

## Comparison of NRS-2002 criteria with nutritional risk in hospitalized patients

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**Abstract** *The Nutritional Risk Screening (NRS-2002) is a gold standard tool in nutritional risk analysis. Thus, the present study aimed to identify which one or which of the criteria evaluated in the NRS-2002 most contribute to determine the nutritional risk. This is a descriptive, cross-sectional and quantitative study with 763 adults and elderly people hospitalized in the year 2015. We applied the NRS-2002, which evaluates the variables Body Mass Index (BMI), weight loss in the last 3 months, reduction of food intake in the last week and severity of the disease. The data statistics was descriptive and analytical, using the univariate logistic regression method. It was observed that 46.4% of the patients presented nutritional risk and that men and the elderly had greater chance of risk. Weight loss was the most prevalent criterion, followed by reduced food intake; BMI < 20.5kg/m<sup>2</sup> had a greater effect on nutritional risk (OR = 31.0, 95% CI: 14.21;67.44). In conclusion, BMI < 20.5kg/m<sup>2</sup> and weight loss in the last three months are the factors that contributed the most in determining nutritional risk, and early identification of nutritional risk is extremely important for guiding dietary management to improvement of food intake with the objective of recovering body weight.*

**Key words** *Nutritional status, Adult, Elderly, Body Mass Index (BMI)*

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## Introduction

Nutritional status can be defined as the result of the relationship between energy, nutrients and micronutrients intake and the needs of the organism, as well as the capacity of digestion, absorption, utilization of nutrients and the interaction of pathological factors<sup>1</sup>. This state, in hospitalized patients, interferes in the clinical evolution due to the increase in the probability of development or worsening of morbidity and mortality<sup>2</sup>. Therefore, the evaluation of such condition in these patients is necessary so that, at an earlier stage, intervention measures are elaborated and applied to those who present some nutritional risk<sup>3</sup>.

To identify patients who are at nutritional risk or at risk of malnutrition, it is necessary to carry out a nutritional evaluation<sup>4</sup>. Among these evaluations, there is the nutritional screening, which consists of the application of a questionnaire to the patient or to their relatives<sup>5</sup>, and that, because it is an easy-to-use, effective-to-reproduce tool and has efficient use time, it has become a recommended method for clinical practice<sup>6</sup>.

Due to the importance of early detecting the nutritional status of hospitalized patients, the Ministry of Health determined through the Ordinance No. SAS 131 of March 8, 2005, the implantation of nutritional screening and evaluation protocols in hospitals linked to the Unified Health System (SUS) for nutritional therapy remuneration<sup>7</sup>. However, these protocols have been rarely used in practice<sup>8</sup>.

The Nutrition Risk Screening NRS-2002 (Nutritional Risk Screening), which aims to detect nutritional risk, was developed in the last decade by Kondrup *et al.*<sup>9</sup> and certified by the European Society for Parenteral and Enteral Nutrition (ESPEN). It stood out by having a good correlation with anthropometric, biochemical parameters, including mortality prediction and greater efficacy when compared to other protocols<sup>3,5</sup>.

Patients at risk should be submitted to a more detailed and objective evaluation so that therapy and individualized nutritional care is established<sup>8</sup>. In this way, it is possible to minimize or prevent the complications of the disease and the treatment, accelerate recovery, reduce expenses and the time of hospitalization<sup>10</sup>.

It is noteworthy that most patients classified at nutritional risk and being followed-up have individually presented a significant reduction in hospitalization time and mortality<sup>11-13</sup>. A study carried out in a university medical center in the

Netherlands showed that the reduction of at least one day of hospitalization results in significant savings to hospitals (approximately US\$ 571.2 for university hospitals)<sup>14</sup>. According to DATASUS<sup>15</sup>, in 2015, a total of 24 billion reais have been spent in Brazil with hospital admissions, which corresponds to an average expenditure of approximately R\$ 1,200 per hospitalization, which highlights the importance of applying nutritional assessment methods.

