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EMPIRICAL STUDIES

Factors determining nurses' knowledge of evidence-based pressure ulcer prevention practices in Finland: a correlational cross-sectional study

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Abstract

Background: Pressure ulcers cause economic burden, human suffering, pain and decreased health-related quality of life in patients. Pressure ulcers are preventable in most cases, and nursing staff knowledge is a key factor in successful pressure ulcer prevention. Further evidence is needed to better tailor pressure ulcer prevention training programmes to the nursing staff.

Aim: To evaluate the level of nursing staff knowledge about evidence-based pressure ulcer prevention practices in both primary and specialised care, and to identify what factors determine nurses' knowledge levels.

Methods: A correlational, cross-sectional study was conducted from 2018 to 2019 in two hospital districts in Finland. The Pressure Ulcer Prevention Knowledge test was used to collect data, and the Attitude towards Pressure ulcer Prevention (APuP) instrument was used as a background variable. The data were statistically analysed with Wilcoxon and Kruskal–Wallis tests, Spearman correlations and multiple linear regression.

Results: The pressure ulcer prevention knowledge of the participating registered nurses, practical nurses and ward managers (N = 554) was on average 24.40 (max. 35.00). There was no difference in the participants' knowledge based on the type of unit in which they were working (primary or specialised care). The participants' attitudes ($p < 0.0001$), current position ($p = 0.0042$), frequency of taking care of patients with pressure ulcers ($p = 0.0001$) and self-evaluated training needs ($p < 0.0001$) independently explained the variation in the knowledge scores.

Conclusions: Special attention needs to be paid to the knowledge of those nurses working in positions that require lower levels of education and those who rarely take care of patients with pressure ulcers. Supporting nurses' positive attitudes towards pressure ulcer prevention should be an essential part of pressure ulcer prevention training. Nurses' self-evaluations of their training needs can be used to target training. The limitations of the study should be considered when generalising the results.

KEYWORDS
nurses, pressure ulcer, prevention, knowledge, evidence-based practice

INTRODUCTION

Pressure ulcer (PU) prevention is possible in most cases with proper prevention methods [1]. PU prevalence in Europe ranges from 4.6% to 27.2% in healthcare settings [2] with a rate of 5.1% in the United States [3]. PU prevention is essential and reflects quality of care [4]; besides causing economic burdens, PUs can also cause human suffering, pain and decreased health-related quality of life in patients [5]. Implementing evidence-based guidelines can decrease both the human and economic burden of PUs. The international clinical practice guideline, Prevention and Treatment of Pressure Ulcers/Injuries (updated in 2019), consists of relevant evidence-based recommendations and good practice statements for healthcare professionals [1].

Nursing staff, among other healthcare personnel, play a significant role in the prevention of PUs [6,7]. Therefore, the knowledge of nursing staff is a key factor in evidence-based and successful PU prevention [1]. We recognised that current evidence on the different factors associated with nursing staff PU prevention knowledge is still limited, as most previous studies have been conducted with relatively small samples and low response rates [8–11]. Additionally, there is still a lack of clarity as to what kind of PU prevention training would be the most beneficial for nurses [12]. Thus, more information is required to strengthen current evidence to be used to improve nurses' knowledge.

BACKGROUND

A lack of knowledge by the nursing staff inhibits the use of PU preventive methods [13]. Even though nurses' knowledge of the prevention of PUs has been found to be moderate [14], significant lack of knowledge [15] and prevention activities [4] have also been observed.

Previous studies show that nurses' knowledge and skills vary between different PU prevention domains [7,8,11,16] and that nurses have a greater ability to recognise PUs than prevent them [11]. Studies have shown that many nurses are unable to identify PU prevention protocols [16,17], reduce the amount of pressure on tissue [8] or classify and assess PU risk [16]. Furthermore, according to previous studies, nurses have limited knowledge of PU development [18] and preventive activities [6,11,19].

Nurses who frequently take care of patients with PUs [20,21] and who receive PU training [19–22] have better knowledge of the prevention and treatment of PUs than those who care for patients with PUs less often or who have not participated in any PU prevention training. Also, the caring culture can cause variation in PU prevention practices [4]. In addition, nurses with higher levels of education [19,21] or those who are specialised in PUs (wound care nurses) have better knowledge and skills than those with lower levels of education (e.g. assistant nurses and nursing students) or those who do not work in clinical settings (e.g. administrative nurses and nurse educators; [21]). Registered nurses trust the knowledge of assistant nurses and often delegate PU prevention to them [4].

