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A national cross-sectional study on the knowledge and attitude of nurses towards prevention of pressure injury and their relationship with its prevalence

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Abstract

Background Pressure injuries can greatly affect a patient's health, safety, and quality of life. The knowledge and attitudes of nurses towards preventing pressure injuries are vital for providing safe, high-quality healthcare. Nursing in Kuwait suffers from a research gap on this topic.

Methods This was a cross-sectional study conducted in the public general hospitals of Kuwait to assess nurses' knowledge and attitudes and to measure the point prevalence of pressure injuries and prevention measures. An online form, a Modified Pieper's Pressure Ulcer Knowledge Test and the Moore and Price scale were used to gather data, covering variables related to hospitals, nurses, patients, pressure injuries, and prevention practices. We processed and analysed data using Microsoft Excel and SPSS 23.

Results The median score of nurses' knowledge on preventing pressure injuries was 73.2% (IQR: 68.3–78.0), and only 31.7% of the knowledge test items were answered correctly by 90% of participants or more. The median attitude score was 41.0 (IQR: 37.0–44.0). There were statistically significant strong positive correlations between nurses' age, years of work experience, attitude score, and the percentage of trained staff complying with measures against pressure injury. Attitude score had a statistically significant and strongly negative correlation with the rate of hospital-acquired pressure injury. The predictors of knowledge score were age, sex, and years since the most recent training was undertaken. Knowledge and a nurse's highest level of education were predictors of attitude scores.

Conclusions This study offers inestimable insights into the field. The study's results reveal that nurses' knowledge is unsatisfactory to borderline satisfactory, whereas attitudes are positive. Despite this, the positive attitude is neither reflected in staff compliance with practices aimed at preventing pressure injury nor the rate of hospital-acquired pressure injury. We recommend implementing effective training programmes to bridge these gaps.

Clinical trial number Not applicable.

Keywords Bedsores, Decubitus ulcers, Hospital-acquired complications, Modified Pieper's Pressure Ulcer Knowledge Test (Modified PUKT), Moore and Price scale, Patient safety, Risk assessment

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Introduction

Sustained or severe pressure, along with shear and friction forces, can cause localised damage to skin and underlying soft tissue, typically occurring over a bony prominence or under medical or other equipment. This condition is known as pressure injury (PI) [1, 2]. Despite the existence of international guidelines on PI prevention, and advances in medical knowledge bringing new effective strategies for their prevention and treatment, PIs are commonplace [3, 4]. As well as placing a high socioeconomic strain on healthcare systems and public resources [5, 6], PI can be a significant burden on the physical and mental health and social well-being of the affected individual [4, 7].

Basic nursing and quality outcomes, along with patient safety, are significantly impacted by the occurrence of PIs in hospitals [3, 8, 9]. Hence, the prevalence of PIs is frequently measured as a standard-of-care clinical indicator [10, 11]. PI prevention has traditionally been a major challenge for nurses [12–14]. In 1860, the iconic Florence Nightingale wrote *"[…], if he has a bed-sore, it is generally the fault not of the disease, but of the nursing*" [15]. In the present day, PI prevention strategies and interventions are primarily implemented by nurses [9, 14, 16, 17]. However, rather than blame inadequate nursing, many managers and clinicians attribute PIs to systemic failures of the healthcare system [8, 18, 19].

Knowledge is a cornerstone of safe, high-quality healthcare [9, 17]. A nurse who intuitively seeks and acts to prevent PIs can compensate for a lack of knowledge [3]. Knowledge is *"the capacity to acquire, retain and use information"*, whereas attitude is the *"inclinations to react in a certain way to certain situations"* [20]. Good practice in PI prevention is built on sufficient knowledge and positive attitudes [21, 22]. However, a wealth of international research has revealed inadequate attitudes (61.8%–78.5%) and a lack of expertise (17.2%–57.4%) among nurses with respect to PI prevention; in the last 10 years, this has remained mostly unchanged [9, 17, 23–25].

In terms of effective management, one cannot stress enough the importance of assessing the prevalence of PIs and the knowledge and attitudes of nurses towards preventing them [26]. Yet, healthcare leaders in Kuwait lacks sufficient research on this topic. Moreover, challenges specific to Kuwait have been reported. The relatively long length of stay of patients with PI is not commensurate with the acute care setting, and other settings providing suitable care are lacking. A significant proportion of PIs last for months at a time, indicating that practices for managing established PIs are ineffective. Also, most patients are not assessed with the Braden tool, and air mattresses are seldom ever used. In addition, repositioning of patients is another expected preventive measure that was not provided due to the shortage of nurses and high workloads. Finally, some of the most prominent public health concerns in Kuwait, such as obesity and diabetes, are known risk factors for PI [27].

To address this situation, the Quality and Accreditation Directorate at the Ministry of Health in Kuwait initiated a national research project to ascertain the prevalence of PIs, evaluate prevention strategies in hospitals [27], and assess nurses' knowledge and attitudes to preventing PIs in hospitalised patients. In this nationwide study conducted on the medical wards of Kuwait's public general hospitals, the mean prevalence of PIs was 17.6%, whereas the mean prevalence of hospital-acquired PIs (HAPIs) was 6.7% [27]. According to two recent systematic reviews and meta-analyses, the overall prevalence of PIs in hospitals around the world was 12.8% [4], whereas the global prevalence of PIs on the medical wards was 4.1% [28].

Given the size of the datasets in this national research, the results pertaining to the prevalence of PIs and preventive measures were reported in a separate article [27]. The present article reports on the assessment of nurses' knowledge and their attitudes towards preventing PIs, and explores the relationship of these two aspects with current PI prevention practices and PI prevalence. We aimed at filling this research gap and to guide strategies for improving nursing care and service outcomes. This study was designed to better understand the nurses' outlook on preventing pressure injuries; in doing so we hope to further the broader aim of enhancing knowledge among the nursing profession and promoting positive attitudes in this area. Achieving those objectives will eventually lower the prevalence of PIs, decrease the costs associated with PI, shorten inpatient hospital stays and reduce the risk of hospital-acquired complications.

Methods

Study design and setting

This observational study was conducted on the medical wards of the seven public general hospitals in Kuwait. The various levels of care provided by Kuwait's public health system are overseen by seven health regions. Each of these regions has numerous health centres (between 12 and 23 health centres) offering primary care [29], and one public general hospital that offers secondary care to medical, surgical, paediatric, critical, emergency, orthopaedic, obstetric and gynaecology patients [30]. Each hospital has between six and 12 wards, numbering 54 in total (Fig. 1).

To assess nurses' knowledge and attitudes towards preventing PIs and the prevalence of PIs, we used a cross-sectional descriptive research design. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist [31] was adhered to in the reporting of this observational study.

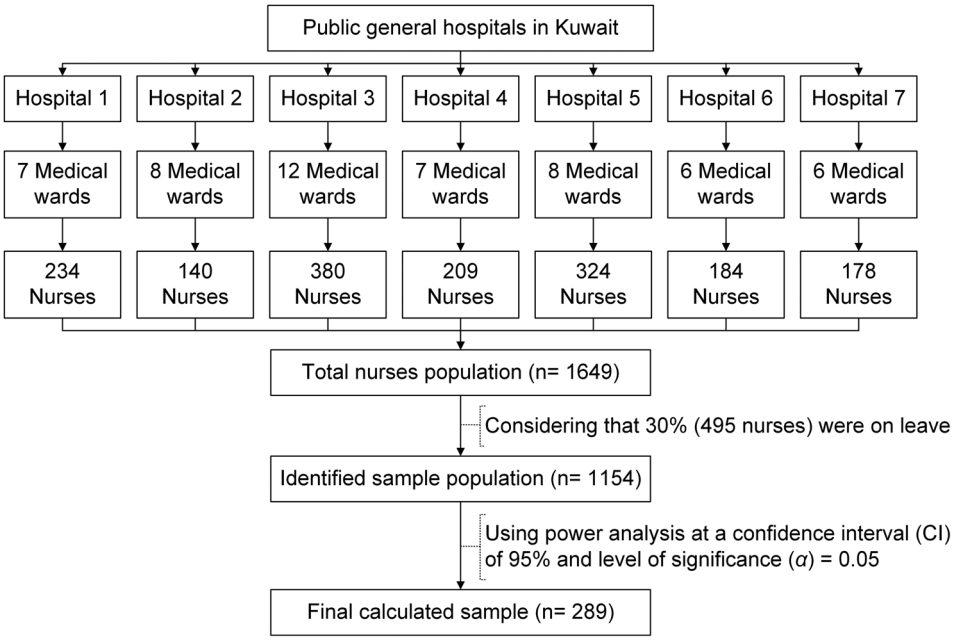

Fig. 1 Flow chart of nurse sample selection in public general hospitals in Kuwait