Therefore, the present study aims to identify in the nutritional screening NRS-2002 which one or which criteria evaluated have most contributed to determine the nutritional risk of hospitalized patients, thus enabling the planning of more targeted nutritional therapy.

## Methodology

This is a cross-sectional and quantitative descriptive study carried out from the implementation of the NRS-2002 as a pilot study, being part of the research project entitled "Characterization, systematization and application of a nutritional risk assessment instrument in University Hospital (UH) patients", approved by the Committee of Ethics in Research with Human Beings (CEP in Portuguese).

The aforementioned UH operates integrally by the Unified Health System (SUS) and develops its work with teaching, research and extension in an outpatient and inpatient system in order to train qualified professionals, as well as improve care and supply the demand of patients, since it serves individuals in medium- and high-complexity multidisciplinary cases in the most diverse outpatient and hospital specialties: Obstetric Clinic, Pediatric Clinic, Medical Clinic, Psychiatric Clinic and Surgical Clinic (General Surgery, Neurological and Gynecological Surgery), of which the latter stands out in the regional level. Approximately 33 municipalities are attended by the hospital, with approximately 800 thousand inhabitants. In 2015, the hospital had 187 beds distributed among infirmaries, maternal-infant area and Adult, Pediatric, Neonatal and Intermediate Care Units, with occupancy rate of 81.3%, average stay rate of 6 days. In the same period, approximately of 3046 hospitalizations were recorded, which represents the great importance of the hospital for public health.

This research was carried out from January to December 2015, and all individuals over 18 years of age of both sexes, having been admitted

for a maximum of 72 hours, regardless of the reason for admission, who agreed to participate and signed the informed consent form or whose person responsible signed it, were invited to participate. Patients hospitalized at the care units: Health Unit II (Surgical Clinic), III (Medical Clinical) and IV (Infectious/Psychiatry Clinic), and psychiatric patients were only evaluated if they had a satisfactory cognitive state, that is, able to answer the screening tool according to medical and nursing assessment. Indigenous patients and pregnant women were excluded since another process of approval by the CEP is necessary for indigenous people, and this screening does not apply to pregnant women.

For this study, the data collection was performed by nutrition course academics duly selected and trained to apply the screening tool. First, information was obtained from the patient's medical record, such as date of birth, date of admission and clinical diagnosis. Anthropometric measurements were performed only once. For weight measurement, a digital scale of the Líder brand (Líder®, Araçatuba, SP) was used, and for the height measurement, a 210-centimeter portable vertical stadiometer of the Altorexata brand (Altorexata®, Belo Horizonte, MG) was used with resolution in millimeters (1 mm) and numbering every centimeter, according to the technique established by the Food and Nutrition Surveillance System (SISVAN)<sup>16</sup>. Patients who were swollen or had ascites were weighed normally and subsequently the weight of the edema or corresponding to the degree of ascites was discounted, as set by James<sup>17</sup>.

In a bedridden patient, an estimation was performed for both weight and height. The indirect method of measurement was used for the weight, taking into account the measures of knee height (KH) measured with pediatric ruler and arm circumference (AC) measured with an inelastic graduated meter of the Sanny brand (Sanny®, São Bernardo do Campo, SP), according to the techniques described by Rosa<sup>18</sup> and calculated by the formula adapted by Chumlea et al.<sup>19</sup>. To estimate the height in order of preference of use: 1<sup>st</sup> recumbent stature, with the individual lying in supine position, completely horizontal bed and the sheet was marked at the height of the extremity of the head and of the foot base, the distance between the marks was measured; 2<sup>nd</sup> demi-span of the arm, also in the supine position and extended arm forming a 90° angle with the trunk, the length between the sternum and the tip of the middle finger was measured and the value found

was multiplied by two<sup>17</sup>; 3<sup>rd</sup> use of the indirect method that takes into account knee height<sup>19</sup>.