Negative attitudes towards PU prevention also inhibit the use of PU preventive methods [15]. Knowledge and attitude correlate positively with one another [9], especially in regard to attitudes concerning the prioritisation of PU prevention [10]. In addition, it seems that there is a positive correlation between years of experience in nursing and nurses' attitudes, but not between years of experience and knowledge [23]. However, conflicting results concerning the role of work experience on knowledge levels have also been presented [19].

Although there is no single effective way to improve the knowledge and skills of nursing staff [24], up-to-date information and leader and team support have been recognised as important facilitators [17]. While researchers recommend training activities to increase nursing staff knowledge and skills [8,19,21], the challenge lies in whether training, and what kind, impacts PU incidence or nursing staff knowledge of PU prevention [12].

There is still a need to strengthen previous understanding of nursing staff PU prevention knowledge and associated factors due to limitations in previously gathered evidence [8–11] and partly contradictory results [19]. This exploration is needed to target PU prevention training for nursing staff with different backgrounds and thereby develop PU prevention practices. The objective of this study was to evaluate the level of nursing staff (registered nurses, practical nurses and ward managers) knowledge about evidence-based PU prevention practices in both primary and specialised care, and to identify what factors determine nurses' knowledge levels.

METHODS

Study design and participants

The study had a correlational, cress-sectional design. The data collection took place in primary (n = 20) and specialised healthcare (n = 27) units in two hospital districts, covering together approximately 420,000 inhabitants in Finland. The two hospital districts represent typical Finnish districts with

central hospitals. They were chosen purposefully because nursing staff in these districts were provided with PU training to improve PU prevention skills. Registered nurses, practical nurses and ward managers working in these units who were willing to take part in the study were included. In addition, the participants were required to be Finnish-speaking and in permanent or long-term positions. The sample size was not determined in advance because all nurses in the regions were given the opportunity to participate in the study, and there was no appropriate reason to exclude some units.

Procedures

The data were collected between May 2018 and January 2019. The Pressure Ulcer Prevention Knowledge (PUPK; Copyright 2018 © Haavisto, Hietanen) test was used in this study to evaluate nursing staff knowledge of evidence-based PU prevention and early-stage treatment practices. The test was developed based on the international clinical practice guideline [25]. The PUPK test consists of 35 items on seven different domains: (1) PU development and risk factors, (2) PU classification, (3) PU risk assessment and PU prevention with: (4) repositioning, (5) pressure relief devices, (6) skin assessment and skin care and (7) nutrition. Each domain includes five items with 'yes', 'no' or 'I don't know' answer options.

The validity and reliability of the PUPK test were evaluated by its content validity and the internal consistency. Three rounds of expert panels evaluated the content validity (the relevance and clarity) of the items sequentially. The purpose of the evaluation was to gain consensus about the items [26]. The items with a content validity index (CVI) of 0.75 or higher were retained. The researcher and the nationally authorised wound care nurse made the decision to remove items if the CVI was less than 0.75. In the first round, three specialised wound care physicians and three nationally authorised wound care nurses participated in the evaluation. The test contained 55 items in seven domains. The second round was evaluated by 32 nationally authorised wound care nurses. After the evaluation, six items were removed, and six items were reworded. In the third round, only 11 items were evaluated: the six items that were reworded after the second round and five items with a CVI of less than 0.75 that were theoretically relevant. The evaluation was carried out by three nurses who participated in the second round. After the third round, one item was removed, and one was reworded. The PUPK test was piloted by 96 nurses in the long-term care of the elderly. The purpose was to gain a preliminary understanding of the test and to assess the difficulty of the items. After the pilot test, 35 items were included in the test (ten items were removed and six items were reworded). Items with dysfunctional distractors (weak evidence or more than 90% of the participants were able to answer correctly) were removed. Six new items with strong evidence were added [25]. The internal consistency was evaluated using item-to-total correlations and Kuder–Richardson coefficients. The item-to-total correlations were over 0.20, with the exception of four statements [27]. The Kuder–Richardson coefficient for the entire test was 0.77. The values of the domains ranged from 0.43 to 0.49 except in the instance of one sum variable (0.14).

