A Multicenter Assessment of Nurses' Knowledge Regarding Pressure Ulcer Prevention in Intensive Care Units Utilizing the PUKAT 2.0

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Abstract

Introduction: Pressure ulcer (PU) care is pivotal in the practice of nurses working in intensive care units (ICUs). Therefore, nurses must possess adequate knowledge about the potential risks leading to the development of PUs, as well as managing complications that worsen patient conditions.

Objective: To evaluate the level of knowledge of ICU nurses concerning PU prevention in tertiary hospitals in Saudi Arabia.

Methods: In this cross-sectional study, the researchers recruited 320 ICU nurses from four tertiary hospitals using convenience sampling. Nurses' knowledge regarding PU prevention was assessed using the revised and updated version of the Pressure Ulcer Knowledge Assessment Tool (PUKAT) 2.0. Data were collected between May and June 2022. The CROSS checklist was observed for reporting.

Results: The mean scores of nurses' level of knowledge regarding PU prevention according to the themes of the revised and updated version of the PUKAT 2.0 were as follows—etiology: 62.81 ± 23.77; classification and observation: 50.86 ± 23.28; risk assessment: 31.19 ± 24.26; nutritious diet: 46.04 ± 25.96; prevention: 22.36 ± 12.41; and specific patient groups: 14.84 ± 22.88. Furthermore, the score for nurses' overall level of knowledge of PU prevention was 39.55 ± 8.84 out of 100, interpreted as low based on the 60% cutoff; the minimum knowledge score was 0. Notably, knowledge of PU etiology, classification, observation, and specific patient groups differed based on the hospital of affiliation. Interestingly, gender was the only demographic characteristic based on which nurses' knowledge regarding specific patient groups differed.

Conclusion: This study identified insufficient knowledge among ICU nurses regarding PU prevention, which can lead to complications among patients. Simulation scenarios related to PU prevention and management will be an effective way to help nurses gain appropriate knowledge that can be applied in clinical practice.

Introduction

Pressure ulcer (PU) development is usually related to reduced tissue perfusion. PUs are mainly caused by extrinsic factors, such as increased pressure and shearing forces (Loudet et al., 2017). However, intrinsic factors, such as limited mobility, malnutrition, older age and conditions requiring intensive care, and spinal cord injuries, may also contribute to the development of PUs (Dalvand et al., 2018). PUs are

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positively associated with increased mortality and a decreased quality of life (Repić & Ivanović, 2014). Although they are complications of immobility owing to the critical stage of a disease or injury, PUs are preventable (Ebi et al., 2019) through the application of specific care bundles or interventions (Tayyib et al., 2015), such as risk assessment, skin assessment, repositioning of the patient, and provision of adequate nutrition (Zuo & Meng, 2015).

PUs are one of the main risks among patients in the intensive care unit (ICU) as they negatively affect health status and may lead to a rise in the cost of treatment, in addition to an increased length of stay (Smit et al., 2016). In patients who develop PUs, the length of hospital stay can be extended from anywhere between 4 and 30 days; this situation increases mortality risk owing to infections (Dalvand et al., 2018).

Review of Literature

According to Johansen et al. (2020), moisture-associated skin damage (MASD) is usually caused by skin destruction, comprising incontinence-associated dermatitis, which is generally caused by urine or feces, and intertriginous dermatitis that occurs inside and near the skin folds because of moisture and friction (Bliss et al., 2011; Coyer & Campbell, 2018; Valls-Matarín et al., 2017; Wang et al., 2018). MASD is a "top down" injury on the surface of the skin while PU is a "bottom-up injury" caused by soft tissue changes from pressure and/or shearing forces (National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel, Pacific, Pressure Ulcer Alliance & Haesle, 2014; Ousey & O'Connor, 2017). However, incontinence-associated dermatitis may increase the risk of developing PUs (Beeckman et al., 2014) and previous studies have reported that 21% to 95% of patients in the ICU may experience incontinence-associated dermatitis (Bliss et al., 2011; Coyer & Campbell, 2018; Valls-Matarín et al., 2017; Wang et al., 2018). Furthermore, nurses must be able to differentiate MASD from PUs as the cause, preventive measures, and care for the two conditions vary (Lee & Kim, 2016).

