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Validity and reliability of the pediatric pressure ulcer prediction and evaluation tool in the Turkish population: Comparison with Braden QD-T

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ABSTRACT

Aim: To evaluate the validity and reliability of the Pediatric Pressure Ulcer Prediction and Evaluation Tool (PPUPET) in the Turkish population and compare it with Braden QD-T.
Materials and methods: The study was conducted methodologically to test the validity and reliability of PPUPET in Turkish on 228 pediatric patients hospitalized in the pediatric intensive care unit of a public hospital in the Southeastern Anatolia Region of Turkey. Data were collected from pediatric patients and their files who were hospitalized in the pediatric intensive care unit of the hospital under investigation for at least 3 days between July 2023 and October 2023, and using a Personal Information Form, PPUPET, and the Braden QD-T Scale. Kaiser-Meyer-Olkin (KMO) analysis, exploratory factor analysis, and confirmatory factor analysis (CFA) were performed, and CFA fit indices were evaluated to assess the construct validity of the scale. Internal consistency (item-total correlation coefficient and Cronbach alpha value) and interobserver consistency were evaluated as reliability analyses using the parallel form method and ROC curve analysis to evaluate the discriminative feature. Guidelines for reporting reliability and agreement studies (GRRAS) were adhered to in the study.
Results: Half (50.9 %) of the children included in the study were male, 66.7 % were not at risk of pressure injuries according to the Braden QD-T Scale, and 64.9 % were not at risk of pressure injuries according to PPUPET. The content validity index of the scale items for which language validity was evaluated using the Davis method ranged between 0.80 and 1.00, and the content validity ratio was found as 0.92. The KMO coefficient was found as 0.791 and the Bartlett sphericity test χ^2 value was 226.354 ($p < 0.001$). In our study, the Cronbach alpha reliability coefficient was 0.835 and the internal consistency coeffiecient value between observers was 0.992.
Conclusion: In the study, it was determined that PPUPET was a valid and reliable assessment tool for the Turkish population.

Introduction

Pressure injuries are damage/tears that are usually localized to the skin and the lower layers of the skin due to long-term, intense pressure or friction, and occur mostly at the points where there are boney protrusions (Gefen et al., 2022; Mutlu, 2015). The United States National Pressure Ulcer Advisory Panel (NPUAP) made some changes regarding pressure injuries and staging in 2016. It was stated that the word "injury" should be used instead of the word "ulcer". Arabic numerals have begun to be used instead of Roman numerals in the staging of pressure injuries (Edsberg et al., 2016).

Pressure injuries are important and preventable problems for children of all age groups. Risk factors that play a role in the formation of pressure injuries are divided into two as internal and external risk factors. Internal factors are inadequate tissue perfusion, infection, presence of anemia, immobility and nutritional deficiency, and external factors are external pressures on tissues and their duration, moisture of the skin, injury, friction, shear, and the inability to change position (Kiss & Heiler, 2014; Manning et al., 2015). In addition, the higher moisture content of children's skin compared with adult skin is seen as an important risk factor in the development of pressure injuries caused by medical devices (Liao et al., 2018). The development of hospital-related pressure injuries in patients receiving treatment/care in the pediatric intensive care unit (PICU) is three times more common than in adults (Seçer, 2018). The use of one or more medical devices for hospital treatment and monitoring of pediatric patients causes this situation. In the formation of pressure injuries in children, it should be taken into consideration that factors such as the use of medical equipment, espcially in intensive care unit (ICUs), monitors, long-term intubation practices, immobility of the child, use of narcotic drugs, hypotension, and hypoxemia may pose risks (Martínez et al., 2012). Schlüer et al.

