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The Nutritional Risk Screening 2002 tool for detecting malnutrition risk in hospitalised patients: Perspective from a developing country

NUTRITION

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ABSTRACT

Background/Aims: To verify the validity of the Nutritional Risk Screening (NRS) 2002 test in a Turkish population.

Materials and Methods: We prospectively investigated 2566 patients at a tertiary referral hospital. Nutritional status was screened using NRS 2002, and the length of the stay (LOS) was the main outcome measure. Hospital stays >10 days were accepted as prolonged LOS. NRS scores ≥3 were accepted as indicating risk for malnutrition. Statistical analyses were performed to determine the independent risk factors for malnutrition risk and prolonged LOS.

Results: The mean age of patients was 56.6±16.9 years. According to the NRS 2002, 964 patients (37.6%) were without risk, 1320 (51.4%) warranted surveillance and 282 (11%) were at high risk for malnutrition. Malnutrition rate was the highest in the intensive care unit (22.01%). Prolonged LOS was seen in 24.4% of patients. Intensive care unit stay [odds ratio (OR): 0.585; confidence interval (CI): 1.45-2.22; p<0.001] and an NRS score ≥3 (OR: 0.88; CI: 1.87-3.13; p<0.001) were independent risk factors for prolonged LOS.

Conclusion: Improving healthcare outcomes while avoiding preventable healthcare costs is an important goal of healthcare provision in developing countries. NRS 2002 was predictive of LOS, and thus, of patient prognosis. Further community-based studies are warranted to assess the impact of NRS 2002 on reducing healthcare costs.

Keywords: Nutritional Risk Screening 2002, hospitalisation time, adult, aged, body mass index, malnutrition, risk factors

INTRODUCTION

According to Turkish Statistical Institute (TurkStat), healthcare costs have become a burden on the government's budget. Depending on the specific report used, total healthcare expenditure increased from 4,985 billion Turkish Liras (TL) (79 TL/person) to 57,740 billion TL (812 TL/person) between 1999 and 2008 (1). Therefore, like in many other countries, Turkish physicians need to be increasingly aware of not only the efficacy and adverse effects of a particular therapeutic strategy, but also the costs.

Malnutrition is largely a treatable condition. Hospitalised patients are at high risk (20%-62%) of being malnourished or having malnutrition during their stay (2-4). Therefore, screening their nutritional status to ensure early diagnosis of malnutrition facilitates effective treatment. In turn, this reduces healthcare expenditures by reducing hospital stay. To detect malnourished patients

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and/or identify patients at nutritional risk, numerous nutritional screening tests have been introduced. The Nutritional Risk Screening 2002 Test (NRS 2002) assesses the nutritional status and possible nutritional risks in hospitalised patients, using parameters of nutritional status and co-morbid disease(s) severity and can be used to identify those who need nutritional support and follow up (5,6). While other tests focus on diagnosing malnutrition by identifying its risks, the NRS 2002 seeks to identify those patients most likely to be successfully treated by nutritional intervention. Additionally, the NRS 2002 is reportedly less time consuming and requires less examiner training than other tests (7). Thus, we planned a cross-sectional study to verify the validity of the NRS 2002 test in a Turkish population at a tertiary referral hospital, using length of hospital stay (LOS) as the main outcome measure.

MATERIALS AND METHODS

We prospectively investigated 2566 patients admitted to intensive care units (ICUs), internal medicine and surgical departments at Baskent University Ankara Research Hospital between October and December 2005. Patients without valid body mass index (BMI) measurements were not included. Patients or their legal guardians were informed about the study and were required to provide signed consent for participation. The study was approved by the Ethics Committee of Baskent University.

Nutritional status screening and assessment were performed using the three-component NRS 2002 Questionnaire (6). The first component assesses the nutritional status across three separate items: BMI categories [<18.5, 18.5-20.5 (plus an additional item of impaired general condition for these two categories) and >20.5 kg/m^2], weight loss categories [>5% in 3 months, >5% in 2 months and >5% in 1 month (>15% in 3 months)] and food intake as a proportion of the normal requirement in the preceding week (0%-25%, 25%-50%, 50%-75% and >75%). The second and third components assess disease severity and age, respectively, with all subjects over 70 years being given an additional weighting. Weight loss was evaluated using either the patient's own history or previous medical records, where available. Decreased food intake was assessed either subjectively by the patient's history or objectively by nutritional diaries. The BMI cut off value for diagnosing malnutrition was 18.5 kg/m^2.

