CLINICAL SCIENCE OF NUTRITION
Clin Sci Nutr. 2025;7(1):22-29
Research Article
DOI: 10.62210/ClinSciNutr.2025.101

Nutritional risk assessment with NRS-2002 in inpatients hospitalized neurology clinic: A single center cross-sectional study

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Cite this article as: Uzdil Z, Devrez ÖN, Kaya S. Nutritional risk assessment with NRS-2002 in inpatients hospitalized neurology clinic: a single center cross-sectional study. *Clin Sci Nutr*. 2025;7(1):22-29.

ABSTRACT

Objective: Long-term illnesses and hospitalizations can negatively affect the nutritional status of individuals, and have a risk for malnutrition. Nutritional status of patients in clinics are important during the treatment process. The aim of this study was to evaluate the nutritional status of inpatients in a neurology clinic.

Methods: This cross-sectional study was conducted on inpatients receiving treatment in neurology clinic. The characteristics of patients were questioned using a questionnaire form. Anthropometric measurements (body height, body weight, mid-upper arm circumference, and calf circumference) were taken, and nutritional risk assessment (with Nutritional Risk Screening – 2002) and biochemical data (hemoglobin, hematocrit, albumin, and vitamin B12) were evaluated. $p<0.05$ was considered statistically significant.

Results: A total of 100 patients, between the ages of 18-86 years were included. The nutritional risk screening scores of patients who stated they had no appetite and non-smoking patients are higher. As the length of hospital stay increases, risk of malnutrition increases and when modeling according to age, gender, and smoking according to the regression analysis still positively affected. As mid-upper arm circumference and calf circumference decreases, the risk of malnutrition increases. Another results of regression analysis is that as hemoglobin and hematocrit decreases, risk of malnutrition increases.

Conclusion: This study showed that patients at risk of malnutrition had low hematocrit levels and was negatively affected by mid-upper arm circumference and calf circumference. Also malnutrition was negatively affected by hospital length of stay. These results reveal importance of nutritional screening in patients hospitalized in the neurology clinic.

Keywords: malnutrition, neurology, nutritional status, nutrition evaluation, NRS-2002

Introduction

The situation resulting from inadequate and unbalanced intake of energy and protein due to excessive nutritional loss or increased catabolism is defined as malnutrition.[1] European Society for Clinical Nutrition and Metabolism (ESPEN) describes malnutrition: "a nutritional condition that has significant adverse clinical effects on tissue or body (means body shape, size, and composition) and functions due to insufficiency or imbalance of "energy, protein, and other nutrients".[2] Malnutrition is common in patients with severe and chronic diseases, and it can

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Received: August 21, 2024 **Accepted:** January 10, 2025
Published: April 25, 2025

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increases morbidity, mortality, and reduces the quality of life. Interaction between nutrition and neurology is increasingly the subject of research. Various studies are showing that malnutrition and nutritional deficiencies are the cause and consequence of specific neurological pathologies. Malnutrition has been shown to cause or exacerbate neurological symptoms and disorders. It is also known that some neurological diseases (such as autism spectrum disorders, dementia, Parkinson's disease, and stroke) lead to increased susceptibility to nutritional deficiencies and feeding difficulties.[3]

Malnutrition (disease-related) is a significant health problem for developing countries. Various studies have reported the prevalence of malnutrition as 20-50% in hospitalized patients. Malnutrition has many negative consequences, such as prolonged hospital stays, increased morbidity and mortality, and hospital costs.[4,5] Neurological patients experience feeding difficulties due to various factors such as neurological deficits and age-related problems such as dementia, dysphagia, and edentulism.[4-7] Patients with dementia may lose their ability to feed and maintain regular meal patterns due to cognitive difficulties and memory loss. In the case of paralysis or impairment of voluntary movements, patients may experience severe problems in handling and swallowing food.[4,8] Dysphagia is a condition characterized by difficulty swallowing, is another determining factor in malnutrition, and its prevalence has been shown in various studies to be over 30% in people with neurodegenerative diseases.[9-11] For all these reasons, this patient population may face malnutrition. It is also important to emphasize that neurological deficits are often associated with nutrition and various comorbidities affecting nutritional status.[12] For all these reasons, detection of malnutrition in these patients and early nutritional support, the rate and cost of malnutrition can be reduced, and the hospital length of stay (LOS) of patients can be shortened.