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(2012) reported that nutrition, physical activity, mobility, decreased sensory perception, friction, shearing, and elevation in skin moisture increased the rate of pressure injuries in children, and that the duration of stay in the ICU, the age of the patient, and the presence of chronic disease were important factors in the formation of pressure injuries (Schlüer et al., 2012). In pediatric patients hospitalized for treatment/care in the PICU, it requires considerable effort to prevent and protect the skin integrity of patient groups with multiple and complex treatments, fluid-electrolyte imbalance, immobility, insufficient tissue perfusion, malnutrition, insufficient oxygenation, skin dryness, and high skin moisture (Schindler et al., 2011; Uysal, 2022; Uysal et al., 2020). It has been stated that newborns and children have more injuries caused by medical devices than adults because the barrier function of the skin is not sufficiently mature (Fernandes et al., 2011). Studies reported that the incidence of pressure injuries caused by medical devices varied between 1 % and 27 % in PICUs and neonatal intensive care units (NICUs) (Curley et al., 2003; Schlüer et al., 2009). In regional studies conducted in our country, it has been stated that the incidence rates of medical devices related pressure injuries (MDPRI) vary between 37.5 % and 21 % (Başbakkal et al., 2023; Elmaoğlu et al., 2024). In a study conducted in Switzerland by Kohr and Curley (Kohr & Curley, 2010), the incidence of pressure injuries in pediatric patients was reported as 27.7 % (Kohr & Curley, 2010). Ventilacion et al. (Ventilacion et al., 2008) stated that 50 % of the development of pressure injuries in their 5-year follow-up in PICUs and NICUs nationally was caused by the nasal intubation tube (Ventilacion et al., 2008). In their study, Kim et al. (2019) examined the incidence of pressure injuries caused by medical devices with 184 pediatric patients receiving respiratory support. They stated that the incidence of pressure injuries caused by medical devices was 11.9 %, 54.2 % of these injuries were caused by intubation tubes, 37.5 % were caused by high-flow oxygen cannulas, and 8.3 % were caused by saturation probes (Kim et al., 2019).

Injuries caused by medical devices impose an economic burden on the patient as well as on healthcare expenses. According to a report published in the United States of America (USA), it was suggested that the total cost of hospital-related pressure injuries in recent years would be 26.8 billion dollars (Padula & Delarmente, 2019). The United Kingdom National Health Service (UK NHS) reported the cost of pressure injuries at £571 million between 2017 and 2018 (Guest et al., 2020). No data could be found regarding the cost of pressure injuries caused by medical devices in our country. In most studies, it has been determined that care packages are 75 % to 100 % effective in preventing pressure injuries and reduce possible financial expenses (Arundel et al., 2021; Crespo et al., 2021; Mariam & Buddhavarapu, 2020; Schrooeder & Sitzer, 2019; Tayyib et al., 2021; Zhang et al., 2022). The first step in preventing pressure injuries is to determine risks using an appropriate assessment scale (Gefen et al., 2022). The Pediatric Pressure Ulcer Prediction and Evaluation Tool (PPUPET) appears to be a tool that comprehensively and accurately evaluates the risk assessment for pressure injury development, including medical device-related injuries, in pediatric age groups (Kottner et al., 2018; Lei et al., 2025). In a study conducted in 2018, the validity and reliability of seven risk assessment tools for the development of pediatric pressure ulcers were highlighted, one of which is PPUPET (Ferreira et al., 2018). According to the results of the network meta-analysis study, which included a total of 4908 patients and 20 articles with 13 risk assessment tools, it was stated that PPUPET has the highest superiority index and demonstrated diagnostic accuracy, explaining that it has the best predictive performance among pediatric pressure ulcer development risk assessment tools. As a result of the study, due to the high accuracy of PPUPET and its ability to effectively assess MDRPI risk, clinical practitioners have been recommended to use PPUPET in children (Lei et al., 2025).

Based on the results of the study, it is thought that the measurement tool will be used in pressure injury risk assessment in the pediatric population and will also contribute to reducing the expense burden by allowing the detection of existing risks. The aim of the study is to establish the validity and reliability of PPUPET in Turkish society.

Research Questions;

1. Is the Turkish adaptation of PPUPET valid?
2. Is the Turkish adaptation of PPUPET reliable?
3. What is the relationship between PPUPET and the Braden QD-T Scale?

Material & method

Study design

This study was conducted methodologically to test the validity and reliability of PPUPET in Turkish in pediatric patients. The reporting of this study was performed using "Guidelines for Reporting Reliability and Agreement Studies (GRRAS)" (Foster et al., 2024; Kottner et al., 2011).

