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ORIGINAL ARTICLE

Validity of nutritional screening with MUST and SNAQ in hospital outpatients

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BACKGROUND/OBJECTIVES: The majority of hospital outpatients with undernutrition is unrecognized, and therefore untreated. There is a need for an easy and valid screening tool to detect undernutrition in this setting. The aim of this study was to determine the diagnostic accuracy of the MUST (Malnutrition Universal Screening Tool) and SNAQ (Short Nutritional Assessment Questionnaire) tools for undernutrition screening in hospital outpatients.

METHODS: In a large multicenter-hospital-outpatient population, patients were classified as: severely undernourished (body mass index (BMI) <18.5 (<65 years) or <20 ($\geqslant 65$ years) and/or unintentional weight loss $>5\%$ in the last month or $>10\%$ in the last 6 months), moderately undernourished (BMI 18.5–20 (<65 years) or 20–22 ($\geqslant 65$ years) and/or 5–10% unintentional weight loss in the last 6 months) or not undernourished. Diagnostic accuracy of the screening tools versus the reference method was expressed as sensitivity (Se), specificity (Sp), positive predictive value (PPV) and negative predictive value (NPV).

RESULTS: Out of the 2236 outpatients, 6% were severely and 7% were moderately undernourished according to the reference method. MUST and SNAQ identified 9% and 3% as severely undernourished, respectively. MUST had a low PPV (Se = 75, Sp = 95, PPV = 43, NPV = 98), whereas SNAQ had a low Se (Se = 43, Sp = 99, PPV = 78, NPV = 96).

CONCLUSIONS: The validity of MUST and SNAQ is insufficient for hospital outpatients. While SNAQ identifies too few patients as undernourished, MUST identifies too many patients as undernourished. We advise to measure body weight, height and weight loss, in order to define undernutrition in hospital outpatients.

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Keywords: malnutrition; screening; validity; MUST; SNAQ; outpatients

INTRODUCTION

Disease-related undernutrition continues to be a substantial problem in all health-care settings. Undernutrition is prevalent in about 25–40% of hospitalized patients[1,2] and is associated with higher care complexity, longer length of stay, and increased morbidity and mortality.[2–6] As undernutrition is often already present at hospital admission, and nutritional status deteriorates further during hospital admission, continuous nutritional care is essential. Nowadays, nutritional screening in the outpatient clinic becomes more important due to declining length of hospital stay and, consequently, the shorter time to improve nutritional status during admission. Outpatient screening enables us to start early nutritional intervention, which may improve the condition of the hospital patient at nutritional risk.

The prevalence of undernutrition among hospital outpatients is relatively low (6–13%).[7–9] However, due to the large numbers of outpatients visiting the hospitals, this adds up to thousands of undernourished patients per year.[10] A recent multicenter study in hospital outpatient departments has shown that only 17% of undernourished patients received dietetic treatment,[7] suggesting that recognition and treatment of undernutrition is insufficient.

In order to early recognize undernourished patients in the outpatient setting, a screening tool to identify undernourished outpatients is required. However, none of the available screening tools has been developed and validated specifically for the outpatient setting. For hospital inpatients, several undernutrition screening tools have been developed over the past decade.[11–15] In the Netherlands, Malnutrition Universal Screening Tool (MUST)[14] and Short Nutritional Assessment Questionnaire (SNAQ)[15] are the only used screening tools for screening of hospital inpatients. MUST was developed for all health-care settings and patient groups, in which 50 consecutive patients visiting the gastroenterology outpatient clinic were included.[14] However, no study has been performed on the diagnostic accuracy of this screening tool for a more diverse group of hospital outpatients. SNAQ was initially developed for hospital inpatients. A recent study on the diagnostic accuracy of this screening tool showed fair validity (sensitivity (Se) 45–67%; specificity (Sp) 95–99%) for hospital outpatients in a single university hospital,[8] suggesting its limited usefulness for hospital outpatients.

The aim of this multicenter study was, therefore, to determine the diagnostic accuracy of MUST and SNAQ for undernutrition screening in a large and diverse sample of hospital outpatients.

