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Assessment of the risk of pressure ulcer during the perioperative period: Adaptation of the Munro scale to Turkish

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ABSTRACT

Aim of the study: This study was conducted to adapt the Munro Pressure Ulcer Risk Assessment Scale (Munro Scale) to Turkish and to test its validity and reliability.
Materials and methods: In the methodological study, the data were collected using the patient identification form, the Braden Scale, and the Munro Scale. A total of 188 patients were diagnosed for the risk of preoperative and intraoperative pressure ulcer, and then re-evaluated in the recovery room and in their bed.
Results: The study group consisted of 81 (43.1%) males and 107 (56.9%) females with a mean age of 51.98 ± 16.87. The Kaiser-Meyer-Olkin sampling adequacy test was 0.588 and the Bartlett's test was 430.471. The results of goodness of fit indices were not as expected value in the confirmatory factor analysis. In the exploratory factor analysis, it was determined that the factor loadings of the Munro Scale varied between 0.336 and 0.873 and explained 62% of the total variance. In the parallel-form method performed for the reliability of the scale, it was observed that there was a weak and negative correlation between the total scores of the Munro Scale and Braden Scales before the surgery and a negative and moderate correlation between the total scores after the surgery. The total Cronbach's alpha value was found to be 0.504. In the reliability analysis of the scale, interrater correlation coefficients were found to be 0.865-0.998.
Conclusions: The Munro Scale can be used to assess the risk of pressure injuries in perioperative patients and may help nurses to identify high-risk patients.

1. Introduction

Pressure ulcers (PUs) are defined as "the localized tissue damage that occurs in the skin and underlying tissues with bone protrusions with the effects of pressure, friction, tearing and other factors" [1]. While the incidence of PUs was determined for the first time by Hicks in patients who underwent surgical intervention [2], it was found to be 9.3% in the prevalence study conducted by Kayser et al. [3]. The incidence of PUs is 4.6–27.2% in Europe [4], however, it was found to be 54.8% in the study conducted by Karadag and Gümüşkaya on 84 patients who underwent surgical intervention in Turkey [5]. These results show that PUs is a major health problem and their prevention is critically important [6].

There are many risk factors that lead to the development of PUs in patients undergoing surgical intervention. These factors can be listed as the risk factors that occur before the surgery (advanced age, obesity, immobilization, being at high risk according to the risk assessment scale), during the surgery (duration of surgery, duration of immobilization, position, features of the operating table used, humidity of the skin) and after the surgery (immobilization, inadequate nutrition) [7]. Staying in the same position for a long time during the operations is the most important factor that increases the risk of developing PUs and that proper positioning of the patient during the operation is important to prevent PUs [3,5,7]. The duration of surgery is one of the important risk factors in PUs [7,8]. There is a direct correlation between the duration of immobilization and the development of PUs, and the risk of developing PUs increases as the duration of immobilization increases [9,10].

Although PUs are preventable problems, it leads to many negative consequences for the patient, hospital and healthcare professional in case of its occurrence. While PUs leads to psychological problems such as loss of patient independence and social isolation, they also extend the length of hospital stay and increase hospital-cost ratio by causing the patient to have pain depending on the wound care [11–13]. PUs also

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increases the workload of healthcare professionals [14]. When all these consequences are considered, PUs are an important problem that should be prevented. Various private institutions, public institutions and professional organizations have developed many guidelines regarding the prevention of PUs, especially in countries where the treatment and care costs of PUs are high. The most used of these guides were developed by National Pressure Ulcer Advisory Panel (NPUAP) and these guidelines include the interventions for the prevention of PUs and the importance of risk assessment is emphasized [15–17] All patients who undergo surgical intervention are at risk of developing pressure injuries. The risk assessment for the development PUs should be first performed to prevent PUs in patients who will undergo surgical intervention. The determination of the risk of the patients before the surgery by nurses will allow them to perform interventions for the preventable risk factors in PUs [5,18]. Therefore, all patients should be assessed for the risk of PUs, and nurses should diagnose the risk factors and plan protective measures [19,20]. Accordingly, nurses need valid and reliable tools with psychometric features assess the risk of developing PUs in patients undergoing surgical intervention [19]. Many minor problems that are noticed as a result of reasonable assessments in the early postoperative period provide a great opportunity to prevent bigger problems later [21]. Although there are many PUs risk assessment tools, there is a limited number of tools that evaluate information on PUs risk assessment during the surgical intervention. There are not enough studies that specifically examine the perioperative period for the development of pressure ulcer [7]. The Munro Pressure Ulcer Risk Assessment Scale is a scale developed to assess the risk of developing PUs during the surgical intervention.

In Turkey, the incidence of PUs, that develops in patients undergoing surgical intervention, is quite high, and there is no comprehensive scale that evaluates the risk in this period. The Braden Scale is used in surgical services, and the risk factors are not considered in the operating room setting. Therefore, it is important to have a scale that can evaluate the patients who are at risk before, during and after surgery to prevent the development of PUs. Risk assessment scales that are valid and reliable, determine the risk factors and have psychometric features should be used for risk assessment. Munro developed the Munro Scale to determine adult general surgery patients at risk of developing pressure ulcers. A committee was established with AORN (The Association of periOperative Registered Nurses) to further develop the scale [22]. The scale was developed by reviewing the literature and evaluated by the experts in perioperative care. Preliminary study revealed that the scale measured what was intended to measure [23]. The Munro Scale is also reported to provide a method for transmitting patient risk among nursing care professionals throughout the perioperative process [22].