Population and sample of the research

The population of the research consisted of pediatric patients hospitalized in the PICU of a public hospital in the Southeastern Anatolia Region of Turkey. Sample size should be calculated by taking into account at least five to a maximum of ten times the total number of items in the scale (nine items * 10 = 90). Also, the sample size should be at least 200 in validity and reliability studies (Can, 2019). The study consisted of 228 children hospitalized in the PICU. Data were obtained from pediatric patients and their files who were hospitalized for at least 3 days in the PICU of the hospital under investigation between July 2023 and October 2023. Before the study, written and verbal consent was obtained from the families for their children to participate in the research.

Data collection tools

A personal information form, PPUPET, and the Braden QD-T Scale were used to collect data.

Personal information form

This form, created by the researchers after reviewing the literature (Curley et al., 2018a; Delmore et al., 2019; Sterken et al., 2015; Törüner et al., 2011), contained a total of 15 questions about the children's sociodemographic and clinical characteristics.

Pediatric pressure ulcer prediction and evaluation tool

PPUPET is a 3-point Likert-type scale consisting of nine items developed by Sterken et al. in 2015 to predict and evaluate the development of pressure injuries in children aged 0 days to 18 years, excluding preterm babies hospitalized in the PICU. The items of the scale are mobility, activity, sensory perception, moisture, external devices, friction/shear, nutrition, tissue perfusion and oxygenation, and skin conditions. A total score from the scale between 18 and 26 means that there is a high risk (Sterken et al., 2015).

Braden QD Scale for assessment of immobility and device-related pressure ulcer risk in pediatric patients

This scale was developed by Curley et al. in 2018 based on device-related pressure injury risk factors and was recommended for use in all age groups from newborns to those aged 21 years. The scale consists of four main dimensions and a total of seven sub-dimensions evaluated under these dimensions (Curley et al., 2018a).

The dimensions and sub-dimensions are presented below:

Intensity and Duration of Pressure

- *Mobility (1)*
- *Sensory perception (2)*

Tolerance of the Skin and Supporting Structure

- *Friction and shear (2)*
- *Nutrition (4)*
- *Tissue perfusion and oxygenation (5)*

Medical devices

- *Number of medical devices (6)*
- *Repositionability/skin protection (7)*

Each sub-dimension in the scale can receive one of the scores of 0, 1, and 2. A total score of 0 from the scale is considered the lowest risk, and 20 points is considered the highest risk. A total scale score of 12.5 points or above indicates high risk. The Turkish validity and reliability of the scale was conducted by (Çiğdem et al., 2025). In their study, Puspitasari et al. stated that Cronbach's alpha coefficient was between 0.756 and 0.834 (Puspitasari et al., 2020). In the study, the Cronbach's alpha coefficient of the scale was found as 0.798.

Validity of PPUPET

Language validity

After obtaining the necessary permission and ethics committee approval from the researchers who developed the scale, language validity steps were first followed. In this step, the translation from English to Turkish was performed by three experts in both languages. Turkish translations were compared with each other and the final Turkish form was created. This form was translated back into English by another expert fluent in English and compared with the original scale.

Content validity

Expert opinion was sought for the content validity of the scale. The original version of the scale, translated into Turkish, along with a cover letter, was sent to 16 experts, including nurses, physicians, and nursing faculty members who had training or experience in the field of pressure injuries, and they were asked to evaluate each item in terms of comprehension. The necessity, clarity, specificity of the items, and the face validity of the scale were determined by experts using the Davis method (Davis, 1992). Accordingly, each item was scored on a scale ranging from 1 to 4 (1 = Not appropriate/needs a lot of change, 2 = Somewhat appropriate/item needs to be modified to appropriate form, 3 = Fairly appropriate/but minor changes are required, and 4 = Very appropriate/no change is required) (Öncü, 1994). According to the content validity analysis (CVA) performed using the Davis technique, the intelligibility levels of the items were found as between 0.80 and 1.00 (Sengul et al., 2022). The scale, which was prepared in line with expert opinions, was evaluated by a Turkish language expert.