Main Points

- Having no appetite is associated with higher NRS-2002 scores.
- The hematocrit value is significantly higher in patients without malnutrition.
- Lenghth of stay in hospital is related with risk of malnutrition.
- Degrease in mid-upper arm circumference and calf circumference are related with risk of malnutrition.

It was aimed to evaluate the nutritional status of inpatients in a neurology clinic, and also it was aimed to determine potential correlations between malnutrition risk and variables of clinical interest, and LOS in this study.

Materials and Methods

This cross-sectional study was carried on inpatients receiving treatment at Ondokuz Mayıs University Health Application and Research Centre of Neurology Clinic between January 17th and April 25th, 2022. Patients were informed about the study, and their verbal voluntary consent was obtained, and they were included. The characteristics of patients evaluated within the scope of the study were questioned using a questionnaire form. Anthropometric measurements were taken, and nutritional risk assessment and biochemical data were evaluated.

Data collection tools

Patient data were evaluated using a questionnaire form, anthropometric measurements were taken, and hospital records were used to identify biochemical characteristics by researchers.

Questionnaire form

Questions to determine patients' demographic characteristics, disease information, and nutritional habits were asked face to face and using a questionnaire form.

Anthropometric measurements

Anthropometric measurements that is including "body height (m), body weight (kg), mid-upper arm circumference (MUAC-cm), and calf circumference (CC-cm)" were taken. Body mass index (BMI) was used and calculated from weight/height.[2] It was calculated and classified reference of World Health Organization's BMI classification for adults.[13]

Biochemical measurements

Biochemical measurements of the participants were evaluated from hospital records that is the most commonly tested biochemical parameters related to nutritional status in all patients during their hospitalization. No

additional blood samples were taken from the patients. Serum hemoglobin (Hb), hematocrit (Htc), albumin, and vitamin B_{12} were evaluated. These parameters were analyzed with a Roche Diagnostic Cobas 8000 device.

Determination of malnutrition

Nutritional risk screening-2002 (NRS-2002) was performed to determine malnutrition. It is one of the screening tests recommended for hospitalized patients to evaluate malnutrition developed by ESPEN.[14] Weight loss, nutritional intake, BMI, disease severity score are evaluated in NRS-2002, and age correction in patients over 70 years of age. It is classified as without risk of malnutrition (RM) (<3 points), and risk of malnutrition (RM) (≥3 points).[15]

Ethical approval and informed consent statements

The Declaration of Helsinki were complied with in the study, and ethics committee permission dated 08.12.2021 and numbered 2021/629 was obtained from Ondokuz Mayıs University Clinical Research Ethics Committee.

Analysis of data

The data of study was analyzed with Statistical Package Program for Social Science (SPSS) for Windows 21.0 program. Continuous parametric data were presented as mean ($\overline{X}$) and standard deviation (SD), non-parametric data as median (min-max), and categorical data as number (n) and percentage (%). The Kolmogorov-Smirnov test was used to evaluate distribution of normality. Independent Sample T-test between parametric pairs, One Way Anova test between more than two groups; Non-parametric Mann Whitney U test was used between two groups, and Kruskal Wallis test was performed between more than two groups. Linear regression analysis was performed to find the relationship between NRS-2002 socres with length of stay in the hospital and nutritional status, including anthropometric and biochemical measurements. $p<0.05$ was considered statistically significant.

Results

A total of 100 patients, 48 females (48.0%) and 52 males (52.0%) between the ages of 18-86 years were included in this study. The descriptive characteristics are given in Table 1. Their mean age was 56.9±18.8 years. The patients treated in the service for complaints which are cerebrovascular disease (46%), epilepsy (10%), myasthenia gravis (6%), multiple sclerosis (5%), other diseases (33%) (patients with diagnoses and complaints of amyotrophic lateral sclerosis, diplopia, encephalitis, neuromuscular disease, guillain-barre syndrome, encephalopathy, polyneuropathy, ptosis, headache, cerebral hemorrhage, sarcoidosis, myelitis, walking difficulty, weakness, double vision, transient ischemic attack, optic neuropathy, Parkinson's disease, plexopathy, Alzheimer's disease and lumbar disc herniation) were evaluated in this study. The length of hospital stay of patients varied between 1-20 days (Median = 4 days). The nutritional route of patients are oral, parenteral, and enteral (respectively 97%, 2% and 1%). Patients' NRS-

