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Original article

Translation and adaptation of the *NUTRIC Score* to identify critically ill patients who benefit the most from nutrition therapy

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SUMMARY

Introduction and objectives: Due to the scarcity of tools to assess the nutritional risk in critically ill patients, the NUTrition Risk in the Critically ill Score (NUTRIC Score) was developed and validated primarily in a limited population to quantify the risk of adverse events that may be modified by aggressive nutrition therapy. The objective of this study was to translate and adapt the NUTRIC Score into Portuguese language for further demonstrate its feasibility and clinical utility in Brazilian Intensive Care Units (ICUs).

Methods: This translation and adaptation process is part of a study for the validation of NUTRIC Score in Brazil. Translation was performed according to standardized steps: initial translation, synthesis of translations, back-translation, revision and application of the instrument by specialists and evaluation of cultural adaptation. We conducted a pilot study within 50 patients mechanically ventilated for more than 48 h in four ICUs in Southern Brazil to determine the prevalence of patients who were the most likely to benefit from aggressive nutrition therapy.

Results: The translation and adaptation process produced a valid version of NUTRIC Score in the Portuguese language. The translated version was easily introduced into four Brazilian ICUs and the prevalence of patients with high score and likely to benefit from aggressive nutritional intervention (mean age 61.4 ± 15.3 years) was 46% (23 individuals, 95%CI 0.33–0.60).

Conclusions: The NUTRIC Score has been successfully translated into Portuguese and the prevalence of nutritionally-high risk patients may be around 50% in Brazilian ICUs.

1. Introduction

Early identification of hospital malnutrition using specific indicators and tools is crucial in different scenarios [1–4], and appropriate instruments to define effective nutritional intervention measures are necessary.

Due to the scarcity of tools to evaluate the nutritional risk in critically ill patients, the NUTrition Risk in the Critically ill Score (NUTRIC Score) was developed and validated in a limited Caucasian population, aiming to quantify the risk of adverse events that may be modified by aggressive nutrition therapy [5]. The scoring system includes six variables: age, Acute Physiology and Chronic Health Evaluation (APACHE II), days from hospital to ICU admission,

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number of comorbidities, Sequential Organ Failure Assessment (SOFA), and interleukin 6 (IL-6) [6,7]. A subsequent analysis demonstrated the validity of the NUTRIC Score without the IL-6 levels in another distinct patient population [7]. The higher the sum of scores from these various components, the greater the likelihood that patients are at nutritional risk and will benefit from a nutritional therapy intervention [5–7].

The NUTRIC Score is the first nutritional risk assessment tool specifically developed for critically ill patients; it is a feasible and clinically useful instrument, since it evaluates variables that are routinely assessed in Intensive Care Units (ICUs). Translation of NUTRIC Score from English to Portuguese language would allow its use in Portuguese speaking countries and the comparisons of critically ill patients between different populations. The objective of this study was to translate and adapt the NUTRIC Score into Portuguese language to further demonstrate its feasibility and clinical utility in Brazilian ICUs. We also aimed to detect the prevalence of individuals at higher scores and who were the most likely to benefit from aggressive nutrition therapy.

2. Materials and methods

This translation and adaptation process is part of a study for the validation of NUTRIC Score to be developed in Brazil. Since the NUTRIC Score includes variables that are not self-reported, translation process was adapted from the method proposed by Beaton et al. [8] and performed according to the following steps: initial translation, synthesis of translations, back-translation, revision and application of the instrument by specialists and evaluation of cultural adaptation.

In the first stage, a forward translation from English [5] to Portuguese language was done. Two bilingual and certified translators, who had Portuguese as mother tongue (Translator1 and Translator2) performed two independent translations, which were defined as T1 and T2 versions. As suggested, the translators had different backgrounds: Translator1 (M.M.K.) is a nutritionist who is familiar with the terminology of the area covered by the instrument, and was aware about the study's objective; Translator2 (T.L.P.), who is not familiar with the area terminology, is a certified translator without knowledge in the nutrition field, and was not aware about the rationale of the study.

In the synthesis of translations phase, the two translators and one of the investigators of the study (A.M.), who also translated the instrument into Portuguese language, discussed all versions and agreed on a common Portuguese version, defined as T12. The investigator made note of discrepancies about the translations and divergent points.

In the phase of back translation, an English native speaking certified translator fluent in Portuguese language translated T12 into English. This professional did not have knowledge in the nutrition field, nor was informed about the objectives of the study.