Pilot study

To determine whether the items in the scale were understandable, a pilot/preliminary study was conducted by the researcher and a nurse evaluating 20 patients, and it was determined that the scale items were understandable. These evaluations were not included in the study.

Construct validity

In the construct validity of the scale, Kaiser-Meyer-Olkin (KMO) analysis was used to determine sample adequacy and Bartlett's test of sphericity was used to evaluate the sample test size, that is, whether the sample was suitable for factor analysis. Exploratory factor analysis (EFA), confirmatory factor analysis (CFA), CFA fit indices, and the construct validity of the scale were examined. Exploratory Factor Analysis (EFA) was employed to identify the underlying factor structure of the scale based on the dataset and to determine how the items load onto distinct dimensions. Confirmatory Factor Analysis (CFA), on the other hand, was conducted to test the extent to which the theoretically proposed factor structure fits the empirical data. The use of CFA was further justified by the inclusion of model fit indices (such as Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residuals (SRMR)), which provide important indicators of the structural validity of the model.

Reliability analysis

Internal consistency (item-total correlation coefficient and Cronbach alpha value), interobserver consistency, the parallel form method, and receiver operating characteristic (ROC) curve analysis were used to evaluate the distinctiveness.

Cronbach alpha coefficient

To determine the internal consistency of the scale, Cronbach's alpha coefficient and item-total score correlation coefficients were examined to see the effect of each item on the total score.

Interobserver consistency

In the study, three observers evaluated the risk of pressure injuries in the same child, simultaneously and independently, using PPUPET. The consistency of the scores obtained by observers from the same measurements under similar conditions was examined using intra class correlation (ICC).

Parallel form method

The Braden QD-T was used as the parallel form in the study.

Receiver operator characteristics (ROC) curve

The scale's distinctive feature of pressure injury risk was examined using an ROC curve. To assess whether the scoring would discriminate, the area under the ROC area under cure (AUC) and the cut-off value for the total score of the scale were calculated.

Moisture measurement

Skin moisture was measured from five points on the body (Glabella, cheek, lower part of the forearm, middle of the calf, lower part of the back and abdomen) using a DMM digital moisture monitor for skin and the average was recorded (Güneş et al., 2020; Hon et al., 2020; Logger et al., 2019; Mayrovitz, 2023).

Data collection

At this stage, study data were collected by the researcher and two nurses through observation between July 1st, and November 10th, 2023. To collect data, two volunteer nurses were given face-to-face training by the researcher about the purpose, content, and evaluation of the scale, which lasted approximately 30 min. One day after the training, the researcher and two nurses completed the personal information form on the same child, simultaneously and independently, and made an evaluation using PPUPET and the Braden QD-T scale. Study data were collected for 228 pediatric patients. It took an average of 5–10 min to collect data for each child.

Statistical analysis

For analysis of the data obtained in the study, descriptive and reliability analyses were performed using the SPSS version 25.0.1.0 program, and validity analyses were conducted using the Lisrel version 8.3 package. Descriptive statistics of the data were examined using frequency, percentage, minimum-maximum, mean and standard deviation (SD) values. For validity analysis, content validity (language validity) and construct validity (structure validity) tests were examined. Multiple fit indices for CFA are Chi-square goodness, the Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), CFI, SRMR, and RMSEA fit indices were examined. Reliability was evaluated using internal consistency (item-total correlation coefficient and Cronbach alpha value) and parallel form methods.

Ethical aspect of research

The research was approved by the Kilis 7 Aralık University Non-Interventional Ethics Committee (Date: 05.05.2023, Number: 2023/09–13). Research permission was obtained from the provincial health directorate to which the hospital was affiliated. Necessary permission was obtained from the researcher who developed the scale to conduct validity and reliability analyses of the Turkish version of PPUPET. Written and verbal consent was obtained from the families of the pediatric patients included in the study before beginning the research.

