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Nutrition Risk in Hospitalized Patients with Acute Exacerbation of COPD: A Comparative Analysis of the Nutritional Screening Tools Accuracy

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Abstract

Background: Around half of chronic obstructive pulmonary disease (COPD) patients present nutritional risk when evaluated by Nutritional Risk Screening 2002 (NRS-2002) in the majority of studies. However, the performance of other nutritional screening tools has not been explored in the detail according to the literature. This study aimed to compare the concurrent validity of four nutritional risk screening tools in hospitalized patients with acute exacerbation of COPD.

Methods: A cross-sectional study with patients admitted for exacerbation of COPD. Nutritional risk screening was performed in the first 72 hours of hospitalization by NRS-2002 (reference method), Malnutrition Screening Tool (MST), Malnutrition Universal Screening Tool (MUST), Nutritional Risk in Emergency 2017 (NRE-2017), and Short Nutritional Assessment Questionnaire (SNAQ).

Results: We evaluated 241 patients (68.3 ± 10.2 years, 53.5% women), and the prevalence of nutritional risk ranged from 36.1 to 54.8%. MST, MUST, and SNAQ showed similar accuracy (AUC ROC >0.790), and were significantly higher than the NRE-2017 (AUC=0.742) when compared to the NRS-2002. The MST showed substantial agreement with the NRS-2002, while the other tools demonstrated moderate agreement (Kappa<0.600).

Conclusion: More than 35% of patients hospitalized for exacerbation of COPD presented a nutritional risk. The use of the MST is suggested for nutritional screening in this population due to its accuracy and sensitivity consistent with NRS-2002 screening tool in addition to it being simple, fast, and with easy applicability.

Keywords: Nutrition screening; Malnutrition; Chronic obstructive pulmonary disease; COPD; Hospitalization

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is highly prevalent: an estimated 15 to 43 million cases in developing countries [1]. It involves systemic manifestations, in which malnutrition stands out. In emerging countries, between 23.5 and 71.5% of these patients are malnourished, being more frequent in those with acute exacerbations of COPD.

Acute exacerbations are periods of respiratory symptoms worsening that can lead to hospitalization, in addition to contributing to malnutrition [2]. Such impairment of nutritional status is due to the combination of a negative energy balance (Reduced food intake and increased energy expenditure due to increased respiratory work) associated with stress and the systemic inflammatory effects of the disease, the drug therapy instituted, and muscle disuse intensification. Malnutrition in hospitalized COPD patients is associated with a prolonged length of hospital stay (LOS), increased risk of additional exacerbations, and increased frequency of readmissions [3-8]. Therefore, this reinforces the need to identify nutritional risk early during hospital admission in order to guide adequate nutrition care [5]. Nutrition screening is the first step in the nutrition care process and thus demands a validated tool [9].

There are many nutritional risk screening tools validated for hospital settings, which differ by the number and complexity of their components. Among the most studied tools are the Malnutrition Screening Tool (MST), the Short Nutritional Assessment Questionnaire (SNAQ), the Malnutrition Universal Screening Tool (MUST), and the Nutritional Risk Screening 2002 (NRS-2002) [10-12]. The Brazilian Nutritional Risk in Emergency 2017 (NRE-2017) tool was recently developed and validated for adult/elderly patients admitted to emergency services [13]. Most studies carried out nutritional risk screening involving COPD patients, used tool NRS-2002, and found nutritional risk ranging from 48.8 to 55.6% [14-19]. In addition, this is the tool primarily used in studies at Pulmonology Department, as evidenced in a systematic review that included 12 studies, and 11 of them used NRS-2002, whose nutritional risk prevalence ranged from 31.1 to 34.1% [20].

Nutritional risk in COPD patients is associated with advanced disease stage, worse quality of life, higher hospital readmission frequency, and lower 1-year survival [15-17]. Thus, nutritional risk screening in COPD patients at hospital admission is of paramount

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importance [17-21]. However, the NRS-2002 considers the metabolic stress of COPD low, which is not consistent in acute exacerbations, and this tool requires obtaining anthropometric measurements, usual weight, and food intake (not always available in the hospital admission) [22]. For this reason, the accuracy of simple, quicker, and easy tools requires investigation. Furthermore, international institutions still lack consensus on the gold-standard for screening tools and there is the recommendation to compare performance among different tools in the same population. Therefore, the present study aimed to compare the accuracy of four nutritional risk screening tools in hospitalized patients with acute COPD exacerbation [23].