The questionnaire was applied to patients within the first 24 hours of their hospitalisation by physicians, dieticians or nurses who had completed four hours of clinical nutrition training. The total NRS 2002 score (range 0-7) is the sum of the nutritional score, the disease severity score and the age adjustment. Patients with a total score of ≥3 were classified 'nutritionally at risk' and a nutritional care plan was initiated. Mortality risk could not be assessed.

Statistical analysis

The normality of the data was tested using normal Q-Q plots, as well as one-sample Kolmogorov-Smirnov and Lilliefors significance correction tests. Spearman's test was used for correlation. The association between the parameters was investigated using cross tables and chi-square tests. To compare the effects of parameters on mean LOS, variables were organised into the following groups: NRS 2002 score (<3 and ≥3), age (<55 and ≥55) and BMI (<18.5 and ≥18.5). Any LOS >10 days was accepted as prolonged LOS. NRS 2002 scores ≥3 were accepted as indicating malnutrition risk. The Mann-Whitney *U* Test was used to assess the effect of parameters on the mean LOS. Logistic regression analysis was used to calculate the odds ratios (OR) with 95% confidence intervals (CIs) and *p* values for independent risk factors on prolonged LOS and malnutrition. Analyses were performed using the commercial software, Statistical Package for Social Sciences (SPSS) for Windows version 15 (SPSS Inc., Chicago, IL). The level of significance was set to $p<0.05$.

RESULTS

We evaluated 2566 patients, of which 1122 (43.7%) were women and 1444 (56.3%) were men, with a mean age of 56.6±16.9 years. Their demographic data is outlined in Table 1. Of the sample, 1065 patients (41.5%) were hospitalised to internal medicine, 1015 (39.6%) to surgical departments and 486 (18.9%) to ICUs. The mean BMI was 25.9±0.09 kg/m^2 and median BMI was 25.3 kg/m^2 (13-50 kg/m^2) (Table 1). In total, 99 patients (3.9%) had a BMI under 18.5 kg/m^2 and 51.5% of patients were overweight or obese (BMI >25 kg/m^2).

The median LOS was 5 days (range: 1-100 days) and the mean LOS was 7.63±0.19 days; furthermore, 289 patients (11.3%) were hospitalised for one day, while 1649 (64.3%) stayed for 2-10 days and 628 (24.4%) had prolonged LOS. When considering the factors that affected LOS, we identified that age, BMI, NRS 2002 score and ICU stay were all significantly associated with the LOS (Table 2). Age was a particularly significant parameter: those older than 55 years had significantly longer mean LOS ($Z=-4.686$, $p<0.001$; Mann-Whitney), and 60.8% of all patients who had a prolonged LOS were older than 55 years (C^2, $p<0.001$). In addition, a larger proportion of patients admitted to ICUs had a prolonged LOS (34%) when compared with patients in internal medicine (23.5%) and surgery (21.0%) departments (Table 2; C^2, $p<0.001$). Patients admitted to ICUs were found to have significant risks for both prolonged LOS (OR: 0.585; CI: 1.45-2.22; $p<0.001$) (Table 3) and malnutrition (NRS ≥3) (OR: 1.01; CI: 2.08-3.64; $p<0.001$) (Table 4).

Having a lower BMI measurement had a weak negative correlation with longer LOS (r: -0.055, $p=0.006$), which was also reflected by higher NRS 2002 scores (r:-0.118, $p<0.001$). However, on binary logistic regression analyses, only an NRS score ≥3 was found to be an independent risk factor for prolonged LOS (OR: 0.88; CI: 1.87-3.13; $p<0.001$). Indeed, neither low BMI (<18.5 kg/m^2) nor older age (≥55 years) were significant risk factors for prolonged LOS (Table 3).

