (0.00%)	–
AIDS/HIV	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	–	0 (0.00%)	0 (0.00%)	–
Charlson Comorbidity Index (x̄, SD)	2.84 (2.37)	2.41 (2.20)	2.09 (1.45)	3.78 (2.59)	0.014*	2.29 (2.04)	3.90 (2.61)	0.001†

*Significant at 0.05; †Significant at 0.01

>0.05); however, the mean Charlson Comorbidity Index was significantly higher (z = 8.57, p = 0.014) among those who were severely malnourished (x̄ = 3.78, SD = 2.59) compared to those who were well-nourished (x̄ = 2.41, SD = 2.20) or only moderately malnourished (x̄ = 2.09, SD = 1.45). On the other hand, between-group comparisons of these characteristics using the MST classification indicated that age and most comorbidities were not significantly different (p >0.05) except for age, peptic ulcer disease, and Charlson Comorbidity Index. For age, those who were classified as at risk of malnutrition (x̄ = 61.38, SD = 16.72) had a significantly higher mean age (t = –3.18, p = 0.002) than those who were not at risk of malnutrition (x̄ = 51.78, SD = 15.37). Similarly, the proportion of participants who were at risk of malnutrition was significantly higher (χ^2 = 10.87, p = 0.029) among those who were ≥80 years old (16.67% vs. 2.50%) and was significantly lower among those who were <50 years old (23.81% vs. 43.75%). For peptic ulcer disease, results showed that those who were at risk of malnutrition (9.52% vs. 1.25%) have a significantly higher (χ^2 = 4.80, p = 0.047) proportion of peptic ulcer disease than those who were not at risk of malnutrition. The mean Charlson Comorbidity Index of those who were at risk of malnutrition (x̄ = 3.90, SD = 2.61) was also significantly higher (z = –3.18, p = 0.001) than those who were not at risk (x̄ = 2.29, SD = 2.04).

The descriptive statistics of the prevalence of malnutrition risk, using Short Nutritional Assessment Questionnaire (SNAQ) and Malnutrition Screening Tool (MST), are presented in Table 2. Results showed that the mean SNAQ and MST scores were 1.52 (SD = 1.62) and 1.02 (SD = 1.09), respectively. Categorizing the SNAQ scores showed 33.61% were severely malnourished, 9.02% were moderately malnourished, and most of the participants (57.38%) were well nourished. Similarly, 34.43% of participants were classified to be at risk of malnutrition.

Table 2. Descriptive statistics on the prevalence of malnutrition risk, using the Short Nutritional Assessment Questionnaire (SNAQ) and the Malnutrition Screening Tool (MST), among the participants (N = 122)

Malnutrition Risk	Mean (SD)	Frequency (%)	95% CI
SNAQ score	1.52 (1.62)		1.23 to 1.81
SNAQ classification			
Well nourished		70 (57.38%)	48.10% to 66.28%
Moderately malnourished		11 (9.02%)	4.59% to 15.63%
Severely malnourished		41 (33.61%)	25.72% to 42.52%
MST score	1.02 (1.09)		0.82 to 1.21
MST classification			
Not at risk of malnutrition		80 (65.57%)	56.43% to 73.94%
At risk of malnutrition		42 (34.43%)	26.06% to 43.57%

95% CI = 95% Confidence Intervals

Table 3. Descriptive statistics of the study outcomes [Intensive Care Unit (ICU) admission, in-hospital mortality, and length of hospital] among the participants according to malnutrition risk (N = 122)

Outcomes	Malnutrition risk							
		SNAQ classification				MST classification		
	Total (N = 122)	Well nourished (n = 70)	Moderately malnourished (n = 11)	Severely malnourished (n = 41)	*p*-value (two-tailed)	Not at risk (n = 80)	At risk (n = 42)	*p*-value (two-tailed)
Intensive Care Unit admission (ICU; f, %)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	–	0 (0.00%)	0 (0.00%)	–
30-day in-hospital mortality (per 1,000 person-day)	0.007	0.000	0.006	0.015	0.009†	0.001	0.016	0.007†
Duration of hospital stay (Days; Md, IQR)	6.00 (4.00 – 12.00)	5.00 (3.00 – 9.00)	6.00 (4.00 – 30.00)	7.00 (5.00 – 16.00)	0.029*	8.86 (8.23)	10.57 (9.16)	0.212