Results

Half (50.9 %) of the children included in the study were male. It was found that 66.7% were not at risk of pressure injuries according to the Braden QD-T Scale, and 64.9 % were not at risk of pressure injuries according to PPUPET. The average age of the children was 48.52 ± 45.21 months, their average body weight was 19.15 ± 24.53 kg, their average height was 97.98 ± 27.57 cm, their average hospital stay duration was 65.56 ± 66.73 days, their average heart rate was 113.52 ± 18.53/min, their average respiratory rate was 26.01 ± 4.83/min, their average systolic blood pressure was 101.36 ± 18.57 mmHg, and their average diastolic blood pressure was 60.85 ± 13.71 mmHg. The mean Braden QD-T scale score was 12.42 ± 2.29, and the mean PPUPET score was 16.14 ± 3.18. The average skin moisture percentage of the children was found as 29.92 ± 1.14 (Table 1) (See Fig. 1).

Validity analysis

Content validity

After language adaptation was achieved, PPUPET was sent to 16 experts in the field of nursing. The content validity index (CVI) of the scale items as evaluated using the Davis method ranged between 0.80 and 1.00, and the content validity ratio (CVR) was found as 0.92.

Construct validity

Sampling adequacy and Bartlett sphericity tests were performed to reveal the suitability of the sample for factor analysis. The KMO sample suitability coefficient was found as 0.791 and Bartlett sphericity test χ^2 value was 226.354 ($p < 0.001$). These results showed that the data were suitable for factor analysis (Table 2).

The factor structure validity of the scale was tested using CFA and goodness of fit indices were calculated. CFA is used to verify the factor structure of a particular scale. The most frequently used goodness-of-fit indices in studies in the literature were used in the study. Some reference values and scale values accepted for the fit indices used are given below (Table 3).

The fact that the scale obtained in Table 3 had a single factor showed that its eigenvalues were greater than 1. Generally, one of the most important and widely used criteria when determining the number of factors to be included in a scale is to include factors with a calculated eigenvalue greater than 1 (Büyüköztürk, 2002:119). It was seen that the total explained variance level of this single factor was 61.833 %. According to these findings, it was determined that the single factor that emerged as a result of the analysis together explained approximately 46 % of the total variance of the main structure. According to Kline, this value is well above the acceptable level because it is over 40 % (Kline, 2005).

The analysis results showed that the fit indices calculated using CFA, were at an acceptable level (Table 4).

Standardized factor loadings, t values and explanatory (R2) values of the items are shown in Table 5.

When the standardized coefficients were examined, it was determined that the factor loadings were high, standard error values were low, t values were significant ($p < 0.001$), and $\mathbf{R^2}$ values were high. These results confirm the construct validity of the previously determined factor structure.

Reliability analyses

In the figure, the AUC in the ROC curve was found to be 0.802.

In the study, it was determined that there was a positive, high-level, statistically significant relationship between the average PPUPET score and the average Braden QD-T scale score. A negative, non-statistically significant relationship was determined between the average skin moisture values of the patients and the average PPUPET score. It was found that there was a statistically significant negative relationship between the average skin moisture values of the children and the average Braden QD-T scale score (Table 8).

Discussion

This study was conducted to test the reliability and validity of PPUPET, which was developed in English, in the Turkish population.

Validity of the pediatric pressure ulcer prediction and evaluation tool

"Validity is one of the important qualities that enable judging to what extent a data collection tool covers or reflects the components related to the theory, concept or variable it aims to examine. Just because the tool makes very accurate measurements does not prove that it does exactly what is intended. The validity problem relates to the question of whether the researcher actually measures the variable he/she thinks he/she is measuring. On the other hand, it is inevitable that a tool that gives measurement errors, makes variable measurements, that is, has limited reliability, will give misleading results even if it contains the most valid indicators. Therefore, validity and reliability are two important qualities of an instrument that cannot be considered independently of each other" (Alpar, 2016; Büyüköztürk et al., 2012; Dedeli et al., 2009; Deniz, 2007; Devellis, 2016; Seçer, 2015).

