

## DIAGNOSTIC CAPACITY OF THE BRADEN Q AND NORTON SCALES FOR PRESSURE ULCERS IN PEDIATRIC PATIENTS IN CRITICAL UNITS

CAPACIDAD DIAGNÓSTICA DE LAS ESCALAS BRADEN Q Y NORTON PARA ÚLCERAS POR PRESIÓN EN PACIENTES PEDIÁTRICOS DE UNIDADES CRÍTICAS

CAPACIDADE DIAGNÓSTICA DAS ESCALAS BRADEN Q E NORTON PARA ULCERES PRESSORES EM PACIENTES PEDIÁTRICOS DE UNIDADES CRÍTICAS

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**Abstract:** The objective of the investigation was to evaluate the diagnostic capacity of the Braden Q and Norton scales for the development of pressure ulcers in pediatric patients of Critical Units in a highly complex hospital in Chile. It is a cross-sectional study comparing diagnostic tests in patients admitted to critical units. The sample was non-probabilistic, for the convenience of 118 children. Both scales were analyzed respecting the precepts, in order to compare the discriminative capacity of two diagnostic tests verifying that both are measured simultaneously while applied on the same subjects. The research was approved by the Ethics Committee, Health Service and Informed Consent signed by the parents of the children. It was determined that the sensitivity of the Braden Q scale, at 24 and 48 hours, is lower than Norton's in the same evaluations; it has a higher positive predictive value in both measurements, as well as the probability ratio (+). It is concluded that Braden Q is the ideal scale to assess the risk of developing pressure ulcers in the pediatric population; it presents greater reliability.

**Keywords:** Scales, Pressure Ulcer, Pediatric Intensive Care Units. Pediatric nurses.

**Resumen:** El objetivo de la investigación fue conocer la capacidad diagnóstica de las escalas Braden Q y Norton para el desarrollo de úlceras por presión en pacientes pediátricos de Unidades Críticas en un hospital de alta complejidad en Chile. Es un estudio transversal de comparación de pruebas diagnósticas en pacientes ingresados a unidades críticas. La muestra fue no probabilística, por conveniencia de 118 niños. Se analizaron ambas escalas respetando los preceptos, para comparar la capacidad discriminativa de dos pruebas diagnósticas y verificar que ambas sean medidas simultáneamente aplicadas sobre los mismos sujetos. La investigación contó con aprobación de comité de Ética Servicio de Salud y Consentimiento Informado firmado de los padres de los niños. Se determinó que la sensibilidad de la escala Braden Q, a las 24 y 48 horas, es menor que la presentada por la Norton en las mismas evaluaciones; presenta valor predictivo positivo más alto en ambas mediciones, como también la razón de probabilidad (+). Se concluye que Braden Q es la escala idónea para valorar el riesgo de desarrollar UPP en la población pediátrica; presenta mayor confiabilidad.

**Palabras clave:** Escalas, Úlcera por Presión, Unidades de Cuidados Intensivos Pediátricos. Enfermeras Pediátricas.

**Resumo:** O objetivo da investigação foi conhecer a capacidade diagnóstica das escalas Braden Q e Norton, para o desenvolvimento de úlceras de pressão (UPP) em pacientes pediátricos de unidades críticas, em um hospital altamente complexo, no Chile. É um estudo transversal que compara testes diagnósticos em pacientes admitidos em unidades críticas. A amostra não era probabilística, para a conveniência de 118 crianças. Ambas as escalas foram analisadas respeitando os preceitos, para comparar a capacidade discriminativa de dois testes de diagnóstico e verificar que ambos são medidos simultaneamente, aplicados nos mesmos assuntos. A pesquisa foi aprovada pelo Comitê de Ética, Serviço de Saúde e Consentimento Informado assinado por pais de crianças. Determinou-se que a sensibilidade da escala de Braden Q, às 24 e 48 horas, é menor que a apresentada por Norton nas mesmas avaliações, possui maior valor preditivo positivo em ambas as medidas, bem como a razão de probabilidade (+). Conclui-se que Braden Q é a escala ideal para avaliar o risco de desenvolver UPP na população pediátrica, e apresenta maior confiabilidade.

**Palavras-chave:** Escalas, Lesão por Pressão, Unidades de Terapia Intensiva Pediátrica, Enfermeiras Pediátricas.

## INTRODUCTION

Children hospitalized in critical units are at greater risk of having pressure areas causing the development of pressure ulcers (PUs) because they are subjected to prolonged immobility, changes in their state of consciousness, reduced sensitivity and long hospital stays (1). PUs are rapidly appearing lesions, slow and difficult to heal, which represent a biomedical problem for health care. They are a measure of the quality of care, and their appearance represents a severe iatrogenic injury at hospital level.

The evidence on the assessment of PU risk in the pediatric population is limited and in Chile, studies of this nature do not exist. It is indicated that 95% of PUs in the total population can be prevented (2) and that there is an increased risk of developing them in

critical units, since although the incidence in the pediatric population is 3.36% (3), in pediatric intensive care units this percentage is widely exceeded with an incidence of 29% (4); therefore, prevention and treatment must be a priority.