In our country, there is no measurement tool which is used to determine surgical patients at risk at the present time. A Munro Pressure Ulcer Risk Assessment Scale will enable perioperative nurses to perform standard quality assessments to identify surgical patients who are at risk of developing PU. This study was conducted to adapt the Munro Pressure Ulcer Risk Assessment Scale to Turkish and to test its validity and reliability.

2. Materials and methods

2.1. Sample size and estimated study power

Patients who underwent surgery at the faculty of medicine of a foundation university in Istanbul constituted the population of this methodological study. The study was conducted between 01 December 2019-31 May 2020 after obtaining the ethics committee approval, and it was planned to take a total of 164 people with an alpha margin of error of 5% and a power of .80. Considering possible losses, a total of 188 people was included in the sample. The data were collected using the patient identification form, the Braden Scale, and the Munro Pressure Ulcer Risk Assessment Scale. The patients who would undergo elective surgery, did not have a problem in vision and hearing that would make communication difficult, and were 18 years of age and older were included in the study. The patients who would undergo immediate surgical treatment were excluded from the study.

2.2. Data collection procedure

The patients were diagnosed for the risk of preoperative and intraoperative pressure injuries, and they were re-evaluated in the recovery room and in their bed after the end of the surgery. PUs was classified according to the National Pressure Ulcer Advisory Panel (NPUAP) practice guidelines. Two nurses were trained on the use of the scale and the evaluation of PUs, obtained patient data when the patients were taken to the operating room, and observed and evaluated whether PUs occurred.

2.3. Data collection tools

The Patient Information Form, the Munro Pressure Ulcer Risk Assessment Scale, and the Braden Risk Assessment Scale for equivalent form reliability were used to collect data.

2.3.1. Patient information form

It consists of questions such as gender, age, body weight, height, type of surgery performed, as well as the occurrence of PUs (yes or no), and the anatomical location and stage of PUs.

2.3.2. Braden Risk Assessment Scale

The first reliability and validity study of the scale, which was developed by Bergstrom et al. [21], in Turkey was conducted in 1998 by Pınar and Oğuz [24] The scale includes six sub-dimensions, including the perception of the stimulus, humidity, activity, motility, nutrition, friction and irritation. A total score ranging between 6 and 23 is obtained by the sum of the subscale scores. Based on total score, 12 points and below are assessed as high risk, 13–14 as risky and 15–16 as low risk, and 15–18 points are considered as low risk among the individuals aged above 75 years old.

2.3.3. Munro Pressure Ulcer Risk Assessment Scale (Munro Scale)

It was developed by Munro in 2010 to evaluate PUs risk factors in patients [25]. The Munro Scale evaluates the patient's risk factors, for PUs development. The Munro Scale emphasizes the assessment of patient risk, and it is not a skin assessment. The risk level of the patient is scored for each stage of the surgery (pre-, intra-, and postoperative) with a cumulative score delivered to the inpatient unit for the continuation of care. It is not only a standardized risk assessment, but also a documentation and communication tool [22,25].

The risk assessment and score are cumulative and evaluates three phases of care: preoperative, intraoperative and postoperative. Each assessment phase is recorded based on a low, medium or high. The level of risk may change throughout the perioperative period based on accumulation of risk factors. The items are scored from 1 to 3.

2.3.3.1. Munro preoperative risk assessment. Preoperatively, the patient has major comorbidities including nutritional status, body mass index, and mobility [25]. Preoperative risk assessment consists of six items, which are mobility, nutritional status, Body Mass Index (BMI), recent weight loss, age and underlying diseases. The sum of the risk factors results in the Preoperative Munro Score Total to determine the Level of Risk. While a score 5–6 indicating low risk, 7–14 indicates moderate risk, and 15 or more indicating high risk.

2.3.3.2. Munro intraoperative risk assessment. Intraoperatively, the patient's risks increase depending on various factors such as the type of anesthesia, the length of the procedure and the positioning devices used

[25]. There are seven items for intraoperative assessment, which are physical status, The American Society of Anaesthesiologists (ASA) score, type of anesthesia, body temperature, hypotension, moisture, surface/-motion and position. The sum of the risk factors plus the Preoperative Munro Score Total results in the Intraoperative Munro Score Total to determine the Level of Risk. While a score of less than 13 indicates low risk, 14–24 indicates moderate risk and a score of higher than 25 indicates high risk.

2.3.3.3. Munro postoperative risk assessment. Postoperatively, factors such as position and frequency of rotation continue to expose the patient to the risk of developing pressure ulcers [25]. Postoperative assessment criteria consist of two items, which are the duration of surgery and whether there is hemorrhage. The Munro Scale assesses a patient's risks in all three perioperative phases. The risk level is scored for each stage with a cumulative score at the end [22,25]. The sum of the risk factors plus the Intraoperative Munro Score Total results in the Postoperative Munro Score Total to determine the Level of Risk. While a score of less than 15 indicates low risk, a score of 16–28 indicates moderate risk and a score of higher than 29 indicates high risk.

