



Clinical study

Cross-cultural adaptation and validation of the neonatal/infant Braden Q risk assessment scale



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KEYWORDS

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Abstract *Aim:* To translate into Brazilian Portuguese and cross-culturally adapt the Neonatal/Infant Braden Q Risk Assessment Scale (Neonatal/Infant Braden Q Scale), and test the psychometric properties, reproducibility and validity of the instrument. There is a lack of studies on the development of pressure ulcers in children, especially in neonates.

Methods: Thirty professionals participated in the cross-cultural adaptation of the Brazilian-Portuguese version of the scale. Fifty neonates of both sexes were assessed between July 2013 and June 2014. Reliability and reproducibility were tested in 20 neonates and construct validity was measured by correlating the Neonatal/Infant Braden Q Scale with the Braden Q Risk Assessment Scale (Braden Q Scale). Discriminant validity was assessed by comparing the scores of neonates with and without ulcers.

Results: The scale showed inter-rater reliability (ICC = 0.98; $P < 0.001$) and intra-rater reliability (ICC = 0.79; $P < 0.001$). A strong correlation was found between the Neonatal/Infant Braden Q Scale and Braden Q Scale ($r = 0.96$; $P < 0.001$).

Conclusion: The cross-culturally adapted Brazilian version of the Neonatal/Infant Braden Q Scale is a reliable instrument, showing face, content and construct validity.

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1. Introduction

Pressure ulcers are lesions typically located over a bony prominence and caused by a local breakdown of soft tissue, as a result of compression between the bony prominence and an external surface, commonly combined with shear forces [1,2]. Unrelieved pressure leads to ischemia by reducing the supply of oxygen and nutrients to the tissues, causing cell death [3]. Compression-induced ischemia is traditionally considered the most important factor in the etiology of pressure ulcers. More recently, other casual pathways have been proposed, including ischemia-reperfusion injury, impaired lymphatic drainage, and sustained tissue deformation [4,5]. The lesion may be limited to the skin or extend deeper to the subcutaneous tissue [1,2].

Several conditions and factors are associated with the development of pressure ulcers. Both intrinsic (e.g., nutrition, arterial pressure, tissue perfusion and oxygenation) and extrinsic (e.g., moisture, friction, and shear) factors affect tissue tolerance to pressure [6–8]. Impaired mobility and decreased sensory perception are also factors that favor the development of ulcerations [9,10].

There is a lack of studies on the development of pressure ulcers in children, especially in neonates [11,12]. However, these lesions cause much suffering and further aggravate the critical state of neonates treated in intensive care units (ICUs). This justifies the study of risk factors for the development of strategies for prevention of pressure ulcers and maintenance of skin integrity in these patients [13].

The more immature the babies, the more critical are their health state and more fragile are their skin, leading to a higher risk of developing pressure ulcers [14,15]. Technological advances in neonatal intensive care have increased the survival of extremely preterm infants and critically ill patients. These patients have multiple risk factors for the development of skin lesions, as they are often sedated or mechanically ventilated, requiring restriction of movement for long periods because of the severity of their condition. They may also present varying degrees of malnutrition and impaired tissue perfusion and oxygenation due to hemodynamic instability [16].

To prevent pressure ulcers, it is necessary to identify risk factors based on a thorough clinical examination and the use of risk assessment tools. There are many pressure ulcer risk assessment scales for children, including the Glamorgan Pediatric Pressure Ulcer Risk Assessment Scale, which is a reliable tool developed using detailed

pediatric inpatient data [17]. In Brazil, the Braden Q Risk Assessment Scale (Braden Q Scale) is one of the scales most commonly used in paediatrics [13,18]. Some risk assessment tools for pressure ulcers have been used specifically in neonates, including the Neonatal Skin Risk Assessment Scale (NSRAS), the Starkid Skin Scale, and the Neonatal/Infant Braden Q Risk Assessment Scale (Neonatal/Infant Braden Q Scale). However, to date, none of these instruments has been translated and adapted to the Brazilian culture [19–21].