Sampling and data collection

To assess the knowledge and attitudes of nurses regarding PI, we adopted a convenience sampling technique to recruit participants. In December 2022, the total number of nurses on the medical wards of the seven public general hospitals in Kuwait was 1649; the number in each hospital ranged from 140 to 380 (Fig. 1). Considering that 30% (495 nurses) of these were on leave at the time, the actual number of available nurses was 1154. Using power analysis at a confidence interval (CI) of 95% and level of significance (α) of 0.05, the sample size was calculated to be 289 nurses. We excluded nurses who were undergoing training on the wards and those having less than 6 months of experience in the setting. Two filtering questions pertaining to those two criteria had to be answered before commencing filling the online tool to ensure that only eligible participants responded.

After explaining the purpose and possible advantages of the research to the hospital and nursing directors, we obtained their agreement and support to proceed with the study. Nurses on medical wards consented to participate having had the value and potential benefits of the study explained to them. A link to the nurses' knowledge and attitudes form was sent to the nursing directors of the seven hospitals, who then distributed the link to all the ward nurses through the instant messaging application WhatsApp. Responses were collected between November 28 and December 16, 2022. Before the study began, we performed a pilot study in the seven hospitals that involved 40 nurses not included in the sample.

To assess the prevalence of PIs and the hospitals' measures for their prevention, we adopted total population sampling. Data were collected using an online form created on Google Forms (Supplementary File 1). The data collectors were nurses with significant auditing experience. Currently working in quality departments, the 40 nurses had previously worked on clinical wards. To ensure accurate and consistent data entry into the tool, a training session for data collectors took place on November 23, 2022. The training included an explanation of the study's objectives and the significance of standardised data collection an overview of the questionnaire, its structure, question types and the key definitions related to PIs, a demonstration of Google Forms, covering the submission process and troubleshooting, a hands-on practice session using a mock questionnaire to simulate real data collection scenarios followed by a review and constructive feedback to address errors and ethical considerations, such as maintaining confidentiality and obtaining informed consent. This structured approach aligns with best practices in research training [32]. Further details about the methodology, including sampling, the tool used, data collection and data management and analysis are published elsewhere [27].

Research tools and scoring systems

For the part on nurses' knowledge and attitudes, an online form composed of three sections was created on Google Forms (Supplementary File 2). The first section extracted nurses' demographic information (hospital name, age, sex, work experience, level of education,

whether they received any formal training on PI prevention, and when and where the last training was received). The second section included 41 items on nurses' knowledge about PIs (Modified Pieper's Pressure Ulcer Knowledge Test, Modified PUKT) [33, 34]. The third section assessed the nurses' attitudes towards preventing PI (Moore and Price Attitude Scale) [35].

The Modified PUKT is a reliable and validated tool [9, 33, 34] based on the original work of Pieper and Mott [36]. The tool consists of 33 items on PI prevention and eight items on PI assessment and staging (items 1, 6, 9, 20, 31–33 and 38). All 41 items are true-or-false questions. The score was calculated by giving 1 point to each correct response to any item; incorrect responses were assigned 0. The total score was then divided by 41 and multiplied by 100 to give a percentage, which falls in one of the following bands [37, 38]: very good (≥ 90%), good (≥80%–<90%), satisfactory (≥70%–<80%) or unsatisfactory knowledge (<70%) of PI prevention. These are the most commonly used categorisation bands [37]. A second parameter, which was used by Pieper and Mattern [39], is that at least 90% of the responses to a particular item should be correct for the knowledge within that organisation to be considered adequate.

Because the original PUKT had 47 items [30, 33] and the modified PUKT was validated in the Portuguese language in a Brazilian study [40], we sought the opinion of experts to use the current modified version. According to the three-expert panel, the tool showed face and content validity. In this study, the reliability (Cronbach's α value) of the tool was 0.71.

The Moore and Price Attitude Scale is a reliable and validated 11-item tool with a five-point scoring system [35]. For seven items, the scoring system ranges from strongly agree (1) to strongly disagree (5). The other four items (1, 6, 7 and 11) are to be reverse-scored (i.e., 5 for strongly agree and 1 for strongly disagree). In the current study, the reliability of the tool (Cronbach's $\alpha = 0.64$) was acceptable, as indicated in the literature [41, 42]. As the score of 3 is assigned to the option 'neither agree nor disagree', a total score of 33 is considered the threshold between a positive (>33) and a negative (≤ 33) attitude [43]. The total score on this scale ranges from 11 (most negative attitude) to 55 (most positive attitude). Also, percentages of responses to individual items have been reported [35]. We grouped the percentage of scores 4 and 5 as they represent a positive attitude. Such reporting practices have been previously adopted [25, 44, 45].

In the present study, the main results pertain to the participating nurses' knowledge on PIs and their attitudes towards preventing them. The term 'attitude score' indicates the sum of the numeric responses of a participant to the 11-item tool. Likewise, we refer to the percentage of correct responses pertaining to an individual participant as 'knowledge score'. Unless specified, the 'knowledge score' is the overall score of the 41 items.

To look at PI prevalence, an online form was created on Google Forms (Supplementary File 1) guided by Chaudhary and Israel's [46] approach in the development and testing of the tool. More information about this tool is available elsewhere [27].

Data management and analysis

Excel (Microsoft) was used to clean and process data; SPSS 23 was used for analysis (α level = 0.05). The normality of data was checked by Kolmogorov–Smirnov and Shapiro–Wilk testing. Then, univariate descriptive analyses (frequencies, percentages, means, standard deviations, confidence intervals, medians and interquartile ranges) were conducted on the data. The analysis also included bivariate analyses (chi-squared test, ANOVA F-test, Pearson's correlation) to examine how trends in the participants' characteristics, knowledge and attitudes differ across hospitals, and how they relate to the prevalence of HAPIs and PI prevention measures adopted. Non-parametric tests (Mann–Whitney U test, Kruskal–Wallis H test, Spearman's correlation) were used if violations of assumptions hindered the use of parametric testing. As per Ratner's guidelines [47], the correlation coefficient |>0.700–1.000| is interpreted as a strong correlation, |>0.300–0.700| as moderate and |0.000–0.300| as weak. To avoid type 1 errors [48], adjusted α levels using the Bonferroni correction were used to indicate the statistical significance of the correlation coefficient in multiple comparisons.

The analysis also included multivariate analysis (multiple regression) to construct a model for predicting the determinants of participants' knowledge and attitude scores. Independent variables with statistically significant ($p \leq 0.05$) correlation coefficients ≥0.100 in the correlational analysis were included in the regression model.

Results

Of the 1154 nurses available, 605 (52.4%) responded to the distributed survey link. This number of responses is higher than the calculated sample size (289). All responses fulfilled the eligibility criteria.

