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Braden scale has low reliability in different patients under care in intensive care unit

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SUMMARY

OBJECTIVE: The aim of this study was to assess the inter-reliability of the Braden scale and its subscales for different patients assisted in the intensive care unit. We hypothesized that the Braden scale has low reliability in different populations.

METHODS: This reliability study involved the Braden scale in intensive care unit of a hospital. A total of 200 patients were admitted to the intensive care unit in four different groups: neurological patients, sepsis, elderly, and adults affected by trauma. The Braden scale is a tool composed of six subscales for patient assessment: sensory perception, humidity, activity, mobility, nutrition, and friction. The total score was also calculated. The Braden scale was applied by two different nurses with an interval of 20–30 min between applications.

RESULTS: For all populations, kappa values considered unsuitable were observed for most categories of the Braden scale, ranging from 0.06–0.25. Only for the total Braden scale score was moderate reliability identified in all groups evaluated, with intraclass correlation coefficient values ranging from 0.48–0.75.

CONCLUSIONS: Braden scale is not a reliable tool to be used in the intensive care unit, and we do not recommend the use of this scale to assess the risk of developing pressure injury.

KEYWORDS: Risk assessment. Validation study. Intensive care unit. Pressure injuries.

INTRODUCTION

At present, pressure injuries (PI) represent a great and growing burden to society[1], especially in the elderly and those with chronic diseases[2]. PI is still considered a major health issue for hospitals, especially in intensive care unit (ICU). Due to technological advances, there are a large number of survivors of ICU admission; however, the ICU can cause other disorders to patients, such as prolonged hospital stay, clinical complications not associated with initial hospitalization, risk of infection, as well as increased costs and expenses[3,4].

Therefore, the risk assessment of developing PI becomes essential, in view of the environmental, psychological, and therapeutic limitations to which patients are submitted to the ICU. Furthermore, through this risk assessment of developing PI, it is possible to detect the patients at an early stage who are at potential risk for acquiring this type of injury. Once the risk is verified, specific prevention measures and interventions must be implemented by the ICU team of professionals[5]. Furthermore, the risk assessment must be adopted in a systematic and applied manner, both on the patient's admission and daily during the physical examination and whenever there is a change in their clinical condition[6].

The risk of PI is usually assessed using scales, among which the most commonly used is the Braden scale (BS)[7,8]. In this context, the BS has been widely used in several hospital services; its validation in the Brazilian Portuguese took place by Paranhos in 1999[9]. It consists of the following six subscales: sensory perception, humidity, activity, mobility, nutrition, and friction and shear. The total score can vary from 6–23 points, where the higher the score, the greater the individual's chance of developing PI[10].

As risk assessment is the first step in preventing this disease, it anticipates the team of health care professionals to gather

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important information, which will help identify the patients who are more likely to develop PI and later plan the individualized and specific care plan for the same[11].

Furthermore, the BS has been used in several populations with different characteristics of sensory perception, mobility, and skin hydration, among other factors. Although studies show that BS has a good sensitivity for the risk assessment for the development of PI and its prevention, these studies show a small number of individuals without considering different clinical characteristics relevant to a possible development or not of PI[7] or even do retrospective analyses in different sectors such as wards and surgical sectors[8]. Additionally, they did not assess the reliability but only the sensitivity of the scale; it is noteworthy that there are different professionals who work in shifts in ICU, evaluating and taking responsibility for the care of the same patient, and that most of the evaluation methods are instrument-dependent, emphasizing the importance of the study of reliability among evaluators in the use of the scale.

Some previous studies aimed to assess the reliability of the BS in the ICU[7,12]; however, without taking into account the different characteristics, such as sensory characteristics, it is known that different populations in the ICU have different sensory perceptions, nutrition, and hair moisture, which should be considered when screening or assessing the risk of developing PI. In addition, considering only the total score, it can induce an error in the risk assessment of PI, because a subscale with a very low score can be an important factor which raises the risk of PI, even if the total score shows no such risk.

In this context, to the best of our knowledge, there is no approach in the literature that attempted to assess the reliability of the BS and its subscales in different populations that are frequently assisted in ICUs. Thus, the aim of this study was to evaluate the inter-rater reliability of the BS and its subscales in different patients, such as elderly and those with neurological disorders, sepsis, and trauma, commonly assisted in the ICU.