As background data, information about the participants' current position (n = 5 questions), education (n = 2), experience (n = 4), participation in additional training (n = 2), self-evaluation of own PU prevention skills (n = 1) and self-evaluation of additional training needs (n = 2) were collected. In addition, 13 items related to nurses' attitudes towards PU prevention (Attitude towards Pressure ulcer Prevention [APuP] instrument; [28]) were used as a background variable. Permission to use the APuP instrument was received from the copyright holders.

Information about the study was provided verbally to the ward managers of the participating hospital districts and units. A link to the electronic questionnaire and written information letter were sent to a contact person at both hospital districts. The contact person forwarded the materials to the nursing staff. A link was sent to a total of 1975 practical nurses, registered nurses and ward managers. The response rate was 28%.

Ethical principles were followed throughout the study [29]. Ethical approval was obtained from the Ethics Committee of Satakunta Higher Education Institution (20.12.2018) prior to data collection. Permission to collect the data was obtained from the participating organisations according to their policies. Participation in the study was voluntary. Taking part in the study by answering the electronic questionnaire was considered as informed consent.

Data analysis

Data were analysed using SAS 9.4 statistical software package (SAS Institute Inc., Cary, NC, USA). Frequencies, percentages, means, medians and standard deviations (SDs) were used to describe the variables. Before calculating the sum scores of the PUPK test, the original items were scored so that the correct answer was given one point, while incorrect, 'I don't know' and missing answers were given zero points. Due to skewed distributions, the differences between the means of the PUPK test domains were analysed by the Wilcoxon signed-rank test. The associations between numeric background characteristics (self-reported PU prevention and early detection skills, and attitudes towards PU prevention) and PUPK test scores were examined using Spearman correlations. To compare PUPK test levels between the classes

TABLE 1 Characteristics of the participants.

Background factors		Number of participants (n)	Percentage (%)
Type of unit (N = 542)	Specialised care	213	39.30
	Primary care	329	60.70
Education (N = 550)	Registered nurse	272	49.45
	Practical nurse	238	43.27
	Other	40	7.27
Current position (N = 551)	Ward manager	24	4.36
	Registered nurse	258	46.82
	Practical nurse	244	44.28
	Other	25	4.54
Work experience in healthcare field after graduation (N = 546)	6 years or less	138	25.27
	6.1–14 years	139	25.46
	14.1–25 years	136	24.91
	25.1 years or more	133	24.36
Working as unit's wound care nurse (N = 547)	Yes	28	5.12
	No	519	94.88
Working with pressure ulcer (PU) prevention and early detection (N = 553)	Daily	312	56.42
	Weekly	123	22.24
	Monthly	71	12.84
	More rarely	47	8.50
Taking care of patients with PUs (N = 553)	Daily	90	16.27
	Weekly	181	32.73
	Monthly	151	27.31
	More rarely	131	23.69
Participation in PU training in the past two years within own organisation (N = 538)	Has not participated	314	58.36
	Participated one time	160	29.74
	Participated two or more times	64	11.90
Participation in PU training in the past two years outside own organisation (N = 539)	Has not participated	433	80.33
	Participated one time	72	13.36
	Participated two or more times	34	6.31
Self-reported PU prevention and early detection skills (min. 4: weak skills; max. 10: excellent skills) (N = 549)	10	11	2.00
	9	93	16.94
	8	242	44.08
	7	139	25.32
	6	48	8.74
	5	13	2.37
	4	3	0.55
Self-evaluated additional PU prevention and early detection training needs (N = 551)	Considerable amount	63	11.43
	Moderate amount	303	54.99
	A little or not at all	185	33.58

of categorical background characteristics, the Wilcoxon two-sample test for two groups and the Kruskal–Wallis test for more than two groups were used. To adjust for multiple comparisons, the Bonferroni method was used to correct the significance levels. To find out the independent determinants of the total PUPK test score, multiple linear regression was used. *p*-values less than 0.05 were considered statistically significant. Internal consistency reliability was evaluated using item-to-total correlations and Kuder–Richardson coefficients.

RESULTS

Participants

In total, 554 registered nurses, practical nurses and ward managers participated in the study. The characteristics of the participants are presented in Table 1. The attitude scores of the participants (n = 548) towards PU prevention (APuP instrument) were on average 43.02 (SD 3.98, max. 52 representing the most positive attitudes). Of the participants, 40 reported training other than practical nurse (vocational level) or registered nurse (bachelor's degree) education. These participants mainly reported their training to be based on different specialties (e.g. midwife and paramedic). In addition, six participants had master's degree in nursing and one participant had a master's degree in nursing science. None of the participants were physicians.