Socio-demographics of study participants

Table 1 shows the characteristics of the participants of the study on the national level and for each of the seven hospitals. Almost one-quarter of responses were from hospital 1, whereas the three hospitals with the fewest respondents (hospitals 5–7) contributed another quarter. Females were around 2.5 times greater in number than males. With more than four-fifths of the sample belonging to two age groups: 30–39 (55.6%) and 40–49 (27.7%) years, the median age was 37 years (IQR: 33–41). The

Table 1 Demographic characteristics of participating nurses

	National		Hospital														*p*
			1		2		3		4		5		6		7		
	n (%)		n (%)		n (%)		n (%)		n (%)		n (%)		n (%)		n (%)		
HAPI prevalence [CI]	6.7%	[3.2–10.2]	8.7%		1.7%		9.0%		12.3%		2.8%		5.0%		7.6%		0.001[¶]
Number of participants	605	(100.0)	146	(24.1)	119	(19.7)	107	(17.7)	80	(13.2)	74	(12.2)	59	(9.8)	20	(3.3)	
Sex																	< 0.001*
Male	179	(29.6)	56	(38.4)	16	(13.4)	36	(33.6)	25	(31.3)	17	(23.0)	19	(32.2)	10	(50.0)	
Female	426	(70.4)	90	(61.6)	103	(86.6)	71	(66.4)	55	(68.8)	57	(77.0)	40	(67.8)	10	(50.0)	
Age distribution in years (n = 599, % = 99.0)																	< 0.001[†]
20–29	61	(10.2)	12	(8.3)	9	(7.7)	13	(12.1)	5	(6.3)	9	(12.3)	10	(17.5)	3	(15.0)	
30–39	333	(55.6)	94	(64.8)	42	(35.9)	58	(54.2)	55	(68.8)	37	(50.7)	33	(57.9)	14	(70.0)	
40–49	166	(27.7)	33	(22.8)	49	(41.9)	29	(27.1)	18	(22.5)	20	(27.4)	14	(24.6)	3	(15.0)	
50–59	34	(5.7)	6	(4.1)	14	(12.0)	6	(5.6)	1	(1.3)	7	(9.6)	0	(0.0)	0	(0.0)	
60–69	5	(0.8)	0	(0.0)	3	(2.6)	1	(0.9)	1	(1.3)	0	(0.0)	0	(0.0)	0	(0.0)	
Median [IQR]	37.0	[33.0–41.0]	37.0	[34.0–40.0]	40.0	[36.0–46.0]	36.0	[32.0–41.0]	35.0	[32.0–39.8]	37.0	[33.5–40.5]	35.0	[31.0–39.5]	35.5	[34.3–38.0]	< 0.001*
Experience in years																	< 0.001*
0–2	15	(2.5)	1	(0.7)	4	(3.4)	3	(2.8)	2	(2.5)	0	(0.0)	3	(5.1)	2	(10.0)	
3–5	56	(9.3)	10	(6.8)	4	(3.4)	15	(14.0)	6	(7.5)	10	(13.5)	10	(16.9)	1	(5.0)	
6–10	126	(20.8)	31	(21.2)	18	(15.1)	25	(23.4)	18	(22.5)	13	(17.6)	17	(28.8)	4	(20.0)	
11–15	211	(34.9)	68	(46.6)	29	(24.4)	29	(27.1)	29	(36.3)	26	(35.1)	17	(28.8)	13	(65.0)	
>15	197	(32.6)	36	(24.7)	64	(53.8)	35	(32.7)	25	(31.3)	25	(33.8)	12	(20.3)	0	(0.0)	
Median [IQR]	13.0	[10.0–18.0]	13.0	[10.0–15.3]	17.0	[12.0–22.0]	12.0	[7.0–19.0]	12.0	[10.0–17.0]	13.0	[9.8–18.0]	10.0	[6.0–14.0]	12.0	[10.0–13.0]	< 0.001[†]
Highest education level																	< 0.001*
Diploma in Nursing	200	(33.1)	44	(30.1)	63	(52.9)	28	(26.2)	34	(42.5)	18	(24.3)	9	(15.3)	4	(20.0)	
Bachelor of Nursing	360	(59.5)	96	(65.8)	51	(42.9)	68	(63.6)	43	(53.8)	47	(63.5)	43	(72.9)	12	(60.0)	
Post graduate diploma	33	(5.5)	5	(3.4)	5	(4.2)	11	(10.3)	3	(3.8)	6	(8.1)	1	(1.7)	2	(10.0)	
Master of Nursing	12	(2.0)	1	(0.7)	0	(0.0)	0	(0.0)	0	(0.0)	3	(4.1)	6	(10.2)	2	(10.0)	
Ever received formal training on PI prevention																	< 0.001*
No	293	(48.4)	80	(54.8)	43	(36.1)	54	(50.5)	20	(25.0)	52	(70.3)	33	(55.9)	11	(55.0)	
Yes	312	(51.6)	66	(45.2)	76	(63.9)	53	(49.5)	60	(75.0)	22	(29.7)	26	(44.1)	9	(45.0)	
Location of last training (n = 312, % = 51.6)																	0.058*
Inside Kuwait	218	(69.9)	46	(69.7)	60	(78.9)	34	(64.2)	45	(75.0)	14	(63.6)	12	(46.2)	7	(77.8)	
Outside Kuwait	94	(30.1)	20	(30.3)	16	(21.1)	19	(35.8)	15	(25.0)	8	(36.4)	14	(53.8)	2	(22.2)	
Years since last training (n = 310, % = 51.2)																	0.002*
≤3	146	(47.1)	23	(34.8)	38	(50.0)	20	(37.7)	40	(69.0)	7	(31.8)	12	(46.2)	6	(66.7)	

Table 1 (continued)

	National		Hospital														*p*
			1		2		3		4		5		6		7		
	n (%)		n (%)		n (%)		n (%)		n (%)		n (%)		n (%)		n (%)		
>3	164	(52.9)	43	(65.2)	38	(50.0)	33	(62.3)	18	(31.0)	15	(68.2)	14	(53.8)	3	(33.3)	
Median [IQR]	4.0	[2.0–8.0]	5.5	[2.0–10.3]	3.5	[2.0–8.0]	2.0	[5.0–7.0]	1.0	[1.0–5.0]	6.5	[3.0–10.0]	4.0	[2.8–7.3]	3.0	[1.0–6.5]	< 0.001[†]

n: number; %: percentage; *p*: *p*-value to determine differences between the seven hospitals as regard to the studied variables (statistically significant at $p \leq 0.05$); HAPI: hospital-acquired pressure injury; CI: 95% confidence interval; IQR: inter-quartile range; ¶: *p*-value determined by ANOVA F-Test; *: *p*-value determined by Chi-squared test; †: *p*-value determined by Kruskal–Wallis H test

distribution of the sample according to years of experience was slightly different, that is, two-thirds were almost equally divided between the two most-experienced groups: 11–15 (34.9%) and >15 (32.6%) years. The majority of participants held either a diploma in nursing (33.1%) or a bachelor's degree (59.5%); only 2% held a master's degree. Half of the participants (51.6%) attended formal training on PI prevention, and around half of those (52.9%) attended that training more than 3 years ago. More than two-thirds of the formally trained (69.9%) received training in Kuwait. Table 1 also shows that there are statistically significant differences in all the socio-demographic characteristics across the hospitals, except the location of the most-recent training on preventing PI ($p = 0.058$).

Using modified Pieper's pressure ulcer knowledge test to score nurses' knowledge on PI

Table 2 shows the scores from the testing of nurses' PI knowledge (using Modified PUKT) according to participant demographic. The median national overall knowledge score was 73.2% (IQR: 68.3–78.0). The range across the seven hospitals was from 70.7% (hospital 1) to 78.0% (hospital 2) and these differences were statistically significant ($p < 0.001$). Regarding categorisation of knowledge scores, 32.9% of the sample answered less than 70% of the items correctly ("unsatisfactory").

Female respondents returned statistically significant ($p = 0.004$) higher overall knowledge scores than males (mean rank: 316.2 and 271.7, respectively). Education level was insignificant as an independent variable when the overall knowledge scores were compared ($p = 0.647$). Regarding age and work experience, the respondents had higher overall knowledge scores if they were older or had more experience. The differences between groups were statistically significant ($p = 0.001$ and $p = 0.007$, respectively). Respondents who received formal training on PI prevention and whose training was undertaken inside Kuwait and within three years prior to sampling scored higher on overall knowledge. The differences were statistically significant ($p < 0.001$, $p < 0.001$ and $p = 0.013$, respectively).