Table 1. Distribution of patients according to descriptive characteristics and NRS-2002 scores of groups

Variables	n	%	NRS-2002 (p)
Gender			0.385*
Women	48	48.0	
Men	52	52.0	
Age groups (years)			0.596**
18-45	25	25.0	
46-64	31	31.0	
> 65	44	44.0	
Education level			0.402**
Not literate	11	11.0	
Primary school	42	42.0	
Secondary school	16	16.0	
High school	23	23.0	
Undergraduate	8	8.0	
Working status			0.909*
Yes	20	20.0	
No	80	80.0	
Marital status			0.207*
Married	71	71.0	
Single	29	29.0	
Mobilization			0.123*
Yes	72	72.0	
No	28	28.0	

NRS-2002: Nutritional risk screening-2002, ᵞ p<0.05, * Mann Whitney U test, **Kruskal Wallis test

2002 scores were between 0-6 and had similar NRS-2002 scores according to gender, age groups, education level, employment status, marital status, presence of chronic disease, and mobilization (p>0.05).

Distribution of patients' eating habits and groups according to NRS-2002 scores is given in Table 2. The NRS-2002 scores do not differ according to drinking alcohol, skipping meals, and BMI. Patients who stated they had no appetite have higher NRS-2002 scores (p<0.05). Also non-smoking patients have higher NRS-2002 score (p<0.05).

A comparison of anthropometric measurements and biochemical values of patients with and without malnutrition is given in Table 3. The BMI, MUAC, and CC measurements did not differ according to malnutrition. Among biochemical measurements, the Htc value was significantly higher in patients without malnutrition (p<0.05).

Table 2. Distribution nutritional habits of patients and groups according to NRS-2002

Variables	n	%	NRS-2002 Median (Min-Max)	p
Smoking				**0.007**$^{*,\gamma}$
Yes	18	18.0	0(0-3)	
No	82	82.0	1(0-6)	
Drinking alcohol				0.462*
Yes	3	3.0		
No	97	97.0		
Meal skipping				0.363**
Yes	49	49.0		
Mid morning	6	12.2		
Lunch	29	59.2		
Afternoon	7	14.4		
Dinner	1	2.0		
Night	6	12.2		
No	51	51.0		
Appetite status (self-reported)				**0.002**$^{*,\gamma}$
Yes	75	75.0	0 (0-5)	
No	25	25.0	2(0-6)	
Body mass index classification				0.076**
Underweight	4	4.0		
Normal	36	36.0		
Overweight	31	31.0		
Obesity	29	29.0		
RM				
Yes	29	29.0		
No	71	71.0		

$^{\gamma}$ p<0.05, * Mann Whitney U test, **Kruskal Wallis test, NRS-2002: nutritional risk screening-2002, RM: risk of malnutrition

Table 3. Anthropometric measurements and biochemical values of patients with and without malnutrition

Variables	PWM	PWNM	p
	$\overline{X}$±SD	$\overline{X}$±SD	
Anthropometric measurements			
BMI	26.7±5.4	26.8±4.9	0.982
MUAC	29.2±5.4	30.9±4.6	0.117
CC	58.2±9.4	60.2±9.1	0.337
Biochemical measurements			
Albumin	3.4(0-5.1)	3.9(0-12.7)	0.534
Hb	12.9±1.6	13.6±1.5	0.096
Htc	36.3±3.9	39.2±4.6	**0.006**ᵞ
Vitamin B_{12}	387(113-1090)	358(162-1381)	0.686

ᵞp<0.05, BMI: body mass index, CC: calf circumference, Hb: hemoglobin, Htc: hematokrit, NRS-2002: nutritional risk screening-2002, PWM: patients with malnutrition risk, PWNM: patients with no malnutrition risk, MUAC: Mid-upper arm circumference

Table 4. Linear regression analysis between NRS-2002 with length of stay in hospital, and nutritional status including anthropometric measurements and biochemical measurements