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SUBJECTS/METHODS

Patients

This study was performed in 2008 as a cross-sectional multicenter study carried out in nine hospitals in the Netherlands.[7] Participating hospitals were two general hospitals ($n = 734$), six teaching hospitals ($n = 1770$) and one university hospital ($n = 80$). Patients were referred from almost all specialisms (surgical and medical patients representing the largest proportion), details of which have been published previously.[7] All patients $\geqslant 18$ years who visited the outpatient department on one of the screening days were included in the study.

Multicenter approval was given by the ethical review board of the VU University Medical Center. Owing to the low subject burden and the fact that data were handled and stored anonymously, informed consent was not considered necessary by the ethical review board.

Nutritional status

Patients were asked to fill out the questionnaires themselves after registration to the outpatient clinic. The study questionnaire consisted of questions on age, sex, recent unintentional weight loss (1 and 6 months), and the individual items of both MUST[14] and SNAQ.[15] The individual items of the screening tools are presented in Table 1.

Height and weight were measured by trained research assistants. Details regarding the measurements have been previously reported.[7] Patients were weighed wearing indoor clothing without shoes. An adjustment for clothing was made by deducting 1.77 kg for men and 1.13 kg for women from their measured weight.[16] An additional correction of 0.40 kg for men and 0.28 kg for women was made when patients were unable to take off their shoes.[16] Nutritional status was based on the self-reported unintentional weight loss and measured body mass index (BMI). Patients were either classified as:[17–20]

- severely undernourished; BMI $< 18.5\,kg/m^2$ (age < 65 years) or $< 20\,kg/m^2$ (age $\geqslant 65$ years), or unintentional weight loss of $> 5\%$ in the last month or $> 10\%$ in the last 6 months;
- moderately undernourished; BMI 18.5–20 kg/m^2 (age < 65) or BMI 20–22 kg/m^2 (age $\geqslant 65$) or 5–10% unintentional weight loss in the last 6 months;
- not undernourished; BMI $> 20\,kg/m^2$ (age < 65) or BMI $> 22\,kg/m^2$ (age $\geqslant 65$) and $< 5\%$ unintentional weight loss in the last 6 months.

Diagnostic accuracy

The MUST and SNAQ screening tools were validated against the above mentioned definition based on unintentional weight loss and BMI. Nutritional status according to the objective definition and according to both the screening tools was subdivided into three categories; not undernourished (MUST = 0, SNAQ $\leqslant 1$), moderately undernourished (MUST = 1 ('medium risk'); SNAQ = 2) and severely undernourished (MUST $\geqslant 2$ ('high risk'); SNAQ $\geqslant 3$). Diagnostic accuracy was assessed for identifying severely undernourished patients (MUST $\geqslant 2$; SNAQ $\geqslant 3$), and for identifying both moderate and severely undernourished patients (MUST $\geqslant 1$; SNAQ $\geqslant 2$). Owing to different BMI cutoff points to determine undernutrition in older individuals, the diagnostic values were determined for the total population, and for patients aged < 65 years and those aged $\geqslant 65$ years separately.

Diagnostic accuracy was expressed as sensitivity (Se), specificity (Sp), positive predictive value (PPV) and negative predictive value (NPV). We considered the diagnostic values to be (un)acceptable according to the following cutoff points: 90-100% excellent; 80–90% good; 70–80% fair; 60–70% insufficient; $< 60\%$ poor. Our main focus is the validity of the screening tools in identifying severely undernourished patients, as these are the patients in need of dietetic treatment.

Statistics

Descriptive statistics were used to express means, s.d.'s, percentages and frequencies. Cross-tabulations were used to establish diagnostic accuracy in terms of Se, Sp, PPV and NPV. Clopper–Pearson intervals were used to express 95% confidence intervals. Statistical analyses were performed using SPSS 20.0 for Windows (IBM corporation, Armonk, NY, USA) and StatXact 4.0.1 for Windows (Cytel Software Corporation, Cambridge, MA, USA).