2.4. Psychometric measurements for using Munro tool

The following stages are included in the study conducted to determine the suitability of the Munro Pressure Ulcer Risk Assessment Scale for Turkish patients:

1. Forward translation: The scale was translated into Turkish by two individuals, who know Turkish and English well, for language validity in accordance with the methodology of translation, and the statements in the Turkish form were compared and reviewed. The most suitable option was determined for each item and a single Turkish form was created.
2. Expert panel: In the validity study of the scale, the Turkish form obtained and scale in original language were submitted to the opinion of nine faculty members, who have WOCN certification and are actively working in this field, for content validity. The Davis technique was used to evaluate the expert opinions. In the Davis technique, expert opinions were rated as (a) appropriate, (b) the item should be slightly revised, (c) the item should be revised extensively and (d) the item is inappropriate. In the analysis performed based on expert opinions, the content validity index (CVI) was determined as 0.855.
3. Back-translation: The Turkish form was translated back to the original language by an individual independent of the individuals who made the first translation. The scale, which was translated back into the original language, was sent to Cassandra Munro in terms of meaning differences.
4. Pre-testing: After the language and content validity, a pilot study was conducted by applying the scale to a group of 10 people.
5. Final version: The final Turkish version of the instrument was applied to the target group.

2.5. Data analysis

The data were coded and evaluated in the SPSS (Statistical Package for the Social Sciences) 20 program. Descriptive statistics were used for demographic data, continuous variables were shown as mean ± SD and categorical variables were presented as percentages (%). The Bartlett's test was used for the suitability of the sample for factor analysis, and the Kaiser-Meyer-Olkin test was used for the adequacy of the sample size. The confirmatory and exploratory factor analyses were performed for construct concept validity. The factor patterns of the scale and the variance percentages they explained were evaluated. Interrater reliability and internal consistency were considered as the indicators of the reliability of the scale. The intraclass correlation coefficient (ICC) was used to assess interrater reliability. Internal consistency was evaluated by Cronbach α. Correlation analysis was used in the correlations between scales, the difference between the groups was examined using the Mann Whitney *U* test, and $p < .05$ was considered statistically significant.

3. Ethical considerations

Before starting the study, permission was obtained from Cassandra Munro, who developed the scale, to adapt it to Turkish. After the authorization of the tool was obtained by mail, written permission was obtained from the Koç University Ethics Committee (August 11, 2019, No: 2019.339.IRB3.174) before the data were collected.

4. Results

4.1. Demographic characteristics of the study group

The study group consisted of 81 (43.1%) males and 107 (56.9%) females with a mean age of 51.98 ± 16.87 (min = 19, max = 87).

4.2. Validity analysis

4.2.1. Construct validity

The factor analysis technique was used for the construct validity of the scale. The Kaiser-Meyer-Olkin (KMO) test, that determines the adequacy of the sample size, and the Bartlett's test, that determines whether the scale is suitable for factor analysis, were performed before the factor analysis. The Kaiser-Meyer-Olkin (KMO) sampling adequacy test was 0.588 and the Bartlett's test was 430.471 ($df = 105$, $p < .001$). The construct validity was examined by confirmatory factor analysis (CFA). In the values of fit index (Goodness of Fit Statistics) of the scale regarding the confirmatory factor analysis are determined Root Mean Square Error of Approximation (RMSEA) = 0.098; Root Mean Square Residual (RMR) = 0.026; Standardized RMR (SRMR) = 0.098; Comparative Fit Index (CFI) = 0.398; Goodness of Fit Index (GFI); Adjusted Goodness of Fit Index (AGFI) = 0.806 and Chi-square/p value = 430.471/$p < .001$ were determined. According to this result, it was determined that the AGFI, GFI and CFI values were below 0.90 and that the RMSEA, SRMR value was greater than 0.05. It was determined that the RMR value was below 0.050. EFA was performed because only the RMR value met the criteria required in fit indexes in CFA. In the exploratory factor analysis, it has been concluded that the factor loadings of the scale from 0.336 to 0.873. and explained 62% of the total variance.

4.2.2. Reliability analysis

The reliability of the scale was examined by the parallel-form method. It was observed that there was a weak and negative correlation($r = -0.338$, $p < .001$) between the total scores of the Munro and Braden Scales before the surgery and a negative and moderate correlation between the total scores after the surgery ($r = -0.501$, $p < .001$) (Table 1).

Cronbach alpha of the scale was determined for internal consistency and reliability. The total Cronbach's alpha value was found to be 0.504. The item total correlation score correlations ranged from 0.078 to 0.550

Table 1
Comparison of the Munro Scale with the equivalent form.

Scales	Mean	SD	r	p
Preoperative Braden Scale	21.69	1.34	-.338	<.001
Preoperative Munro Scale	7.50	1.81		
Postoperative Braden Scale	19.26	2.65	-.501	<.001
Postoperative Munro Scale	33.22	4.78		

Table 2
Results of reliability.