Subsequently, the nutritional status of the patients was classified according to the BMI obtained by dividing the body weight (Kg) by the squared height (m<sup>2</sup>), considering the cut points for adults: low weight (< 18.5 Kg/m<sup>2</sup>), eutrophy (18.5 to 24.9 Kg/m<sup>2</sup>), overweight (25 to 29.9 Kg/m<sup>2</sup>) and obesity (> 30 Kg/m<sup>2</sup>)<sup>20</sup>. For the elderly, the cut points were low weight (< 22.9 Kg/m<sup>2</sup>), eutrophy (23 to 27.9 Kg/m<sup>2</sup>), overweight (28 to 29.9 Kg/m<sup>2</sup>) and obesity (> 30 Kg/m<sup>2</sup>)<sup>21</sup>.

The first step is composed of four questions, related to BMI < 20.5kg/m<sup>2</sup>; weight loss in the last three months; reduction of food intake in the previous week and presence of severe illness. If the answer was positive for any of these questions, the second stage was carried out, consisted of the quantification of each criterion according to the nutritional status and severity of the disease, and for patients aged ≥ 70 years old a point was added to the score. A total score < 3 was classified as without nutritional risk and a total score ≥ 3 was classified as with nutritional risk.

The data obtained with the nutritional screening protocol forms were introduced into a database of the statistical program SPSS (version 22.0). Data analysis was performed using a descriptive and analytical statistical approach. In the descriptive approach, the absolute and relative frequencies were distributed for categorical variables and Box Plot's type graphs; and the means, with standard deviation (SD) for continuous variables. For the analytical approach, the univariate logistic regression method was used to evaluate the effect of each variable on nutritional risk, considering a significance level of 5% ( $p < 0.05$ ) and confidence interval (CI) of 95%, with calculation of odds ratios (OR).

## Results

Participants were 763 patients, of whom the majority were men (50.5%). The mean age was  $53.5 \pm 18.1$  years, the mean current weight was  $69.6 \pm 23.6$  kg, the mean height was  $162.7 \pm 8.9$  cm and the mean BMI was  $26.0 \pm 6.0$ kg/m<sup>2</sup>.

Table 1 shows the results of the association of demographic variables, health-related habits and unit of care with nutritional risk. The variables alcohol consumption, smoking and physical activity level have not shown association with nutritional risk ( $p > 0.05$ ). The variables gender and age group have shown association with nutritio-

**Table 1.** Association of demographic variables, health-related habits and care unit with nutritional risk in adult and elderly patients, University Hospital/UFGD, Dourados, MS, 2015.

Variable	No risk		With risk		OR	95% CI	p
	n	(%)	n	(%)			
Gender							
Male	173	22.7	212	27.8	2.04	1.53; 2.72	0.000*
Female	236	31.9	142	18.6	1.00	-	-
Age range							
Elderly	137	18.0	170	22.3	1.83	1.37; 2.46	0.000*
Adult	272	35.6	184	24.1	1.00	-	-
Alcohol consumption							
Yes	94	12.3	84	11.0	1.04	0.74; 1.46	0.808
No	315	41.3	270	35.4	1.00	-	-
Smoking							
Yes	57	7.5	54	7.1	1.20	0.79; 1.84	0.387
Ex-smoker	132	17.3	127	16.6	1.22	0.89; 1.68	0.209
No	220	28.8	173	22.7	1.00	-	-
Physical Activity Level							
Sedentary	347	43.5	312	43.1	0.80	0.30; 2.10	0.649
Mild	54	6.8	33	4.3	0.54	0.19; 1.55	0.253
Moderate	8	0.8	9	1.4	1.00	-	-
Care Unit							
Infectious and Psychiatry Unit	86	11.3	108	14.2	2.12	1.49; 3.04	0.000*
Medical clinic	82	10.7	137	18	2.91	2.05; 4.12	0.000*
Surgical clinic	186	24.4	164	21.5	1.00	-	-

\* significant difference ( $p < 0.05$ ).

nal risk ( $p < 0.000$ ), in which the probability of presenting nutritional risk was 1.83 times higher in elderly patients than in adults. And men were 2.04 times more likely to present nutritional risk than women.