Table 2 also shows the median scores for PI assessment and staging knowledge and knowledge on preventing PI. The median PI assessment and staging knowledge scores were satisfactory at the national level and for all demographic groups, except the median score of hospital 7. The differences between the demographic groups were statistically insignificant except for the sex ($p = 0.034$) and formal training ($p = 0.038$) groups. Conversely, the test scores on PI prevention knowledge were always satisfactory except in two instances: the age group 20–29 years and the experience group 0–2 years. Also, the differences

Table 2 Nurses' knowledge and attitude scores per their demographic characteristics

	Overall knowledge score[1]		PI assessment and staging knowledge score[2]		PI prevention knowledge score[3]		Attitude score[4]	
	Median [IQR]	***p***	**Median [IQR]**	***p***	**Median [IQR]**	***p***	**Median [IQR]**	***p***
Overall	73.2 [68.3–78.0]		75.0 [62.0–87.5]		72.7 [66.7–78.8]		41.0 [37.0–44.0]	
Hospital		< 0.001†		0.450†		< 0.001†		0.002†
1	70.7 [65.9–78.0]		75.0 [62.5–78.1]		71.2 [66.7–75.8]		40.0 [37.0–44.0]	
2	78.0 [70.7–82.9]		75.0 [62.5–87.5]		78.8 [69.7–81.8]		41.0 [36.0–44.0]	
3	73.2 [68.3–78.0]		75.0 [62.5–87.5]		72.7 [69.7–78.8]		40.0 [38.0–43.0]	
4	73.2 [68.3–78.0]		75.0 [62.5–75.0]		72.7 [66.7–78.8]		40.0 [36.0–42.0]	
5	73.2 [68.3–78.0]		75.0 [62.5–87.5]		72.7 [66.7–78.8]		42.0 [38.8–44.0]	
6	73.2 [68.3–78.0]		75.0 [62.5–75.0]		72.7 [66.7–78.8]		43.0 [38.0–46.0]	
7	75.6 [64.6–80.5]		68.7 [62.5–87.5]		75.8 [64.4–81.1]		40.5 [36.8–45.5]	
Sex		0.004*		0.034*		0.003*		0.292*
Male	73.2 [65.9–78.0]		75.0 [62.5–75.0]		72.7 [66.7–75.8]		41.0 [37.0–45.0]	
Female	73.2 [68.3–80.5]		75.0 [62.5–87.5]		72.7 [69.7–78.8]		40.0 [37.0–43.0]	
Highest education level		0.647†		0.405†		0.241†		< 0.001†
Diploma in Nursing	73.2 [65.9–78.0]		75.0 [62.5–75.0]		75.8 [66.7–78.8]		40.0 [36.0–42.8]	
Bachelor of Nursing	73.2 [68.3–78.0]		75.0 [62.5–87.5]		72.7 [66.7–78.8]		41.0 [37.0–44.0]	
Post graduate diploma	73.2 [69.5–78.0]		75.0 [62.5–87.5]		72.7 [69.7–78.8]		40.0 [38.5–43.0]	
Master of Nursing	75.6 [70.7–80.5]		75.0 [62.5–84.4]		78.8 [68.2–81.8]		45.5 [45.0–48.5]	
Age in years		0.001†		0.381†		0.001†		0.902†
20–29	70.7 [64.3–75.6]		75.0 [62.5–81.3]		69.7 [66.7–75.8]		40.0 [36.5–43.5]	
30–39	73.2 [68.3–78.0]		75.0 [62.5–87.5]		72.7 [66.7–78.8]		41.0 [37.0–44.0]	
40–49	75.6 [68.3–80.5]		75.0 [62.5–87.5]		75.8 [69.7–81.8]		40.5 [37.8–43.0]	
50–59	76.8 [70.7–81.1]		75.0 [62.5–87.5]		77.3 [69.7–81.8]		41.0 [36.0–45.0]	
60–69	80.5 [69.5–81.7]		75.0 [68.8–100]		78.8 [68.2–80.3]		40.0 [39.0–41.5]	
Experience in years		0.007†		0.169†		0.007†		0.890†
0–2	70.7 [63.4–78.0]		75.0 [62.5–87.5]		69.7 [63.6–75.8]		39.0 [36.0–43.0]	
3–5	73.2 [66.5–77.4]		75.0 [62.5–84.4]		72.7 [66.7–78.0]		41.0 [37.0–44.0]	
6–10	70.7 [65.9–78.0]		75.0 [62.5–75.0]		72.7 [66.7–78.8]		40.0 [35.0–44.0]	
11–15	73.2 [65.9–78.0]		75.0 [62.5–87.5]		72.7 [66.7–78.8]		41.0 [38.0–44.0]	
>15	75.6 [68.3–80.5]		75.0 [62.5–87.5]		75.8 [69.7–81.8]		41.0 [37.0–43.0]	
Ever received formal training on PI prevention		< 0.001*		0.038*		< 0.001*		0.807*
No	73.1 [65.9–78.0]		75.0 [62.5–75.0]		72.7 [66.7–78.8]		40.0 [37.0–43.0]	
Yes	74.5 [69.3–80.5]		75.0 [62.5–87.5]		75.8 [69.7–81.8]		41.0 [37.0–44.0]	
Location of last training		< 0.001*		0.229*		< 0.001*		0.072*
Inside Kuwait	75.6 [70.7–80.5]		75.0 [62.5–87.5]		75.8 [69.7–81.8]		41.0 [37.0–44.0]	
Outside Kuwait	72.0 [65.9–75.6]		75.0 [62.5–87.5]		72.7 [63.6–75.8]		40.0 [35.8–44.3]	

Table 2 (continued)

	Overall knowledge score[1]		PI assessment and staging knowledge score[2]		PI prevention knowledge score[3]		Attitude score[4]	
	Median [IQR]	***p***	**Median [IQR]**	***p***	**Median [IQR]**	***p***	**Median [IQR]**	***p***
Years since last training		0.013*		0.582*		0.007*		0.732*
≤3	75.6 [70.7–80.5]		75.0 [62.5–87.5]		75.8 [69.7–81.8]		41.0 [37.0–44.0]	
>3	73.2 [68.3–78.0]		75.0 [62.5–87.5]		72.7 [66.7–78.8]		41.0 [37.0–44.0]	
Nurses' knowledge score categories								< 0.001†
Unsatisfactory (32.9%)							38.0 [34.0–42.0]	
Satisfactory (44.6%)							41.0 [38.0–44.0]	
Good (20.8%)							42.0 [39.0–45.0]	
Very good (1.7%)							48.5 [45.3–49.0]	

1: Modified Pieper´s Pressure Ulcer Knowledge Test (All items)

2: Modified Pieper´s Pressure Ulcer Knowledge Test (Items 1, 6, 9, 20, 31, 32, 33, 38)

3: Modified Pieper´s Pressure Ulcer Knowledge Test (All items except 1, 6, 9, 20, 31, 32, 33, 38)

4: Moore and Price scale

IQR: inter-quartile range; *p*: *p*-value to determine differences between the seven hospitals as regard to the studied variables (statistically significant at $p \le 0.05$); *: *p*-value determined by Mann–Whitney U test; †: *p*-value determined by Kruskal–Wallis H test

between the demographic groups were statistically significant except for education level ($p = 0.241$).

Table 3 shows the percentages of correct answers to the individual items of the Modified PUKT. At the national level, only 13 out of 41 items (31.7%) were answered correctly by 90% or more of participants. Less than 50% of participants answered nine items correctly. In two instances, less than 20% of answers were correct (items 14, 'Donut-shaped or ring-shaped cushions help with the pressure ulcer prevention' and 17, 'A person who cannot move should be repositioned while sitting in bed every 2 hours').

The hospital returning the highest number of items (18) correctly answered by >90% of respondents was hospital 2; hospital 4 returned the lowest, with 7 (Table 3). Only three items were answered corrected by ≥90% participants in all hospitals: item 10 'A diet intake suitable to the patient protein-calorie needs should be maintained during the disease', item 12 'A timetable for decubitus change should be written for each patient at risk' and item 27 'Patients and relatives should be oriented about the causes and risk factors of development of pressure ulcer'. The differences between the percentages of correct answers were statistically insignificant for all items except in 13 instances (items 3–5, 8, 13, 14, 23, 24, 29, 35, 37, 40, 41).

Using the Moore and Price Scale to score nurses' attitudes to preventing PI

Table 2 also shows the test scores for nurses' attitudes to PI prevention according to their demographic characteristics. The median national score was 41.0 (IQR: 37.0–44.0), which is considered to be a positive attitude. Across the seven individual hospitals, median scores ranged from 40.0 (hospitals 1, 3 and 4) to 43.0 (hospital 6), and these differences were found to be statistically significant ($p = 0.002$). Unlike the overall knowledge scores, the differences in median attitude between the groups of education level were statistically significant ($p < 0.001$). The differences in median attitude scores between the other demographic characteristics were statistically insignificant.