*Significant at 0.05; †Significant at 0.01

Comparison of intensive care unit admission, in-hospital mortality, and length of hospital stay according to malnutrition risk

Table 3 illustrates descriptive statistics of the study outcomes according to malnutrition risk using the SNAQ and MST score classifications. Results showed that none of the participants were admitted in the intensive care unit (ICU), and the overall incidence rate of 30-day in-hospital mortality was 7 per 1,000 person-day. In addition, the median duration of hospital stay was 6.00 days (IQR = 4.00 – 12.00). Comparative analyses of the duration of hospital stay showed that the median duration of hospital stay was statistically higher among those who were severely malnourished (Md = 7.00, IQR = 5.00 – 16.00). In addition, results indicated that the incidence of 30-day in-hospital mortality was significantly higher (p = 0.009) among those who were severely malnourished (15 per 1,000 person-day), using the SNAQ classification. Likewise, the incidence of 30-day in-hospital mortality was significantly higher (p = 0.007) among those who were at risk of malnutrition (16 per 1,000 person-day), using the MST classification, compared to those who were not at risk of malnutrition (1 per 1,000 person-day).

Associations of demographic characteristics and malnutrition risk

Table 4 presents the univariate binary logistic regression analyses of the associations of demographic and clinical characteristics with malnutrition risk. Classifying malnutrition risk using the SNAQ classification, results indicated that age, sex, and all comorbidities were not significantly associated with malnutrition risk (p >0.05). However, the Charlson Comorbidity Index significantly predicted the likelihood of severe malnutrition (cOR = 1.28, p = 0.005, 95% CI = 1.08 – 1.52), denoting that every 1-unit increase in the Charlson Comorbidity Index leads to a 28% increase in the odds of developing severe malnutrition.

On the other hand, analyses of the association of the demographic and clinical characteristics with malnutrition risk using the MST classification indicated that sex and all comorbidities were not significantly associated (p >0.05) except for age and Charlson Comorbidity Index. Age (cOR = 1.04, p = 0.003, 95% CI = 1.01 – 1.07), for this part, positively predicted the likelihood of being at risk for malnutrition, with every 1-year increase in age leading a 4% increase in the odds of being at risk for malnutrition. Likewise, results showed that those who were 70 to 79 years old (cOR = 12.25, p = 0.004, 95% CI = 2.19 – 68.51) were 12.25 times more likely to be at risk for malnutrition than those who were <50 years old. For Charlson Comorbidity Index (cOR = 1.35, p=0.001, 95% CI = 1.13 – 1.61) showed a positive association, indicating a 35% increase in the odds of being at risk for malnutrition for every 1-unit increase in Charlson Comorbidity Index.

Associations and hazards of 30-day in-hospital mortality and malnutrition risk

The associations and the hazards of 30-day in-hospital mortality with malnutrition risk are presented in Table 5. Crude analyses of the associations of SNAQ (cOR = 3.56, *p* = 0.002, 95% CI = 1.57 – 8.03) and MST scores (cOR = 5.39, *p* = 0.001, 95% CI = 1.94 – 14.93) with 30-day in-hospital mortality indicated that every 1-unit increase in SNAQ and MST scores lead to a 3.56 times and 5.39 times increase in the likelihood of 30-day in-hospital mortality, respectively. Similarly, malnutrition risk using SNAQ classification was significantly associated with 30-day in-hospital mortality. In particular, those who were severely malnourished (cOR = 16.47, *p* = 0.010, 95% CI = 1.95 – 139.06) were 16.47 times more likely to expire within 30 days compared to those who were not severely malnourished. Likewise, malnutrition risk using the MST positively predicted 30-day in-hospital mortality (cOR = 15.80, *p* = 0.011, 95% CI = 1.87 – 133.32), which denote that those who are at risk of malnutrition were 15.80 times more likely to develop 30-day in-hospital mortality than those who were not at risk of malnutrition. After adjusting for the significant confounders, results showed that malnutrition risk, using both SNAQ and MST scores and classifications, were not significantly associated with 30-day in-hospital mortality (*p* >0.05).