Patients from the Infectious/Psychiatry Care Unit were 2.12 times more likely to present nutritional risk than patients from the Surgical Unit ( $p < 0.000$ ). And patients of the Medical Clinic had 2.91 chances of having nutritional risk than patients of the Surgical Unit ( $p < 0.000$ ).

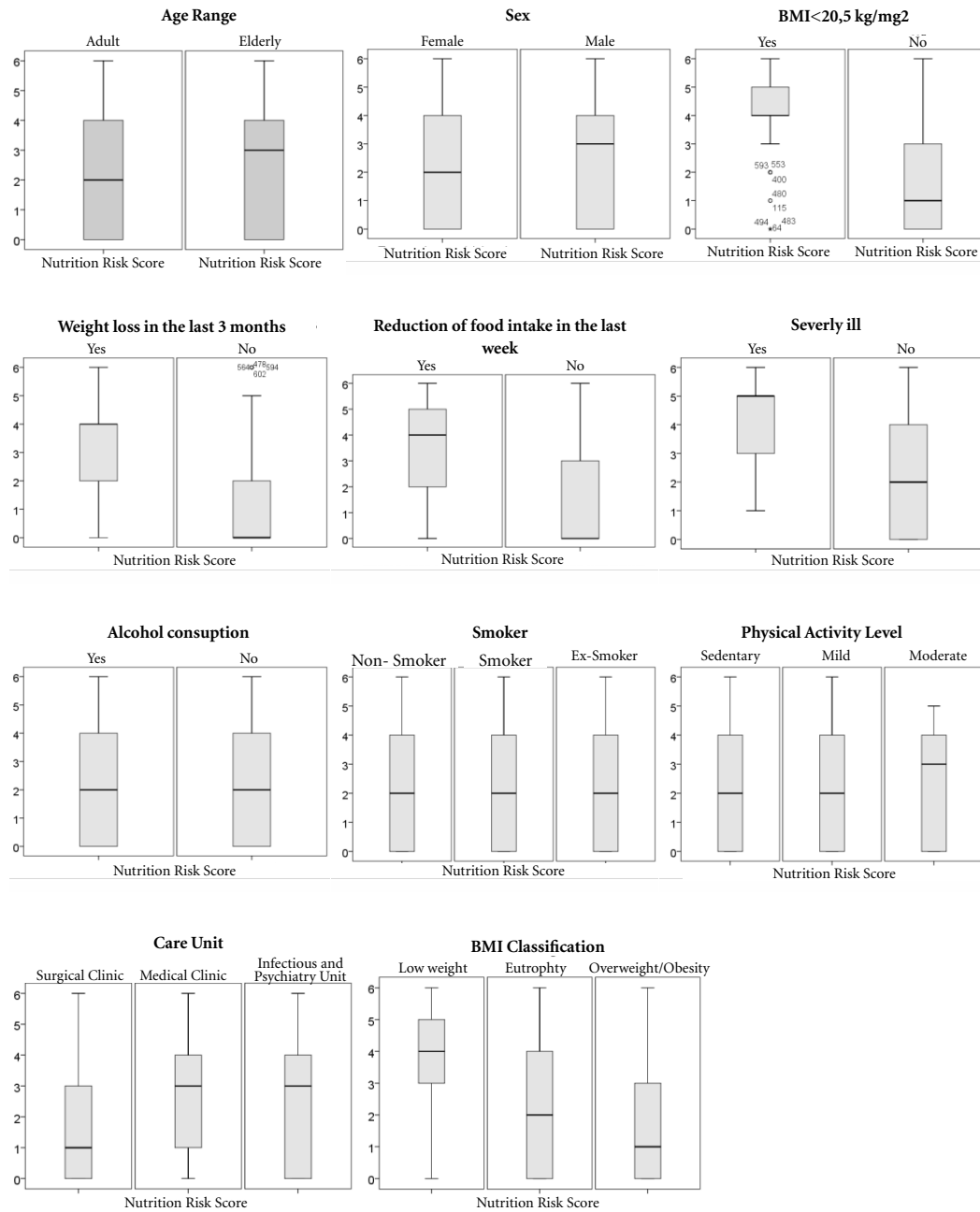
Figure 1 shows the position measurements (Minimum, 1st Quartile, Median, 3rd Quartile, Maximum), comparing the categorical variables in relation to the nutritional risk score. It is possible to visualize in the graphs the difference between the evaluated groups, which is reflected by the displacement of the box in each graph.