Variables	n	Crude Model			Adjusted Model		
		Beta	t	p	Beta	t	p
LOS (day)	100	0.246	2.513	**0.014**ᵞ	0.246	2.460	**0.016**ᵞ
BMI (kg/m$^{2)}$	100	-0.143	-1.425	0.157	-0.093	-0.689	0.494
MUAC (cm)	100	-0.263	-2.693	**0.008**ᵞ	-0.246	-2.467	**0.015**ᵞ
CC (cm)	100	-0.197	-1.986	**0.050**ᵞ	-0.192	-1.874	0.064
Albumin (g/dl)	64	0.024	0.193	0.848	-0.030	-0.214	0.831
Hb (g/dl)	80	-0.248	-2.260	**0.027**ᵞ	-0.174	-1.581	0.118
Htc (%)	80	-0.332	-3.113	**0.003**ᵞ	-0.284	-2.637	**0.010**ᵞ
Vitamin B_{12} (pg/ml)	63	-0.013	-0.101	0.920	-0.093	-0.689	0.494

ᵞp<0.05, β: Beta coefficient, BMI: body mass index, CC: calf circumference, Hb: hemoglobin, Htc: hematokrit, LOS: hospital length of stay, MUAC: Mid-upper arm circumference, t: t-statistics, SE: Standard error. Each model is adjusted by age, gender, and smoking. Significant results are shown in bold.

The linear regression analysis of between NRS-2002 score with length of stay in hospital and nutritional status, including anthropometric measurements and biochemical measurements, is given in Table 4. As the LOS increases, RM increases (β=0.246, p=0.014) and when modeling according to age, gender, and smoking according to the regression analysis still positively affected (β=0.246, p=0.016). According to the regression analysis, as MUAC (β=-0.263, p=0.008) and CC (β=-0.197, p=0.050) decreases, the RM increases. The NRS-2002 was still affected by MUAC when modeling according to age, gender, and smoking (β=-0.246, p=0.015). As Hb (β=-0.248, p=0.027) and Htc (β=-0.332, p=0.003) decreases, the RM increases according to the regression analysis. This relationship for Htc was also observed when modeling was performed according to age, gender, and smoking (β =-0.284, p=0.010).

Discussion

Malnutrition is common in hospitalized patients due to various factors, such as underlying diseases and comorbidities that prevent proper nutrition. Malnutrition

is also a common risk in neurological patients due to feeding difficulties and/or inability to communicate or meet nutritional needs, as well as therapeutic interventions.[4] In this study, the risk of malnutrition was detected in 29% of patients hospitalized in the neurology clinic. Similarly, in the study conducted in a neurology clinic, the risk of malnutrition was found to be 28.4%.[16] A retrospective study conducted in the neurology clinic determined that patients faced a 53.8% risk of malnutrition in hospitalization.[17] The different rates of malnutrition risk in the studies may be due to the difference in the scales and sample numbers. It is important to routinely screen hospitalized patients for malnutrition because these patients are at risk for malnutrition. The NRS-2002 is a nutritional screening tool, also recommended by ESPEN, that detects the presence of malnutrition and the risk of malnutrition in the hospital environment. It is a test that questions the severity of the disease and includes age in the scoring, in addition to weight loss, body mass index, and oral intake.[18]

In this study, no significant relationship was found between the risk of malnutrition and demographic information and nutritional habits, except for smoking status. Non-smoking patients have higher NRS-2002 score. Unlike our study, in the literature[19], cigarette consumption is associated with the risk of malnutrition. While finding a different result in our study may be a statistical coincidence, in this study only consumption was questioned and no further evaluation was made to question the duration and amount of smoking. The 25% of the patients declared that their appetite was not good. The percentage of patients with loss of appetite is approximately similar to the percentage of patients with malnutrition risk (PWM) (Table 2). A positive relationship was found between the hospital length of stay and the risk of malnutrition. And according to the regression analysis, the same result was found when modeling was done according to age, gender and smoking status. Similarly, it was conducted on patients hospitalized in the neurology department, a strong correlation was found between the duration of hospital stay and the risk of malnutrition.[1] In neurological diseases, nutritional problems and comorbidities that develop due to the disease may increase the risk of malnutrition. Another factor that may increase the risk of malnutrition in patients may be the hospital diet.