Nursing staff knowledge about evidence-based PU prevention practices

The PU prevention knowledge of the participants (n = 554) measured with the PUPK test was on average 24.40 (SD 4.09, min. 0, max. 35). Only one participant achieved the maximum score. The participants' knowledge varied between the different domains (Table 2). The participants scored the highest on the PU risk assessment domain (mean 4.42, SD 0.84, min. 0, max. 5 for all the domains). The participants' knowledge was weakest in the areas of PU classification (mean 2.92, SD 0.96), PU prevention with repositioning (mean 2.87, SD 0.80) and PU prevention with pressure relief devices (mean 2.76, SD 1.05). The statistical difference of these three domains compared to the other domains, tested with the Wilcoxon signed-rank test, was $p < 0.044$ or lower. The participants' (n = 549) self-reported PU prevention skills were on average 7.69 (SD 1.03) on a scale from four (weak skills) to ten (excellent skills). The three most and least known PUPK test items are presented in the Table 3.

TABLE 2 Participants' (N = 554) knowledge of different Pressure Ulcer Prevention Knowledge test domains ranked in order (min 0 - max 5).

Domain	Mean	Median	Standard deviation
Pressure ulcer (PU) risk assessment	4.424	5.00	0.839
PU development and risk factors	4.061	4.00	0.820
PU prevention/skin assessment and skin care	3.884	4.00	1.156
PU prevention/nutrition	3.477	4.00	1.021
PU classification	2.919	3.00	0.963
PU prevention/ repositioning	2.866	3.00	0.800
PU prevention/pressure relief devices	2.764	3.00	1.045

Factors determining nursing staff knowledge

The participants' (n = 554) total PU prevention knowledge varied based on the participants' education ($p = 0.0139$) and current position ($p = 0.0011$). There was no difference in the participants' knowledge based on the type of unit they worked in (primary vs specialised care; Table 4). In pairwise comparisons, those participants with practical nurse (vocational level) education had lower PU prevention knowledge compared to those with registered nurse (bachelor's degree) education ($p = 0.0105$). Those currently working as ward nurses had better knowledge than those working as practical nurses ($p = 0.003$).

There was also a difference in the PU prevention knowledge based on the participants' work experience after

TABLE 3 The three most and least known Pressure Ulcer Prevention Knowledge test items among the participants (N = 554).

The three most known items	Participants that knew the right answer	
Item 31: It is not needed to take the patient's nutritional status into account while conducting pressure ulcer (PU) risk assessment. (false)	n = 539	97.29%
Item 30: A sense of numbness is irrelevant in PU assessment. (false)	n = 538	97.11%
Item 27: Clinical assessment of the patient and of the skin is necessary, regardless of which tool is used for risk assessment. (true)	n = 535	96.57%
The three least known items	**Participants that knew the right answer**	
Item 35: When repositioned, the pressure on the tissues should be removed. (false)	n = 14	2.55%
Item 24: A stage III PU penetrates fascia. (false)	n = 38	6.91%
Item 40: Donut-shaped aids are used to elevate heels. (false)	n = 75	13.89%

TABLE 4 Pressure Ulcer Prevention Knowledge (PUPK) test sub scores and differences based on background characteristics.