In the revision stage, a Committee was organized to discuss all translated versions against the original tool, and a "prefinal version" of the NUTRIC Score was designed. The composition of the Committee included the following figures: one of the translators (A.M.), one physician (an intensivist, J.A.H.) and three nutritionists (M.R., E.I.R. and D.F.). They participated in a focus group, aiming to consolidate all the versions of the instrument, including instructions for revisions and application of the instrument in a pilot study. Each question was evaluated according to the viewpoints from all professionals, mainly about the idiomatic, semantic, contextual and cultural equivalences.

In the last stage, all reports and forms of the translation and adaptation processes were submitted to the author of the original instrument (D.K.H.) for approval.

A pilot study was conducted in 50 critically ill patients consecutively enrolled within 48 h from their admission to four ICUs of the Santa Casa de Porto Alegre hospital complex, to assess understanding and applicability of the "prefinal version" of the translated NUTRIC Score among five healthcare professionals (nutritionists and physicians). Individuals who were expected to remain less than 24 h in the ICU, those with overdoses and whose medical records were incomplete (without APACHE II and SOFA score values) were excluded.

Demographic data (age, gender), hospital length of stay (in days), number of comorbidities (registered in accordance to the International Classification of Diseases [ICD-10] and stratified as cardiovascular/vascular, cancer, endocrine, respiratory, gastrointestinal, neurologic, AIDS/infectious and renal comorbidities), and body mass index (BMI, in kg/m^2) were obtained from medical records previously to ICU admission. Mechanical ventilation was registered at ICU, and the first data available regarding APACHE II [9], SOFA score [10] (which were calculated by physicians and registered at patients' charts), C-reactive protein (CRP) and arterial blood gasometry were collected from medical records. Arm circumference, in cm, was measured by nutritionists in ICU at midway between the acromion and the inferior border of the olecranon with an inelastic tape, and registered in a standardized questionnaire.

Both dietitians and physicians calculated the NUTRIC Score, after data collection from medical records. Because of the absence of data regarding IL-6 levels in the medical records, since this interleukin is not evaluated among patients admitted in the Santa Casa de Porto Alegre hospital complex, the final NUTRIC score was calculated without this variable as previously suggested [5] and validated [7]; individuals were classified at high score (5–9) or low score (0–4).

The prevalence of the patients who are the most likely to benefit from aggressive nutrition therapy and the 95% confidence interval was calculated using the SPSS statistical package, version 17.0 (SPSS Inc., Chicago, IL, USA). Data were described as mean [±standard deviation (SD)], median [interquartile range (IR)] or n (%); Kolmogorov–Smirnov was performed to test the normality of the variables. Student's *t* test was used to compare parametric variables (age, BMI, arm circumference, pH, bicarbonate [HCO_3], oxygen saturation [SO_2], partial pressure of carbon dioxide [pCO_2], partial pressure of oxygen [PO_2]); Mann–Whitney test was used to compare nonparametric variables (days from hospital admission to ICU, APACHE II, SOFA score, number of comorbidities, lactate, CRP); and Chi-squared test was used to compare proportions (gender and use of mechanical ventilation) according to NUTRIC Score groups (low score and high score). Pearson's correlation test was used to detect a possible correlation between the number of comorbidities and NUTRIC Score, and the Cronbach's alpha was calculated in order to verify internal consistency of the instrument. The study was approved by the Research Ethics Committee of this hospital (protocol number 40073414.9.0000.5335), and by the Research Ethics Committee of the Federal University of Health Sciences of Porto Alegre.

3. Results

All the 50 individuals evaluated had their data easily obtained from medical records, and neither the nutritionists nor the physicians reported difficulties in register them. Table 1 shows the main clinical characteristics of the sample; individuals were pronominally male, with overweight according to BMI, had more than 2 comorbidities and a long hospitalization before ICU admission. As expected, patients with high NUTRIC Score were older, had higher

Table 1
Characteristics of the population (pilot study) admitted in the ICU.