Item	Item-total correlation	Cronbach's Alpha if item deleted
Mobility	.105	.501
Nutritional status	.156	.498
BMI	.211	.479
Weight loss	.078	.503
Age	.470	.378
Comorbidity	.408	.435
Physical status/ASA score	.550	.364
Anesthesia	.112	.502
Body temperature	.102	.505
Hypotension	.335	.440
Moisture	.219	.554
Surface/Motition	.082	.503
Position	.136	.606
Length of perioperative duration	.324	.450
Blood loss	.155	.493

(Table 2).

The interrater correlation coefficients in the reliability analysis of the scale are presented in Table 3.

The risk factor distribution and scores of the Munro Pressure Ulcer Risk Assessment scale including before, during and after surgery are given in Table 4. For the perioperative period, 12.2% (n = 23) of patients were found to be at high risk for PUs.

In the postoperative period, only 3 patients developed 1st degree pressure ulcers in the sacrum and heel and 2nd degree in the scapula. A statistically significant difference was found between the patients with and without pressure ulcers (Table 5).

5. Discussion

This study was conducted to adapt the Munro Pressure Ulcer Risk Assessment Scale to Turkish society. Accordingly, it is considered that the adaptation of the Munro Pressure Ulcer Risk Assessment Scale, which includes the risks specific to patients who have undergone surgery, to Turkish will contribute to the literature in the process of identifying the patients who are at risk and diagnosing the risk factors. The assessment for PUs risk factors and development should be targeted and consistently performed in three periods: preoperative, intraoperative and postoperative. The Munro scale evaluates preoperative, intraoperative and postoperative risk factors [20,25]. It is reported that approximately half of the patients who undergo surgery develop PUs [26]. When national and international studies are examined, it is observed that the number of scales evaluating PUs in the operating room setting is insufficient [27,28]. The Munro scale went through several

Table 3
Interrater correlation coefficients of the Munro Scale.

Item	ICC	95% Confidence Interval
Mobility	.941	.921–.956
Nutritional status	.951	.935–.963
BMI	.995	.993–.996
Weight loss	.965	.953–.974
Age	1	–
Co-morbidity	.994	.992–.996
Physical status/ASA score	.997	.996–.998
Anesthesia	.922	.895–.942
Body temperature	.954	.938–.965
Hypotension	.997	.996–.998
Moisture	.945	.926–.959
Surface/motion	.941	.922–.956
Position	.992	.989–.994
Length of perioperative duration	.995	.994–.997
Blood loss	.985	.980–.989
Total Score	.900	.865–.925

Table 4
Risk factor distribution and scores of the Munro Pressure Ulcer Risk Assessment in the perioperative period.

Preoperative Risk Factor Score	Mobility	n	%
	Not limited, or slightly limited, moves independently	186	98.9
	Very limited, requires transfer assistance	–	–
	Completely immobile, requires full assistance	2	1.1
	Nutritional state - Length of NPO status		
	12° or <	183	97.3
	>12° but <24°	5	2.7
	>24°	–	–
	BMI		
	<30 kg/m^2	139	74.0
	30kg/m^2-35 kg/m^2	42	22.3
	>35 kg/m^2	7	3.7
	Weight Loss (Weight loss in 30–180 days)		
	Up to 7.4% weight loss, no change or unknown	184	97.9
	Between 7.5% and 9.9% weight loss	3	1.6
	≥10% weight loss	1	0.5
	Age		
	39 or less	55	29.3
	40–59	60	31.9
	60 or greater	73	38.8
	Co-morbidity (Each co-morbidity/grouping equals a score of 1. A minimum score of 0 and a maximum score of 6 is possible) (n = 121)		
	Smoking (current)	54	27.7
	Prehypertension or high BP levels (BP > 120/80)	61	31.3
	Vascular/Renal/Cardio-vascular/ Peripheral-vascular Disease	38	19.5
	Asthma/Pulmonary/Respiratory Disease	13	6.7
	Prior History of Pressure Ulcer/ Existing Pressure Ulcer	1	0.5
	Diabetes/IDDM	28	14.3
	Preoperative Munro Score Total (mean ± SD, min-max):	7.11 ± 1.40 (5–11)	
	5-6 = Low risk	7-14 = Moderate risk	15 or greater: High risk
	n = 72; 38.3%	n = 116; 61.7%	–
Intraoperative Risk Factor Score	Physical Status/ASA Score- As per anesthesia provider	n	%
	Healthy & mild systemic disease, no functional limitations	52	27.7
	Moderate to severe systemic disease, some function limitation	100	53.2
	Moderate to severe systemic disease, constant threat to life and functionally incapacitating or ASA >3	36	19.1
	Anesthesia		
	Minimum alveolar concentration (MAC), local	–	–
	Regional	3	1.6
	General	185	98.4
	Body Temperature		
	36.1°–37.8 °C Body T° maintained	55	29.2
	<36.1° or >37.8° (+or - 2°) T° fluctuated + or - 2°	121	64.4
	<36.1° or>37.8° (+or - >2°) T° fluctuated + or - >2°	12	6.4
	Hypotension		
	Absent or <10% change in BP	19	10.1
	Fluctuating or 11%–20% change in BP	38	20.2
	Persistent or 21%–50% change in BP	131	69.7
	Moisture (Skin under patient)		
	Remains dry	151	80.3
	Some moisture	37	19.7
	Pooled or heavy fluid	–	–