The NSRAS is based on the Braden Scale for Predicting Pressure Sore Risk (Braden Scale), and differs from the others in taking into account the gestational age of the newborn [19]. The Neonatal/Infant Braden Q Scale is an adaptation of the Braden Q scale and the NSRAS that not only evaluates the Braden Q subscales, adapting terms used on that scale to the neonatal period, but also includes the gestational age as a subscale, as in the NSRAS [21].

The cross-cultural adaptation and validation of the Neonatal/Infant Braden Q Scale is relevant because it results in an additional tool for assessing risk of pressure ulcers to be used by health professionals providing neonatal care, which contributes to the development of prevention and management strategies, reduction in treatment costs, and improvement in quality of care for the target population.

Thus, the aim of this study was to translate into Brazilian Portuguese and cross-culturally adapt the Neonatal/Infant Braden Q Scale, and test the psychometric properties, reproducibility and validity of the instrument.

2. Materials and methods

The study was approved by the Institutional Research Ethics Committee. Patient selection was conducted between July 2013 and June 2014. Written informed consent was obtained from parents or legal representatives of all patients and from the participating professionals after the procedures had been fully explained, and prior to their inclusion in the study; anonymity was assured.

Fifty patients were consecutively selected and examined for the presence of pressure ulcers based on the guidelines of the National Pressure Ulcer Advisory Panel (NPUAP) [1]. The sample included neonates of both genders, 0–28 days of age, as well as preterm infants >23 weeks' gestational age, who remained in the neonatal intensive care unit (NICU) of a university hospital

in Brazil for more than 24 h, and did not have pressure ulcers on admission to the NICU. The patients were examined by two health professionals (observers) with specialization in this area and more than 5 years of experience working in NICUs.

2.1. The instrument

The present study was conducted after Dr. McLane, the first author of the original version of The Neonatal/Infant Braden Q Risk Assessment Scale, granted permission to translate, culturally adapt and validate the instrument to Brazilian Portuguese.

The Neonatal/Infant Braden Q Scale contains six subscales or items (sensory perception, activity, mobility, moisture, nutrition, and friction and shear) adapted from the Braden Q Scale and two additional subscales (tissue perfusion and oxygenation, and gestational age) [21].

The subscales mobility, activity, and sensory perception are related to the intensity and duration of pressure, whilst moisture, friction and shear (extrinsic factors), and gestational age, nutrition, and tissue perfusion and oxygenation (intrinsic factors) are related to the tolerance of the skin and its supporting structures to pressure. Each of the 8 subscales is rated from 1 to 4. The sum of the ratings gives a total risk score (possible range, 8 to 32), with lower scores indicating higher risk of pressure ulcers.

The tool was translated and adapted to the Brazilian culture according to the internationally accepted methodology [22–26].

2.2. Translation

The original version of the Neonatal/Infant Braden Q Scale was translated from English into Brazilian Portuguese by two independent translators. Only one of the translators was informed about the objectives of the study, so as to obtain a conceptual rather than a literal translation of the scale. Both translations were evaluated by a multidisciplinary group composed of three nurses and three physicians, all with a large experience in neonatal intensive care. All items were checked by the multidisciplinary group for possible mistakes made during the translation and evaluated for content validity. A consensus Brazilian Portuguese version of the scale was then obtained by combining elements from both translations [22].

Idiomatic, semantic, conceptual, and cultural equivalences were considered during the translation phase. The consensus version in Brazilian

Portuguese was back-translated into English by two independent translators who did not have any knowledge about the original scale or purpose of the study. Both back-translated versions were evaluated and compared with the original one by the same multidisciplinary group to check for possible errors made during back-translation [23]. The analysis resulted in the development of the consensus version 1 of the Neonatal/Infant Braden Q Scale in Brazilian Portuguese, which was appropriately adapted to the linguistic and cultural context of the target population, maintaining all the essential characteristics of the original scale in English [24].