According to Tubaishat et al. (2018), the prevalence rates of PUs worldwide vary between 6% and 18.5% in acute care settings. Meanwhile, a study in Saudi Arabia reported a PU prevalence of 44.4% and incidence of 38.6% in acute care (Saleh et al., 2009; Tayyib & Coyer, 2016). Another study reported a 12% overall PU prevalence in a healthcare setting and 29% in an intensive care setting (Tayyib & Coyer, 2016; Tubaishat et al., 2011). Furthermore, the National Pressure Injury Advisory Panel stated in 2014 that in an acute care facility, the prevalence of PUs among adults differs between 0% and 12%; in a critical care facility, between 24.3% and 53.4%; and in an older adult care facility, between 1.9% and 59% (Ebi et al., 2019).

Moreover, as patients in the ICU are considered critically ill, prevention of PUs is vital. Nurses, therefore, need to receive adequate opportunities and training to gain sufficient knowledge about PUs, including the necessary skills to prevent their development (Jacob, 2019). Nurses must also engage in interdisciplinary teamwork to prevent PUs; they must collaborate with other healthcare professionals to maintain the skin integrity of patients and to avoid complications (Dalvand et al., 2018). Furthermore, to prevent the formation of PUs, nurses must be knowledgeable about alleviating risk for individual patients by focusing on reducing prolonged pressure episodes using pads at pressure points or by repeatedly readjusting patient positioning. More importantly, nurses must ensure that their patients consume a nutritious diet to help avoid the formation of PUs (Boyko et al., 2018). However, a study showed that new ICU staff nurses who lack the necessary knowledge about PUs do not regularly engage in PU prevention practices (Jacob, 2019).

Nurses' knowledge is a key factor in evidence-based and effective PU prevention (Parisod et al., 2022). Wu et al. (2022) conducted a systematic review and meta-analysis and revealed that ICU nurses have insufficient knowledge of PU prevention, with an average value of 51.5%; the cutoff was 60%. Likewise, Gedamu et al. (2021) conducted a meta-analysis and demonstrated poor knowledge of PU prevention among nurses, with an average of 46.24% using the same cutoff of 60%. Similarly, Muhammed et al. (2020) reported that nurses' knowledge of PU was inadequate. These results are consistent with the broader literature on the topic (Khojastehfar et al., 2020; Miller et al., 2017; Shrestha et al., 2018; Taha, 2014; Tirgari et al., 2018). One of the reasons for ICU nurses' inadequate knowledge about PU prevention and management is the lack of in-service training programs offered at hospitals (Khojastehfar et al., 2020).

Knowledge gaps should be addressed to avoid complications in health settings (De Meyer et al., 2019). Although many studies have conducted assessments of nurses' knowledge regarding PU prevention, the findings largely remain inadequate. In this context, the revised Pressure Ulcer Knowledge Assessment Tool (PUKAT 2.0) is useful for identifying the knowledge gaps and areas of improvement to achieve continuous professional education.

Nurses are mainly responsible for PU prevention, a crucial aspect of nursing practice in intensive care facilities that is influenced by knowledge. Therefore, nurses must thoroughly understand the probability and risks of developing PUs as well as potential complications that can lead to the deterioration of a patient's condition. Although there have been studies in Saudi Arabia to assess nurses' knowledge regarding PU prevention, they are limited and outdated. Continuous assessment of nurses' knowledge in multiple locations is also necessary to address current knowledge gaps. Nurses' knowledge in this regard should be nurtured by up-to-date evidence-based work that supports the prevention of PUs, as limited resources will not improve the quality of nursing care. Against this background, this study aimed to evaluate

the level of nurses' knowledge of PU prevention in ICUs at four tertiary hospitals in Saudi Arabia.