On the other hand, results of the Cox proportional hazards showed that SNAQ (cHR = 2.58, *p* = 0.009, 95% CI = 1.27 – 5.26) and MST scores (cHR = 3.67, *p*=0.001, 95% CI = 1.67 – 8.05) significantly predicted the hazard of 30-day in-hospital mortality, increasing the hazard of mortality by 2.58 times ad 3.67 times, respectively, for every 1-unit increase in SNAQ and MST scores. Similarly, malnutrition risk using the SNAQ classification indicated the severely malnourished category (cHR = 9.22, *p* = 0.038, 95% CI =

Table 4. Univariate binary logistic regression analyses of the associations of the demographic and clinical characteristics on malnutrition risk, using the Short Nutritional Assessment Questionnaire (SNAQ) and the Malnutrition Screening Tool (MST), among the participants (N = 122)

Characteristics	Malnutrition risk[a]								
	SNAQ classification						MST classification (at risk)		
	Moderately malnourished			Severely malnourished					
	cOR	95% CI	*p*-value (two-tailed)	cOR	95% CI	*p*-value (two-tailed)	cOR	95% CI	*p*-value (two-tailed)
Age (years)	0.98	0.94 – 1.02	0.388	1.02	1.00 – 1.05	0.061	1.04†	1.01 – 1.07	0.003
Age categories									
<50 Years Old	Referent	–	–	Referent	–	–	Referent	–	–
50 to 59 Years Old	0.55	0.10 – 3.04	0.492	1.80	0.65 – 4.96	0.258	2.21	0.81 – 6.06	0.123
60 to 69 Years Old	0.55	0.10 – 3.04	0.492	1.20	0.40 – 3.57	0.746	1.75	0.60 – 5.08	0.303
70 to 79 Years Old	1.16	0.11 – 12.38	0.898	3.18	0.72 – 14.09	0.127	2.33	0.55 – 9.92	0.251
≥80 Years Old	1.00	–	0.988	3.18	0.72 – 14.09	0.127	12.25†	2.19 – 68.51	0.004
Sex (Female)	1.56	0.42 – 5.81	0.507	1.55	0.70 – 3.41	0.280	1.81	0.83 – 3.94	0.135
Comorbidities									
Myocardial infarction	1.65	0.17 – 16.30	0.668	1.07	0.92 – 1.12	0.984	1.00	–	–
Congestive heart failure	1.07	0.12 – 9.82	0.955	1.83	0.55 – 6.10	0.326	1.74	0.54 – 5.55	0.351
Peripheral vascular disease	1.30	0.14 – 12.31	0.819	0.67	0.12 – 3.60	0.638	1.15	0.26 – 5.08	0.850
Cerebrovascular disease	1.08	0.95 – 1.12	0.990	0.84	0.20 – 3.56	0.815	1.58	0.40 – 6.22	0.514
Dementia	1.06	0.95 – 1.13	0.991	1.72	0.10 – 28.32	0.703	1.93	0.12 – 31.60	0.646
Chronic obstructive pulmonary disease	1.09	0.98 – 1.16	0.991	0.85	0.15 – 4.84	0.851	0.95	0.17 – 5.41	0.954
Connective tissue disease	1.03	0.95 – 1.09	0.988	1.14	0.18 – 7.15	0.885	0.46	0.05 – 4.28	0.498
Peptic ulcer disease	1.03	0.96 – 1.11	0.993	1.07	0.80 – 69.11	0.077	8.32	0.90 – 76.97	0.062
Liver disease									
None	Referent	–	–	Referent	–	–	Referent	–	–
Mild	1.09	0.97 – 1.16	0.988	5.51	0.55 – 54.83	0.146	1.97	0.27 – 14.55	0.504
Moderate to severe	1.07	0.96 – 1.12	0.990	1.84	0.11 – 30.23	0.670	1.97	0.12 – 32.42	0.634
Diabetes mellitus									
None or diet-controlled	Referent	–	–	Referent	–	–	Referent	–	–
Uncomplicated	2.00	0.55 – 7.31	0.295	1.46	0.63 – 3.40	0.379	1.24	0.55 – 2.79	0.608
End-organ damage	1.03	0.92 – 1.11	0.991	4.18	0.71 – 24.48	0.113	4.42	0.76 – 25.79	0.099
Hemiplegia	0.68	0.08 – 5.95	0.726	0.35	0.07 – 1.69	0.191	0.61	0.16 – 2.37	0.473
Moderate to severe CKD	1.03	0.95 – 1.09	0.986	3.10	0.70 – 13.72	0.136	3.47	0.79 – 15.30	0.100
Solid tumor									
No tumor	Referent	–	–	Referent	–	–	Referent	–	–
Localized	1.65	0.17 – 16.29	0.668	2.50	0.63 – 9.93	0.193	2.21	0.60 – 8.13	0.234
Metastatic	1.04	0.95 – 1.12	1.000	1.04	0.96 – 1.09	0.986	1.00	–	–
Leukemia	1.02	0.94 – 1.07	0.993	1.06	0.97 – 1.13	0.993	1.93	0.12 – 31.60	0.646
Lymphoma	1.00	–	–	1.00	–	–	1.00	–	–
AIDS/HIV	1.00	–	–	1.00	–	–	1.00	–	–
Charlson Comorbidity Index	0.92	0.67 – 1.28	0.632	1.28†	1.08 – 1.52	0.005	1.35†	1.13 – 1.61	0.001