Methods

Design

We performed a cross-sectional study in a Brazilian public hospital approved by the Local Ethical Committee (Approval number 3.126.689) and conducted it according to the Brazilian resolution for ethics in research involving humans. All participants signed the research informed consent form before data collection.

Sample

Patients admitted with a clinical diagnosis of COPD exacerbation registered in the electronic health record composed the sample. We included in the study patients aged >18 years, lucid, oriented, and able to stand, and excluded patients with fluid retention (Edema or Ascites), as these could mask signs of muscle mass loss in the physical exam, and those with upper or lower limbs amputation or were bedridden, whose conditions made it impossible to measure weight and height on an anthropometric scale.

For sample size calculation we considered: the mean prevalence of nutritional risk in patients with lung diseases (33%),20 the estimated value of 600 COPD patients admitted annually in hospital pulmonology ward, considering 80% power and 5% significance level, with an additional 20% for potential adjustments in multivariate analysis. It resulted in a sample size of 215 patients.

Study Protocol

Data were collected between March 2019 and February 2020 within the first 24 to 72 hours after hospital admission by four previously trained researchers. The researchers collected sociodemographic characteristics (age, sex, origin, ethnicity, marital status, and years of study) and clinical data [date and the reason for admission, medical history, and results from spirometry tests performed up to one year before hospitalization, including Forced Expiratory Volume in the first second (FEV1), Forced Vital Capacity (FVC), and the ratio FEV1/FVC] from electronic health records.

We classified the COPD severity in four stages, 1 (mild), 2 (moderate), 3 (severe), or 4 (very severe), according to Global Initiative for Chronic Lung Disease (GOLD) Spiro metric criteria; and the dyspnea severity according to the patient perceptions, using the modified Medical Research Council (mMRC) scale (Brazilian validated version): considering scores >3 points as limitations in daily activities due to dyspnea [24, 25].

The nutritional risk screening was performed with five tools: MST, SNAQ, MUST, NRS-2002, and NRE-2017 [10-13]. Table 1 summarizes the variables from each tool and its respective scores for the classification of nutritional risk [14]. We categorized nutritional risk by all tools in two categories (with or without nutritional risk), aiming to standardize the comparisons. For screening tools with more than two risk categories (MUST and SNAQ), we've grouped the patients classified as at medium/moderate and high risk into the nutritional risk category.

During nutritional anamnesis, patients answered a structured interview contemplating the questions from the screening tools: unintentional weight loss (last six months), usual body weight, reduced food intake/appetite (previous two weeks and month), enteral tube feeding, or high calorie and protein oral nutritional supplements use (last 30 days), and food consistency change (last two weeks), and likely to be no nutritional intake for >5 days. Regarding food intake assessment, the patients selected on a percentage scale (0%, 25%, 50%, 75%, and 100%) that best represented their food consumption in the previous weeks concerning the habitual.

As a component of the NRE-2017 tool, [14] we performed a physical exam to assess muscle mass loss, inspecting the temples, clavicles, quadriceps, and gastrocnemius muscles, with its magnitude classified as absent, mild, moderate, or severe [26].

Table 1: Nutritional risk screening employed in the current study: tools, criteria, points, and classification.

Nutritional risk Criteria	MST	MUST	NRE-2017	NRS-2002	SNAQ
Body mass index		X		X	
Weight loss %		X		X	
Weight loss patient-reported	X		X		X
Reduced food intake/ appetite	X		X	X	X
Use of nutrition supplements/enteral tube feeding					X
Food consistency change			X		
Likely to be no nutritional intake for >5 days		X			
Severity of disease			X	X	
Loss of muscle mass moderate/severe in the physical exam			X		
Age			X	X	
Points for nutritional risk classification					
Classification	MST	MUST	NRE-2017	NRS-2002	SNAQ
No risk	<2	0	<1.5	<3	<2
At-risk	**≥2**	**≥1[a]**	**≥1.5**	**≥3**	**≥2[a]**

A Patients classified as being at medium and high nutritional risk were grouped into the at nutritional risk category.