METHODS

Design and ethical aspects of the study

This is a prospective and analytical reliability study. Data collection took place in an adult ICU of a tertiary hospital located in the city of São Luís (MA, Brazil) from February to December 2019. This study was conducted according to the Guidelines for Reporting Reliability and Agreement Studies (GRRAS)[13].

Sample

The sample size was based on measurement property evaluation guidelines, recommending a minimum of 50 participants to assess reliability[14].

A total of 200 individuals were included in the study who were divided into the following four groups:

1. adults with neurological disorders (n=50),
2. adults with sepsis (n=50),
3. elderly (n=50), and
4. adults affected by trauma (n=50).

The anthropometric and sociodemographic data of the patients were collected by means of the electronic medical record used in the ICU of the studied service.

Inclusion and exclusion criteria

The sample of patients in this study included those who were under the care of health care professionals in the ICU, with age over 18 years and of both sexes. The composition of the groups considered the clinical diagnosis of admission to the ICU.

Thus, in the trauma group, individuals affected by various traumas were allocated as the most common polytrauma and head trauma. The elderly group included those specifically aged over 60 years, who were admitted to the ICU, the majority being due to decompensation of the underlying diseases, especially congestive heart failure and chronic obstructive pulmonary disease. In the sepsis group, individuals with a diagnosis of sepsis were included, the majority being urinary tract infection and acute abdomen. Finally, the patients in the neurological group were composed of individuals affected mainly by stroke and encephalitis.

Exclusion criteria were as follows: the presence of injury due to previous pressure or any other problem that makes the application of BS unfeasible.

Initial evaluation

An initial evaluation was undertaken to collect the participants' demographic and personal data, which were extracted from the electronic medical records of the patients participating in the study, such as gender; age; anthropometric and clinical data such as weight, height, BMI, diagnosis, comorbidities, and the Charlson comorbidity index; nutritional data such as protein intake (kg/day) and kcal/day; and risk factors such as smoking, use of vasoactive drugs, and mobility that were collected via medical records of the evolution of physiotherapy assessment through the Functional Status Score for the ICU.

Reliability procedures

The BS was completed on admission of patients to the ICU by two different nurses, previously trained, with an experience of approximately 10 years in completing it. A draw was carried out in order to select which evaluator would start applying the BS. An interval between evaluations of 20 and 30 min was performed in order to ensure that the conditions or characteristics of sensory perception, mobility, and skin hydration of the patients did not change.

Statistical analysis

Reliability was assessed based on an inter-rater model. For the total BS score, the intraclass correlation coefficient ($ICC_{2,1}$) was measured, along with 95% confidence interval (95%CI), standard error of measurement (SEM) in absolute score and percentage, and the minimum detectable change (MDC) in absolute score and percentage. The interpretation of the ICC value was based on the study by Fleiss[15]: for values below 0.40, the reliability will be considered low; between 0.40–0.75, moderate; between 0.75–0.90, substantial; and, finally, for values greater than 0.90, the reliability was considered excellent. The interpretation of the percentage of SEM was based on the study by Ostelo et al.[16]: 5% or less, very good; greater than 5% and less than or equal to 10%, good; greater than 10% and less than or equal to 20%, doubtful; and greater than 20%, negative.

For the reliability of each BS item and the categories resulting from the stratification of the total score (no risk, light, moderate, high, and very high), the kappa value with linear weighting and 95%CI was used, since the possible responses for each BS item are categorical. The interpretation of the kappa value was based on the study by Landis and Koch[17]: <0, null; 0.01–0.19, poor; 0.21–0.39, weak; 0.40–0.59, moderate; 0.60–0.79, substantial; and 0.80–1, almost perfect.

RESULTS

Table 1 shows the sample characterization data. Most patients were lean, nonsmokers, under mechanical ventilation (except neurological patients), and using vasoactive drugs.

Regarding the reliability of the BS subscales, the data are presented in Table 2. We observed that most of the kappa values were below 0.40, ranging from 0.20–0.53 for neurological patients, from 0.04–0.42 for sepsis, from 0.01–0.42 for the elderly, and from 0.04–0.45 for the trauma group. Considering the reliability of the categories generated from the BS stratification (no risk, light, moderate, high, and very high), as shown in Table 3, kappa values below acceptable were observed, varying between 0.06–0.25.