In the first part of the nutritional screening, which consists of four questions whose affirmative responses may characterize nutritional risk, 516 patients (67.6%) had at least one affirmative answer, of which weight loss in the last 3 months was prevalent, as reported by 409 patients

(53.6%), followed by reduction in food intake in the last week, identified in 302 patients (39.6%). Regarding the risk of malnutrition, 354 (46.4%) patients had a score  $\geq 3$ , characterizing nutritional risk, and 409 (53.6%) presented a score  $< 3$ , that is, without nutritional risk.

Regarding the questions of the NRS-2002 nutritional screening instrument, all remained as a nutritional risk factor ( $p < 0.000$ ) in the univariate analysis, and among the questions evaluated, the BMI  $< 20.5\text{kg/m}^2$  had a greater effect on nutritional risk. If the patient has BMI  $< 20.5\text{kg/m}^2$ , they are 31 times more likely to have nutritional risk than patients with BMI  $> 20.5\text{kg/m}^2$  (Table 2). It is also observed that low-weight patients are 4.49 times more likely to have nutritional risk than eutrophic patients, whereas eutrophic patients are 2.28 times more likely to present nutritional risk than patients with overweight and obesity.

In addition, there was a high variation of the Odds Ratio (OR) confidence interval for the variable severely ill because of the small sample size in this category. Only nine patients were classi-



**Figure 1.** Comparison between groups of the variables evaluated according to nutritional risk score in adults and elderly people, University Hospital /UFGD, Dourados, MS, 2015.

fied as severely ill because the patients evaluated were those hospitalized in the heal units and not those of the Intensive Care Unit (ICU).

## Discussion

The NRS-2002 is a nutritional screening tool suggested by ESPEN, considered to be the gold

**Table 2.** Result of univariate logistic regression analysis for the association of the questions evaluated in the NRS-2002 nutritional screening instrument and BMI classification with nutritional risk, University Hospital/UFGD, Dourados, MS, 2015.

Variable	No risk		With risk		OR	95% CI	p
	n	(%)	n	(%)			
BMI classification							
Low weight	26	3.4	116	15.2	4.49	2.76; 7.32	0,000*
Overweight/Obesity	247	32.4	103	13.5	0.42	0.30; 0.58	0.000*
Eutrophy	136	17.8	135	17.7	1.00	-	-
BMI < 20.5kg/m <sup>2</sup>							
Yes	7	0.9	124	16.3	31.0	14.21; 67.44	0,000*
No	402	52.7	230	30.1	1.00	-	-
Weight loss in the last 3 months							
Yes	128	16.8	281	36.8	8.45	6.07; 11.77	0,000*
No	281	36.8	73	9.6	1.00	-	-
Reduction of food intake in the last week							
Yes	78	10.2	224	29.4	7.31	5.27; 10.15	0.000*
No	331	43.4	130	17.0	1.00	-	-
Severely ill							
Yes	1	0.1	8	1.0	9.43	1.17; 75.80	0.035*
No	408	53.5	346	45.3	1.00	-	-

\* significant difference ( $p < 0.05$ ).

standard in nutritional risk investigations to assess anthropometric variables, food intake, disease severity, and the age of the patient<sup>22</sup>. It has many advantages over other tools, such as easiness to use, speed, high reproducibility, yield and, unlike other methods, it evaluates the consumption of foods recently, being able to consider the risk according to the reduction of the appetite<sup>23-26</sup>. Studies comparing NRS-2002 with other nutritional screening tools have demonstrated that this method has high specificity and sensitivity in patients with different clinical situations and ages, and that it presents greater precision and prediction of clinical evolution, mortality and length of stay<sup>3,22,25,27-29</sup>.