		Total PUPK scores[a]		Pressure ulcer (PU) development and risk factors[b]		PU classification[b]	
		Mean (SD)	*p*-value	Mean (SD)	*p*-value	Mean (SD)	*p*-value
Type of unit	Primary care (n = 329)	24.48 (4.00)	0.9689	4.06 (0.86)	0.5678	3.04 (0.94)	0.0008
	Specialised care (n = 213)	24.29 (4.07)		4.05 (0.78)		2.74 (0.98)	
Education	Registered nurse (n = 272)	24.81 (3.90)	0.0139	4.09 (0.71)	0.9553	2.89 (1.03)	0.2672
	Practical nurse (n = 238)	23.95 (4.13)		4.04 (0.89)		2.99 (0.86)	
	Other (n = 40)	23.93 (4.93)		4.00 (1.11)		2.68 (1.12)	
Current position	Ward manager (n = 24)	26.42 (2.22)	0.0011	4.21 (0.59)	0.8037	3.17 (0.87)	0.2301
	Registered nurse (n = 258)	24.65 (3.99)		4.09 (0.72)		2.86 (1.04)	
	Practical nurse (n = 244)	23.97 (4.13)		4.03 (0.90)		2.99 (0.87)	
Work experience (after graduation, *quartiles*)	6 years or less (n = 138)	23.46 (5.20)	0.0103	3.96 (0.91)	0.1480	2.88 (1.15)	0.8903
	6.1-14 years (n = 139)	24.35 (3.06)		4.17 (0.69)		2.95 (0.92)	
	14.1-25 years (n = 136)	25.03 (3.57)		4.00 (0.80)		2.99 (0.90)	
	25.1 years or more (n = 133)	24.76 (4.16)		4.10 (0.86)		2.88 (0.88)	
Works as unit's wound nurse	Yes (n = 28)	26.79 (5.88)	<0.0001	4.46 (1.00)	0.0002	3.36 (1.03)	0.0073
	No (n = 519)	24.27 (3.95)		4.04 (0.81)		2.89 (0.96)	
Works with PU prevention and early detection	Daily (n = 312)	24.80 (3.48)	0.0006	4.09 (0.71)	0.5158	3.03 (0.89)	0.0050
	Weekly (n = 123)	24.82 (4.12)		4.10 (0.91)		2.96 (0.91)	
	Monthly (n = 71)	23.58 (3.36)		4.04 (0.82)		2.65 (1.00)	
	Rarely (n = 47)	21.79 (6.89)		3.81 (1.19)		2.47 (1.28)	
Cares for patients with PUs	Daily (n = 90)	24.53 (3.39)	0.0013	4.11 (0.73)	0.0271	2.99 (0.89)	0.0323
	Weekly (n = 181)	25.10 (3.59)		4.04 (0.83)		3.09 (0.85)	
	Monthly (n = 151)	24.70 (3.49)		4.20 (0.75)		2.86 (0.92)	
	Rarely (n = 131)	22.96 (5.35)		3.90 (0.92)		2.70 (1.16)	
Participation to PU training within own organisation	Has not participated (n = 314)	23.77 (4.47)	0.0001	4.01 (0.89)	0.5818	2.82 (1.02)	0.0110
	Participated one time (n = 160)	25.01 (3.28)		4.11 (0.74)		2.98 (0.81)	
	Participated two or more times (n = 64)	25.72 (3.12)		4.11 (0.72)		3.23 (0.90)	
Participation to PU training outside own organisation	Has not participated (n = 433)	24.11 (4.25)	0.0003	4.03 (0.86)	0.1382	2.85 (0.97)	0.0016
	Participated one time (n = 72)	25.08 (3.09)		4.13 (0.73)		3.11 (0.83)	
	Participated two or more times (n = 34)	26.79 (2.92)		4.32 (0.59)		3.44 (0.79)	
Self-evaluated additional training about PU prevention and early detection needs	Considerable amount (n = 63)	22.13 (5.80)	<0.0001	3.63 (1.04)	0.0002	2.65 (1.09)	0.0168
	Moderate amount (n = 303)	24.17 (3.94)		4.07 (0.81)		2.89 (0.94)	
	A little or not at all (n = 185)	25.54 (3.23)		4.19 (0.71)		3.06 (0.95)	

The differences were tested with the Wilcoxon two-sample test/Kruskal–Wallis test.

[a]Possible range 0–35.

[b]Possible range 0–5.