Table 1. Characterization of the individuals according to the clinical condition.

	All (n=200)	Neurological (n=50)	Sepsis (n=50)	Elderly (n=50)	Trauma (n=50)
Age (years)	69.61 (18.91)	68.94 (16.93)	71.18 (16.18)	78.44 (9.35)	59.90 (25.25)
Gender					
Male (%)	92 (46)	19 (38)	17 (34)	29 (58)	27 (54)
Female (%)	108 (54)	31 (62)	33 (66)	21 (42)	23 (46)
Weight (kg)	65.24 (15.67)	64.90 (17)	64.13 (16.11)	63.33 (13.58)	68.58 (15.76)
Height (m)	1.60 (0.10)	1.41 (53.05)	1.59 (0.09)	1.60 (0.09)	1.61 (0.11)
BMI (kg/m^2)	25.25 (5.05)	25.30 (5.08)	25.30 (6.05)	24.46 (4.70)	25.95 (4.23)
Protein supply (kg/day)	91.06 (71.16)	87.98 (24.63)	81.48 (30.61)	89.22 (19.08)	105.55 (135.42)
Protein supply (kcal/day)	1474.51 (297.39)	1390.00 (297.15)	1450.06 (266.24)	1507.82 (291.58)	1550.16 (316.37)
Smoker					
No (%)	164 (82)	39 (78)	45 (90)	41 (82)	39 (78)
Yes (%)	36 (18)	11 (22)	5 (10)	9 (18)	11 (22)
Use of vasoactive drugs					
No (%)	118 (59)	25 (50)	26 (52)	33 (66)	34 (68)
Yes (%)	82 (41)	25 (50)	24 (48)	17 (34)	16 (32)
IMV					
No (%)	108 (54)	20 (40)	25 (50)	32 (64)	31 (62)
Yes (%)	92 (46)	30 (60)	25 (50)	18 (36)	19 (38)
CCI	2.09 (1.95)	2.18 (1.76)	2 (1.78)	2.96 (2.03)	1.24 (1.87)

Data are expressed as mean (standard deviation) or absolute number (percentage). BMI: body mass index; IMV: invasive mechanical ventilation; CCI: Charlson comorbidity index.

Table 2. Inter-examiner reliability of the subscales of the Braden scale for the different samples studied.

Item	Examiner 1	Examiner 2	Kappa (95%CI)
Neurological			
Sensory perception	2.30 (0.99)	2.52 (0.93)	0.53 (0.38–0.68)
Moisture	2.38 (0.67)	2.66 (0.63)	0.24 (0.03–0.45)
Activity	1.12 (0.44)	1.24 (0.69)	0.27 (0.00–0.60)
Mobility	2.28 (0.76)	2.22 (0.84)	0.22 (0.05–0.39)
Nutrition	2.90 (0.30)	2.82 (0.48)	0.20 (0.00–0.51)
Friction and shear	1.56 (0.76)	1.70 (0.68)	0.28 (0.06–0.50)
Sepsis			
Sensory perception	2.40 (0.82)	2.82 (1.00)	0.38 (0.21–0.54)
Moisture	2.36 (0.62)	2.68 (0.59)	0.11 (0.00–0.25)
Activity	1.04 (0.20)	1.12 (0.48)	0.04 (0.00–0.09)
Mobility	2.44 (0.61)	2.40 (0.73)	0.42 (0.22–0.62)
Nutrition	2.96 (0.20)	2.86 (0.45)	0.41 (0.05–0.78)
Friction and shear	1.32 (0.55)	1.82 (0.72)	0.08 (0.00–0.24)
Elderly			
Sensory perception	2.66 (0.75)	2.98 (1.02)	0.38 (0.23–0.52)
Moisture	2.34 (0.59)	2.78 (0.58)	0.01 (0.18–0.21)
Activity	1.30 (0.61)	1.14 (0.45)	0.04 (0.07–0.16)
Mobility	2.62 (0.60)	2.42 (0.73)	0.42 (0.23–0.61)
Nutrition	2.94 (0.24)	2.92 (0.34)	0.05 (0.04–0.09)
Friction and shear	1.34 (0.56)	1.96 (0.64)	0.14 (0.00–0.30)
Trauma			
Sensory perception	2.62 (0.85)	3.04 (0.92)	0.43 (0.26–0.61)
Moisture	2.60 (0.64)	2.96 (0.70)	0.07 (0.00–0.24)
Activity	1.22 (0.68)	1.14 (0.50)	0.05 (0.02–0.08)
Mobility	2.44 (0.67)	2.50 (0.81)	0.45 (0.25–0.66)
Nutrition	2.74 (0.60)	2.80 (0.49)	0.04 (0.00–0.25)
Friction and shear	1.54 (0.68)	1.96 (0.78)	0.31 (0.13–0.49)

CI: confidence interval.