Methods

Design

This study utilized a cross-sectional design.

Sample

This study was conducted at the general ICUs of four tertiary hospitals in Saudi Arabia: two private and two government hospitals. The ICU capacity of the four hospitals ranged from 20 to 25 beds. All ICUs provided care to both medically and traumatically ill patients requiring higher levels of care, as well as patients with severe surgical complications. The patients' length of stay ranged from 4 to 12 days. These hospitals were chosen because of the capacities of their ICUs, which mostly cater to bedridden patients with PUs.

The survey included 320 out of a total of 342 ICU nurses selected using convenience sampling. The participants were equally distributed across the four tertiary hospitals (80 nurses each) to ensure appropriate representation of the population as the number nurses in the four ICUs ranged from 84 to 91. Some nurses were on annual leave, which interfered with participation in the study. Additionally, nurses who did not meet the inclusion criteria were excluded from the study.

Inclusion Criteria

To be included in the study, the participants had to:

- Have a diploma, bachelor's, or master's degree in nursing.
- Have a license to practice nursing in Saudi Arabia.
- Have at least one year of work experience in the ICU.

Data Collection

The researchers administered the questionnaire to the participants on an individual basis, answering all their questions. The researchers visited the study settings three to five times over 1 week and surveyed those who were available during the visits, met the inclusion criteria, and were willing to participate in the study until the desired sample size was achieved. The questionnaires took approximately 30 min to complete. Finally, the researchers requested the participants to hand in the completed questionnaires and placed them in a locked cabinet to ensure confidentiality. Data were collected from May to June 2022.

Research Instrument

The revised and updated version of the PUKAT (Manderlier et al., 2017) was adopted. The PUKAT 2.0 (Manderlier et al., 2017), which focuses on assessing the expertise of nurses in

PU prevention, has acceptable psychometric properties. The tool comprises 25 multiple-choice questions within six themes, covering the essential factors on how to prevent PUs. The themes of the tool are etiology (six items), classification and observation (four items), risk assessment (two items), nutrition (three items), prevention of PUs (eight items), and specific patient groups (two items). All items were used. A correct answer is scored 1 point, while a wrong answer is scored 0, with a final score ranging from 0 to 25. The total score for each participant was translated as a percentage. The validity and reliability of the tool were tested using Cronbach's α; in this study, the value was .81. According to Taber (2018), a Cronbach's α value ranging from .45 to .98 indicates acceptable reliability.

Data Analysis

The collected data were analyzed using descriptive and inferential statistics using SPSS Statistics 20 software (IBM Corp., Armonk, NY, USA). Descriptive analysis was performed to describe the frequency, range, mean, median, and standard deviation of participants' demographic characteristics and knowledge of PU prevention. The interpretation of the scores was as follows: 0 to 29 = very low; 30 to 59 = low; 60 to 89 = high; and 90 to 100 = very high. Additionally, inferential statistics, such as the *t*-test for independent samples and one-way analysis of variance, were used to perform a hospital-wise comparison of the nurses' responses. Statistical significance was set at $P < .05$.

Ethical Considerations

The study was conducted with prior approval from the relevant institutional review board (approval no.: KSA: H-11-N-081). The necessary permissions were also obtained from the participating hospitals. The researchers scheduled a meeting with the ICU managers and explained the study's purpose and data collection process. The researchers then met the ICU nurses on the same day, and written informed consent was obtained. This was performed through direct contact, which included explaining the study's purpose and informing participants that the information obtained would only be shared with members of the research team. Additionally, their responses were anonymous and not directly linked to their names; however, the identification numbers linked to their survey responses were kept confidential. The researchers ensured that participants' cooperation was voluntary and informed them that they could withdraw from the study at any time without penalty.