Identifying patients at risk of PUs is fundamental, because once they are detected with the suitable scale, targeted measures can be taken early on to prevent their emergence (5). The risk assessment for PUs has not been considered a habitual practice in minors (6) and when it is done, instruments designed for the adult population have been used.

In the Unit being studied, the Norton scale is applied daily, a scale designed and validated for use on the adult population (7) by current quality regulations in the hospital (8). This scale is used to categorize the risk of developing PUs in both adult and pediatric patients, but does fulfill the aim of recommended prevention practices for the pediatric population; the Braden Q scale (9) is a widely used, validated and reliable instrument for use in this group (10, 11).

The aim of this study was to determine the diagnostic capacity of the Braden Q and Norton scales for developing PUs in pediatric patients in critical units in a hospital of high complexity in southern Chile in 2014-2015.

## **METHODOLOGY**

A cross-sectional study compared diagnostic tests (12), where the gold standard is the Braden Q scale. Three measurements were taken of the risk of developing PUs with the Norton and Braden Q scales, at 0 hours (first 12 hours after admission), 24 and 48 hours of hospitalization. The non-probability sample by convenience contained 118 children hospitalized in pediatric critical units. The selection criteria were: children over 30 days and under 14 years, 11 months and 29 days of age, hospitalized in critical units, whose parents agreed for their children to participate in the study by signing and informed consent. Both scales were analyzed respecting the precepts. In order to compare the discriminative capacity of two diagnostic tests, it is important to verify that they are measured simultaneously, applied to the same subjects and contrasted.

The program STATA 11.0v was used for the data analysis. The Ethics Committee of the Health Service (Annexes) approved the study, with the informed consent form signed by the parents of the participants. In addition, ethical aspects were considered according to the principles of Ezekiel Emanuel (13).

## **RESULTS**

The sample contained 118 patients, 55 of whom (46%) were hospitalized in the pediatric intensive care unit (PICU). The diagnosis of greatest prevalence was respiratory (52%). No patients were recorded with PUs on admission; 76 children (64%) had no prior days of hospitalization. The average age of the population was 45.36 months ( $\pm 53.14$  SD), with minimum of 1 month and maximum of 178 months. Of the patients admitted to the PICU, 16% were admitted connected to mechanical ventilation, which decreased to 14% at 48 hours of hospitalization. 20% and 14% of the sample were under sedation and paralysis, which at 48 hours dropped to 15% and 11%, respectively. The PU prevention measures for these patients were: anti-decubitus

mattress use 54% at 0 hours, decreasing to 51% at 48 hours. Skin lubrication: 23% had this done every two hours, 6% were scheduled every three hours and 26% every four hours, measures without much variation in the subsequent assessments. Change of position: for 33% this was scheduled every two hours, 6% every three hours and 44% every four hours, as shown in Table 1.

Presence of PUs in the evaluation at 24 hours according to the Braden Q scale: 7 children presented PUs, which increased to 12 patients at 48 hours; with the Norton scale, there were 10 and 16, respectively. Although the Braden Q scale at 24 and 48 hours is less sensitive than the Norton scale in the same evaluations, its positive predictive value in both measurements is higher, as is the positive likelihood ratio that this scale displays (Table 2).

**Table N°1:** Pressure ulcer prevention measures, children in Critical Units (values expressed in %)

	<b>0 h</b> <b>(n*=118)</b>	<b>24 h</b> <b>(n*=114)</b>	<b>48 h</b> <b>(n+=97)</b>
<b>Mechanical ventilation</b>	<b>16.9</b>	<b>15.8</b>	<b>14.4</b>
<b>Sedation</b>	<b>20.3</b>	<b>19.3</b>	<b>15.4</b>
<b>Paralysis</b>	<b>14.4</b>	<b>15.8</b>	<b>11.3</b>
<b>Use of anti-decubitus mattress</b>	<b>54.2</b>	<b>50.9</b>	<b>51.6</b>
<b>Skin lubrication every 2 h</b>	<b>23.7</b>	<b>25.4</b>	<b>28.9</b>
<b>Skin lubrication every 3 h</b>	<b>6.8</b>	<b>5.3</b>	<b>3.1</b>
<b>Skin lubrication every 4 h</b>	<b>26.3</b>	<b>23.7</b>	<b>26.8</b>
<b>Change of position every 2 h</b>	<b>34</b>	<b>30</b>	<b>30</b>
<b>Change of position every 3 h</b>	<b>7</b>	<b>7</b>	<b>5.2</b>
<b>Change of position every 4 h</b>	<b>44.1</b>	<b>47.4</b>	<b>46.4</b>

Source: Personal Collection (2017)