2.3. Cross-cultural adaptation or pretest

The cross-cultural adaptation of a measure for use in a different country, culture or language is necessary to reach equivalence between the original source and the target language. The items must not only be translated well linguistically, but also adapted culturally to maintain the content validity of the instrument across different cultures [22–24]. This stage of cross-cultural adaptation is also called pretest and performed before testing the psychometric properties of a measure. If more than 15% of respondents at this stage have no doubts about the items and content of the translated measure, the instrument can be considered culturally adapted to the target language, without having lost its original characteristics [22–26].

The version 1 of the scale was administered to 30 health professionals (10 nurse technicians, 10 nurses, and 10 physicians) to test eventual failures of the respondents to comprehend the items. After informed consent, every participant had the opportunity to express their comprehension of the scale and suggest any changes they considered necessary. All participants understood that the scale items were related to risk factors for pressure ulcer development in the target population. Item relevance was evaluated by the participating health professionals using the content-relevance index, which is rated on a 1–5 scale ranging from “not important” (1) to “extremely important” (5). The content-relevance index was calculated by the formula: $R = F \times I$; where R = relevance, F = frequency; and I = importance.

The final version (Appendix A) was obtained when translators and participating health professionals reached a consensus [24] with no change required in version 1.

2.4. Psychometric evaluation

After translation and cultural adaptation, the final version of the scale was tested for reliability in 20 patients and for construct validity in 30 different patients.

2.4.1. Reliability

Test-retest reliability (reproducibility) is the ability of an instrument to produce stable or similar results on repeated administration when no change in the patient characteristics has occurred. It evaluates the extent to which variation in scores between assessments reflects real differences rather than random fluctuation [25].

For test-retest analysis, 20 neonates were examined by two independent observers, who were blinded to each other's results. A physician (the first author of this study) and a nurse from the NICU independently assessed the patients on the day of admission using the final version of the scale. A week later, the patients were reassessed by the same observers. Inter- and intra-rater reliability analyses were performed.

Statistical analysis of test-retest reliability was performed using Pearson's correlation coefficient (r) and the intra-class correlation coefficient (ICC).

2.4.2. Validity

Face validity evaluates whether the instrument measures what it was designed to measure. In this study, face validity was determined by consensus of the multidisciplinary group responsible for the Brazilian version of the scale [26].

Content validity is defined as the degree to which each item is relevant in measuring the target content. It examines the extent to which a scale represents the universe of concepts or domains. It is usually evaluated by specialists in the field. Establishing content validity requires a defining standard against which the content of a measure is compared [25,26]. The conceptual framework of the Braden Scale for the study of the etiology of pressure ulcers served as the gold standard for evaluating content validity. This conceptual framework involves two critical determinants: intensity and duration of pressure, and tolerance of the skin and its underlying structures to pressure [27].

Construct validity is the process in which the correlation of a measure with other variables is tested for theoretical consistency. In testing construct validity, hypotheses are stated regarding the direction and strength of expected relationships

[26]. Our hypothesis was that the presence of risk factors for pressure ulcer development was correlated with occurrence of pressure ulcers. Construct validity was measured in a group of 30 neonates by correlating the Neonatal/Infant Braden Q Scale with the validated Brazilian version of the Braden Q Scale (for children), which together with the Braden Scale (for adults) are the most widely used tools in Brazil for pressure ulcer risk assessment.

Construct validity was assessed using convergent and discriminant validity analyses. Convergent validity refers to the degree to which two measures of constructs that theoretically should be related are in fact related. It was measured by studying the correlation between subscale scores of the Neonatal/Infant Braden Q Scale and the Braden Q Scale at each time point, using Pearson's linear correlation. Discriminant validity refers to the ability of a measure to discriminate between different groups of subjects (e.g., patients with and without pressure ulcers) or between different levels of health (e.g., evolution of the patient's health status over time). It was determined by comparing mean scores on the Neonatal/Infant Braden Q Scale between patients with and without pressure ulcers at each time point, using the Mann–Whitney U test. The Wilcoxon test was performed to test for differences in Neonatal/Infant Braden Q Scale scores over time (i.e., differences in scores between the first and last assessment).