Results

Sociodemographic Characteristics of the Nurses

Table 1 presents the participants' demographic characteristics. Regarding gender, 56.88% were women and 43.13%

were men. Of the sample, 3.75% were aged 21 to 25 years, 21.25% were aged 26 to 30 years, 26.25% were aged 31 to 35 years, 24.38% were aged 36 to 40 years, and 24.38% were above 40 years. By experience in the ICU department, the distribution was as follows: 1 to 3 years, 1.25%; 4 to 6 years, 20.94%; 7 to 9 years, 30.31%; and more than 10 years, 47.50%. Regarding educational qualifications, 43.44% of the participants had a diploma in nursing, 55% had a bachelor's degree in nursing, and 1.56% had a master's degree in nursing. Finally, the participants were equally distributed across the four tertiary hospitals (25% each; Table 1).

ICU Nurses' Level of Knowledge Based on PUKAT 2.0 Scores

Table 2 illustrates the nurses' level of knowledge regarding PU prevention according to the themes of the PUKAT 2.0 and the overall mean percentage score. The mean knowledge scores were as follows—etiology: 62.81 ± 23.77; classification and observation: 50.86 ± 23.28; risk assessment: 31.19 ± 24.26; nutritious diet: 46.04 ± 25.96; prevention: 22.36 ± 12.41; and specific patient groups: 14.84 ± 22.88. Nurses' overall knowledge of PU prevention had a mean score of 39.55 ± 8.84.

Furthermore, nurses' knowledge of PUs according to the PUKAT 2.0 domains of etiology and classification and observation, as well as demographic characteristics,

Table 1. Sociodemographic Characteristics of the Nurses.

Demographics	Frequency	Percentage
Gender		
Men	138	43.13
Women	182	56.88
Age (years)		
21–25	12	3.75
26–30	68	21.25
31–35	84	26.25
36–40	78	24.38
>40	78	24.38
Years of experience		
1–3	4	1.25
4–6	67	20.94
7–9	97	30.31
≥10	152	47.50
Educational qualification		
Diploma in nursing	139	43.44
Bachelor's degree in nursing	176	55.00
Master's degree in nursing	5	1.56
Hospital affiliation		
Hospital 1	80	25
Hospital 2	80	25
Hospital 3	80	25
Hospital 4	80	25

showed a significant difference only by hospital affiliation, with *P*-values of .005 and .012, respectively. Regarding nurses' knowledge of risk assessment, nutrition, and prevention, there were no significant demographic differences ($P >$ .05). Additionally, regarding nurses' knowledge of specific patient groups, there was a significant difference by gender and hospital affiliation, with *P*-values of .047 and .032, respectively. Finally, nurses' overall knowledge regarding PU prevention showed a significant demographic difference only by hospital affiliation, with a *P*-value of .011 (Table 2).

Discussion

This study focused on nurses' levels of knowledge regarding PU prevention in ICUs at four tertiary hospitals in Saudi Arabia. The majority of the respondents were women aged 31 to 35 years, working in the ICU department for more than 10 years, and with a bachelor's degree in nursing. Nurses' knowledge of PU prevention in terms of etiology and classification and observation were high, whereas their knowledge of risk assessment and nutritious diet were low. Nurses' knowledge levels regarding prevention and specific patient groups were even lower. Additionally, nurses' overall level of knowledge of PU prevention was interpreted as low based on the 60% cutoff using the PUKAT 2.0. Notably, knowledge of PU etiology, classification, and observation and specific patient groups differed based on the hospital of affiliation. Interestingly, age was the only demographic characteristic based on which nurses' knowledge regarding classification and observation differed.

De Meyer et al. (2019) identified that nurses scored low on three PUKAT 2.0 themes—prevention, etiology, and specific patient groups; the scores were 42.7%, 45.6%, and 46.6%, respectively. The findings showed inadequate knowledge among nurses regarding PU prevention. Furtado et al. (2022) also reported that nurses scored lower on questions related to prevention and risk, with only two of the 221 nurses achieving 90% correct answers or more. Meanwhile, Tulek et al. (2016) noted a lack of knowledge among nurses regarding PU prevention. Aydogan and Caliskan (2019) also recorded low scores of participating nurses on etiology, classification, and observation. Fulbrook et al. (2019) reported that participants received low scores on the classification and observation themes. The variety of scores across the themes may have resulted from differences in the nurses' working environments.