Data on the reliability of the total BS score can be found in Table 3, and the ICC values were moderate (ranging from 0.48–0.75). Regarding the interpretation of the percentage of SEM, unacceptable values (greater than 10%) were observed in patients with sepsis and the elderly. For neurological and trauma patients, acceptable values of the percentage of SEM were observed, but very close to the 10% error limit.

DISCUSSION

The main findings of this study were:

1. BS reliability varies according to the target population of the assessment;
2. BS has a low reliability for most of its items and for the four groups assessed here;
3. the majority of BS subscales do not have acceptable reliability; and
4. total score and moderate ICC values were verified for the four groups and the percentage of adequate SEM (very close to the 10% limit) for neurological and trauma patients.

The use of risk assessment scales for developing PI is important for nurses and other health care professionals, making it possible, through these instruments, to identify vulnerable points and reinforce constant assessment as a means for preventing

Table 3. Reliability of the categories established by stratifying the total score of the Braden scale and reliability of the total Braden score for the different samples evaluated.

Group	Categories	Examiner 1 (%)	Examiner 2 (%)	Kappa (95%CI)
Neurological	Without risk	1 (2)	1 (2)	0.17 (0.00–0.36)
	Light	12 (24)	14 (28)	
	Moderate	5 (10)	13 (26)	
	High	30 (60)	19 (38)	
	Very high	2 (4)	3 (6)	
Sepsis	Without risk	0 (0)	2 (4)	0.10 (0.00–0.32)
	Light	8 (16)	17 (34)	
	Moderate	18 (36)	14 (28)	
	High	21 (42)	14 (28)	
	Very high	3 (6)	3 (6)	
Elderly	Without risk	1 (2)	1 (2)	0.25 (0.03–0.47)
	Light	10 (20)	23 (46)	
	Moderate	22 (44)	12 (24)	
	High	15 (30)	12 (24)	
	Very high	2 (4)	2 (4)	
Trauma	Without risk	1 (2)	3 (6)	0.06 (0.00–0.26)
	Light	11 (22)	20 (40)	
	Moderate	15 (30)	11 (22)	
	High	19 (38)	15 (30)	
	Very high	4 (8)	1 (2)	

Sample	Examiner 1	Examiner 2	ICC (95%CI)	SEM (score)	SEM (%)	MDC (score)	MDC (%)
Neurological	12.54 (2.06)	13.68 (2.57)	0.68 (0.50–0.80)	1.31	9.99	3.63	27.69
Sepsis	13.00 (2.67)	14.22 (2.43)	0.64 (0.45–0.78)	1.53	11.24	4.24	31.16
Elderly	12.54 (2.84)	13.20 (2.84)	0.48 (0.19–0.64)	2.05	15.91	5.68	44.11
Trauma	13.10 (2.60)	14.34 (2.67)	0.75 (0.60–0.85)	1.32	9.60	3.65	26.62

ICC: intraclass correlation coefficient; CI: confidence interval; SEM: standard error measurement; MDC: minimal detectable change.

PI[17]. In addition, BS has proved to be valid for predicting the risk of PI when compared to the simple judgment of the team of health care professionals[18,19]. However, again, inter-examiner reliability has not been achieved. In addition, it is known that reliability is about the ability to reproduce a result consistently in time and space, or from different observers, who will indicate coherence, precision, stability, equivalence, and homogeneity[14]. Thus, this study shows that BS has low reliability in PI prediction in patients who are in the ICU.