Table 1. Characteristics of the Dutch hospital outpatient sample divided by nutritional status according to the objective definition ($n = 2236$)

	Severely undernourished	*Moderately undernourished*	*Not undernourished*
n (%)	134 (6.0%)	155 (6.9%)	1947 (87.1%)
Sex, % women	53.7%	61.9%	51.5%
Age in years (± s.d.)	59.5 ± 20.4	56.7 ± 18.9	56.4 ± 15.7
Age ⩾65 years	67 (50.0%)	68 (43.9%)	645 (33.1%)
BMI in kg/m^2 (± s.d.)	20.7 ± 4.0	21.4 ± 3.0	27.3 ± 4.8
BMI < 18.5 (< 65 years)	37 (27.6%)	—	—
BMI < 20 (⩾ 65 years)	37 (27.6%)	—	—
> 10% weight loss in 6 months, *n* (%)	47 (35.1%)	—	—
> 5% weight loss in 1 month, *n* (%)	47 (35.1%)	—	—
SNAQ			
Weight loss > 6 kg in 6 months (= 3 points)	49 (36.6%)	13 (8.4%)	0
Weight loss > 3 kg in 1 month (= 2 points)	60 (44.8%)	3 (1.9%)	2 (0.5%)
Decreased appetite last month (= 1 point)	60 (44.8%)	42 (27.1%)	248 (12.7%)
Use of sip/tube feed last month (= 1 point)	25 (18.7%)	6 (3.9%)	49 (2.5%)
SNAQ score (0 points)			
0–1 No undernutrition	63 (47.0%)	142 (91.6%)	1915 (98.4%)
2 Moderate undernutrition	13 (9.7%)	0	29 (1.5%)
⩾3 Severe undernutrition	58 (43.3%)	13 (8.4%)	3 (0.2%)
MUST			
BMI (kg/m^2)			
> 20 (= 0 points)	56 (41.8%)	89 (57.4%)	1947 (100%)
18.5–20 (= 1 point)	28 (20.9%)	66 (42.6%)	0
< 18.5 (= 2 points)	50 (37.3%)	0	0
% Weight loss 3–6 months			
< 5% (= 0 points)	65 (48.5%)	109 (70.3%)	1947 (100%)
5–10% (= 1 point)	22 (16.4%)	46 (29.7%)	0
> 10% (= 2 points)	47 (35.1%)	0	0
Acute disease effect score (= 2 points)	29 (21.6%)	4 (2.6%)	99 (5.1%)
MUST score (0–6 points)			
0 Low risk	3 (2.2%)	48 (31.0%)	1848 (94.9%)
1 Medium risk	30 (22.4%)	98 (63.2%)	0
⩾2 High risk	101 (75.4%)	9 (5.8%)	99 (5.1%)

Abbreviations: BMI, body mass index; MUST, Malnutrition Universal Screening Tool; SNAQ, Short Nutritional Assessment Questionnaire.

RESULTS

A total of 2584 patients filled out the questionnaire. Of these, 296 patients (11%) were excluded because nutritional status could not be defined due to missing data on measured height and/or

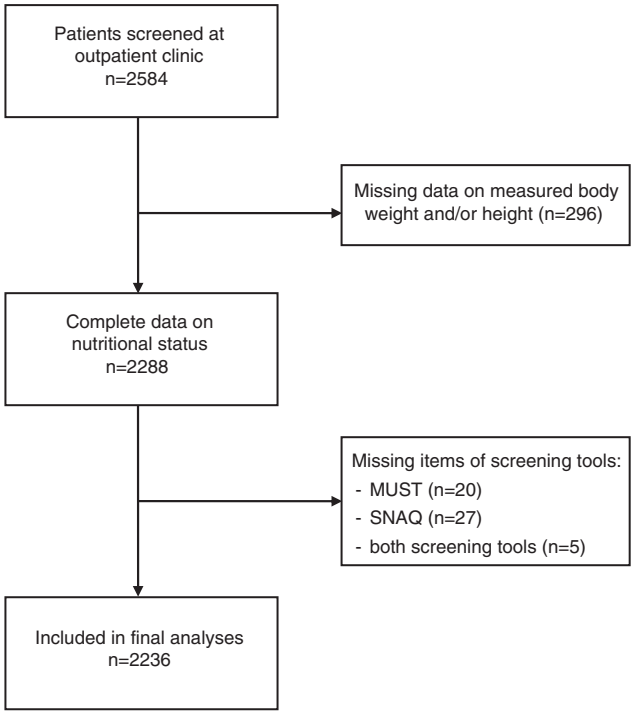

Figure 1. Flowchart.