[a]Short Nutritional Assessment Questionnaire (SNAQ) referent or baseline outcome is the "well-nourished classification". On the other hand, the Malnutrition Screening Tool (MST) used the classification of "Not At Risk of Malnutrition" as the baseline outcome.

cOR = Crude Odds Ratio; 95% CI = 95% Confidence Intervals

*Significant at 0.05; †Significant at 0.01

1.13 – 75.09) significantly predicted the hazard of mortality, increasing it by 9.22 times for those who are severely malnourished. In a similar vein, malnutrition risk using the MST classification indicated that those who were at risk of malnutrition (cHR = 9.80, p = 0.033, 95% CI = 1.20 – 79.74) were 9.80 times at greater hazard of mortality than those who were not at risk of malnutrition.

It can also be seen in the covariate-adjusted Kaplan Meier survival curves (Figure 1) that the survival estimates of those who were not severely malnourished, using the SNAQ classification (X^2 = 13.40, p = 0.004), and those who were not at risk of malnutrition, using the MST classification (X^2 = 13.57, p = 0.004, have significantly higher survival estimates even after controlling for confounders.

Table 5. Binary logistic and cox-regression hazards regression on the association of malnutrition risk, using the Short Nutritional Assessment Questionnaire (SNAQ) and the Malnutrition Screening Tool (MST), on the 30-day in-hospital mortality of the participants (N = 122)

Characteristics	30-day in-hospital mortality (expired)							
	cOR (95% CI)	*p*-value (two-tailed)	aOR[a] (95% CI)	*p*-value (two-tailed)	cHR (95% CI)	*p*-value (two-tailed)	aHR[a] (95% CI)	*p*-value (two-tailed)
SNAQ score	3.56† (1.57 – 8.03)	0.002	2.19 (0.86 – 5.63)	0.102	2.58† (1.27 – 5.26)	0.009	1.81 (0.77 – 4.28)	0.179
SNAQ classification								
Not severely malnourished	Referent	–	Referent	–	Referent	–	Referent	–
Severely malnourished	16.47† (1.95 – 139.06)	0.010	7.45 (0.58 – 95.05)	0.122	9.22* (1.13 – 75.09)	0.038	4.29 (0.43 – 42.24)	0.212
MST score	5.39† (1.94 – 14.93)	0.001	4.25 (0.87 – 20.79)	0.074	3.67† (1.67 – 8.05)	0.001	2.50 (0.94 – 6.68)	0.067
MST classification								
Not at risk of malnutrition	Referent	–	Referent	–	Referent	–	Referent	–
At risk of malnutrition	15.80* (1.87 – 133.32)	0.011	7.77 (0.60 – 101.34)	0.118	9.80* (1.20 – 79.74)	0.033	4.55 (0.46 – 44.94)	0.194

[a]Odds ratios were adjusted for the following confounders: liver disease, moderate to severe chronic kidney disease, solid tumor, and leukemia. On the other hand, hazards ratios were adjusted for liver disease and solid tumor.