	Total ($N = 50$)	Low NUTRIC score ($N = 27$)	High NUTRIC score ($N = 23$)	P-value
Age, in years	61.4 ± 15.3	57.7 ± 16.5	65.9 ± 12.6	0.06
Gender (M/F)	26 (52)/24 (48)	17 (63)/10 (37)	9 (39)/14 (61)	0.09
Days from hospital admission to ICU	16.4 (1–18.5)	4 (1–18)	5 (1–43)	0.22
APACHE II[a]	18.5 (11.8–25.3)	13 (6–15)	26 (20–32)	<0.001
SOFA score[a]	5 (2–10)	3 (0–5)	10 (8–12)	<0.001
Number of comorbidities	3 (1.75–4)	2 (1–3)	4 (3–5)	<0.001
Body mass index, in kg/m^2	25.1 ± 4.9	25.0 ± 4.9	25.2 ± 5.2	0.88
Arm circumference, in cm	29.3 ± 4.9	29.1 ± 4.4	29.6 ± 5.6	0.75
Use of mechanical ventilation	37 (74)	18 (66.7)	19 (82.6)	0.33
C-reactive protein (CRP), in mg/dL[a]	121 (64.2–184.3)	99.5 (23.7–114.0)	182 (72.2–254)	0.02
Lactate, in mmol/L[a]	1.6 (1.2–2.1)	1.6 (1.2–2.10)	1.4 (1.1–2.2)	0.60
pH[a]	7.3 ± 0.1	7.4 ± 0.1	7.3 ± 0.1	0.06
Bicarbonate (HCO_3), in mEq/L[a]	20.6 ± 5.4	21.1 ± 3.2	19.9 ± 7.3	0.45
Partial pressure of oxygen (PO_2), in mmHg[a]	115.6 ± 48.3	105.3 ± 41.1	127.7 ± 54.1	0.10
Partial pressure of carbon dioxide (pCO_2), in mmHg[a]	40.8 ± 14.6	39.4 ± 6.7	42.4 ± 20.4	0.50
Oxygen saturation (SO_2), in %[a]	96.9 ± 3.5	97.0 ± 2.7	96.8 ± 4.3	0.86

APACHE II: Acute Physiology and Chronic Health Evaluation.
SOFA: Sequential Organ Failure Assessment.
Number of comorbidities: registered in accordance to the International Classification of Diseases (ICD-10) and stratified as cardiovascular/vascular, cancer, endocrine, respiratory, gastrointestinal, neurologic, AIDS/infectious and renal.
Values described as mean [±standard deviation (SD)], median [interquartile range (IR)] or *n* (%).
[a] First data available in ICU.

APACHE II and SOFA score values, more comorbidities and higher levels of inflammation (CRP).

The most prevalent comorbidities detected were hypertension, acute coronary syndrome, previous heart attack, chronic heart failure, cancer/neoplasia, diabetes mellitus, obesity, chronic kidney disease, deep vein thrombosis, chronic obstructive pulmonary disease/pneumonia, chronic migraine, previous stroke (ischemic and hemorrhagic), Parkinson and Alzheimer diseases, hepatic steatosis and/or cirrhosis, intestinal occlusion, sepsis, erysipelas and AIDS. The prevalence of patients with high score and likely to benefit from aggressive nutritional intervention was 46% (23 individuals, 95%CI 0.33–0.60), and a significant correlation between NUTRIC Score and the number of comorbidities was found ($r = 0.54$, $P < 0.001$).

In the first stage, the version in Portuguese of the NUTRIC Score was produced. Few words and expressions differed in the translations of the professionals, and the presence of one of the investigators of the study with experience in the field helped on the definition of the synthesized version. It was decided to keep the terms that most matched the reality of the tool and that were more appropriate and familiar to the professionals in the field, so as to improve understanding of the items and their level of clarity. The

Table 2
Modifications carried out during the translation stage.