Table 2. Diagnostic accuracy (95% CI) of MUST and SNAQ in the total sample of hospital outpatients and stratified by age group

	Sensitivity (95% CI)	*Specificity (95% CI)*	*Positive predictive value (95% CI)*	*Negative predictive value (95% CI)*
MUST ⩾2 points				
All patients	75 (67–82)	94 (94–96)	43 (41–55)	98 (98–99)
Patients <65 years	93 (83–98)	94 (93–95)	43 (35–52)	100 (99–100)
Patients ⩾65 years	58 (46–70)	96 (95–97)	59 (46–71)	96 (94–97)
MUST ⩾1 point				
All patients	82 (77–87)	95 (94–96)	71 (65–75)	97 (96–98)
Patients <65 years	99 (95–100)	94 (93–96)	68 (61–74)	100 (99–100)
Patients ⩾65 years	64 (55–72)	96 (94–97)	76 (67–84)	93 (90–95)
SNAQ ⩾3 points				
All patients	43 (35–52)	99 (99–100)	78 (67–87)	96 (96–97)
Patients <65 years	45 (33–57)	99 (99–100)	81 (65–92)	97 (96–98)
Patients ⩾65 years	42 (30–54)	99 (98–99)	76 (59–88)	95 (93–96)
SNAQ ⩾2 points				
All patients	29 (24–35)	98 (98–99)	72 (63–80)	90 (89–92)
Patients <65 years	27 (20–35)	98 (97–99)	66 (53–77)	92 (90–93)
Patients ⩾65 years	31 (23–40)	98 (97–99)	81 (67–90)	87 (85–90)

Abbreviations: CI, confidence interval; MUST, Malnutrition Universal Screening Tool; Short Nutritional Assessment Questionnaire.

weight. Another 52 patients were excluded because scores on the screening tools could not be calculated due to missing data on one or more items of the screening tools (Figure 1). Therefore, the total study sample consisted of 2236 patients (52.4% female), with a mean age of 56.6 (s.d. 16.3) years.

Characteristics of the outpatient sample are presented in Table 1. According to the definition based on BMI and weight loss, 6% was severely undernourished and 7% was moderately undernourished. Sex ($P<0.01$), percentage of patients ⩾65 years ($P=0.04$) and mean BMI ($P<0.01$) statistically significant differed between the three nutritional status categories.

Based on MUST, 209 patients (9%) were identified as severely undernourished and 128 patients (6%) as moderately undernourished. Based on SNAQ, 74 patients (3%) were identified as severely undernourished and 42 patients (2%) as moderately undernourished (Table 1).

The diagnostic accuracy of both screening tools is presented in Table 2. These results demonstrate that MUST ⩾2 ('high risk') showed an overall low PPV (43–59%) and a low Se for older individuals (58%). Other diagnostic values were fair to excellent. For MUST ⩾1 ('medium and high risk') PPVs were 68–76% and Se was 82% for the total sample, and 64% for patients aged ⩾65 years. SNAQ ⩾3 (severely undernourished) showed an overall low Se (42–45%), although other diagnostic values were fair to excellent. Combining the moderately and severely undernourished patients (SNAQ ⩾2) resulted in sensitivities of 27–31%.

DISCUSSION

The purpose of this study was to determine the validity of MUST and SNAQ for undernutrition screening in a large, heterogeneous sample of hospital outpatients. After comparing both screening tools against our objective definition of undernutrition, the validity of MUST and SNAQ turned out to be insufficient for hospital outpatients. While the SNAQ had a poor Se, thereby identifying too few patients as undernourished, the MUST had a poor PPV, identifying too many patients as undernourished, as well as a poor Se for older individuals.

The poor PPV of the MUST is likely due to the 'acute disease effect score'. Patients with a normal BMI and no history of weight loss were screened as severely undernourished when they report to be acutely ill and when there is (likely to be) no nutritional intake for >5 days.[14] While hospital outpatients may be unlikely to apply to this criterion,[21] 132 patients responded positively to the question about acute disease effect, resulting in a MUST score of 2 points and thus indicating severe undernutrition. However, of these only 29 patients (22%) were in fact severely undernourished based on the objective definition. Overestimation of undernutrition would increase the number of incorrect referrals to a dietician and thus, unnecessarily increase their workload. As proper treatment of undernourished outpatients requires further nutritional assessment and consult time is limited, we believe that it is unfavorable to implement a screening tool with low PPV.