Abbreviations: MST, Malnutrition Screening Tool; MUST, Malnutrition Universal Screening Tool; NRE-2017, Nutritional Risk in Emergency 2017; NRS-2002, Nutritional Risk Screening 2002; SNAQ, Short Nutritional Assessment Questionnaire.

The severity of disease rating respected the tool applied: as mild for the NRS-2002 (as this tool considers the metabolic demand of COPD); and as high for the NRE-2017 (acute condition) [13]. MUST classification also considered the disease severity by assessing the likelihood of patients not receiving nutrition for more than five days [14]. Patients older than 65 years and those aged 70 years or over received additional point in the NRE-2017 (0.25 point) and NRS-2002 (1.0 point) scores, respectively [12].

To complete the NRS-2002 [13] and MUST tool [12], we measured the body weight (kg) and height (cm) using weight scale (Plena®) and audiometer portable (Sanny®), respectively. For this anthropometric evaluation, patients wore light clothing and were barefoot. After it, we calculated the body mass index, the amount (kg), and the percentage of weight loss (usual body weight – current body weight] × 100/usual body weight).

Statistical analysis

Mean and standard deviation (Parametric variables) or median and interquartile range (Nonparametric variables) described the continuous variables, while absolute and relative frequencies expressed the categorical variables. The Kolmogorov-Smirnov test assessed the normality of the variables.

The agreement among nutritional risk screening tools with the NRS-2002 (Reference method) was analyzed applying the kappa coefficient, classified as: <0.20 poor; 0.21-0.40 fair; 0.41-0.60 moderate; 0.61-0.80 substantial; and >0.8 almost perfect. The accuracy of the MUST, MST, SNAQ, and NRE-17 to identify nutritional risk using NRS-2002 as the reference method was assessed based on the area under the curve (AUC) by the Receiver Operating Characteristic (ROC) and data on sensitivity, specificity, and positive and negative predictive values [27]. To consider the tool's performance satisfactory, we determined values >70% for sensitivity and specificity as a prerequisite [28]. We used the SPSS version 21.0 for the statistical analysis. The comparison of AUCs from the nutrition screening tools used the De Long test in the MedCalc Statistical Software [29]. Values of p<0.05 were considered statistically significant [30].

Results

The study included a total of 241 patients, the mean age was 68.3±10.2 years, and most of them were women (n = 129; 53.52%) and white ethnicity (n = 197; 81.7%). In the sample, patients reported 5.0 (3.0-5.0) years of study, 71.0% (n=171) were ex-smokers, 23.5% (n=57) were active smokers, and 5.4% (n= 13) had never smoked. The median smoking time was 40 (30-50) years, and majority patients (n = 196; 81.3%) had limitations in functional capacity on daily activities according to the mMRC scale.

Table 2 presents the clinical and nutritional characteristics of the sample. Among the 241 patients included in this study, spirometry test data were available for 140 (58.0%), prevailing the severe (n=57; 40.7%) and moderate (n=52; 37.1%) stages of COPD, according to the GOLD criteria. The median LOS was 11 (7-18) days, and in-hospital death was 7.5% (n = 18). The relative frequency of patients at nutritional risk was different among the screening tools: 54.8% (n =132) of patients were at nutritional risk by the NRS-2002, 47.7% (n = 114) by the NRE-2017, 44.4% (n = 107) by the MST, 40.7% (n = 98) by the SNAQ and 36.1% (n = 87) by the MUST.

Table 3 shows the concurrent validity of the screening tools to identify nutritional risk using NRS-2002 as the reference method.

Table 2: Clinical and nutrition characteristics in hospitalized patients with exacerbation of COPD at first 72 h admission, throughout March 2019 and February 2020, in Brazil.