NUTRIC Score expressions	T1 and T2	T12
NUTRIC Score	T1: *NUTRIC Score* T2*: Pontuação NUTRIC*	*NUTRIC Score*
NUTRIC Score variables	T1*: Variáveis do NUTRIC Score* T2*: Variáveis da pontuação NUTRIC*	*Variáveis do NUTRIC Score*
Days from hospital to ICU admission	T1*: Dias entre internação hospitalar e admissão na UTI* T2*: Dias de internação até entrada na UTI*	*Dias de internação hospitalar até entrada na UTI*
If IL-6 available	T1*: se houver IL-6 disponível* T2*: se IL-6 estiver disponível*	*se IL-6 estiver disponível*
High score	T1*: Escore alto* T2*: Pontuação Alta*	*Escore Alto*
Low score	T1*: Escore baixo* T2*: Pontuação Baixa*	*Escore Baixo*
Clinical outcomes	T1*: desfechos clínicos* T2*: evoluções clínicas*	*desfechos clínicos*
If no IL-6 available	T1*: se não houver IL-6 disponível* T2*: se IL-6 não estiver disponível*	*se IL-6 não estiver disponível*
These patients are the most likely to benefit from aggressive nutrition therapy.	T1*: Esses pacientes são os que mais provavelmente se beneficiariam de uma terapia nutricional agressiva.* *T2: Estes pacientes são os mais indicados para se beneficiar com uma terapia nutricional agressiva.*	*Estes pacientes são os que mais provavelmente se beneficiariam com uma terapia nutricional agressiva.*
It is acceptable to not include IL-6 data when it is not routinely available; it was shown to contribute very little to the overall prediction of the NUTRIC Score.	T1*: É aceitável não incluir dados de IL-6 quando esses não estiverem disponíveis na rotina; demonstrou-se que contribuem muito pouco para a predição global do NUTRIC Score.* T2*: É aceitável não incluir o IL-6 quando este não for rotineiramente disponível; foi comprovado que sua contribuição é muito pequena na previsão geral da pontuação para NUTRIC.*	*É aceitável não incluir dados de IL-6 quando esses não estiverem rotineiramente disponíveis; demonstrou-se que sua contribuição é muito pequena para a predição global do NUTRIC Score.*

Tabela 1: Variáveis do NUTRIC Score

Variável	Intervalo	Pontos
Idade	<50	0
	50 - <75	1
	≥75	2
APACHE II	<15	0
	15 - <20	1
	20-28	2
	≥28	3
SOFA	<6	0
	6 - <10	1
	≥10	2
Número de comorbidades	0-1	0
	≥2	1
Dias de internação hospitalar até	0 - <1	0
entrada na UTI	≥1	1
IL-6	0 - <400	0
	≥400	1

Tabela 2: sistema de pontuação do NUTRIC Score: se IL-6 estiver disponível

Soma de pontos	Categoria	Explicação
6-10	Escore Alto	Associada a piores desfechos clínicos (mortalidade, ventilação). Estes pacientes são os que mais provavelmente se beneficiariam com uma terapia nutricional agressiva.
0-5	Escore Baixo	Estes pacientes apresentam baixo risco de desnutrição.

Tabela 3: sistema de pontuação do NUTRIC Score: se IL-6 não estiver disponível*

Soma de pontos	Categoria	Explicação
5-9	Escore Alto	Associada a piores desfechos clínicos (mortalidade, ventilação). Estes pacientes são os que mais provavelmente se beneficiariam com uma terapia nutricional agressiva.
0-4	Escore Baixo	Estes pacientes apresentam baixo risco de desnutrição.

*É aceitável não incluir dados de IL-6 quando esses não estiverem rotineiramente disponíveis; demonstrou-se que sua contribuição é muito pequena para a predição global do NUTRIC score.

Fig. 1. NUTRIC Score: translated version into Portuguese language.

discrepancies between T1 and T2 were resolved in the synthesis of translations (T12). The back-translated version was very resembling to the original version and only a few semantic and grammar changes were required. Table 2 shows in details the discrepancies between the two independent translations (T1 and T2) and also the final discussed version (T12), summarizing all modifications made during the translation stage.

All the five healthcare professionals who participated in the pilot study reported that the "prefinal Portuguese version" of NUTRIC Score was easy and clear to understand, additionally to be practical and fast to apply. Because the medical records are electronic available in the four ICUs were the pilot study was conducted, no professional reported difficulties in obtaining all necessary data for NUTRIC Score calculation; nutritionists and physicians had full access to the patients' charts. Just one professional suggested the deletion of the symbol ">" when it appeared in the middle of a numerical interval, and the addition of a new item to describe the final score of the instrument. Another professional answered the questions of the instrument, but did not fill in the score classification table. These issues were considered by the

investigators, who chose to maintain the original version's structure of the NUTRIC Score because these suggestions did not significantly alter the original meaning and the intelligibility of the items, not being, therefore, applied to the process of cultural adaptation. The Cronbach's alpha calculated for internal consistency was 0.58.

The reports and forms of translation, cultural adaptation and back-translation processes were analyzed by the original instrument's author, who also approved the final versions of the NUTRIC Score, the one translated into Portuguese (Fig. 1), and the back-translated version.

4. Discussion

The aim of the translation and cultural adaptation process of NUTRIC Score was achieved, since we produced an easy to understand, widely applicable instrument, similar to the original version. Despite the increasing number of scales and tools to assess health status, a lot of them are not available in countries different from their original language. These instruments are frequently available in English, and a process of translation and cross-cultural adaptation is required [11]. A complete analysis of the measurements' instrument properties was not performed in this study, since the NUTRIC Score variables are not self-reported, i.e., they are directly obtained from patients' medical charts.