The poor Se of MUST for older patients could at least be partly explained by the difference in BMI cutoff points to assess undernutrition. MUST uses BMI <18.5 kg/m^2 to define undernutrition for all patients, whereas in our definition of undernutrition we used a BMI <20 kg/m^2 for patients aged ⩾65 years.

The poor Se of SNAQ can be most likely explained by the large number of patients who were classified as undernourished based on a low BMI. SNAQ was originally developed for hospital inpatients, in whom unintentional weight loss due to acute illness is more prevalent than a low BMI. As the SNAQ is a quick-and-easy screening tool in which BMI is not included, the tool is likely to miss patients with a low BMI.[15] Forty-six percent of undernourished patients in our sample were classified as undernourished due to low BMI in the absence of weight loss.

We *post hoc* combined SNAQ with measured BMI, using the following cutoff points: for patients <65 years old: BMI <18.5 = 3 points; 18.5–20 = 2 points; >20 = 0 points. For patients ⩾65 years old: BMI <20 = 3 points; 20–22 = 2 points; >22 = 0 points. This increased the diagnostic values significantly (Se: 95% (90–98); Sp: 99% (99–100); PPV: 89% (82–93); NPV: 100% (99–100)). However,

this very much resembles the used gold standard and can hardly be considered a screening tool.

An important finding within the analysis of the SNAQ was the high prevalence of patients reporting on decreased appetite. In severely undernourished patients, the prevalence of decreased appetite was just as high as the prevalence of reported weight loss, whereas in moderately and not undernourished patients decreased appetite was the vastly most reported of all the four screening questions. It is important to realize that decreased appetite is not the same as low intake. Even though patients could experience a decreased appetite, some still manage to obtain sufficient protein and energy. However, health-care professionals should be extra aware of the risk of undernutrition in patients reporting decreased appetite.

To our knowledge, this is the first large-scale study to assess the validity of MUST and SNAQ in hospital outpatients. A major strength is that we used a large, multicenter sample with patients from nine different hospitals across the Netherlands and covering 23 different outpatient departments.[7]

Some limitations of the study should also be acknowledged. The individual questions of both MUST and SNAQ were integrated in the general research questionnaire, which patients received at admission to the outpatient clinic. Consequently, patients answered the questions of the screening tools themselves. As both screening tools were originally developed to be carried out by a health-care worker, this may have biased our results. Especially acute disease effect may have been broadly overestimated by self report. On the other hand, our study design better reflects daily practice, as in several outpatient departments patients are filling out the nutritional screening forms ('self screening') because of limited consultation time. Cawood *et al.*[21] recently assessed the validity of self screening with the MUST in hospital outpatients. Good agreement was shown between self screening and screening by a health-care professional. We believe that self screening or assessment could be beneficial in this health-care setting, but more research is warranted.

A second limitation is the absence of a generally accepted gold standard. This is a point of discussion in every study on disease-related undernutrition[22] and is of major importance in validation studies. In this study, we applied a commonly used and acknowledged definition based on a combination percentage of unintentional weight loss and objectively measured BMI[18,22] to indicate both acute undernutrition (weight loss) and chronic undernutrition (low BMI).

A final limitation is that we examined only two screening tools, as they are applied to hospital patients in the Netherlands. It would be worthwhile to assess the diagnostic accuracy of other internationally used undernutrition screening tools, such as NRS-2002,[13] and MST.[11] Moreover, the MNA-SF[12] and the recently developed SNAQ^{65+23} might be applicable screening tools for older hospital outpatients, and the validity of these tools should be considered in future studies.

As hospitals increasingly introduce electronic patient records, we advise a frequent (for example, at least at each first outpatient visit) registration of measured height and weight. The calculation of BMI and previous weight loss can be easily programmed. Our study shows that this objective information may be crucial to determine undernutrition in hospital outpatients, as the previously developed screening tools MUST and SNAQ were found not to be valid in this study.

CONCLUSION

This study concludes that the MUST and SNAQ nutritional screening tools are not valid to assess undernutrition in a heterogeneous group of hospital outpatients. We advise to measure body weight, height and inquire weight loss to determine undernutrition in hospital outpatients.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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