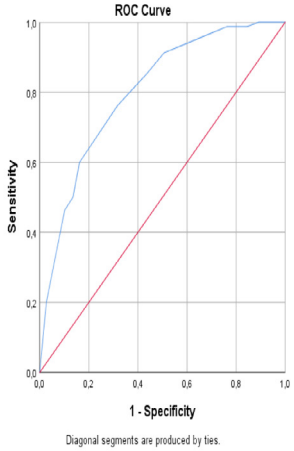
Whether PPUPET measured the structure it was intended to measure was examined using CFA. The factor structure validity of the scale was tested using CFA, and goodness of fit indices were calculated. CFA results showed that there was grouping reliability. The df/X2 = 2.1 value of the scale was within the acceptable limit value (Büyüköztürk et al., 2012).

Values of 0.33 and above on the scales indicate good fit. The desired value for RMSAE is close to 0. Values of 0.05 and lower are excellent, and values approaching 0.08 indicate the complexity of the model. This value was 0.006 for PPUPET. PPUPET's GFI value was 0.92. For GFI, 0.90 and above was considered a good fit. AGFI is the adjusted GFI

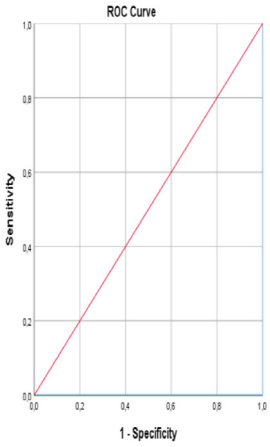
Table 1
Children's Sociodemographic and Clinical Characteristics, Scale Score Averages, and Moisture Percentage.

Features		n	%
Sex	Female	112	49.1
	Male	116	50.9
Risk according to Braden QD-T Scale	Yes	76	33.3
	No	152	66.7
Risk according to PPUPET	Yes	80	35.1
	No	148	64.9
		Mean ± SD	Min-Max
Age (months)		48.52 ± 45.21	3.00–184.00
Weight (kg)		19.15 ± 24.53	4.00–179.00
Height (cm)		97.98 ± 27.57	58.00–172.00
Number of days of stay		65.56 ± 66.73	3.00–245.00
Heart rate (min)		113.52 ± 18.53	67.00–156.00
Respiratory rate (min)		26.01 ± 4.83	18.00–40.00
Systolic blood pressure (mm Hg)		101.36 ± 18.57	13.00–133.00
Diastolic blood pressure (mm Hg)		60.85 ± 13.71	6.00–97.00
Braden QD-T Scale score		12.42 ± 2.29	9.00–17.00
PPUPET total score		16.14 ± 3.18	10.00–21.00
Moisture (%)		29.92 ± 1.14	27.80–34.2

PPUPET ROC



Braden QD-T ROC



Scale	Area Under Curve (AUC)	Std. Error	p	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
PPUPET	0.802	0.030	0.001	0.744	0.859
Braden QD-T	1.000	0.000	0.001	1.000	1.000

Fig. 1. ROC Curve.

value considering the sample size. For AGFI, 0.90 and above indicates perfect fit, and 0.90–0.94 indicates fit at the desired level. The AGFI value for PPUPET, for which validity and reliability studies were conducted, was 0.90, and indicating an appropriate level of fit. For CFI values, 0.90 and above indicates good fit. This value of the scale was 0.90. Based on the results, it can be concluded that the scale has reliable and very successful fit indices (Brown, 2015; Büyüköztürk et al., 2012; Seçer, 2015; Yurdugül, 2005).

Reliability of PPUPET

Internal consistency of measurement tools is a concept based on the assumption that a tool consists of independent units for a certain purpose and that these have known and equal weights within the whole. For this reason, internal consistency is also called the homogeneity of the tool. Reliability determines that all units of the scale are capable of measuring the variable of interest. The alpha coefficient (Cronbach) and item-total score correlation are two of the methods used to test internal consistency reliability (Alpar, 2016; Büyüköztürk et al., 2012; Devellis, 2016; Seçer, 2015; Yurdugül, 2005). In the study, the correlation coefficient of the total score of PPUPET and the scores obtained from each item were found to be between 0.06 and 0.74, and it was determined that the item scores were positively correlated with the total score. Within the scope of reliability, Cronbach's alpha analysis was used to test internal consistency (Büyüköztürk et al., 2012). The evaluation criteria used in the evaluation of Cronbach's alpha coefficient are; "$0.00 \leq \alpha < 0.40$, the scale is not reliable", "$0.40 \leq \alpha < 0.60$, the scale has low reliability", "$0.60 \leq \alpha < 0.80$, the scale is quite reliable", and "$0.80 \leq \alpha < 1.00$, the scale is highly reliable" (Bujang et al., 2018). In our study, the Cronbach alpha reliability coefficient was found as 0.835. These data suggested that the internal consistency of the Turkish form of PPUPET was preserved.