(*continued on next page*)

Table 4 (*continued*)

	Surface/Motion (Positioning aids, warming blanket, position change)		
	None/use of blanket over/ stationary	2	1.1
	Use of aids/blanket under/ stationary	183	97.3
	Shearing force/added pressure/ variable position	3	1.6
	Position (for procedure)		
	Lithotomy	61	32.4
	Lateral	56	29.8
	Supine/Prone	71	37.8
	Intraoperative Score Subtotal (mean ± SD, min-max)	14.52 ± 1.42 (11–18)	
	Add **Preoperative** Munro Score Total for a cumulative total (mean ± SD, min-max):	7.11 ± 1.40 (5–11)	
	Intraoperative Munro Score Total (mean ± SD, min-max):	21.63 ± 2.39 (17–27)	
	13 = Low Risk	14-24 = Moderate Risk	25 or greater = High Risk
	n = 42, 22.3%	n = 146, 77.7%	-
Postoperative Risk Factor Score	Length of perioperative duration (Total time from arrival to preoperative and departure from postoperative units)	n	%
	Up to 2°	6	3.2
	>2° but <4°	56	29.8
	>4°	126	67.0
	Blood loss (Intraop plus PACU sanguinous fluid via wound, orifice &/or drain as per LIP)		
	Up to 200 cc	182	96.8
	201–400 cc	1	0.5
	>400 cc	5	2.7
	Postoperative Score Subtotal (mean ± SD, min-max):	3.69 ± 0.66 (2–6)	
	Add **Intraoperative** Munro Score Total for a cumulative total:	21.63 ± 2.39 (17–27)	
	Postoperative Munro Score Total:	25.32 ± 2.68 (20–32)	
	15 = Low Risk	16-28 = Moderate Risk	29 or greater = High Risk
	–	n = 165; 87.8%	n = 23; 12.2%

Table 5
Total Munro scale scores of patients with and without pressure ulcers in the postoperative period.

	Postoperative Munro Score Total			
	n	%	Mean ± SD	Z
				p
Occurrence of postoperative pressure ulcer	3	1.6	29.33 ± 0.57	−2.637
No occurrence of postoperative pressure ulcer	185	98.4	25.26 ± 2.65	0.008

rounds of Delphi study to reach consensus on its content [20,29]. The Munro scale was published by the American Operating Room Nursing Association (AORN) in 2010 [25]. It was adapted for the Turkish population since it is a scale that comprehensively assesses the risk of PUs in adult perioperative surgical patients.

Risk scales should be evaluated for minimum reliability and validity [23]. Although validity and reliability are two different criteria, both are intertwined in determining the quality of a study [30]. It is necessary to work and comment in accordance with many criteria and standards during the development and use of the scale so that a scale would be valid and reliable [31]. Validity refers to whether a measuring instrument measures the variable it intends to measure [32]. The current study, language equivalence and content validity of the scale were first performed. During the development of the original Munro Scale, most comments, including the recommendations indicating that the rating was made incorrectly and malnutrition should also be added, were made in the BMI statement, and the least number of comments were made on mobility and the length of the perioperative period. Consensus was reached with the panel of experts on BMI, temperature, comorbidity, ASA, friction and shear [20,25]. In this study, the minimum content validity ratio was found in the body mass index classification of the scale. However, the content validity ratio was found to be high in all statements of the scale except for BMI. Based on this result, it was concluded that the Turkish form of the scale was an appropriate measurement tool in terms of language and content validity.

KMO test determines whether the scale is suitable for factor analysis [33]. Furthermore, the suitability of factor analysis should be supported by Bartlett's test of sphericity, which is an indicator of the strength of the relationship between variables [30]. Li et al. adapted the Munro scale to Chinese and determined that KMO was 0.592 [29]. The present study, KMO and Bartlett's test result showed that the scale was suitable for factor analysis. The two main factor analysis techniques are Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) [34]. In the studies, there is no rule about how many groups of people should be present to perform CFA because the sample size depends on many factors [35]. On the other hand, the number of samples should be higher than the number of variables and should be at least 50, and the number of observations per statement should be at least 1 to 5 in order to perform factor analysis [36]. It is also reported that the minimum number of participants that should be present may be in a wide range of up to 3 to 50 times the number of variables [35].

Construct validity tests the relationships between the structures and CFA is used for this purpose. CFA is an extension of exploratory factor analysis (EFA) that evaluates the underlying structure of the data [36]. In this study, the fact that the misfit indices were found to be higher than expected values in the confirmatory factor analysis indicated that the fit of the model was not good. Although a good fit of one of the fit indexes indicates the general fit of the data, another part of the model may have a poor fit [37]. Nevertheless, there are many fitness statistics with advantages and disadvantages over each other. Therefore, it would be wrong to say that the model fits the reality well or badly based on a single statistic [36]. Kılıç et al. they found that the increase in sample size generally did not lead to a significant difference in the model-data fit in RMSEA and CFI indexes [38]. In the EFA, the factor loadings varied between 0.336-.873 and explained 62% of the variance on average. The fact that the explained variance exceeds 50% of the total variance is an important criterion of factor analysis [39]. Li et al. determined that it explained 61% of the total variance [29]. The result in the study shows that the scale has an acceptable construct validity.