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Table 1. Patient demographics

Age (year, n, %)		
<55	1051	(41%)
≥55	1515	(59%)
Sex		
Female	1122	(43.7%)
Male	1444	(56.3%)
Hospital admission		
Departments of Medical Sciences	**1065**	**(41.5%)**
Endocrinology and Metabolic Diseases	34	(1.3%)
Gastroenterology	144	(5.6%)
Medical Oncology	97	(3.8%)
Nephrology	123	(4.8%)
Hematology	30	(1.2%)
Internal Medicine	264	(10.3%)
Cardiology	232	(9.0%)
Chest Diseases	66	(2.6%)
Neurology	75	(2.9%)
Departments of Surgical Sciences	**1015**	**(39.6%)**
Neurosurgery	137	(5.3%)
General Surgery	639	(24.9%)
Thoracic Surgery	6	(0.2%)
Cardiovascular Surgery	21	(0.8%)
ENT	52	(2.0%)
Urology	80	(3.1%)
Orthopedics	78	(3.0%)
Sports Medicine	2	(0.1%)
Intensive care unit	**486**	**(18.9%)**
BMI (kg/m^2)		
<18.5	99	(3.9 %)
18.5-24.9	1144	(44.6%)
25-29.9	909	(35.4%)
≥30	414	(16.1%)
Length of stay		
1 day	289	(11.3%)
2-4 days	980	(38.2%)
5-9 days	669	(26.1%)
≥10 days	628	(24.4%)

BMI: body mass index

The median NRS 2002 score was 1 (range 0-7); 964 patients (37.6%) were without risk, 1320 (51.4%) required surveillance and 282 (11%) were at high risk for malnutrition. Further, malnutrition risk was highest among ICU patients (Table 5), with nutritional supplementation indicated in 22.01% and surveillance in 52.05%. Malnutrition risk was significantly lower in medical (9.85%) and surgical (6.9%) departments of ($C^{2,}$ p<0.001; Table 5). Older patients (age ≥55) also had significantly higher rates of malnutrition risk (14.78%) than younger patients (5.52%) ($C^{2,}$ p<0.001; Table 5).

We found a significant correlation between LOS and NRS scores (r: 0.314, p<0.001). Nearly half of all patients (41.1%) with an NRS 2002 score ≥3 had a statistically longer mean LOS than patients without a score <3 (Z =−7.885, p<0.001; Mann-Whitney Test).

DISCUSSION

According to data provided by TurkStat, total healthcare expenditure was 57.740 billion TL (44.364 billion US dollars) for 2008, with 39.8% of this expenditure being for the hospital stay itself, and 73% of the expenditure provided by the government (1). Given that this represents 6.1% of the gross national product of Turkey (1), improving healthcare while avoiding every preventable healthcare cost is an important policy consideration for developing countries such as Turkey.

The prevalence of malnutrition at hospitalisation ranges from 20% to 62% (2-4). This is associated with higher rates of infection and increased morbidity and mortality, which can be prevented if attention is paid to the nutritional care of patients (8). Other important healthcare features are routinely screened and treated at presentation (*e.g.* dehydration, blood pressure and fever), and it is unacceptable that nutritional problems associated with significant clinical risk are not identified and treated with equal urgency (5). Therefore, it is now widely recommended that hospitalised patients should be routinely screened for malnutrition. However, more than 40 nutritional evaluation methods have been described to date, making the selection of the optimal screening tool problematic. The ideal tool needs to be valid and reliable when predicting malnutrition, yet practical and easy to use; most importantly, it should meet the individual patient care needs of a given institution or country. Considering the twelvefold increase in the healthcare expenditure of Turkey in less than ten years, we planned to adopt a screening test with a predictive value on hospitalisation outcomes. Of the available nutritional screening tools, the NRS 2002 was developed mainly to predict the outcomes of intervention in hospitalised patients (5); therefore, we designed this prospective study to assess the validity of the NRS 2002 in over 2500 patients in a Turkish tertiary referral centre, using LOS as the major outcome measure.

Malnutrition risk was present in 11% of patients, and rescreening was necessary in nearly half (Table 4). The rate of malnutrition was lower than that in similar studies from Turkey, with different measurement methods producing variable malnutrition rates from 15% to 67.4% (9-12). In a larger multicentre study in

Table 2. Factors influencing the length of stay (LOS)