When categories of nurses' knowledge scores were compared, the group with very good overall knowledge showed the highest positive attitude score (48.5). The differences in median attitude score between the four categories of knowledge score were statistically significant ($p < 0.001$).

Table 4 reports the percentage of positive responses to individual items. Nationally, nine of the 11 items were assigned a positive response by at least 50% of participants. Item 3, 'In my opinion, patients tend not to get as many pressure ulcers nowadays', and item 9, 'My clinical judgement is better than any pressure ulcer risk

Table 3 Percentages of correct answers of nurses' knowledge questions (modified PUKT)

	National (*n* = 605)	Hospital							*p*
		1	2	3	4	5	6	7	
		(*n* = 146)	(*n* = 119)	(*n* = 107)	(*n* = 80)	(*n* = 74)	(*n* = 59)	(*n* = 20)	
1 Stage I of pressure ulcer is defined as an erythema that does not whiten (T)	76.4	74.0	86.6	71.0	77.5	78.4	67.8	75.0	0.070
2 Risks of developing pressure ulcer: mobility; incontinence; suitable nutrition and alteration in the consciousness level (T)	62.5	56.2	62.2	68.2	61.3	66.2	71.2	45.0	0.173
3 All the individuals at pressure ulcer risk should have a systematic skin inspection at least once a week (F)	45.8	48.6	58.8	38.3	42.5	55.4	25.4	25.0	< 0.001
4 Hot water and soap may dry the skin and increase the risk of pressure ulcer (T)	67.1	67.8	79.8	64.5	66.3	60.8	57.6	55.0	0.028
5 It is important to massage the osseous prominences if they are reddish (F)	46.0	33.6	55.5	41.1	47.5	56.8	50.8	45.0	0.005
6 A pressure ulcer in stage III is a partial skin loss involving epidermis (F)	53.2	53.4	48.7	57.0	46.3	59.5	54.2	60.0	0.584
7 Everybody, at admission, should be evaluated regarding the risk of developing pressure ulcer (T)	90.9	90.4	95.8	91.6	85.0	85.1	96.6	90.0	0.057
8 Starch, creams, transparent dressings and hydrocolloid dressings do not protect against the friction effects (T)	35.4	37.0	32.8	37.4	45.0	17.6	40.7	40.0	0.019
9 Pressure ulcers in stage IV show total skin loss with intense destruction and tissue necrosis or muscles, bones or supporting structures damage (T)	92.7	93.2	95.0	94.4	91.3	89.2	91.5	90.0	0.766
10 A diet intake suitable to the patient protein-calorie needs should be maintained during the disease (T)	94.2	95.9	96.6	93.5	91.3	91.9	94.9	90.0	0.560
11 Bedridden people should be repositioned every 3 hours (F)	46.6	42.5	52.9	43.9	42.5	40.5	55.9	65.0	0.140
12 A timetable for decubitus change should be written for each patient at risk (T)	93.6	95.9	96.6	92.5	90.0	90.5	91.5	95.0	0.355
13 Protector such as water gloves soothe the calcaneus pressure (F)	20.7	12.4	12.6	28.0	40.0	17.6	10.2	55.0	< 0.001
14 Donut-shaped or ring-shaped cushions help with the pressure ulcer prevention (F)	17.5	13.7	10.9	13.1	31.3	20.3	25.4	20.0	0.003
15 Laterally, the person should be in a 30 degree angle with the bed (T)	77.4	76.7	81.5	75.7	78.8	75.7	69.5	90.0	0.482
16 The bed should be raised and maintained in a low level of elevation (not higher than a 30 degree angle) in compliance with the clinical conditions and medical recommendations (T)	85.3	87.0	85.7	84.1	82.5	79.7	91.5	90.0	0.547
17 A person who cannot move should be repositioned while sitting in bed every 2 hours (F)	14.4	15.8	11.8	18.7	13.8	17.6	6.8	10.0	0.399
18 The people who can learn should be oriented to change their weight every 15 minutes while sitting in the chair (T)	57.4	50.7	65.5	54.2	55.0	56.8	62.7	70.0	0.201
19 The people who remain in the chair should use a cushion for the chair protection (T)	79.8	72.6	81.5	84.1	78.8	81.1	86.4	80.0	0.246
20 Pressure ulcers in stage II show skin loss in the total thickness (F)	41.2	39.0	42.0	43.9	32.5	41.9	49.2	45.0	0.568
21 The skin should remain clean and dry (T)	92.7	93.2	97.5	91.6	92.5	89.2	89.8	90.0	0.363
22 Prevention measures are not required to prevent new lesions when the patient already has pressure ulcer (F)	83.6	87.7	89.1	78.5	78.8	83.8	78.0	85.0	0.164
23 Mobile sheets or bedding should be used to transfer or move patients (T)	92.2	91.8	97.5	94.4	86.3	90.5	93.2	80.0	0.031
24 Dependent patients should be repositioned or transferred by two individuals (T)	91.1	95.2	95.8	91.6	85.0	90.5	81.4	85.0	0.007
25 Rehabilitation measures should be instituted if the general status of the patient permits (T)	90.7	91.8	90.8	90.7	90.0	90.5	91.5	85.0	0.983

Table 3 (continued)

	National (*n* = 605)	Hospital							*p*
		1	2	3	4	5	6	7	
		(*n* = 146)	(*n* = 119)	(*n* = 107)	(*n* = 80)	(*n* = 74)	(*n* = 59)	(*n* = 20)	
26 Every patient admitted in the Intensive Care Unit should be subjected to a risk evaluation of developing pressure ulcer (T)	91.6	91.1	95.0	89.7	88.8	90.5	93.2	95.0	0.714
27 Patients and relatives should be oriented about the causes and risk factors of development of pressure ulcer (T)	94.4	94.5	97.5	95.3	90.0	94.6	96.6	95.0	0.420
28 The osseous prominences may be in touch (F)	37.5	34.9	38.7	39.3	36.3	44.6	30.5	40.0	0.738
29 Every person evaluated as at risk of developing pressure ulcer should be placed on a pressure reducing mattress (water mattress) (T)	87.3	87.7	95.8	83.2	86.3	81.1	91.5	70.0	0.005
30 The skin exposed to humidity is more easily damaged (T)	84.3	84.2	89.9	86.0	81.3	81.1	81.4	80.0	0.557
31 Pressure ulcers are sterile wounds (F)	64.1	65.1	67.2	55.1	68.8	62.2	66.1	70.0	0.472
32 A pressure ulcer scar may be damaged faster than the whole skin (T)	88.1	87.0	91.6	92.5	86.3	86.5	83.1	80.0	0.351
33 A blister in the calcaneus should not be a reason for concern (F)	91.7	92.5	94.1	93.5	85.0	91.9	89.8	95.0	0.343
34 A measure to reduce the calcaneus pressure is to elevate them (T)	84.0	81.5	90.8	85.0	81.3	82.4	78.0	90.0	0.276
35 All the administered care to prevent and treat pressure ulcers should not be documented (F)	84.8	86.3	90.8	86.0	75.0	91.9	74.6	75.0	0.005
36 Shear is the power that occurs when the skin adheres to a surface and the body slides in the opposite direction (T)	80.0	78.1	85.7	77.6	86.3	73.0	76.3	85.0	0.222
37 Friction may occur when the person is moved in bed (T)	80.8	76.0	95.8	76.6	72.5	79.7	83.1	80.0	< 0.001
38 The pressure ulcers in stage II may be extremely painful because of the exposure of the nervous ends (T)	67.8	65.8	67.2	67.3	75.0	75.7	59.3	55.0	0.257
39 For people with incontinence, the cleaning of the skin should start the moment it occurs and in the routine intervals (T)	90.4	90.4	94.1	89.7	88.8	87.8	91.5	85.0	0.741
40 Educational programs may reduce the pressure ulcer incidence (T)	94.4	91.8	98.3	97.2	93.8	91.9	98.3	85.0	0.035
41 Hospitalised patients need to be evaluated regarding the risk of pressure ulcer only once (F)	82.5	89.0	86.8	80.4	71.3	81.1	76.3	90.0	0.017
Number of percentages ≥90.0	**13**	**13**	**18**	**12**	**7**	**10**	**12**	**12**	**0.255**

n: number; %: percentage; *p*: *p*-value (determined by Chi-squared test) to determine differences between the seven hospitals as regard to the studied variables (statistically significant at $p \leq 0.05$); T: true is the correct answer of the item; F: false is the correct answer of the item

assessment tool available to me', were both assigned a negative response by the majority of participants in all hospitals except one (hospital 7 and hospital 2, respectively). Interestingly, two items (6 and 11) were assigned positive responses by 90% or more of participants according to the national average. Item 6 'Continuous nursing assessment of patients will give an accurate account of their pressure ulcer risk' was also assigned a positive response by more than 90% of participants in each hospital. The differences in percentages of positive responses were statistically significant ($p < 0.05$) between hospitals for all but four items (5, 6, 9 and 11).