Almost half of the patients of this study were at nutritional risk, a result similar to those found in other studies<sup>5,6,22,24,25,27,29-33</sup>.

On the other hand, several studies<sup>3,34-37</sup> have found nutritional risk in more than 74% of the evaluated patients, but these studies had been carried out with elderly, surgical patients, patients with AIDS and hematological patients, which may have contributed to the presence of higher percentages of nutritional risk.

However, in studies carried out by Burgos et al.<sup>12</sup>, Gobbardo and Boscaini<sup>38</sup> and Rabito et

al.<sup>39</sup> nutritional risk was observed in only, 28.9%, 14.8% and 29.3% of the patients, respectively.

Thus, we have seen in the literature a large variation in the nutritional risk percentage, from 14.8% to over 74%, when evaluated by the NRS-2002. This finding may be justified by the diversity of clinical situations of the patients evaluated.

Regarding the treatment unit, it was observed that patients from the Medical Clinic followed by Infectious/Psychiatry Clinic had a greater chance of nutritional risk. Similar results were observed in other studies<sup>12,22,26,33</sup>. In a study carried out by Silva et al.<sup>32</sup> no difference was observed between surgical and clinical patients. However, it is worth emphasizing that these studies did not separately evaluate patients of medical clinic and infectious clinic, but rather only clinical patients in relation to surgical ones.

In the present study, the elderly and the male sex presented a greater chance of nutritional risk. These results are in agreement with the majority of studies found in the literature<sup>6,12,27,28,31,33,40</sup>. However, in a study carried out by Silva et al.<sup>32</sup> age and sex were not associated with nutritional risk. This result may be due to homogeneity and to the small sample size. Giryes et al.<sup>41</sup> and Olivares et al.<sup>26</sup> also did not observe a significant differen-

ce between the sexes, but individuals with high malnutrition were significantly older. Camelo<sup>11</sup>, when evaluating only the elderly, did not observe a significant difference between the sexes.

The relationship between risk and age can be explained by changes in body composition, as well as by the increased incidence of chronic diseases, reduced food intake, immobility, absent dentition, cognitive and psychological disorders in the elderly, favoring the risk of malnutrition<sup>3,31,33</sup>. In addition, according to Bezerra et al.<sup>2</sup>, the NRS-2002 protocol gives special attention to the elderly due to the adjustment of the final score when the patient's age is over 70 years old.

The variables alcohol consumption, smoking and physical activity level have not been associated with nutritional risk in the present study. Camelo<sup>11</sup> and Giryes et al.<sup>41</sup> found similar results in relation to the consumption of alcoholic beverages and cigarettes. In relation to physical activity, results found by Meira<sup>6</sup> showed that patients who perform physical activities regularly had 50 times lower risk of malnutrition.

In the present study, in the first part of the nutritional screening, most patients presented at least one affirmative answer and, consequently, continued the second phase. Similar results were found by Giryes et al.<sup>41</sup> and Alvarez-Altamirano et al.<sup>28</sup>. On the other hand, Gabbardo and Boscaini<sup>38</sup> found that 81.6% of patients had provided at least one affirmative answer. Regarding the answers of the initial part of the screening tool, results were similar to those found by Aquino and Philippi<sup>40</sup>, Leonhardt and Paluto<sup>42</sup> and Alvarez-Altamirano et al.<sup>28</sup>. Gabbardo and Boscaini<sup>38</sup> found the opposite, and the most prevalent answer was the reduction of food intake in the last week followed by weight loss in the last three months. For Giryes et al.<sup>41</sup> the most prevalent answers, in descending order, were critically ill patients, weight loss in the last three months, reduction in food intake in the last week and BMI < 20.5kg/m<sup>2</sup>.