LOS	1 day	2-4 days	5-9 days	≥10 days	N (%)	p
Age (year)						
<55	155	421	229	246	1051 (41.0%)	<0.001
≥55	134	559	440	382	1515 (59.0%)	
Hospital services						
Intensive care unit	55	128	138	165	486 (18.9%)	<0.001
Internal medicine	85	452	278	250	1065 (41.5%)	
Surgical disciplines	149	400	253	213	1015 (39.6%)	
Body Mass Index						
<18.5	13	34	24	28	99 (3.9%)	<0.001
18.5-25	122	406	296	320	1144 (44.6%)	
26-30	119	374	222	194	909 (35.4%)	
>30	35	166	127	86	414 (16.1%)	
NRS 2002 Score						
0	154	505	186	119	964 (37.6%)	<0.001
1-2	114	411	402	393	1320 (51.4%)	
≥3	21	64	81	116	282 (11%)	
Total	289 (11.3%)	980 (38.2%)	669 (26.1%)	628 (24.5%)	2566 (100%)	

LOS: length of stay; NRS: Nutritional Risk Screening 2002 Test

Table 3. Independent risk factors on prolonged length of stay (LOS ≥10 days)

	LOS <10 days (%n)	LOS ≥10 days (%n)	OR	CI (95%)	p
NRS Score ≥3	71 (2.8%)	28 (1.1%)	0.88	1.87-3.13	<0.001
Age ≥55	166 (6.5%)	116 (4.5%)	0.098	0.92-1.33	N.S.
BMI <18.5	1133 (44.2%)	382 (14.9%)	0.205	0.79-1.92	N.S.
ICU patient	321 (12.5%)	165 (6.9%)	0.585	1.45-2.22	<0.001

LOS: length of stay; OR: odds ratio; CI: confidence interval; NRS: Nutritional Risk Screening 2002 Test; BMI: body mass index; ICU: intensive care unit; N.S: non-significant at p<0.05 level

Table 4. Risk factors for malnutrition (NRS 2002 ≥3)

	NRS 2002 <3 n (%)	NRS 2002 ≥3 n (%)	OR	CI (95%)	p
LOS ≥10 days	512 (20.0%)	116 (4.5%)	0.8	1.70-2.92	<0.001
Age ≥55	1291(50.3%)	224 (8.7%)	1.18	2.37-4.49	<0.001
BMI <18.5	63 (2.5%)	36 (1.4%)	2.07	4.92-12.72	<0.001
ICU patient	379 (14.8%)	107 (4.2%)	1.01	2.08-3.64	<0.001

LOS: length of stay; OR: odds ratio; CI: confidence interval; NRS: Nutritional Risk Screening 2002 Test; BMI: body mass index; ICU: intensive care unit

Turkey that used the NRS 2002, the estimated malnutrition risk was 15% on admission in a population of over 29,000 hospitalised patients (9). Patients were followed for two weeks and they found additional nutritional risk in 6.25% by the end of the first week and 5.2% by the end of the second week, independent of nutritional support. That study is one of the largest population based studies to utilise the NRS 2002 and provides a good indication of the status of malnutrition in Turkish hospitals. However, in this study, we mainly focused on studying the predictive value of the NRS 2002 on the impact of nutritional status on patient outcomes. Our results can be discussed under the following three major headings.

Patients admitted to ICU merit special nutritional attention

Intensive care units are special medical units that accept patients with distinct medical problems that require closer follow

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Table 5. Distribution of NRS scores according to age and departments

	NRS 0	NRS 1-2	NRS ≥3	n (%)	p
Age (years)					
<55	566	427	58	1051 (41%)	<0.001
≥55	398	893	224	1515 (59%)	
Hospital admission					
Intensive care unit	126	253	107	486 (18.9%)	<0.001
Internal medicine	396	564	105	1065 (41.5%)	
Surgical disciplines	442	503	70	1015 (39.6%)	
n (%)	964 (37.6%)	1320 (51.4%)	282 (11.0%)	2566 (100%)	

NRS: Nutritional Risk Screening 2002 Test

up and higher levels of medical and nursing care. In addition to the impact of their underlying medical illness, such as infection or fistula, patients may suffer anxiety, which further impairs their appetite. Therefore, besides having increased requirements through their physiological stress, an individual may refuse to eat and move from a good to a poor nutritional status in a matter of weeks (5,13). This well-known problem was supported by our analyses: ICU patients had higher rates of malnutrition (22.01%) (Table 5) and significant risk for malnutrition (OR: 1.01; CI: 2.08-3.64; p<0.001) (Table 4). Consequently, our study confirms previous studies emphasising the importance of the NRS 2002 in defining malnutrition risk in ICU patients.