Predictors of nurses' knowledge and attitude scores

Table 5 reports the results of the multiple regression analysis. Only the predictor variables included in the regression model are listed. The table shows three dependent variables: the 'PI prevention knowledge score', the 'PI assessment and staging knowledge score' and the 'attitude score'. The amount of deviation in the knowledge or attitude score is determined by a unit change in the predictor variable (non-standardised coefficient). It is possible to compare the relative importance of each coefficient in the model through the standardised coefficients. Empty cells in the table indicate that the regression model for the corresponding dependent variable did not include the predictor.

Table 4 Percentages of positive responses to nurses' attitude statements (Moore and Price scale)

	National (*n* = 605)	Hospital							*p*
		1	2	3	4	5	6	7	
		(*n* = 146)	(*n* = 119)	(*n* = 107)	(*n* = 80)	(*n* = 74)	(*n* = 59)	(*n* = 20)	
1 All patients are at potential risk of developing pressure ulcers.	51.4	41.4	54.6	49.5	53.8	48.6	64.4	80.0	0.007
2 Pressure ulcer prevention is time consuming for me to carry out.	53.2	50.7	54.6	53.3	41.3	66.2	64.4	30.0	0.008
3 In my opinion, patients tend not to get as many pressure ulcers nowadays.	38.0	33.6	29.4	47.7	30.0	45.9	42.4	60.0	0.006
4 I do not need to concern myself with pressure ulcer prevention in my practice.	79.7	78.1	82.4	87.9	58.8	86.5	81.4	85.0	< 0.001
5 Pressure ulcer treatment is a greater priority than pressure ulcer prevention.	67.8	72.6	63.9	66.4	61.3	71.6	72.9	60.0	0.445
6 Continuous nursing assessment of patients will give an accurate account of their pressure ulcer risk.	96.7	95.9	97.5	97.2	95.0	97.3	98.3	95.0	0.913
7 Most pressure ulcers can be avoided.	72.9	74.0	78.2	59.8	80.0	70.3	72.9	85.0	0.022
8 I am less interested in pressure ulcer prevention than other aspects of nursing care.	85.0	84.2	90.8	90.7	73.8	85.1	81.4	80.0	0.022
9 My clinical judgement is better than any pressure ulcer risk assessment tool available to me.	45.3	43.2	54.6	45.8	37.5	39.2	49.2	45.0	0.246
10 In comparison with other areas of nursing care, pressure ulcer prevention is a low priority for me.	84.8	82.9	94.1	85.0	70.0	90.5	86.4	75.0	< 0.001
11 Pressure ulcer risk assessment should be regularly carried out on all patients during their stay in hospital.	91.2	87.0	95.8	93.5	87.5	91.9	93.2	90.0	0.148
Number of percentages ≥50.0	**9**	**8**	**10**	**8**	**8**	**8**	**9**	**9**	**0.923**

n: number; %: percentage; *p: p*-value (determined by Chi-squared test) to determine differences between the seven hospitals as regard to the studied variables (statistically significant at $p \leq 0.05$)

Table 5 Predictors of nurses' knowledge and attitude scores (dependent variables)

R^2	Overall knowledge score				Attitude score			
	0.11				0.12			
	B	(SE)	Beta	*p*	B	(SE)	Beta	*p*
Constant	59.7	(3.3)		< 0.001	28.1	(1.4)		< 0.001
Age (in years)	0.4	(0.1)	0.3	< 0.001				
Sex (Male)	−3.0	(1.3)	−0.1	0.027				
Years since last training	−0.3	(0.1)	−0.1	0.009				
PI prevention knowledge score					0.2	(0.0)	0.3	< 0.001
Highest education level					1.4	(0.3)	0.2	< 0.001

R^2: *R*-squared value; B: Unstandardised regression coefficient; SE: Standard error; Beta: Standardised regression coefficient

In this regression analysis, the demographic characteristics of nurses accounted for 11% of the variability in the 'overall knowledge score'. Based on the standardised beta coefficients, 'age' is threefold more important than both 'sex' and 'years elapsed since last training' for predicting 'PI prevention knowledge score'. A year of work experience in a hospital setting can increase the overall knowledge score by a value of 0.4. By contrast, each elapsed year since training was last undertaken decreases the score by a value of 0.3. A 1% increase in the number of male nurses can decrease the overall knowledge score by a value of 3.0.

The 'highest educational level' of nurses and their 'PI prevention knowledge score' accounted for 12% of the variability in 'attitude score'. A higher level of education can increase the attitude score by a value of 1.4, whereas a 1% increase in the PI prevention knowledge score can result in a higher attitude score of 0.2. The PI prevention knowledge score is 1.5-fold more important than 'education level' for predicting the attitude score, based on the standardised beta coefficients.

Summary of PI prevalence and prevention practices

The prevalence of HAPI and PI prevention at these hospitals at this time was reported previously [27]. The mean national prevalence of HAPIs was 6.7% (95% CI: 3.2–10.2), ranging from 1.7% to 12.3% across the seven hospitals. The Braden scale assessment was documented in the files of 18.2% of patients with PIs. With a varying compliance rate, the eight queried preventive measures

Table 6 Association of nurses' demographic characteristics, knowledge and attitude scores (independent variables) with HAPI prevalence rate and prevention measures (dependent variables)

	HAPI prevalence	Braden scale assessment score documented	Prevention measures	
			PI assessment on admission	Manage moisture
Demographic characteristics				
Age in years	−0.464*	0.964‡¶	0.107¶	0.500*
Work experience in years	−0.393*	0.927‡¶	0.107¶	0.607*
Percentage of trained staff	0.464*	0.000¶	−0.321¶	0.786†*
Overall knowledge score	−0.512*	0.123¶	0.709¶	0.177*
Attitude score	−0.815†*	0.115¶	0.778†¶	−0.482*

†Correlation coefficient is significant at the adjusted α level using Bonferroni correction

‡Correlation coefficient is significant at the 0.001 level ($p \leq 0.001$)

*Correlation coefficient determined by Pearson's Correlation

¶Correlation coefficient determined by Spearman's Correlation

were documented as being provided to patients with PIs: repositioning depending on patient condition (67.5%), pressure injury assessment on admission (65.5%), pressure-reducing surfaces (63.5%), manage moisture (42.4%), optimise nutrition/hydration (38.9%), daily inspection of skin of at-risk patients (36.0%), daily reassessment of risk for all patients (5.4%), and using air mattresses (1.5%).

Association between nurses' knowledge and attitude and the use of preventive measures and the prevalence of HAPIs

Table 6 shows the association of nurse demographics and knowledge and attitude scores (independent variables) with rates of HAPI and the preventive measures used (dependent variables). Only three demographic variables were found to have statistically significant correlations with any of the dependent variables. There are strong positive correlations between age (ρ = 0.964) and work experience (ρ = 0.927) and the percentage for documenting Braden score in the patient's file. The percentage of trained staff also strongly and positively correlates (ρ = 0.786) with the percentage that use moisture management to prevent PI.