PU risk assessment[b]		PU prevention/ repositioning[b]		PU prevention/pressure relief devices[b]		PU prevention/skin assessment and skin care[b]		PU prevention/ nutrition[b]	
Mean (SD)	***p*-value**	**Mean (SD)**	***p*-value**	**Mean (SD)**	***p*-value**	**Mean (SD)**	***p*-value**	**Mean (SD)**	***p*-value**
4.35 (0.83)	0.0010	2.85 (0.79)	0.3129	2.81 (1.01)	0.3444	3.90 (1.09)	0.7302	3.48 (1.02)	0.7428
4.54 (0.80)		2.91 (0.80)		2.71 (1.09)		3.88 (1.22)		3.46 (1.02)	
4.55 (0.78)	<0.0001	2.95 (0.83)	0.0112	2.78 (1.04)	0.8589	4.04 (1.12)	0.0017	3.51 (0.94)	0.5075
4.28 (0.88)		2.75 (0.75)		2.75 (1.04)		3.74 (1.16)		3.41 (1.07)	
4.40 (0.93)		2.93 (0.80)		2.70 (1.16)		3.70 (1.24)		3.53 (1.20)	
4.63 (0.58)	<0.0001	3.21 (0.72)	0.0032	3.00 (0.83)	0.4706	4.38 (0.77)	0.0016	3.83 (0.82)	0.1728
4.55 (0.78)		2.93 (0.83)		2.74 (1.06)		3.99 (1.16)		3.48 (0.97)	
4.27 (0.87)		2.75 (0.75)		2.76 (1.05)		3.75 (1.16)		3.42 (1.08)	
4.28 (1.02)	0.1437	2.86 (0.88)	0.1354	2.59 (1.06)	0.0061	3.62 (1.32)	0.0005	3.27 (1.14)	0.1005
4.49 (0.61)		2.79 (0.74)		2.63 (0.81)		3.80 (1.02)		3.53 (0.98)	
4.49 (0.67)		3.00 (0.73)		2.92 (1.19)		4.13 (1.09)		3.51 (0.95)	
4.46 (0.97)		2.81 (0.85)		2.90 (1.06)		4.00 (1.12)		3.61 (0.96)	
4.54 (1.00)	0.2053	2.96 (1.07)	0.4781	3.39 (1.17)	0.0009	4.25 (1.11)	0.0377	3.82 (1.09)	0.0295
4.42 (0.83)		2.87 (0.78)		2.73 (1.03)		3.86 (1.16)		3.46 (1.01)	
4.48 (0.75)	0.5822	2.89 (0.77)	0.6249	2.85 (1.03)	0.0003	3.98 (1.10)	0.0042	3.48 (0.97)	0.1677
4.42 (0.84)		2.89 (0.84)		2.90 (1.09)		3.97 (1.07)		3.58 (1.00)	
4.35 (0.79)		2.77 (0.70)		2.52 (0.88)		3.73 (1.15)		3.51 (1.01)	
4.19 (1.31)		2.79 (1.02)		2.19 (1.08)		3.26 (1.52)		3.09 (1.33)	
4.41 (0.70)	0.2581	2.86 (0.79)	0.9765	2.78 (1.09)	0.0047	3.96 (1.18)	0.0052	3.43 (1.06)	0.2525
4.52 (0.69)		2.90 (0.76)		2.95 (1.03)		4.01 (1.08)		3.60 (0.86)	
4.47 (0.81)		2.8 (0.79)		2.77 (0.94)		3.99 (0.99)		3.53 (0.97)	
4.25 (1.09)		2.82 (0.87)		2.48 (1.10)		3.53 (1.34)		3.27 (1.21)	
4.34 (0.93)	0.1277	2.79 (0.81)	0.0635	2.64 (1.05)	0.0024	3.78 (1.21)	0.0260	3.38 (1.07)	0.0250
4.50 (0.76)		2.91 (0.80)		2.88 (0.99)		3.96 (1.10)		3.66 (0.84)	
4.58 (0.53)		3.03 (0.69)		3.08 (1.06)		4.20 (0.91)		3.48 (1.07)	
4.41 (0.89)	0.4296	2.85 (0.80)	0.3645	2.74 (1.06)	0.2042	3.82 (1.19)	0.0030	3.42 (1.05)	0.0099
4.39 (0.68)		2.90 (0.82)		2.88 (1.03)		4.08 (1.02)		3.60 (0.74)	
4.56 (0.61)		3.03 (0.83)		3.06 (0.85)		4.44 (0.70)		3.94 (0.89)	
4.06 (1.24)	<0.0001	2.62 (0.89)	0.0370	2.40 (1.10)	0.0020	3.48 (1.32)	0.0041	3.29 (1.28)	0.0511
4.37 (0.84)		2.85 (0.76)		2.71 (1.01)		3.85 (1.20)		3.42 (0.99)	
4.64 (0.58)		2.97 (0.81)		2.97 (1.04)		4.08 (0.97)		3.63 (0.96)	

TABLE 5 Correlation coefficients of the participants' self-reported skills (N = 549) and attitudes towards (N = 548) pressure ulcer (PU) prevention and early detection with the Pressure Ulcer Prevention Knowledge (PUPK) test scores.