In the present study, ICU nurses at four hospitals scored 39.55/100. The cutoff for adequate knowledge on the PUKAT 2.0 was set at 60%. A research conducted by Sallam et al. (2020) in Hail, Saudi Arabia, showed a similar level of knowledge, with a mean score of 40.53%. However, compared with a similar study conducted by De Meyer et al. (2019) at 16 Belgian hospitals using the PUKAT 2.0, the findings were comparatively high, with a mean score of 50.7%. Conversely, a multicenter study

Table 2. ICU Nurses' Level of Knowledge as Demonstrated by PUKAT 2.0 Scores.

Knowledge of Etiology	n	%	Mean ± SD	Test statistic value	df	P-Value
Gender						
Men	138	43.13	60.14 ± 23.98	−1.75	318	.081
Women	182	56.88	64.84 ± 23.48			
Age (years)						
21–25	12	3.75	75.00 ± 19.31	2.20	319	.069
26–30	68	21.25	64.12 ± 20.89			
31–35	84	26.25	65.71 ± 25.90			
36–40	78	24.38	57.44 ± 21.71			
>40	78	24.38	62.05 ± 25.50			
Educational qualification						
Diploma in nursing	139	43.44	63.17 ± 23.25	0.99	319	.373
Bachelor's degree in nursing	176	55.00	62.95 ± 24.00			
Master's degree in nursing	5	1.56	48.00 ± 30.33			
Years of experience						
1–3	4	1.25	70.00 ± 25.82	0.77	319	.511
4–6	67	20.94	62.69 ± 24.34			
7–9	97	30.31	65.36 ± 22.64			
≥10	152	47.50	61.05 ± 24.22			
Hospital affiliation						
Hospital 1	80	25.00	67.75 ± 24.95	4.36	319	.005
Hospital 2	80	25.00	64.25 ± 23.32			
Hospital 3	80	25.00	55.00 ± 20.75			
Hospital 4	80	25.00	64.25 ± 24.38			
Knowledge of etiology			62.81 ± 23.77			
Knowledge of Classification and Observation						
Gender						
Men	138	43.13	46.92 ± 24.62	0.78	318	.436
Women	182	56.88	53.85 ± 21.80			
Age (years)						
21–25	12	3.75	41.67 ± 16.28	0.71	319	.587
26–30	68	21.25	52.57 ± 21.82			
31–35	84	26.25	52.38 ± 21.82			
36–40	78	24.38	49.68 ± 24.67			
>40	78	24.38	50.32 ± 25.00			
Educational qualification						
Diploma in nursing	139	43.44	52.16 ± 23.02	0.51	319	.603
Bachelor's degree in nursing	176	55.00	49.72 ± 23.60			
Master's degree in nursing	5	1.56	55.00 ± 23.02			
Years of experience						
1–3	4	1.25	56.25 ± 23.94	0.19	319	.900
4–6	67	20.94	52.40 ± 22.92			
7–9	97	30.31	50.77 ± 21.79			
≥10	152	47.50	50.16 ± 24.50			
Hospital affiliation						
Hospital 1	80	25.00	53.75 ± 20.71	3.72	319	.012
Hospital 2	80	25.00	53.13 ± 21.19			
Hospital 3	80	25.00	43.44 ± 25.08			
Hospital 4	80	25.00	53.13 ± 24.64			
Knowledge of classification and observation			50.86 ± 23.28			
Knowledge of Risk Assessment						
Gender						
Men	138	43.13	31.16 ± 24.32	−0.02	318	.984
Women	182	56.88	31.22 ± 24.28			
Age (years)						
21–25	12	3.75	29.17 ± 25.75	0.82	319	.516

Table 2. Continued.