Characteristics	Descriptive Statistics
Clinical characteristics (n =140)	
GOLD stage	
1	5 (3.6)
2	52 (37.1)
3	57 (40.7)
4	26 (18.6)
FEV_1 (%)	56.84 ± 18.89
FVC (%)	60.40 ± 17.40
FEV_1/FVC (%)	72.28 ± 22.73
Nutrition characteristics (n =241)	
Current weight (kg)	66.76 ± 21.64
Usual weight (kg)	68.94 ± 20.51
Weight loss (n)	120 (49.8)
Magnitude weight loss (%)	7.69 [3.84 – 14.56]
Body mass index (kg/m²)	26.84 ± 8.28
Loss of muscle mass in the physical exam	125 (51.9)
Reduced food intake/ appetite	99 (41.1)
Changing of food consistency	61 (25.3)
Nutritional supplements in last 30 days	14 (5.8)

Note: Data presented as absolute (relative) frequency, mean ± standard deviation, or median [P25-P75].

Abbreviations: FEV_1, Forced expiratory volume in the first second; FEV_1/FVC, Ratio of the forced expiratory volume in the first second to the forced vital capacity; FVC, Forced vital capacity.

Table 3: Concurrent validity of nutritional risk screening tools considering the NRS-2002 as the reference method in hospitalized patients with exacerbation of COPD at first 72 h admission, throughout March 2019 and February 2020, in Brazil.

Nutrition Screening Tool	AUC ROC curve	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Kappa (P value)
MST	0.834 (0.781 - 0.888)	74.2	92.6	91.6	74.6	0.654 p< 0.001
MUST	0.796 (0.788 - 0.863)	62.9	96.3	95.4	68	0.57 p< 0.001
NRE-2017	0.742 (0.678 - 0.806)	65.7	78.2	80	68	0.477 p< 0.001
SNAQ	0.804 (0.777 - 0.861)	68.2	92.6	91.8	70.4	0.591 p< 0.001

Among the screening tools, MST showed higher accuracy and sensitivity. MST also demonstrated a substantial agreement with NRS-2002, while for the other tools this agreement was moderate (Kappa coefficient between 0.477-0.596).

The comparisons between the AUC of the ROC curves represent the accuracy of the screening tools for nutritional risk identification. There was no significant difference between the AUC of MST and MUST (p = 0.150) and between MST and SNAQ (p = 0.086). However, the AUC of MST was significantly higher than the NRE-2017 (p = 0.002). Likewise, AUC for SNAQ was higher than the NRE-2017 (p = 0.044), while the AUC for MUST did not differ significantly from NRE-2017 (p = 0.072) and SNAQ (p = 0.271).

Discussion

The present study compared the accuracy of different nutritional risk screening tools in patients hospitalized with COPD exacerbation to identify an easy and quick tool for application in hospital pulmonology wards. The prevalence of nutritional risk varied from 36% to 55%, depending on the screening tool applied. Among the tools, the MST showed the highest sensitivity and concordance with the NRS-2002.

Previous studies involving COPD patients showed a prevalence of nutritional risk ranging from 20.7% to 56% [31]. Possible factors that explain this variation include the tool used, the clinical context of patients, and the COPD severity [15]. One study involving 422 stable COPD outpatients identified 22% of these at nutritional risk using the MUST tool, lower than the prevalence of nutritional risk verified among our patients applying the same tool (36.1%) [32]. Similarly, a recent study among ≥ 60 years hospitalized patients detected a prevalence of 36.5% and 23.2% for the risk of malnutrition in COPD with or without exacerbation, respectively, applying the MST tool [33].

Probably such differences are explained by the COPD clinical instability, which tends to contribute to higher nutritional depletion than the stable condition [5, 6].

Studies involving hospitalized COPD patients screened by the NRS-2002 tool demonstrated a nutrition risk prevalence range from 54.6 to 55.6%, in line with our findings from the NRS-2002 application (54.8%) [15, 16, 18 and 34]. Probably, the high proportion of older people included in these studies justifies the presence of nutritional risk in more than half of samples, considering that age equal to or more than 70 years receives an additional point in the risk score by the NRS-2002 [15,18 and 34]. Furthermore, due to worsening respiratory symptoms and loss of appetite, the exacerbation periods tend to reduce food intake 35 and increase protein catabolism favoring weight loss [35]. These two components are also part of the NRS-2002 tool [36].