The level of significance was set at an alpha level of 0.05 ($P < 0.05$) for all tests. Data are expressed as mean \pm SD.

3. Results

Thirty neonates, with a mean gestational age at birth of 31.5 ± 4.4 weeks range, 24–39 weeks, mean birth weight of 1777 ± 1003 g (range, 465–4250 g) hospitalized in a NICU were assessed using the Brazilian version of the Neonatal/Infant Braden Q Scale. Most patients were girls ($n = 18$, 60%) and preterm infants ($n = 25$, 83.3%). Among the patients, 24 (80%) patients acquired infection during hospitalization, 22 (73.3%) used vasoactive drugs, and 28 (93%) used ventilatory support at some point during their NICU stay. Only 4 neonates developed pressure ulcers during the 1-year study period for an incidence of 13% (4/30). Two (50%, 2/4) ulcers occurred in the occipital region and 2 (50%, 2/4) in the nasal septum. The ulcers found on examination were Categories 2 and 3 ulcers, according to the NPUAP [1].

Table 1 Content-relevance index for each item of the instrument.

Item	Mean	Minimum	Maximum
Gestational age	4.8	3	5
Mobility	4.6	3	5
Activity	4.4	3	5
Sensorial perception	4.3	3	5
Moisture	4.0	3	5
Friction and shear	4.4	3	5
Nutrition	4.3	3	5
Tissue perfusion and oxygenation	4.4	3	5

The translated and cross-culturally adapted Brazilian-Portuguese version of the Neonatal/Infant Braden Q Scale is shown in [Appendix A](#).

The data from the 30 health professionals who participated in the pretest of the instrument were not included in the statistical analysis. The participants had no doubts about the questionnaire items and found the instrument easy to understand. The mean content-relevance index was >4.0 for all subscales, according to evaluation performed by the health professionals ([Table 1](#)).

The instrument demonstrated excellent inter-rater reliability (first assessment, $r = 0.98$, $P < 0.001$; last assessment, $r = 0.99$, $P < 0.002$) at the two time points and good intra-rater reliability (first assessment, $r = 0.87$, $P < 0.001$; last assessment, $r = 0.84$, $P < 0.001$), as seen in [Table 2](#).

The multidisciplinary group established by consensus that the instrument had face validity, measuring the risk of a neonate developing pressure ulcers it intends to measure, as well as content validity, meaning that each subscale was considered relevant in measuring the risk of pressure ulcers in neonates [\[26\]](#).

A strong correlation (first assessment, $r = 0.91$, $P < 0.001$; last assessment, $r = 0.96$, $P < 0.001$) was found between the Neonatal/Infant Braden Q Scale and Braden Q Scale ([Figs. 1 and 2](#)).

No significant differences in Neonatal/Infant Braden Q Scale scores were found in both the first

($P = 0.257$) and last ($P = 0.071$) assessments between patients who did and did not develop pressure ulcers. There was a significant increase in scores from the first to the last assessment (indicating a significant decrease in the risk of pressure ulcers) in the group of neonates without pressure ulcers ($P < 0.001$, Mann–Whitney test). In contrast, no significant difference in scores was observed between the first and last assessments in the group of neonates with pressure ulcers ($P = 0.285$). This result should be evaluated with caution due to the small number ($n = 4$) of patients who developed pressure ulcers.

Overall, an increase in Neonatal/Infant Braden Q Scale scores was found from the first to the last assessment ($P < 0.001$).