Giving a precise figure for cost of ICU care is difficult; because cost could be variable depending on the pathology itself or comorbid diseases. Although we cannot estimate the additional impact of untreated malnutrition on the cost of ICU care with our data, we are able to make interpretations from data produced in earlier studies and by the Ministry of Health in Turkey (14,15). According to figures produced by the Ministry of Health, there are 50 million adults in Turkey and 12,886 beds allocated for ICUs at the time the study was conducted (2005). Furthermore, in a study from Turkey that was conducted to detect the factors affecting the cost of ICU care in a tertiary referral centre like ours, the median cost of care of an ICU patient was estimated to be 3668 US dollars for a median LOS of 7 days (15). Therefore, the additional financial burden of prolonged ICU stays is evident.

Patients who need nutritional supplementation should be carefully selected

Malnutrition is a prevalent problem defined as a state of nutrition in which a deficiency, excess or imbalance of energy, protein and other nutrients causes measurable adverse effects on tissue or body form, function and clinical outcomes (13,16). Malnutrition thus includes both over nutrition and under nutrition. According to our results, 51.5% of patients in this study were overweight or obese. However, we detected malnutrition risk in 50% of those patients whose BMI was within the normal range, as well as in 37.2% of patients whose BMI was more than 25 kg/m^2. Therefore, BMI was not a sensitive method for evaluating either the nutritional status or disease related malnutrition. Conversely, the NRS 2002 was more suitable for detecting the presence of under nutrition and the risk of developing under nutrition in the hospital setting.

Nutritional support itself is not free from complications. Unnecessary enteral or parenteral supplementation can not only cause metabolic problems, such as hyperglycaemia and osmotic load, but also bring additional healthcare costs. Therefore, we suggest that a community-based health economic analysis is needed to assess the economic impact on the national health care budget of using nutritional supplements for the treatment of disease related malnutrition.

Elderly patients should be particularly targeted for screening and intervention

Elderly patients are particularly vulnerable to malnutrition. Moreover, attempts to provide them with adequate nutrition frequently encounter practical problems. First, their nutritional requirements are not well defined; because both lean body mass and basal metabolic rate decline with age, an older person's energy requirement per kilogram of body weight is also reduced (17). Second, the ageing process is not uniform between ethnic groups, countries or even people in the same household. Therefore, the age at which someone becomes elderly is not well defined. Although the NRS 2002 adds a point to the total score (the sum of the impaired nutrition and disease severity scores) if the patient is older than 70 years old (6), life expectancy in the Turkish population is approximately 70 years (17,18).

Turkey is a developing country with over 50 million people aged 15-64 years (18). According to population figures and projections produced by TurkStat, there are currently approximately 5.879 million people (7.7%) in the elderly population (65+ age group) and a three-fold increase in this number is expected in the next 50 years (18). Regarding the NRS 2002 scoring system in our study, there were 636 patients (24.8%) older than 70 years. Therefore, in our cross-sectional single centre study,

a relatively higher percentage of elderly people were hospitalised compared with the normal population distribution. When we considered the nutritional status of those patients, 46.4% had a BMI within the normal range, of whom 3.0% had normal nutritional status (NRS score =0). However, the vast majority of those patients required rescreening (71.2%) and 25.8% had malnutrition risk according to the NRS 2002. Regarding the higher rate of complications with enteral nutrition in this age group, such as intolerance, hypernatraemia, hyperglycaemia and diarrhoea (17,19), we suggest careful patient selection and frequent rescreening.

Risk screening in general can fulfil at least two roles. First, it should help to identify or predict the risk of developing a condition and the features associated with it, including complications, death, resource use and costs (19). Second, the information should assist health care providers or planners in allocating resources and should help insurers to design life insurance policies (19). This study provides analysis of our experiences with NRS 2002 in a large sample from a single institution. The NRS 2002 was a convenient screening tool that required minimal training and no new technology (*i.e.* only a weighing scale was necessary). Depending on our experiences, we can conclude that the NRS 2002 is reliable for predicting malnutrition and has a predictive value on patient prognosis through LOS. Further community-based studies are needed to assess the impact of the NRS 2002 on reducing healthcare costs.

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Informed Consent: Written informed consent was obtained from patients who participated in this study.

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