Compared with the NRS-2002, the MUST, SNAQ, and MST presented similar accuracy to identify nutritional risk among the sample. Noteworthy, the MST tool was the only one with a substantial agreement and sensitivity >70% compared to the reference method. We did not find studies evaluating the concurrent validity of nutritional risk screening tools in patients with COPD. However, two studies involving hospitalized patients from general wards also demonstrate similar and satisfactory accuracy of the MUST, SNAQ, and MST tools compared to NRS-2002. In contrast, among this sample, MUST, SNAQ, and MST tools demonstrated sensitivity values of at least 70%, higher than those found in the current study [28, 37]. The nutritional screening process demands tools with high sensitivity, that is, that generates a low frequency of false-negative results [28, 37]. That is important for carrying out the other nutrition care process steps in patients at nutritional risk (such as nutritional assessment, malnutrition diagnosis, and dietary intervention). Utmost, the timely nutrition care cannot be affected by flawed nutritional screening (misclassification of patients as at no risk), resulting from the tools with low sensitivity use [9].

The presence of nutritional risk in COPD is a prognostic factor according to the literature. However, few studies involving COPD patients evaluated the association between nutritional risk and in-hospital outcomes. In three studies analyzing in-hospital death, the NRS-2002 and MST tools were also unable to predict mortality during hospitalization. However, one study applying the MST tool among patients with COPD exacerbation at nutritional risk had significantly higher LOS (3.5 days) when compared to those without nutritional risk (3 days), although such difference was tiny and its clinical relevance doubtful [18, 21 and 34]. On the other hand, nutritional risk in patients with COPD exacerbation seems to be mortality one year after hospitalization and readmission 30 days after discharge predictor. Unfortunately, in the current study, we did not follow up with the patients until the discharge to investigate the possible predictive validity of nutritional risk in this sample, so this theme requires further investigation in future studies [34]. Probably, for this aim, a large sample size would be necessary.

As already recognized, the ideal nutritional risk screening tool must have simple, easy, fast applicability, and high sensitivity. Concerning these characteristics, compared to the other tools evaluated in our study, the MST showed the best performance; due to its greater sensitivity and substantial agreement with the NRS-2002 [38]. In addition to having simple questions and can be applied by any health professional or family member. Besides, a recent systematic review considered the MST the only tool with a good/strong evidence level, valid and reliable for nutritional risk screening [10]. The Academy of Nutrition and Dietetics (AND) recommends its implementation for all clinical settings [39]. Furthermore, from a pragmatic point of view, compared to the NRS-2002 tool, widely used in studies involving lung diseases patients, the MST tool is easier and quicker; given that it does not depend on the anthropometrics measurement of weight, height, and does not require BMI calculation and a quantitative assessment of food intake [40].

The strengths of the current study are the originality of involving patients admitted for COPD exacerbation, which have clinical particularities to consider in the nutrition care process, and whose literature is scarce. Besides, to our knowledge, this is the first study comparing the accuracy of different nutrition screening tools in these patients. Among the limitations, the interpretations of the results deserve consideration since spirometry tests were unavailable to assess all patients' pulmonary function, making it impossible to investigate a stratified analysis of nutritional risk according to COPD severity.

Conclusion

This study identified nutritional risk in more than 35% of the patient' sample, underscoring the need for screening on the nutrition care process of COPD patients. Our findings suggest the MST tool use in nutritional risk screening of patients hospitalized for COPD exacerbation, given its satisfactory accuracy, sensitivity, and substantial agreement with the NRS-2002 added to its simple, fast, and easy applicability.

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Author contributions

F M Silva and V H Kowalski equally contributed to the conception and design of the research; V H Kowalski, P P Teixeira, K Valduga, and B E Araújo contributed to the acquisition and analysis of the data; F M Silva, and S Bernard's contributed to the interpretation of the data; and V H Kowalski, F M Silva, and S Bernard's drafted the manuscript. All authors critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

Conflict of interest disclosures

The authors have no conflict of interest to declare.

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