4. Discussion

In this study, 30 neonates from a NICU were assessed daily for pressure ulcer risk and development. Only 4 neonates developed pressure ulcers during the 1-year study period for an incidence of 13%. This is consistent with the international literature, which shows prevalence rates between 0.47% and 13% in the pediatric population [\[2\]](#), especially during hospitalization in ICUs. Noonan et al. [\[18\]](#) described the occurrence of pressure ulcers in 27% of the children in pediatric ICUs. McLane et al. [\[21\]](#) studied the prevalence of pressure ulcers in nine pediatric hospitals, in a sample of 1064 hospitalized children between the ages of 10 days and 17 years. These authors found that 26% of study population with pressure ulcers were infants less than 3 months old and that, in this age group, 45% of patients had skin breakdown [\[21\]](#). Unfortunately, samples from most studies on pressure ulcers include neonates within a larger pediatric population and, therefore, there is a lack of studies specifically targeting the neonatal population [\[21,28,29\]](#).

Because the pediatric age group includes children from birth to 18 years of age, often a scale that is suitable for use with older children do not assess specific issues of the neonatal period,

Table 2 Intraclass correlation coefficient and Pearson's correlation coefficient.

Correlation	Intraclass correlation coefficient			Pearson's correlation coefficient		
	ICC	95% CI	<i>P</i>	<i>r</i>	95% CI	<i>P</i>
Inter-rater (First assessment)	0.980	[0.951; 0.992]	<0.001	0.98	[0.967; 0.995]	<0.001
Inter-rater (Last assessment)	0.986	[0.966; 0.994]	<0.002	0.99	[0.969; 0.994]	<0.002
Intra-rater 1	0.791	[0.551; 0.911]	<0.001	0.87	[0.738; 0.944]	<0.001
Intra-rater 2	0.743	[0.464; 0.889]	<0.001	0.84	[0.654; 0.940]	<0.001

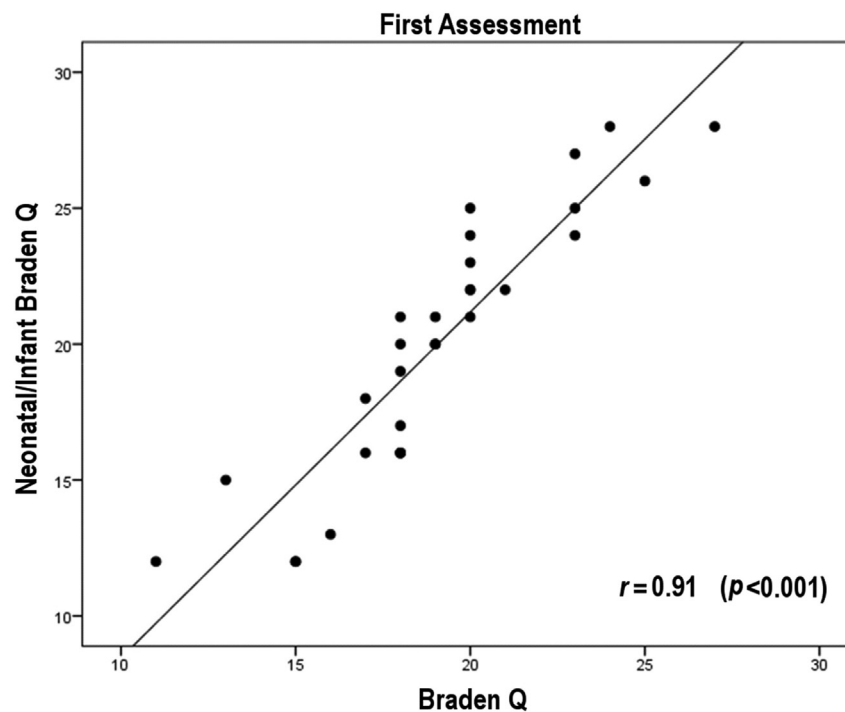


Fig. 1 Scatter plot of the Neonatal/Infant Braden Q Risk Assessment Scale versus the Braden Q Scale and the Pearson's correlation coefficient (r) for the first assessment.