Reliability can also be determined by the high degree of correlation between the parallel forms used [31]. The current study, the Braden Scale was used as an equivalent form. Although it was not developed specifically for the perioperative setting, the Braden Scale can also be used as a preoperative baseline to estimate perioperative patients who are at risk [20]. In this study, when the Monro Scale and Braden Scale were compared in the postoperative period, a moderate and negative correlation was found. While a low score on the Munro scale indicates that the risk is also low, a low score on the Braden scale indicates that the risk is high. Therefore, it can be interpreted that negative correlation was found because the Braden Scale supported the Munro scale. Although the Braden scale is widely used for PUs risk assessment, it should also be known that it does not include the risk factors associated with surgery [20]. In the current study, the r value was determined to be -.338 in the preoperative period and -.501 in the postoperative period. Asuero et al. reported a low correlation between 0.300-.490 and a moderate correlation between 0.500 and 0.690 [39]. We do not have a national scale that includes perioperative risk factors. It is considered that the use of a relevant scale can keep the correlation between scales stronger.

The reliability of measurement procedures can be defined as a measure of stability or consistency [30]. If the scale is not reliable, the results will not be consistent, and different nurses will get different results [23]. Cronbach alpha is used to obtain the reliability index of the scales. The reliability index range is between zero ($\alpha = 0$) to one ($\alpha = 1$). High alpha value means higher reliability [28]. In this study, the Cronbach alpha value was found to be 0.504. When the literature is reviewed, it is observed that the α value is classified and interpreted in different ways. There are different recommendations on the minimum acceptable α value [40]. According to Kılıç (2016) [40] and Özdemir (2018) [41], the scale has a low reliability if the α value is ≥ 0.400 - $<$ 0.600. Li et al. found Cronbach alpha value as 0.400 in their study that adapted the Munro Scale to Chinese society. The authors reported that every item in the scale was not homogeneous and that PUs risk factors were independent from each other [29]. Although the risk factors are independent from each other, the incidence of PUs will increase when they come together. It is reported that every stage of the perioperative experience contributes to the patient's risk of developing pressure ulcers [22]. There is increasing acceptance that the risk of perioperative PU formation is multifactorial [7].

More than one method can be used to assess reliability. For example, we can look at the measurements taken by different raters and determine their degree of similarity (inter-rater reliability) [23]. However, inter-rater correlation data were found to be high in the study. Interrater reliability is measured by applying a single form by two practitioners and examining the correlation between them [32]. ICC is classified as poor if it is below 0.400, moderate if it is between 0.400 and 0.750, and good if it is above 0.750 [42]. Li et al. adapted the Munro scale to Chinese and found that the ICC rate were high like this study [29]. It is reported that the reliability of the scale increases as ICC approaches +1 [42]. This result means that more than one practitioner can achieve the same results when they independently assess a patient for the risk of PUs, and that the Munro Scale is consistent and reliable.

In the perioperative setting, the incidence of PUs is high in patients and it is necessary to perform risk assessment and to implement preventive measures [26]. The Munro Scale evaluates a total of 15 parameters such as preoperative mobility, nutrition, weight loss, BMI, age and additional diseases, intraoperative physical status/ASA, anesthesia, body temperature, hypotension, surface/motion and position, and postoperative duration of surgery and blood loss. The Munro Scale assesses a patient's risks in three perioperative stages. The risk level is scored for each stage, with a cumulative score at the end [20,22,25]. It is reported that every phase of the perioperative process contributes to the patient's risk for PUs development [22]. The risk of PUs in the preoperative and intraoperative periods of the patients included in the study was moderate. The number of patients with low risk of PUs preoperatively decreased further during the intraoperative period. During the perioperative period, all patients were found to be at medium and high risk for PUs. This result shows that it is important to evaluate the patient in terms of PUs at every phase of surgery and should be taken into consideration. In this study, although a small number of patients developed pressure ulcers, the total scale scores of the patients who developed pressure ulcers were found to be high. The Munro Scale may help nurses to identify high, moderate, or low risk patients during the preoperative (eg mobility, body mass index), intraoperative (eg, American Society of Anesthesiologists score, body temperature), and postoperative (eg, perioperative length of time, blood loss) periods [8]. The Munro Scale emphasizes the patient risk [22]. The Munro scale is specific to the perioperative period and its use will also increase the quality of patient care.

5.1. Study limitations

The study has several limitations. First, the study was conducted in a single center. Second, the Turkish PU assessment scale for the perioperative period is not available, which also limits the discussion of the results. Another limitation is that there are two specialist wound care nurses in the hospital where the study was conducted, and the hospital is at a very good level in preventing pressure ulcers, treatment and care. Another limitation is that the sensitivity and specificity of the scale could not be determined due to the development of pressure ulcers in only 3 patients in the study.