Unintentional weight loss has related to morbidity and mortality, mainly due to its association with serious diseases and to have a negative impact on the physiological functions. Studies have shown that 25.0% of the patients with weight loss die within a year<sup>33,43</sup>. Significant weight loss is directly associated with reduced food intake that is influenced by psychological, cultural, and social factors. In addition, difficulties in chewing and swallowing and chronic problems, such as pain or difficulties in preparing meals, are possible reasons for the decrease in oral food intake, mainly

in the elderly<sup>6,38</sup>. However, it is worth noting that both weight loss and reduced food intake are not simple variables to obtain, since both suffer interference from personal perceptions, memory and even the patient's unwillingness to dialogue with the professional and may not represent reality. Nevertheless, this situation is presented by all existing nutritional screening methods<sup>38,40</sup>.

Alvarez-Altamirano et al.<sup>28</sup> observed that weight loss showed a moderate correlation with nutritional risk. Besides that, Giryes et al.<sup>41</sup>, Saka et al.<sup>31</sup>, Badia-tahull et al.<sup>27</sup>, Alvarez-Altamirano et al.<sup>28</sup> and Lima et al.<sup>3</sup> found that BMI was significantly lower among individuals identified as at risk of malnutrition. It was observed that BMI < 20.5kg/m<sup>2</sup> had a greater effect on nutritional risk and these patients are 31 times more likely to have nutritional risk than patients with BMI > 20.5kg/m<sup>2</sup>.

It is noteworthy that, in this study, low-weight patients were more likely to have nutritional risk than eutrophic patients, and eutrophic patients were more likely to present nutritional risk than patients with overweight and obesity. Similar results were found by Pineda et al.<sup>22</sup> and Bicudo-Salomão et al.<sup>44</sup> who, when evaluating postoperative complications, observed a higher occurrence thereof in patients with BMI < 24 Kg/m<sup>2</sup>. This relationship can be explained by the several physiological and biochemical changes that malnutrition causes in the body, such as reduction of immunity, wound healing, increased hospital stay and others<sup>45</sup>.

In addition, these patients may present serious diseases, which contributes to the worsening of clinical prognosis. This criterion evaluated by the NRS-2002 refers to a clinical condition that is life-threatening, mainly due to systemic disorders<sup>45</sup>. These disorders result in typical alterations of the secretion and hormonal functioning, leading to mass reduction, especially lean mass and its respective complications, thus contributing to worsening of clinical evolution and increased mortality in these patients<sup>46,47</sup>.

Although some authors have analyzed the relationship between nutritional risk and NRS-2002 questions, after a systematic review, no studies were found in the literature that assessed the likelihood of risk according to these criteria. When evaluating the factors that contributed the most to the nutritional risk, we observed that the first place was the BMI < 20.5kg/m<sup>2</sup>, followed by severe illness, weight loss in the last three months and lastly the reduction in food intake in the last week. However, the high variation of the Odds

Ratio (OR) confidence interval for the variable severe illness was due to the small sample size in this category.

Regarding the limitations found in this research, it is important to note the difficulty in measuring the reduction of food intake and the impossibility of carrying out patients' weight and height measurement, which was previously minimized during the pilot study with the development of the standardization manual for the application of the NRS-2002 screening tool and its routine implantation in the hospital, as described in the methodology section.

### **Conclusion**

We concluded that almost half of the patients presented nutritional risk, mainly men and el-

derly. Patients hospitalized in the Medical Clinic and Infectious/Psychiatry Clinic presented more chances of nutritional risk when compared to those of the surgical unit.

Among the criteria for the initial part of the screening, weight loss in the last three months was the most prevalent, followed by reduction in food intake in the last week. However, BMI < 20.5kg/m<sup>2</sup> had a greater effect on nutritional risk. The NRS-2002 nutritional screening proved to be a satisfactory tool. It should be emphasized that early identification of nutritional risk is extremely important for directing dietary management to improve dietary intake for the recover of body weight, but BMI < 20.5kg/m<sup>2</sup> and weight loss in the last three months are the factors that contributed the most in the determination of nutritional risk.

### **Collaborations**

AAO Barbosa participated in the methodological conception, literature review and analysis, data collection and tabulation, writing, critical review and approval of the final version of the article to be published. AP Vicentini participated in the methodological conception, literature review and analysis, data analysis, writing, critical review and approval of the final version of the article to be published. FR Langa participated in the data analysis and approval to be published.



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