Malnutrition in patients can be assessed through anthropometric measurement and evaluation of nutritional status, muscle function and strength, laboratory tests such as albumin, prealbumin and transferrin, immune and inflammatory biomarkers, and quality of life assessment. Many laboratory parameters such as albumin, prealbumin, Hb, Htc and total protein are used as determinants of malnutrition even in the presence of chronic inflammation.[20] The protein most studied in diagnosing malnutrition is albumin. High or low levels of albumin in the body can be attributed to various factors such as food intake, especially protein, inflammatory response, and malnutrition.[21] Our study found no significant relationship between albumin level and malnutrition risk. Serum albumin has prognostic value only for the prevalence of malnutrition, where there is a relationship between serum albumin levels and malnutrition. Still, it cannot be used as a marker of nutritional status. Albumin is a better indicator of inflammation than nutritional status.[22] The half-life of albumin is 20 days, and a decrease in serum levels can occur in long-term malnutrition, assuming the hydration is kept constant.[23] Many studies in the literature have found that albumin, prealbumin, total protein, hemoglobin and low total cholesterol are associated with the risk of malnutrition.[24] In our study, hematocrit values were higher in patients without malnutrition risk than in those with malnutrition risk. Another study found low albumin, high C-reactive protein, and high creatinine levels in patients at risk of malnutrition.[16] It has been shown that the more severe the degree of malnutrition in cancer patients, the lower the average Hb level.[25] Mid-upper arm circumference is a good indicator of skeletal muscle and protein mass. Reduction in subcutaneous fat and overall body muscle mass is an essential indicator of malnutrition.[26] According to the regression analysis in our study, the risk of malnutrition was negatively affected by MUAC and CC. Another notable finding was that the risk of malnutrition was still affected by MUAC when modelled by age, gender, and smoking. This reflects that malnutrition will reduce lean body mass due to the breakdown of energy reserves from sources other than fat stores.

Studies on the nutrition of hospitalized patients mostly cover intensive care units, oncology, surgery and internal services.[27-30] In addition, it is important to evaluate the nutritional status of patients in other services where there are problems that may affect nutritional intake, such as patients being hungry for examination, presence of infection, hospital psychology, etc., for the success of the treatment. In addition to these features, it may affect the gastrointestinal systems of patients and cause dysfunction due to neurological symptoms, and may affect individuals' appetite and food intake.[31] The results of this study aimed to draw attention to the fact that

patients hospitalized in neurology services may also be at risk of nutritional deficiency and that patients should be regularly screened for nutrition.

This study has some limitations that it was conducted in a single center, not have control group, not evaluated food consumption records, and the disease distribution of patients in the neurology clinic differed. The design of the study is cross-sectional, and a cross-sectional study has limitations. Additionally, another limitation is that we could only use routine biochemistry results. In terms of generalizability of the results, there is a need to increase the number of multicenter samples to evaluate the effect of nutritional support on clinical outcomes.

Conclusion

Malnutrition was detected in approximately one-third of the patients participating in the study. Our research showed that patients at risk of malnutrition had low hematocrit levels. The malnutrition risk was positively affected by hospital length of stay and was negatively impacted by MUAC and CC. Nutritional support appropriate to the needs of the patient and the disease is essential. The presence of malnutrition should be detected at an early stage, which may negatively affect the clinical course of patients, and to establish hospital protocols for using nutritional screening tools during hospitalization as a part of medical treatment. The initiation of diet or nutritional counseling may complement it. To consider food consumption records of patients and if they need additional support to start rigorous nutritional intervention early may also prevent more serious nutritional complications during the disease process.

Ethical approval

This study has been approved by the Ondokuz Mayıs University Clinical Research Ethics Committee (approval date 08.12.2021, number 2021/629). Written informed consent was obtained from the participants.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: ZU, OND; data collection: OND; analysis and interpretation of results: ZU, SK; draft manuscript preparation: ZU, OND, SK. All authors reviewed the results and approved the final version of the article.

Source of funding

The authors declare the study received no funding.

Conflict of interest

The authors declare that there is no conflict of interest.

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