cOR = Crude Odds Ratio; aOR = Adjusted Odds Ratio; cHR = Crude Hazards Ratio; aHR = Adjusted Hazards Ratio; 95% CI = 95% Confidence Intervals

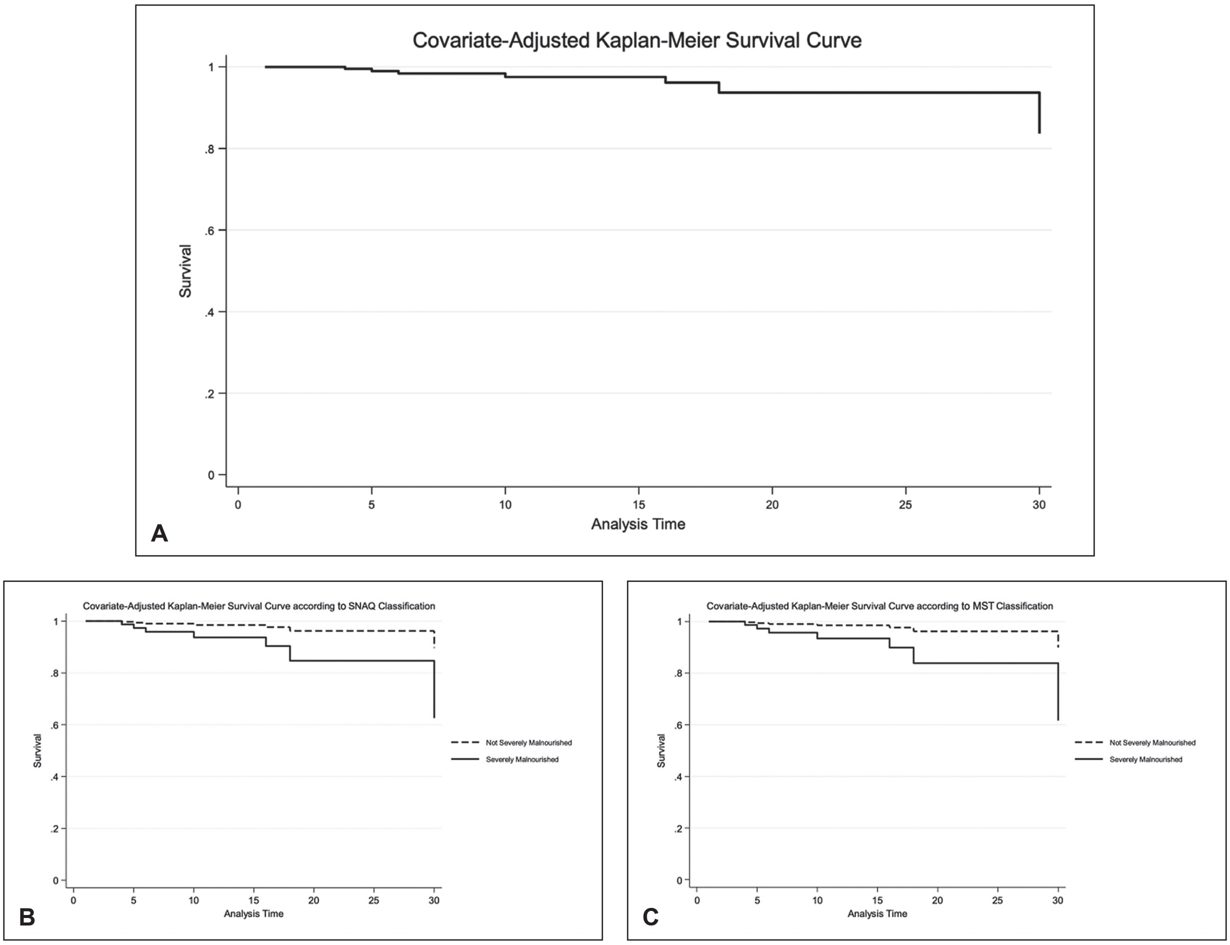

Figure 1. Covariate-adjusted Kaplan-Meier survival curves for **(A)** all the participants and according to Malnutrition Risk using the **(B)** SNAQ Classification and **(C)** MST classification.