Cross-cultural adaptation of instruments enables the standardization of information and the development of multicentric studies based on cultural differences between the countries. In addition, a new version of the instrument is produced, similar to the original one, but including linguistic and cultural adaptations according to the environment in which the instrument will be used. Therefore, the adaptation of instruments to different contexts facilitates comparisons and exchange of knowledge among the international scientific community [8].

Early identification of individuals at nutritional risk who may benefit from nutritional therapy is paramount in the hospital environment, including the intensive care setting. Although many instruments have indicated that all critically ill patients are at nutritional risk due to their clinical conditions [2,3], they may not have the same risk of adverse events related to malnutrition [5]. NUTRIC Score is the first instrument that specifically assesses nutritional risk in critically ill patients, which corroborates the importance of the development of specific tools for these individuals with particular clinical conditions. Additionally, it is a fast, practical instrument that can be incorporated into the routine care of ICUs. One clear advantage of NUTRIC Score is its applicability in situations in which patients are unable to respond verbally, as in mechanical ventilation, since the variables of this scoring system are objectively obtained from data routinely registered in patients' medical records.

In our pilot study, the prevalence of patients with high score and who are likely to benefit from aggressive nutrition therapy was higher than that reported in previous studies using NUTRIC Score and its variations [6,7]. Despite this could be explained by the profile of the patients as demonstrated by the long hospital length of stay before admission in ICU, the number of previous comorbidities and its positive correlation with NUTRIC Score, our finding reinforces that NUTRIC Score may be used in the early detection of nutritional risk in intensive care settings of different locations and populations. When compared to subjective global assessment (SGA) as a tool for identifying nutritional risk or malnutrition, NUTRIC Score showed similar results regarding patients requiring additional rehabilitation after discharge and ICU length of hospital stay, but it was associated with highest rates of death when compared to SGA [12].

NUTRIC Score does not include traditional markers of nutritional risk, such as BMI, weight loss, oral intake, or physical assessment, and it may represent just a severity of illness score. However, in the original study regarding the validation NUTRIC Score, data such as BMI, percentage oral intake in prior week, and percentage weight loss in past three months were not associated with mortality [5]. The importance of inflammation and the severity/etiology of illness is well recognized in the characterization of malnutrition [13,14], such as its association with hospital length of stay [15]; despite it may have limited clinical application due to the exclusion of nutrition history variables in its score, NUTRIC is the first tool that is based on a conceptual model that addresses current lines about malnutrition and includes constitutional factors, severity of disease, starvation and inflammation. It is worth mentioning that our study focused on the process of translation and adaptation of NUTRIC Score, and the pilot study was an explorative analysis. Further studies to validate the instrument showing its association with prognosis and to confirm its clinical applicability in ICUs in Brazil are still needed, and to compare our data with the original score used in the Caucasian cohort is equally important.

According to the original article regarding NUTRIC Score construction and validation, some limitations of the instrument are: it only applies about to macronutrients and energy provision, being not able to identify patients who may benefit from pharmaconutrient supplementation; the primary aim of the original validation study was to evaluate NUTRIC Score as a sepsis marker, and the standardization of nutrition practices and compliance with nutritional history variables was suboptimal (the nutrition history and intake information was only available in a minority of patients) [5]. Besides, data regarding mortality in the original validation study was based on 28-days and choosing longer term outcomes may be necessary to improve the results; and finally, not all data necessary for NUTRIC Score calculation may be available in all ICU settings, restricting this use in many hospitals.

5. Conclusion

Translation of NUTRIC Score from English into Portuguese language following internationally accepted methodology has succeeded in achieving idiomatic, semantic, and conceptual equivalence between the original source and the version produced in Portuguese. In addition, we were able to demonstrate the feasibility of the instrument showing a high number of patients at nutritional risk in a sample of Brazilian ICUs. The Portuguese translated NUTRIC score may be useful for detecting critically ill patients at risk in other Portuguese speaking countries and further validation work is warranted.

Authors' contributions

M.R. and M.O. were responsible for the data collection; M.R. and A.M. wrote the manuscript; D.K.H., E.I.R. and D.F. revised the manuscript. All authors read and approved the final version of the article.

Competing interests

The authors declare that they have no competing interests.

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