Knowledge of Etiology	n	%	Mean ± SD	Test statistic value	df	P-Value
26–30	68	21.25	31.62 ± 24.29			
31–35	84	26.25	27.38 ± 25.04			
36–40	78	24.38	33.12 ± 23.80			
>40	78	24.38	33.33 ± 23.72			
Educational qualification						
Diploma in nursing	139	43.44	28.78 ± 24.80	1.26	319	.284
Bachelor's degree in nursing	176	55.00	33.14 ± 23.70			
Master's degree in nursing	5	1.56	30.00 ± 27.39			
Years of experience						
1–3	4	1.25	37.50 ± 25.00	0.19	319	.900
4–6	67	20.94	27.61 ± 25.05			
7–9	97	30.31	30.93 ± 24.41			
≥10	152	47.50	32.78 ± 23.84			
Hospital affiliation						
Hospital 1	80	25.00	33.75 ± 23.57	3.23	319	.777
Hospital 2	80	25.00	36.08 ± 22.56			
Hospital 3	80	25.00	30.00 ± 24.65			
Hospital 4	80	25.00	25.00 ± 25.16			
Knowledge of risk assessment			31.19 ± 24.26			
Knowledge of Nutrition						
Gender						
Men	138	43.13	47.34 ± 25.41	0.78	318	.436
Women	182	56.88	45.05 ± 26.40			
Age (years)						
21–25	12	3.75	50.00 ± 30.15	0.86	319	.489
26–30	68	21.25	46.57 ± 26.48			
31–35	84	26.25	45.24 ± 25.69			
36–40	78	24.38	42.31 ± 23.21			
> 40	78	24.38	49.57 ± 27.78			
Educational qualification						
Diploma in nursing	139	43.44	45.08 ± 25.96	0.86	319	.426
Bachelor's degree in nursing	176	55.00	47.16 ± 26.03			
Master's degree in nursing	5	1.56	33.33 ± 23.57			
Years of experience						
1–3	4	1.25	33.33 ± 27.22	0.52	319	.670
4–6	67	20.94	42.27 ± 26.56			
7–9	97	30.31	47.77 ± 26.31			
≥10	152	47.50	45.18 ± 25.56			
Hospital affiliation						
Hospital 1	80	25.00	49.58 ± 27.04	1.64	319	.181
Hospital 2	80	25.00	46.67 ± 25.77			
Hospital 3	80	25.00	40.83 ± 25.97			
Hospital 4	80	25.00	47.08 ± 24.70			
Knowledge of nutrition			46.04 ± 25.96			
Knowledge of PU Prevention						
Gender						
Men	138	43.13	22.06 ± 12.73	−0.37	318	.707
Women	182	56.88	22.59 ± 12.19			
Age (years)						
21–25	12	3.75	19.44 ± 14.31	0.29	319	.886
26–30	68	21.25	22.88 ± 13.14			
31–35	84	26.25	22.75 ± 12.43			
36–40	78	24.38	21.65 ± 11.20			
>40	78	24.38	22.65 ± 12.07			

(continued)

Table 2. Continued.