Interobserver consistency is a method in which data are collected based on observation and multiple observers are trained and make measurements independently of each other, in the same situation, at

Table 2
KMO and Bartlett's Test values.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.791	
Bartlett's Test of Sphericity	Approx. Chi-square	226.354
	df	36
	Sig.	0.000

Table 3
Exploratory Factor Analysis results.

Total Variance Explained						
Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.137	45.968	45.968	4.137	45.968	45.968

Table 4
The fit indices of CFA findings of the scale.

χ^2	df	χ^2/SD	GFI	AGFI	CFI	RMR	RMSEA
56.80	27	2.1	0.92	0.90	0.90	0.11	0.006

χ^2: Chi-square, df: Degrees of freedom, GFI: Goodness of Fit Index, AGFI: Adjusted Goodness of Fit Index, CFI: Comparative Fit Index, SRMR: Standardized Root Mean Square Residual, RMSEA: Root Mean Square Error of Approximation.

Table 5
Factor Loadings and Regression Coefficients for Items.

		Factors	Estimates	S.E.	t values	P	R^2
Item1	<—--	Factor_1	1				
Item2	<—--	Factor_1	0.776	0.178	4.366	**p < 0.001**	0.755
Item3	<—--	Factor_1	0.960	0.192	4.991	**p < 0.001**	0.721
Item4	<—--	Factor_1	0.103	0.148	0.696	**p < 0.001**	0.790
Item5	<—--	Factor_1	0.345	0.090	3.826	**p < 0.001**	0.689
Item6	<—--	Factor_1	0.954	0.183	5.209	**p < 0.001**	0.607
Item7	<—--	Factor_1	0.108	0.080	1.135	**p < 0.001**	0.793
Item8	<—--	Factor_1	1.245	0.223	5.587	**p < 0.001**	0.470
Item9	<—--	Factor_1	0.984	0.188	5.527	**p < 0.001**	0.846

the same time, with the same measurement tool. It is calculated by determining the agreement between scores given by more than one observer. It is defined as the degree of agreement or consistency between two or more observers. ICC is used to look at the similarity between two evaluations. In the study, ICC was used to examine the consistency of the scores obtained by observers from the same measurements made under similar conditions. ICC is evaluated as poor (< 0.4), moderate (0.41–0.59), good (0.6–0.74) and excellent (0.75–1) (Herting et al., 2018). In the study, the ICC value between observers was found as 0.992 and it was decided that the interobserver consistency was good (Table 6). (See Table 7.)

ROC curve analysis is a method used to test the adequacy of a variable that takes continuous values within a certain definition range (continuous variable) in its use as a diagnostic test. One of the important concepts used in ROC curve analysis is the AUC, which determines the accuracy of the test in distinguishing patients from non-patients. AUC values range between 0.50 and 1.00, and larger values (area) indicate that the test better distinguishes patients/risk from healthy persons. In the interpretation of AUC, 0.90–1.00 = excellent, 0.80–0.90 = good, 0.70–0.80 = fair, 0.60–0.70 = poor, and 0.50–0.60 = unsuccessful. The fact that the AUC was 0.802 showed that the determined cut-off point and the real situation were 80 % compatible (Hoo et al., 2017; Kamarudin et al., 2017; Kiliç, 2013).

In the study in which the PPUPET tool was developed, it was determined that the discriminatory power of the tool was 95 % CI: 76.48–96.33 (Sterken et al., 2015). In the study, the 95 % CI was 74.44–85.90, and it was seen that the risk detection power of the tool was high.

Table 6
Item–total correlations, α values if item deleted, and Cronbach alpha values.