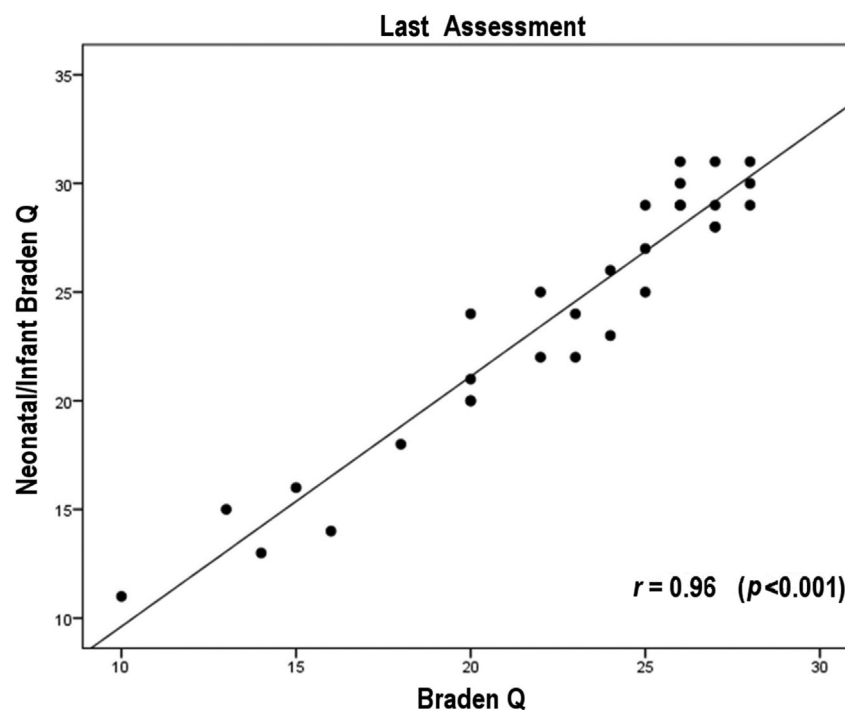


Fig. 2 Scatter plot of the Neonatal/Infant Braden Q Risk Assessment Scale versus the Braden Q Scale and the Pearson's correlation coefficient (r) for the last assessment.

especially those regarding preterm infants. In addition, some subscales may be inappropriate for use in neonates if specific risk factors, such as mobility, activity, and moisture (incontinence) are

not taken into account. In NICUs there are also risk factors for pressure ulcers inherent to any equipment that comes in contact with patients that cannot be neglected [30,31].

The Brazilian version of the Neonatal/Infant Braden Q Scale demonstrated excellent internal consistency (Cronbach's alpha = 0.939). Item-total correlations showed values above 0.6, indicating moderate to strong correlations between each item and the total score, except for the subscale "moisture", whose item-total correlation was about 0.3 in both assessments, indicating a weak correlation of this subscale with the other items of this instrument. This may be explained by the fact that neonates in a NICU go through frequent changes of diapers and bedding, reducing the influence of moisture on the development of pressure ulcers. Perhaps the results would be different if the study was conducted in a surgical ICU, where the presence of drains, ostomy and other factors would increase the exposure of the patient's skin to moisture. Therefore, our results may be restricted to NICUs. The importance of moisture as a risk factor for the development of pressure ulcers or skin breakdown in neonates cannot be ignored, and therefore the item was maintained in the instrument.

The instrument was reproducible, showing excellent inter-rater reliability ($r = 0.98-0.99$) and good intra-rater reliability ($r = 0.84-0.87$). However, it had an ICC for intra-rater reliability below 0.800 (range, 0.743-0.791). This may be attributed to clinical changes in patients during their one-week-stay in the NICU. To confirm that this result was due to clinical changes in the NICU patients and not due to low intra-rater reliability, the instrument was administered by two independent observers at two time points (i.e., on admission and one week later).