The correlation analysis revealed that a nurse's knowledge has no statistically significant association with any of the dependent variables. By contrast, the attitude score has a statistically significant strong negative correlation ($\rho = -0.815$) with the HAPI prevalence rate, and a strong positive correlation ($\rho = 0.778$) with the percentage of 'PI assessment on admission'. The regression analysis for predicting the values for prevalence of HAPIs and use of prevention measures—based on nurse knowledge and attitude scores—yielded statistically insignificant results.

Discussion

According to the knowledge–attitude–practice model, knowledge and attitude have a direct impact on practice aimed at preventing PIs [25, 26]. Despite the literature reporting generally positive attitudes towards PI prevention, many barriers have been identified that suggest that nurses are still *"grappling with the attitude–behaviour gap"* [16]. The commonly cited issues can be categorised as modifiable barriers [49] such as heavy workload [13, 24, 25], inadequate staff numbers [13, 24, 25, 35, 50], lack of universal guidelines on PI prevention [24, 25], inadequate or lack of training [13, 24, 25, 50, 51], shortage of pressure-relieving devices and other resources in general [13, 24, 25, 50, 52] and lack of time [24, 35, 50, 52], and non-modifiable barriers [49] such as patient condition, uncooperative patients [24, 35, 50, 52] and low job satisfaction among nurses [24, 25].

In Kuwait, the prevalence of PIs and HAPIs is higher than the global rate, and practices aimed at preventing them are regarded as unacceptable [27]. We considered that poor knowledge and/or attitudes among nurses regarding preventing PI might underlie these lower outcomes [24, 53]; to test that, we devised this cross-sectional study.

This study represents a baseline assessment of nurses' knowledge and attitudes towards PI prevention, and explores their relationship with PI rates and prevention practices. The results satisfactorily reflect the objectives of the study. However, some aspects warrant further discussion.

Many studies have reported unacceptably low levels of knowledge about PI [3, 17, 23, 50, 54–57], although one study characterised the level of knowledge among ICU nurses as "desirable" [58]. A study by Lawrence et al. [38] also found satisfactory levels of knowledge, although again their respondents were adjudged to inadequately consider more than half of the items (55.3%) with Pieper and Mattern's parameter [39] applied. Compared to our present study, the original study by Pieper and Mott [36] reported a similar percentage of items (63.8%) for which knowledge was inadequate. To conclude, the knowledge level revealed by the present study is consistent with the literature.

The literature reports the use of a variety of tools for studying nurses' knowledge on preventing PI [59]. There is little consensus on what constitutes a satisfactory level of knowledge, and wide acknowledgement that it is arbitrarily set [37, 38]. Such variation makes a universal benchmark difficult to set, and forces researchers to compare percentage values between studies instead of using the narrative categories of knowledge adequacy/acceptability, if comparisons are to be accurate. Hu et al. [26] and Jiang et al. [9] found that nurses' knowledge on preventing PIs was insufficient; however, their threshold score (≥ 80%) was higher than ours. Adopting this higher cut-off score would increase the proportion of our sample deemed to have unsatisfactory knowledge to almost four-fifths. Thus, we can conclude that nurses in Kuwait have inadequate knowledge on PI prevention based on two criteria: the Pieper and Mattern's parameter [39], and the higher threshold set by some studies for satisfactory levels of knowledge [9, 26].

Concerning the demographic groups, our results are consistent with other studies that reported statistically significant differences in knowledge score based on age [9, 58, 60], sex [3], years of experience [3, 9, 38, 50, 55] and training [3, 9, 50, 61]. In contrast to this study, Muhammed et al. reported a difference in the knowledge score in favour of males versus females [61]. Some studies reported no differences in the knowledge score between the demographic groups [12, 36]. Hu et al. [26] also found the same except for nurses who received training, which is to be expected.

Knowledge on PI prevention is a predictor of a nurse's attitude. This is consistent with other studies that stated that a satisfactory level of knowledge leads to positive attitudes towards preventing PI [17]. Tharu et al. [22] also reported a positive correlation between knowledge and attitude, as well as between knowledge and practice. Hence, knowledge can influence the incidence of HAPI and PI prevention practice both directly and indirectly.

Since the level of knowledge on PI prevention was found to be generally unsatisfactory, the undergraduate and training programmes in Kuwait should be revised to deliver content that is in line with the latest evidence-based practices. The literature has supported this call for many years [3, 23, 25, 26]. A study from Saudi Arabia attributed the knowledge gap to deficient theoretical and practical education in nursing curricula in universities [62]. Lack of training was associated with poor knowledge [63], whereas educational intervention resulted in better knowledge, attitude and practice [64]. Currently, PIs are part of a single lecture taught to first-year undergraduates at the only nursing college in Kuwait. Also, there are no mandatory accredited and standardised training programmes addressing PI-related topics. Furthermore, the evaluation that currently takes place after the completion of a training course predominantly assesses a trainee's theoretical knowledge. According to the Kirkpatrick Model [65], evaluation should assess a trainee's reaction (attitude) and behaviour in addition to their learning (knowledge) and results of the new practice.

From the above discussion, we can conclude that training in PI prevention has little value if it did not increase knowledge, or if the gained knowledge did not affect behaviour and practice. Underlining that statement, and in contrast to the knowledge score, we found no difference in the attitude score between those who attended training and those who did not. Nonetheless, the number of years passed since the most recent training is one of the predictors of knowledge score. The number of training episodes has been reported to affect knowledge and behaviour [9, 26]. Therefore, training programmes have to be recurrent in order to maintain nurse competence in terms of their knowledge and practice on PI prevention.

The responses to some items of the Modified PUKT are interesting. In the few instances in which at least 90% of the nurses' responses were correct, that display of knowledge did not translate into practice. For example, the nurses' response to item 10 'A diet intake suitable to the patient protein-calorie needs should be maintained during the disease' was not reflected in the proportion of patients who underwent nutritional assessment on admission [27]. Also, nutrition was optimised for only less than two-fifths of patients [27]. Likewise, with items 7, 'Everybody, at admission, should be evaluated regarding the risk of developing pressure ulcer', and 21, 'The skin should remain clean and dry', the proportion of patients who underwent PI assessment on admission did not exceed two-thirds, whereas the proportion of those who were offered moisture management was slightly more than one-fifth [27]. Even for items that less than 90% of the nurses answered correctly, such as item 29, 'Every person evaluated as at risk of developing pressure ulcer should be placed on a pressure reducing mattress (water mattress)', the practice was unacceptably rare. Use of an air mattress was the least frequently used practice aimed at preventing PI [27].

More studies have reported positive attitudes to PI prevention [16, 26, 35, 49, 51, 52, 54, 56, 58] than have reported negative attitudes [3, 9, 17, 25, 57]. Sometimes, attitudes deemed negative are actually more positive than those deemed positive, highlighting that these thresholds, although important, are arbitrary. Jiang et al. reported a negative attitude (78.5%), however, their definition of a positive attitude was set intriguingly high (≥80%) [9]. On the other hand, Hu et al. used a comparable threshold (≥75%) and concluded that the attitude among their participants towards PI prevention was acceptable (76.7%) [26]. Balan et al. also used the a threshold

of 75%, however, they reported negative attitudes (67%) [17]. Another study claimed that negative attitudes might be due to the participants being positioned in inpatient units [25], although their somewhat unorthodox explanation was not discussed further; notably, the participants in the present study were also from inpatient wards.

Concerning the demographic groups, numerous studies supported our findings of statistically insignificant differences in attitude scores based on age [25, 26, 58], sex [26, 58], years of experience [25, 26, 58], and training [25, 58]. In contrast to this study, Ghazanfari et al. [58] reported no significant differences based on level of education, whereas Emami Zeydi et al. [57] found the opposite. Interestingly, Emami Zeydi et al. [57] reported significant differences in attitude scores based on all the studied demographic groups. Charalambous et al. [56], Hu et al. [26] and Etafa et al. [25] also reported significant differences in attitude scores based on age, receiving training, and sex, respectively, in contrast to the current study.

Regarding the tool used, an update of a systematic review of 35 studies [66] reported that the use of the Moore and Price Attitude Scale—once the predominant tool for measuring nurses' attitudes towards PI prevention [16]—was declining in favour of other tools. Despite the update revealing slightly lower scores, attitudes were still positive [16, 66], which is consistent with our current results. The systematic review revealed that studies from the Middle East had reported the lowest mean attitude score (55%), whereas the highest was from Europe (79%) [66]. Interestingly, our result from Kuwait is comparable to the findings from Europe.