DISCUSSION

We studied 122 patients and the mean age was 55.08 years old (SD = 16.43), with most of them being <50 years old (36.89%). In addition, majority of the participants were females (57.38%), and the most prevalent comorbidity was uncomplicated diabetes mellitus (31.97%). Their nutritional status using SNAQ and malnutrition risk using MST classification were assessed, 41 patients (33.61%) being severely malnourished using the SNAQ classification and 42 patients (34.43%) being at risk using the MST classification.

After adjusting for the significant confounders, results showed that nutritional status using SNAQ and malnutrition risk using MST, were not significantly associated with 30-day in-hospital mortality ($p>0.05$) which were different from a study that showed an association using similar nutrition tools and another study that used the MST.[13,14] On another note, results of the Cox proportional hazards showed that SNAQ and MST scores significantly predicted the hazard of 30-day in-hospital mortality, increasing the hazard of mortality by 2.58 times and 3.67 times, respectively, for every 1-unit increase in SNAQ and MST scores. Moreover, those who were severely malnourished (SNAQ) and at risk for malnutrition (MST) significantly predicted the hazard of mortality, increasing it by 9.22 times and 9.80 times respectively than those who were not at risk of malnutrition or those who were not severely malnourished. On the writing of this research, there seems to be no local data available that had similar results from our study which also used these two simple tools among patients admitted at the wards.

In a study by Isenring et al., malnutrition prevalence was found out to be 42.8%[15] and this is alarming since regardless of the cause of death, malnutrition and risk of malnutrition are associated with increased mortality[16] which stresses the importance for nutritional screening to identify those who may require nutritional support in order to avoid preterm death. When the MST was used to classify patients, it was found out that it is an effective predictor of nutritional risk. Also, it was found that the MST predicted patients that were at increased risk for death[17] and was also comparable with SGA in terms of sensitivity and specificity.[18] Badosa et al.,[19] used the SNAQ classification and was able to identify a higher rate of nutritionally at-risk patients, and was also present among those with a higher CCI which was similar to our study since our data revealed that a higher CCI would have a higher risk of severe malnutrition which can lead to undesirable outcomes for patients. We also found that the hazard of mortality was higher in those at risk for malnutrition risk using the MST classification or patients classified as severely malnourished using the SNAQ classification indicating the usefulness of both of these tools in assessing nutritional risk and malnutrition at the onset of their hospital course.

There is currently no gold standard among the various screening tools available, but tools with the highest evidence for validity included the SNAQ and MST.[20] Most of the studies that used the tools involved elderly patients, and those admitted at the critical care unit. Our study provides a new light on these tools since we included adults aged 19 years old and above. We also only included those who were at the regular ward of the hospital and excluded those who were critically ill at the onset. Although none of the patients were admitted at the ICU, the hazard of 30 day in-hospital mortality was still evident among those at risk for malnutrition and severely malnourished groups indicating the usefulness and predictive value of both tools. The ease and validity of administering these tools may be applied to the patients, especially at the first day of hospitalization to detect at risk patients.

This study has potential limitations. These include the accuracy of recall of some patients regarding their answers to the questionnaires provided since the questions were to be answered based on the time of admission. Also, this study was done via total enumeration sampling hence may not be fully representative of the population being studied and given the high confidence interval even adjust for confounders would mean that a larger sample size would be appropriate for future studies.

More studies may be conducted to further analyze the advantage of using one tool over the other, or by comparing these tools to what is commonly used in the institutions since there is still no gold standard when it comes to screening tools for malnutrition.

CONCLUSION

The MST and SNAQ classification are screening tools for nutritional status (SNAQ) and malnutrition risk (MST) that can be administered at the onset of the patient's hospital course and have been demonstrated in this study to predict 30-day in-hospital mortality. It is important to note that none of the patients included in this study required intensive care unit admission.

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All authors certified fulfillment of ICMJE authorship criteria.

CRediT Author Statement
KHN: Conceptualization, Validation, Formal Analysis, Investigation, Resources, Data curation, Writing – original draft preparation, Writing – review and editing, Visualization, Project administration; **MHJ:** Conceptualization, Methodology, Validation, Formal Analysis, Resources, Writing – review and editing, Supervision.

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