6. Conclusions

In the reliability and validity study aimed to adapt the Munro Scale to Turkish; language validity, content validity, construct validity, and internal consistency reliability were tested. According to these results, it was concluded that the Munro Scale is suitable for use with Turk surgery patients. The Munro scale, which was published by AORN, is a risk assessment tool for evaluating the risks of perioperative PUs in adults. It can be used to assess the risks of PUs in perioperative patients. It can help nurses in clinical practice to diagnose high-risk patients. Nurses can take appropriate preventive measures after diagnosis. The result in this study shows that this scale can be used in Turkish surgical patients. However, more studies should be conducted to support validation for Turkish society. The incidence of pressure ulcers in this study is given in the results. We suggested that this scale clinical use of a risk assessment tool and the significant influence of preventive care on the predictive risk measured with Munro scale.

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Declaration of competing interest

The authors declare that there is no potential conflict of interest for this work.

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References

[1] Sengul T, Karadag A. Determination of nurses' level of knowledge on the prevention of pressure ulcers: the case of Turkey. J Tissue Viability 2020;29(4):337–41. https://doi.org/10.1016/j.jtv.2020.06.005.
[2] Gefen A. How much time does it take to get a pressure ulcer? Integrated evidence from human, animal, and in vitro studies. Ostomy/Wound Manag 2008;54:26–8.
[3] Kayser SA, VanGilder CA, Ayello EA, Lachenbruch C. Prevalence and analysis of medical device-related pressure injuries: results from the international pressure ulcer prevalence survey. Adv Skin Wound Care 2018;31(6):276–85. https://doi.org/10.1097/01.ASW.0000532475.11971. aa.
[4] Moore Z, Avsar P, Conaty L, Moore DH, Patton D, O'Connor T. The prevalence of pressure ulcers in Europe, what does the European data tell us: a systematic review. J Wound Care 2019;28(11):710–9. https://doi.org/10.12968/jowc.2019.28.11.710.
[5] Karadag M, Gümüşkaya N. The incidence of pressure ulcer in surgical patients: a sample in Turkey. J Clin Nurs 2005;15:413–21. https://doi.org/10.1111/j.1365-2702.2006.01369.x.
[6] Gul A, Isik Andsoy I, Ozkaya B, Zeydan A. A descriptive, cross-sectional survey of Turkish nurses' knowledge of pressure ulcer risk, prevention, and staging. Ostomy/Wound Manag 2017;63(6):40–6.
[7] Hosie L. Learning from theatre acquired pressure ulceration. Wounds U K 2018;14(5):40–4.
[8] Spruce L. Back to Basics: preventing perioperative pressure injuries. AORN J 2017;105(1):92–9. https://doi.org/10.1016/j.aorn.2016.10.018.
[9] Stotts NA. Risk of pressure ulcer development in surgical patients: a review of the literature. Adv Wound Care 1999;12:127–36.
[10] Rastinehad D. Pressure ulcer pain. J Wound, Ostomy Cont Nurs 2006;33:252–7. https://doi.org/10.1097/00152192-200605000-00005.