The mean attitude score of the European region was derived from 13 studies [66]. Of these, only three studies also used the Moore and Price Attitude Scale: the original study from Ireland in 2004 (attitude score: 72.7%), which proposed the scale [35], a 2009 study from Sweden (78.2%) [52], and one from Cyprus in 2019 (76.0%) [44]. The latter, more recent study [44] did not report participants' responses to the scale items, unlike the other two [35, 52]. Compared to the participants' responses to items 3 and 9 in our study, those two studies [35, 52] assigned a third item (item 2) a positive response from less than 50% of participants.

In addition to the use of different tools, as reported by the systematic review [66], it is notable that some of the included studies applied varying methodologies. For instance, Florin et al. [67] employed a validation study instead of the cross-sectional design used in 20 other studies. The study settings and sampling methods also varied. Källman and Suserud [52] randomly selected 240 participants from six hospital clinics and six municipality healthcare centres, whereas Jiang et al. [9] used cluster sampling then randomly selected 2100 participants from 10 tertiary general hospitals representing one province. Thus, any comparisons between the results of this study and previously published results should be interpreted with caution.

The crucial role that nurses' attitudes play in the effectiveness of PI prevention practices has been extensively discussed in the literature [16, 66]. Nurses might not be sufficiently appraised on the newest care procedures or the latest evidence-based practices. As a result, rather than being guided by knowledge, their behaviours might instead rely on instinct, past performance, or ingrained habits [3, 26, 54]. The current study supports a comparable narrative. Nurses' attitudes significantly impacted the prevalence of HAPI and one PI prevention practice. However, both the HAPI rate and use of preventive measures are unacceptable despite the positive attitude.

The responses to some items of the Moore and Price Attitude Scale warrant further comment. For example, more than 90% of nurses responded positively to items 6, 'Continuous nursing assessment of patients will give an accurate account of their pressure ulcer risk', and 11, 'Pressure ulcer risk assessment should be regularly carried out on all patients during their stay in hospital' [27]. However, the skin was inspected daily for only one-third of at-risk patients. Furthermore, only 5.4% of patients were reassessed daily for the risk of developing PI [27].

A critical evaluation of the study tools is beyond the scope of this paper. However, there is a further point to note about the two tools used in this study. The Modified PUKT measures declarative knowledge only. Higher levels of knowledge can be measured by discussing patient cases to test a nurse's ability to recall and apply relevant knowledge [54]. With respect to the Moore and Price Scale, some claim that it includes items that measure knowledge (e.g. item 7, 'Most pressure ulcers can be avoided'). Furthermore, some items on both tools even appear to be a rephrasing of the same thing (e.g. item 41 in the Modified PUKT 'Hospitalised patients need to be evaluated regarding the risk of pressure ulcer only once' vs item 11 in Moore and Price Attitude Scale 'Pressure ulcer risk assessment should be regularly carried out on all patients during their stay in hospital'). This is because attitude has a cognitive component pertaining to an individual's knowledge/belief about a particular topic [66].

Strengths and limitations

This is the first nationwide study in Kuwait and the region to assess the PI-specific knowledge and attitudes of nurses and explore the relationship of these two factors with PI rates and practices aimed at prevention. The cross-sectional design of the study made it possible to measure several parameters at one time point, producing reliable data that is less vulnerable to the potential biases of case reports and case series [68]. Also, the study used

internationally recognised validated tools, which allowed international benchmarking.

Nevertheless, there are limitations. The self-reported responses obtained from the two tools used are prone to influence by social desirability and subjective biases [69]. In addition, the Modified PUKT measures declarative knowledge rather than higher levels of knowledge [54]. Also, the study was designed to determine associations between variables, not to infer causation. Moreover, we could not compare study variables between the PI group and the PI-free group. Finally, data about PI prevention practices were extracted from patient files. The validity of such data is subject to the documenting accuracy of the nurses.

Practice and research implications

In light of the discussed limitations concerning the study tools, we suggest that the professional and relevant bodies revise the tools currently available and adopt standards for measuring knowledge on PI prevention and attitudes towards it. We stress the importance of developing tools that measure higher levels of knowledge and that are less prone to subjectivity. Also, we encourage researchers to state and standardise the cut-off scores of their tools.

There is a deficiency in the literature regarding nurses' knowledge and attitudes towards PI prevention in other hospital wards or tertiary or private hospitals in Kuwait. To overcome some of the study's limitations such as social desirability and subjective biases, and to offer insights into human behaviour, gain a deeper understanding and provide a context for this complex subject, we advise the use of qualitative approaches.

Revealing the gap in nurses' knowledge on preventing PIs should not discourage us from further investigating other barriers to practicing PI prevention. The scant use of air mattresses as a preventive measure cannot be attributed to their unavailability in a high-income country like Kuwait. In addition, nurse availability, workload, and the presence of updated workable PI prevention guidelines are aspects in need of further investigation.

It is necessary to update the curriculum of the undergraduate nursing degree and formal in-service training programmes to match the most recent evidence-based practices that aim to improve nurses' knowledge and skills in PI prevention. As recommended in the literature, all concerned parties (e.g. the Nursing Administration Directorate, Kuwait Nursing Association and Nursing College) should cooperate to create and deliver effective nursing education and training programmes [70]. Such training should be recurrent and tailored to the specific needs of the different trained individuals in each hospital according to age, sex, experience and highest level of education. Post-training evaluation must assess practice change and its impact on results.

Conclusions

In Kuwait, nurses' knowledge of how to prevent PIs is unsatisfactory to borderline satisfactory. The nurses generally have positive attitudes towards preventing PIs, which has a strong negative correlation with HAPI rate. Despite this, the prevalence of HAPIs is still higher in Kuwait than it is globally. Preventing PIs is a complex, multifaceted process, and a high prevalence of PI and low compliance with prevention practices cannot be explained solely by poor knowledge or negative attitudes. Studying the barriers to practicing PI prevention and managing established PIs would offer a wider perspective into this national issue, especially since the positive attitude of Kuwait's nurses was not mirrored by compliance with PI prevention practices. However, there is an urgent need to work with the parties concerned to establish effective education and training programmes to bridge these gaps.

Abbreviations

B	Unstandardised regression coefficient
Beta	Standardised regression coefficient
CI	Confidence interval (95%)
F	False
HAPI	Hospital-acquired pressure injury
IQR	Inter-quartile range
n	Number
p	*p*-value
PI	Pressure injury
PUKT	Pressure Ulcer Knowledge Test
R^2	*R*-squared value
SD	Standard deviation
SE	Standard error
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
T	True

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12912-025-02947-8.

Supplementary Material 1: An online form includes variables on the demographics of a patient with pressure injuries and the characteristics of these injuries.

Supplementary Material 2: An online form composed of three sections. The first section records the participants' demographic information. The second section includes the modified Pieper's Pressure Ulcer Knowledge Test. The third section is the Moore and Price Attitude Scale.

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Author contributions

T.A., M.L., Sh.A. and H.E. contributed to the study conception and design. M.L., Sh.A. and H.E. contributed to the acquisition of data. H.E. and Sh.A. cleaned and validated data. Sh.A. drafted the background and methods sections. H.E. analysed data and wrote the main manuscript text and tables. T.F., Gh.A. and

H.A. substantively revised the manuscript. All authors read and approved the final manuscript and agreed to be personally accountable for their contributions. H.E. is the guarantor of the manuscript.

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Ethical approval was granted by the Standing Committee for Coordination of Health and Medical Research in Kuwait (Registration Number: 1962/2022), which is part of the Ministry of Health. It is the only body that approves and oversees research conducted in public healthcare institutions in Kuwait, and we confirm that all methods were performed in accordance with their relevant guidelines and regulations. Participating hospitals provided permission for the study to take place, and patients' and nurses' identities were kept confidential and coded to ensure anonymity. All medical ward nurses provided voluntary written informed consent after receiving an explanation of the study's value, benefits and risks, and after their questions were satisfactorily answered.

Consent for publication
Not applicable.

Competing interests
The authors declare that there is no conflict of interest regarding the publication of this paper.

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Publisher's Note

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