Knowledge of Etiology	n	%	Mean ± SD	Test statistic value	df	P-Value
Educational qualification						
Diploma in nursing	139	43.44	23.42 ± 12.74	2.04	319	.132
Bachelor's degree in nursing	176	55.00	21.78 ± 12.01			
Master's degree in nursing	5	1.56	13.33 ± 14.49			
Years of experience						
1–3	4	1.25	19.44 ± 13.98	1.64	319	.180
4–6	67	20.94	20.23 ± 11.75			
7–9	97	30.31	24.40 ± 13.19			
≥10	152	47.50	22.08 ± 12.06			
Hospital affiliation						
Hospital 1	80	25.00	21.81 ± 12.68	1.21	319	.306
Hospital 2	80	25.00	22.36 ± 13.17			
Hospital 3	80	25.00	24.44 ± 12.30			
Hospital 4	80	25.00	20.83 ± 11.37			
Knowledge of PU prevention			22.36 ± 12.41			
Knowledge of Specific Patient Groups						
Gender						
Men	138	43.13	17.75 ± 24.01	1.99	318	.047
Women	182	56.88	12.64 ± 21.79			
Age (years)						
21–25	12	3.75	8.33 ± 19.46	1.25	319	.289
26–30	68	21.25	18.38 ± 24.29			
31–35	84	26.25	12.50 ± 21.78			
36–40	78	24.38	17.31 ± 23.94			
>40	78	24.38	12.82 ± 21.97			
Educational qualification						
Diploma in nursing	139	43.44	13.67 ± 22.37	0.48	319	.617
Bachelor's degree in nursing	176	55.00	15.91 ± 23.35			
Master's degree in nursing	5	1.56	10.00 ± 22.36			
Years of experience						
1–3	4	1.25	0.00 ± 0.00	0.93	319	.428
4–6	67	20.94	17.16 ± 23.92			
7–9	97	30.31	13.40 ± 22.26			
≥10	152	47.50	15.13 ± 23.05			
Hospital affiliation						
Hospital 1	80	25.00	11.88 ± 21.41	2.97	319	.032
Hospital 2	80	25.00	10.63 ± 20.58			
Hospital 3	80	25.00	16.88 ± 23.79			
Hospital 4	80	25.00	20.00 ± 24.65			
Knowledge of specific patient groups			14.84 ± 22.88			
Nurses' Overall Knowledge of PU Prevention						
Gender						
Men	138	43.13	38.62 ± 8.55	−1.65	318	.099
Women	182	56.88	40.26 ± 9.00			
Age (years)						
21–25	12	3.75	39.24 ± 10.43	1.04	319	.389
26–30	68	21.25	40.69 ± 8.52			
31–35	84	26.25	39.93 ± 8.31			
36–40	78	24.38	37.88 ± 8.26			
>40	78	24.38	39.85 ± 9.88			
Educational qualification						
Diploma in nursing	139	43.44	39.81 ± 8.56	2.06	319	.129
Bachelor's degree in nursing	176	55.00	39.57 ± 9.04			
Master's degree in nursing	5	1.56	31.67 ± 6.32			

(continued)

Table 2. Continued.

Knowledge of Etiology	n	%	Mean ± SD	Test statistic value	df	P-Value
Years of experience						
1–3	4	1.25	38.54 ± 14.97	1.08	319	.357
4–6	67	20.94	38.87 ± 9.07			
7–9	97	30.31	40.89 ± 8.12			
≥10	152	47.50	39.02 ± 8.99			
Hospital affiliation						
Hospital 1	80	25.00	41.25 ± 9.94	3.78	319	.011
Hospital 2	80	25.00	40.40 ± 8.50			
Hospital 3	80	25.00	36.88 ± 7.90			
Hospital 4	80	25.00	39.69 ± 8.41			
Nurses' overall knowledge of PU prevention			39.55 ± 8.84			

conducted by Gunningberg et al. (2015) in Swedish hospitals reported a mean score of 58.9%. Furthermore, according to Hu et al. (2021), some surveys have reported that nurses did not demonstrate an acceptable level of knowledge regarding PU prevention. However, Hu et al. (2021) utilized the Pieper–Zulkowski Pressure Ulcer Knowledge Test. The results presented by Hu et al. (2021) are consistent with those of Qaddumi and Khawaldeh (2014), Aydogan and Caliskan (2019), and Ebi et al. (2019), who concluded that nurses had inadequate knowledge about PU prevention. In comparison, mean scores of 43%, 44%, and 42% were reported in Ethiopia, Turkey, and Jordan, respectively. Alternatively, several studies reported that nurses' knowledge regarding the prevention of PUs was adequate, with 77% in Cyprus (Charalambous et al., 2019), 70% in Australia (Barakat-Johnson et al., 2018), and 64.4% in Nigeria (Tolulope Esan et al., 2018). However, a systematic review and meta-analysis conducted by Dalvand et al. (2018) showed a lower level of nurses' knowledge (55.4%, 95% confidence interval: 42.4–68.4) with regard to PU prevention compared with the recommended level, which is 60%. Grešš Halász et al. (2021) also reported insufficient knowledge (45.5%) of nurses regarding PU prevention. Evidently, the results on this issue have been inconsistent.