A previous study with the secondary objective of verifying inter-examiner reliability in the risk assessment of PI of 87 patients from different sectors (surgical clinic, internal medicine, adult, ICU, and semi-intensive) also found that the subscales of moisture and nutrition showed relatively low kappa values. The authors attribute this result to the insufficient training of the nursing team[6]. However, it is worth mentioning that such subscales also showed low reliability for most of the samples tested in the present study. Thus, the explanation given by the aforementioned authors does not seem convincing, given that the examiners of the present study had a great experience of 10 years in the application of BS.

Hyun et al.[20] conducted a retrospective study, using a 4-year time window and using data from electronic medical records of 7790 patients in order to verify the predictive validity of BS to assess the risk of developing PI in ICU patients. The authors identified that BS has insufficient predictive validity

and low precision in discriminating patients in intensive care who are at risk of developing PI. In addition, they concluded that BS may not sufficiently reflect the characteristics of patients in intensive care. Although it did not discriminate the clinical characteristics of the population, it reinforces the results found in our study, in which BS has low reliability for populations with neurological disorders, sepsis, the elderly, and adults with trauma.

A robust and recent study aimed at investigating the structural validity of BS, using a structural equation model, which has the ability to isolate an observational error from measuring possible variables, such as the risk of pressure ulcers, concluded that BS in its original form has inadequate validity for ICU patients[21]. Still, it indicates that the most important scores of the subscale were sensory perception, mobility, and humidity, concluding that professionals should pay special attention to patients with low scores in one or more of these subscales. In this study, the subscales showed acceptable reliability only for the item mobility in patients with sepsis, trauma, and the elderly; sensory perception in neurological and trauma patients; and nutrition only in elderly patients.

Recently, a study aiming to assess the accuracy of the predictive capacity for the development of pressure ulcers using BS in traumatized and burned patients in the ICU was emphatic in concluding that BS has a median discriminatory capacity among the traumatized and burned population, also suggesting that it generates unnecessary expenditure of time and human resources, which could be concentrated on the prevention of pressure ulcer formation[22]. In our study, in addition to evaluating the accuracy of BS in trauma patients, we evaluated three other populations with different clinical characteristics; however, all of them with intensive care needs, and we found results similar to the study mentioned above. The question is, would these four populations have the same sensory perception, skin moisture, and even friction and shear so that BS would then be used as a useful tool?

Contrary to the results of this study and the aforementioned studies, Sundaram et al.[23] observed positive results, that is, the use of BS was able to predict the risk of PI in hospitalized patients after liver transplantation. However, these authors did not investigate the reliability of BS in this population; they focused only on its predictive aspect.

In this study, we affirm that BS is not a useful clinical tool, that is, it has no reliable applicability for the populations in question, assisted in the ICU. Reinforcing our study, Ranzani et al.[24], with the objective of validating a new version and improving the BS for critically ill patients, added clinical variables to the original scale, since the author reports that BS cannot be considered accurate for critically ill patients. From this view, again, we do not indicate its use, since the majority of patients in the ICU are considered to be serious.

The main limitation of this study is related to the multiple diagnoses or the coexistence of comorbidities in the population. However, one of the strengths of the article was to precisely evaluate four different populations that are most part of the routine of an ICU and conclude that the BS is not a good tool for predicting pressure ulcers in these populations.

The clinical implications conveyed in this study are the nonrecommendation of the use of the BS for ICU and we also encourage the scientific population to address studies that seek to create a more adequate tool that considers intrinsic factors of the diseases.

CONCLUSIONS

We do not recommend the use of this scale and emphasize the need to develop another tool to assess the risk of developing PI in ICU patients.

AUTHORS' CONTRIBUTIONS

TPV: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. **ASR:** Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. **WSM:** Formal Analysis, Methodology, Supervision, Writing – original draft, Writing – review & editing. **PRF:** Formal Analysis, Methodology, Supervision, Writing – original draft, Writing – review & editing. **DSR:** Formal Analysis, Methodology, Supervision, Writing – original draft, Writing – review & editing. **IMAF:** Formal Analysis, Methodology, Supervision, Writing – original draft, Writing – review & editing. **ADSA:** Formal Analysis, Methodology, Supervision, Writing – original draft, Writing – review & editing. **RGM:** Formal Analysis, Methodology, Supervision, Writing – original draft, Writing – review & editing. **RRJT:** Formal Analysis, Methodology, Supervision, Writing – original draft, Writing – review & editing. **DBD:** Conceptualization, Data curation, Formal Analysis, Methodology, Investigation, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing.

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