**Table N°2:** Presence of eschar in critical children according to the Braden Q and Norton scales

<b>Presence of eschar</b>									
				<b>Yes</b>	<b>No</b>				
<b>Braden Q</b>				<b>SN*</b>	<b>SP**</b>	<b>VP+**</b>	<b>VP-°</b>	<b>LR+°</b>	<b>LR-°</b>
						*		°	°°
<b>24h</b>	<b>Yes</b>	<b>7</b>	<b>19</b>	<b>53.8</b>	<b>81.2</b>	<b>26.9</b>	<b>93.2</b>	<b>2.8</b>	<b>0.5</b>
	<b>No</b>	<b>6</b>	<b>82</b>						
<b>48h</b>	<b>Yes</b>	<b>12</b>	<b>11</b>	<b>60.0</b>	<b>85.7</b>	<b>52.2</b>	<b>89.2</b>	<b>4.2</b>	<b>0.4</b>
	<b>No</b>	<b>8</b>	<b>66</b>						
<b>Norton</b>									
<b>24</b>	<b>Yes</b>	<b>10</b>	<b>55</b>	<b>76.9</b>	<b>45.5</b>	<b>15.4</b>	<b>93.9</b>	<b>1.41</b>	<b>0.5</b>
	<b>No</b>	<b>3</b>	<b>46</b>						
<b>48</b>	<b>Yes</b>	<b>16</b>	<b>33</b>	<b>80.0</b>	<b>57.1</b>	<b>32.7</b>	<b>91.7</b>	<b>1.8</b>	<b>0.3</b>
	<b>No</b>	<b>4</b>	<b>44</b>						

**\*n, total of children admitted to the study; values expressed in %**

**\*Sensitivity; \*\*specificity; \*\*\*positive predictive value; negative predictive value; °° positive likelihood ratio; °°° negative likelihood**

Source: Personal Collection (2017)

## **DISCUSSION**

Braden Q, although less sensitive than Norton (a scale designed for adults), is more specific in all the measurements. The greater positive predictive value and likelihood ratio (+) of Braden Q makes it possible to recommend it for use on the pediatric population, as was reported in 2003 (14) in a prevalence study that showed that this scale is a valid and reliable instrument for use in this age group. This is of interest and adds value to the results obtained, as it demonstrates that the scales must be used for the

group for which they were designed (15). In addition, the pediatric population has its own specific areas where PUs appear (16), which require valid and reliable instruments for their early detection (17) and/or prevention (15). This invalidates the use of the Norton scale due to its low effectiveness in the pediatric population, obtaining an overestimated result for this age group according to the results obtained.

It is also important to emphasize that the study population presents a minimum of age of 1 month and maximum of 178 months; therefore, the study group is within the age range for which the use of the Braden Q pressure ulcer risk assessment scale is recommended (6). It has been shown that the Braden Q is more effective for assessing the risk of developing PUs than Norton, and agreeing with the study conducted in 2009 (18), the use of the Braden Q is recommended for the pediatric population.

In a Slovak study, the incidence of pressure ulcers was 14%. The sensitivity, specificity, positive predictive value and negative predictive value were 85.71%, 53.48%, 23.07% and 95.83%, respectively, for the Braden Q scale (a cut-off of 15); 85.71%, 48.83%, 21.42% and 95.45%, respectively for the Norton scale (a cut-off of 12); and 85.71%, 30.23%, 16.66% and 92.85%, respectively, for the Waterlow scale (a cut-off of 13). The areas under the ROC curve were 0.696 (Braden), 0.672 (Norton) and 0.579 (Waterlow). It may be concluded that the best values for predictive validity, with slight differences, were observed for the Braden Q scale, followed by the Norton scale and the Waterlow scale (19).

A study randomized by groups found no statistically significant difference in the incidence of pressure ulcers using Braden Q (n = 74), (RR 0.97, 95% CI: 0.53 to 1.77) and those patients evaluated by the opinion of nurses using a structured risk assessment (n = 106) (RR 1.43, 95% CI: 0.77 to 2.68); however, a high-quality randomized clinical trial (RCT) found no statistical difference in the incidence of PUs when they were evaluated using any of the risk assessment tools, or the use of clinical judgment. There is no reliable evidence that the use of risk assessment tools for ulcers reduces the incidence of PUs (20).

The Braden Q scale is the only one that shows acceptable values of validity and predictive ability; although it is inter-observer, reliability has not been measured and needs more studies to confirm these data (21).

## CONCLUSIONS

To date the Braden Q scale has been a valid and reliable instrument to assess the risk of developing PUs, and the overestimation and/or underestimation that can occur when assessing PU risk is reduced. Treatments, routines of high-complexity units and how these exacerbate or reduce the risk of developing pressure ulcers and knowing how these scales behave in low-complexity units remain to be examined. Studies with new scales which would promote greater adherence to their applicability need to continue.

It is recommended that the PU risk be assessed, although with the level of knowledge we have today it is not possible to recommend any one scale over the others. Further research on the risk of PUs in children and on the validation of the previously described

ulcer risk assessment scales is needed.

Limitations of the study: Increasing the sample size would help find significant relations and generalizations. Also, access to the study subjects was another obstacle, as was the time available to study the issue and measure the change or stability over time.

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