Nurses must be frontline members in PU prevention, and their knowledge in this regard may be critical and a huge responsibility (Beeckman et al., 2011; Jackson et al., 2016; Jiang et al., 2020; Li et al., 2018; Slawomirski et al., 2017). Aside from the importance of nurturing knowledge of PU prevention among nurses, there should be data that serve as an initial baseline for the current level of knowledge. Global standards for PU management advocate a standard assessment of nurses' knowledge using a tool that can accurately measure their cognitive process levels (National Pressure Ulcer Advisory Panel, Grada & Phillips, 2017).

Strengths and Limitations

This study demonstrated the current status of nurses' knowledge regarding PU prevention in the study settings. Differences in knowledge scores were observed depending on the hospital affiliation. The present results regarding nurses' insufficient knowledge of PU prevention are in line with the many existing studies on the topic. The findings of this study should be an eye opener to nurse administrators to address this longstanding problem.

However, the study has certain limitations. First is the small sample size, which limits the generalizability of the results. Further empirical studies are required to deeply assess nurses' knowledge regarding PU prevention in a geographical area of Saudi Arabia. Second, as the participants' educational qualifications were not equally distributed, knowledge levels may have differed across those with diplomas, bachelor's degrees, and master's degrees in nursing.

Implications for Practice

Nurses' limited knowledge on how to prevent PUs may impair the quality of patient care they provide, thereby increasing the possibility of PU development in patients. The findings revealed low knowledge based on the 60% cutoff using the PUKAT 2.0. The results can be used to develop a comprehensive action plan that will address nurses' knowledge gap in PU prevention. Furthermore, conducting simulations related to PU prevention and management will be an effective way to help nurses gain appropriate knowledge that can be applied in clinical practice. According to Guerrero et al. (2022), the use of high-fidelity simulation can develop and improve nurses' critical thinking skills and boost their learning retention. Additionally, conducting a routine evaluation of ICU nurses' knowledge of the prevention, assessment, and management of PUs may help nurse administrators and educators identify their strengths and weaknesses and form the basis for developing scenarios for simulation sessions. Moreover, all implemented interventions should be based on evidence-based care, which may help reduce the occurrence of PUs and their consequent complications. Nurses' knowledge in this regard must be nurtured with updated evidence-based

practice to prevent PUs, which will improve the quality of care they provide.

Conclusion

Interestingly, nurses' knowledge of PU prevention in terms of etiology and classification and observation were high. However, their knowledge of risk assessment and nutritious diet were low. Moreover, nurses' knowledge of prevention and specific patient groups was very low. Altogether, overall knowledge regarding PU prevention was identified as insufficient. This inconsistency in knowledge should be addressed, and urgent efforts are required to avoid complications among patients in the ICU.

PU prevention should address a variety of aspects within the field in order to deliver safe and efficient care to patients in ICUs. Nurses' knowledge of PU prevention and management is as essential as other nursing interventions, serving as another step in providing optimal patient care.

Authors Contributions

The authors confirm contribution to the manuscript as follows: study conception and design: J.G.G.; data collection: H.M. and I.A.; analysis and interpretation of results: J.G.G, R.P.C and I.A.; draft manuscript preparation and editing: J.G.G. All authors reviewed the results and approved the final version of the manuscript.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Statement

The Ethics Review Committee of the Ministry of Health (MOH), Dr. Soliman Fakeeh Hospital (DSHF), and Fakeeh College for Medical Science (FCMS), approved our study (IRB registration number: KSA: H-11-N-081 and IRB log number: 2022-04 E). A written consent form was furnished to respondents for review and signature before starting to answer the questionnaires.

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Patient or Public Contribution

This study focused on assessing nurses' knowledge of pressure ulcer prevention; therefore, patient and public involvement may not be feasible in the current study.

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