Sub-dimensions	Items	Mean	SD	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach Alpha (Test)
Factor 1	Item 1	1.66	0.66	0.633	0.807	0.835
	Item 2	1.71	0.55	0.624	0.808	
	Item 3	1.56	0.59	0.705	0.797	
	Item 4	1.19	0.47	0.067	0.862	
	Item 5	2.91	0.28	0.499	0.828	
	Item 6	2.00	0.56	0.709	0.798	
	Item 7	1.07	0.25	0.171	0.845	
	Item 8	2.00	0.68	0.744	0.791	
	Item 9	2.01	0.58	0.702	0.798	

Table 7
Agreement between Observers.

Intraclass Correlation Coefficient							
	Intraclass Correlation[b]	95 % Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.992[a]	0.988	0.995	381.313	56	112	0.000
Average Measures	.997[c]	0.996	0.998	381.313	56	112	0.000

Table 8
Correlation Between PPUPET Total Score Mean and Braden QD-T Scale Score Mean.

Scales		PPUPET	Skin moisture
PPUPET	r		0.101
	p		0.457
Braden OD-T	r	0.724**	0.430
	p	0.000	0.000

In a study comparing the performance of the Braden Q scale and PPUPET, it was stated that PPUPET performed better (Jipping, 2015). In the study, it was observed that the reliability of PPUPET was highly correlated with the similar scale Braden QD-T and in the risk assessment of pressure injuries. This means that the tool has a high level of measurement reliability because it has a high level of relationship with the scale, which has been previously validated and reliable in Turkish population.

Moisture percentages of the patients were measured in five different parts of the body during the study. According to the reference value of the moisture meter device, 0 %–30 % is classified as dry skin and 30 %–5 % is classified as normal skin. According to the values obtained in the study, it was determined that the average skin moisture of the patients was close to the normal level. A negative, non-statistically significant relationship was found between the PPUPET score and moisture value. However, a statistically significant negative relationship was found between the Braden QD-T scale and PPUPET. In the study, it meaned that the risk of pressure injuries was higher in children with dry skin according to PPUPET and the Braden QD-T scale. In the literature, dry skin or high moisture is considered an important risk factor in pressure injuries (Curley et al., 2018b; Delmore et al., 2019; Mutlu, 2015). These results indicate that PPUPET and Braden QD-T Scale are accurate and reliable measurement tools in the risk assessment of pressure injuries.

Limitations and strengths of the research

Conducting the research in a single center was a limitation of the study. Another limitation of the study is that although PPUPET demonstrated good reliability and validity in this study, its applicability may vary in different environments, disease types, or care models. The strength of the research was the comparison of risk tools with moisture, which posed a great risk of pressure injuries caused by medical devices. Another strength was that it was the first study to compare two assessment tools that directly used medical devices in the risk assessment of pressure injuries. Another strong aspect of the study is that the PUPPET scale is the first research applied to pediatric patients in the Turkish society.

Clinical implications

This study will enable a more accurate assessment of pressure ulcer risk in pediatric patients. This, in turn, will contribute to the improvement of clinical decision-making processes and support the development of early intervention and prevention strategies in nursing practice. Moreover, the scale may be considered by healthcare policy makers in updating guidelines related to pediatric patient safety, and it can also be integrated into nursing curricula by educators for training purposes.

Conclusion

It was determined that PPUPET was a valid and reliable assessment tool for the Turkish population. In addition, it was determined that low moisture content of the skin posed a risk of pressure injuries.

Recommendations

Predicting pressure injuries by using PPUPET in pediatric critical care and treatment centers and taking the necessary precautions and care will largely prevent pressure injuries. It is recommended for pediatric nurses to use PPUPET because it is easy to use and practical. It is recommended that validity and reliability studies of the PUPPET scale be conducted in different regions and with different groups of pediatric patients.

CRediT authorship contribution statement

Erhan Elmaoğlu: Writing – review & editing, Writing – original draft, Validation, Methodology, Formal analysis, Conceptualization. **Zerrin Çiğdem:** Writing – review & editing, Validation, Supervision, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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