[11] Stephen Haynes J. NICE Pressure Ulcer Guideline: summary and implications for practice. Br J Community Nurs 2006;11:18. https://doi.org/10.12968/bjcn.2006.11.Sup3.21213.
[12] Gorecki C, Brown JM, Nelson EA, Briggs M, Schoonhoven L, Dealey C, et al. Impact of pressure ulcers on quality of life in older patients: a systematic review. J Am Geriatr Soc 2009;57:1175–83. https://doi.org/10.1111/j.1532-5415.2009.02307.x.
[13] Feuchtinger J, de Bie R, Dassen T, Halfens RA. 4-cm thermo active visco elastic foam pad on the operating room table to prevent pressure ulcer during cardiac surgery. J Clin Nurs 2006;15:162–7. https://doi.org/10.1111/j.1365-2702.2006.01293.x.
[14] Pressure ulcer risk assessment and prevention: clinical practice guidelines. Royal College Of Nursing; 2001. http://www.rcn.org.uk/_data/assets/pdf_file/0003/109839/002166.pdf. [Accessed 26 July 2013].
[15] Risk assessment & prevention of pressure ulcers registered nurses' association of Ontario nursing best practice guidelines program. www.rnao.org/bestpractices. [Accessed 27 July 2013].
[16] Pressure ulcers: the prevention and treatment (Quick reference guide). National Institute Healty and Clinical Excellence; 2005. http://www.nice.org.uk/nicemedia/live/10972/29883/29883.pdf. . [Accessed 30 July 2013].
[17] Prevention and Treatment of Pressure Ulcers: Quick Reference. National pressure ulcer advisory Panel, European pressure ulcer advisory Panel and Pan pacific pressure injury alliance. 2nd.ed 2014.
[18] Guide Bayers PH, Carta SG, Mayrovitz AN. Pressure ulcer research issues in surgical patients. Adv Skin Wound Care 2000;13:115–21.
[19] Gul Ş. Prevention of pressure ulcers in patients undergoing surgery. Hacettepe Üniversitesi Hemşirelik Fakültesi Dergisi. 2014:54–61.
[20] Fawcett DL. Positioning the patient for surgery. In: Rothrock JC, editor. Alexander's care of the patient in surgery - E-book. 16. Edition: Elsevier Health Sciences; 2018. p. 497–594.
[21] Bergstrom N, Braden BJ, Laguzza A, et al. The Braden Scale for predicting pressure sore risk. Nurs Res 1987;36(4):205–10.
[22] Mathias JM. New pressure ulcer risk tool moves forward with implementation study. OR Manag 2014;30(7):1–3.
[23] Russell-Babin K. Selecting risk scales for clinical practice. Nurs Manag 2017:23–5.
[24] Pınar R, Oğuz S. Norton ve Braden Bası Yarası Değerlendirme Ölçeklerinin yatağa bağımlı aynı hasta grubunda güvenirlik ve geçerliğinin sınanması. *Uluslararası Katılımlı VI. Ulusal Hemşirelik Kongresi, Kongre Kitabı*. Ankara. 1998:172–5.
[25] Munro C. The development of a pressure ulcer risk assessment scale for preoperative patients. AORN J 2010;92(3):272–87. https://doi.org/10.1016/j.aorn.2009.09.035.
[26] Lopes CMM, Haas VJ, Dantas RAS, Oliveira CG, Galvão CM. Assessment scale of risk for surgical positioning injuries. Rev. Latinoam. Enfermagem. 2016;24:e2704. https://doi.org/10.1590/1518-8345.0644.2704.
[27] Soyer Ö, Özbayır T. Turkish adaptation of the 3S intraoperative pressure ulcer risk assessment scale. Int Refereed J Nurs Res 2018;13:46–64. https://doi.org/10.17371/UHD.2018.2.9.
[28] Chan LL, Idris N. Validity and reliability of the ınstrument using exploratory factor analysis and Cronbach's alpha. Int J Acad Res Bus Soc Sci 2017;7(10):400–10. https://doi.org/10.6007/IJARBSS/v7-i10/3387.
[29] Li D, Tang J, Gan X. Reliability and validity of the Munro Scale on the assessment of pressure ulcer risks in adult perioperative patients: a cross-sectional study. Int J Clin Exp Med 2018;11(9):9811–8.
[30] Karakoç FY, Dönmez L. Basic principles of scale development. Tıp Eğitimi Dünyası. 2014:39–49. https://doi.org/10.25282/ted.228738.
[31] Aktürk Z, Acemoğlu H. Reliability and validity in medical research. Dicle Medical J. 2012;39(2):316–9. https://doi.org/10.5798/diclemedj.0921.2012.02.0150.
[32] Hadi NU, Abdullah N, Sentosa I. An easy approach to exploratory factor Analysis: marketing perspective. J. Edu. Social Res. 2016;6(1):215–23. https://doi.org/10.5901/jesr.2016.v6n1p215.
[33] Yong AG, Pearce SA. Beginner's guide to factor Analysis: focusing on exploratory factor Analysis. Tutorials Quanti. Methods Psychol. 2013;9(2):79–94. https://doi.org/10.20982/TQMP.09.2.P079.
[34] Erkorkmaz Ü, Etikan İ, Demir O, Özdamar K, Sanisoğlu SY. Confirmatory factor analysis and fit indices: review. Turkiye Klinikleri J Med Sci 2013;33(1):210–23. https://doi.org/10.5336/medsci.2011-26747.
[35] Uyumaz G, Sırgancı G. What is the required sample size for confirmatory factor Analysis. Bayesian approach and maximum likelihood estimation. Int. J. Soc. Res. 2020;32(16):5302–40. https://doi.org/10.26466/opus.826895.
[36] Yaşlıoğlu MM. Factor Analysis and validity in social Sciences: application of exploratory and confirmatory factor Analyses, vol. 46. Istanbul University Journal of the School of Business; 2017. p. 74–85.
[37] Kılıç AF, Koyuncu I. Ölçek uyarlama çalışmalarının yapı geçerliği açısından incelenmesi. Ö. Demirel ve S. Dinçer (Ed.), Küreselleşen Dünyada Eğitim içinde (ss. 415–438). Ankara: Pegem Akademi. doi:10.14527/9786053188407.27.
[38] Kılıç AF, Koyuncu İ, Uysal İ. Doğrulayıcı faktör analizinde uyum: kategorik verilerle bir benzetim çalışması. 2020. https://doi.org/10.14527/9786257228619. Ankara, IPCEDU 2020 E-Kitabı.
[39] Asuero AG, Sayago A, Gonzalez AG. The correlation coefficient: an Overview. Crit Rev Anal Chem 2006;36:41–59. https://doi.org/10.1080/10408340500526766.
[40] Kılıç S. Cronbach's alpha reliability coefficient. J Mood Disord 2016;6(1):47–8. https://doi.org/10.5455/jmood.20160307122823.
[41] Özdemir Z. Development of a likert type Attitude scale in health sciences. J. Hacettepe Univ. Facult Nurs. 2018;5(1):60–8.
[42] Trevethan R. Intraclass correlation coefficients: clearing the air, extending some cautions, and making some requests. Health Serv Outcome Res Methodol 2017;17(2):127–43. https://doi.org/10.1007/s10742-016-0156-6.