Construct validity was assessed using convergent and discriminant validity analyses. Convergent validity was established by the strong association found between the Neonatal/Infant Braden Q Scale scores and Braden Q Scale scores, both assessing risk of pressure ulcers. Discriminant validity was determined by comparing mean scores on the Neonatal/Infant Braden Q Scale between patients with and without pressure ulcers at each time point, and assessing differences in scores on the Neonatal/Infant Braden Q Scale over time. Although no significant differences in Neonatal/Infant Braden Q Scale scores were found between patients with and without pressure ulcers at both time points, there was a significant increase in scores from the first to the last assessment among neonates without pressure ulcers, suggesting a significant decrease in the risk of pressure ulcers over time. In contrast, no significant difference in scores was observed

between the first and last assessments in neonates who developed pressure ulcers. This indicates that the instrument shows discriminant validity. The results should be evaluated with caution due to the small number ($n = 4$) of patients who developed a pressure ulcer.

Risk assessment is an important step in the process of predicting the occurrence of pressure ulcers and should be combined with a thorough clinical examination performed on patient admission and during their stay in the NICU. A specific tool for pressure ulcer risk assessment in neonates will help determine best practices for the care of these patients and establish prevention strategies. Once the presence of risk factors is confirmed, appropriate interventions need to be performed to prevent new lesions from developing. Risk assessment is an essential part of this process and should be objective and routinely translated into care to improve results in the short and long term [31].

In this study, 4 pressure ulcers were identified during the study period. Two of the pressure ulcers were located in the occipital region. In the pediatric population, the occiput is the largest bony prominence and the most common site of pressure ulcer development [2,19]. The other 2 pressure ulcers were found in the nasal septum of the neonates, for an incidence of 6.7% (2/30). Special attention should be paid to the use of continuous positive airway pressure (CPAP) devices, such as the nasal CPAP, which may cause compression ischemia and subsequent development of pressure ulcers in the nasal septum. Recent studies have shown incidences of pressure ulcers in the nasal septum similar to that found in this study [32]. Xie [32] reported an incidence of nasal trauma of 10.7% in neonates who had paraffin oil smeared around their nostrils prior to the insertion of nasal prongs and an incidence of 3% among neonates whose nasal surface was covered with a hydrocolloid dressing before inserting the prongs.

The small sample size was the major limitation of this study. Further studies with a larger number of infants in different hospital units are necessary to generalize and extend our results.

Current risk assessment scales do not specifically assess the development of pressure ulcers in neonates caused by the use of devices such as the nasal CPAP. This study indicates that the use of such devices is an important risk factor for pressure ulcers in this population and that it should be addressed in future investigations.

The cross-culturally adapted Brazilian-Portuguese version of the Neonatal/Infant Braden

Q Scale was incorporated into a computer-based decision support system for use in NICUs. This system will be used to monitor, standardize and improve the care delivered and the research on this population. The software allows access to the risk assessment tool via Web Services from any computing device (e.g., personal computers, notebooks, cell phones, and tablets). Patient scores on the different subscales together with information about the patient's clinical condition, use of medications and medical devices, presence of infection, and other factors associated with the development of pressure ulcers will be immediately sent to the patient's file. Health professionals (e.g., physicians, nurses and researchers) will then be able to access the entire patient's information and evaluate which subscales (i.e., moisture, mobility, activity, sensory perception, friction and shear, nutrition, and tissue perfusion) require more attention.

The software will make the risk assessment tool more accessible, facilitating the use of the instrument in health care practice. It will guide the user through the main issues of neonatal care, as described in the recent literature [33]. Up-to-date information on prevention of pressure ulcers will also be provided by the system, as a means of continuing education. The software allows the immediate transmittal of information about the patient's risk of pressure ulcers and ensures that this information is simultaneously available for patient care and academic research.

5. Conclusion

The cross-culturally adapted Brazilian-Portuguese version of the Neonatal/Infant Braden Q Scale is a valid, reproducible and reliable instrument for pressure ulcer risk assessment in neonates. It is a useful tool that can contribute to the management and prevention of pressure ulcers in NICU patients.

Conflicts of interest statement

The authors have no conflicts of interest, financial interest or commercial association with any of the subject matter or products mentioned in the manuscript.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.jtv.2015.12.004>.

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