		Total PUPK scores	PU development and risk factors	PU classification	PU risk assessment	PU prevention/ repositioning	PU prevention/ pressure relief devices	PU prevention/skin assessment and skin care	PU prevention/ nutrition
Self-reported PU prevention and early detection skills[a]	Spearman correlation coefficient	0.268	0.111	0.171	0.145	0.097	0.162	0.167	0.167
	p-value	<0.0001	0.0093	<0.0001	0.0007	0.0225	0.0001	<0.0001	<0.0001
Attitudes measured with APuP[b] instrument	Spearman correlation coefficients	0.294	0.041	0.159	0.222	0.129	0.178	0.203	0.213
	p-value	<0.0001	0.3368	0.0002	<0.0001	0.0025	<0.0001	<0.0001	<0.0001

[a]min. 4: weak skills; max. 10: excellent skills.

[b]APuP: Attitude towards Pressure ulcer Prevention; min. 0: most positive attitudes; max. 52: least positive attitudes.

graduation ($p = 0.0103$), whether the participant worked as a unit's wound nurse ($p < 0.0001$), how often they worked with PU prevention and early detection ($p = 0.0006$) or how often they took care of patients with PUs ($p = 0.0013$; Table 4). Those who had six years or less of work experience had less knowledge than those who had worked in nursing roles for 14.1 years or more ($p = 0.0426$ or less). Those participants working daily or weekly with PU prevention and early detection had better PU prevention knowledge than those who encountered PUs on a monthly basis ($p = 0.0084$ and $p = 0.0156$, respectively). The participants' knowledge also varied based on the frequency that they took care of patients with PUs; those caring for patients with PUs on a weekly or monthly basis had better knowledge than those who cared for patients with PUs more rarely ($p = 0.0006$ and $p = 0.0462$, respectively).

Differences in the participants' knowledge were observed based on how often they participated in PU training within ($p = 0.0001$) and outside their own organisations ($p = 0.0003$). Those who had participated in PU training within their own organisation once ($p = 0.0036$) or more than once ($p = 0.0018$) during the past two years had better PU prevention knowledge than those who had not participated in PU training at all. Those who had participated in PU training outside their own organisation two times or more had better knowledge than those who had not participated in PU training at all during the past two years ($p = 0.0006$; Table 4).

The participants' total PUPK test scores varied based on the self-reported additional training needs ($p < 0.0001$). All three categories related to training needs differed significantly from one another ($p = 0.0114$ or less; Table 4). The participants' numeric self-evaluation of their PU prevention skills correlated with their knowledge levels. The same was observed in relation to PU prevention attitudes (Table 5). The details of the subscores concerning the different PUPK test domains are shown in Table 4.

In the multivariate regression analysis of all univariately significant background factors, current position ($p = 0.0042$), frequency of taking care of patients with PUs ($p = 0.0001$), self-evaluation of additional training needs ($p < 0.0001$) and attitudes towards PU prevention ($p < 0.0001$) remained independent determinants of the total PUPK scores (Table 6). After taking these factors into account, education, work experience, participation in training and self-reported skills seemed to be unnecessary to include in the explanation model. Self-evaluated need for additional training was a stronger predictor than participation in training.

DISCUSSION

The objective of our study was to evaluate the level of nursing staff knowledge about evidence-based PU

TABLE 6 Independent determinants of the total Pressure Ulcer Prevention Knowledge test scores (N = 518).

Determinant		n	Beta	Standard error	95% Confidence interval	p^a	p^b
Intercept			29.37	0.92	27.56 to 31.18		
Current position	Ward manager	24	2.28	0.73	0.84 to 3.73	0.0020	0.0042
	Registered nurse	253	0.57	0.31	−0.04 to 1.17	0.0648	
	Practical nurse	241	0				
Cares for patients with pressure ulcers	Daily	89	1.42	0.49	0.47 to 2.38	0.0035	0.0001
	Weekly	175	1.81	0.42	0.99 to 2.62	<0.0001	
	Monthly	144	1.63	0.43	0.79 to 2.47	0.0001	
	Rarely	110	0				
Self-evaluated additional training needs	Considerable amount	57	−2.23	0.52	−3.26 to −1.20	<0.0001	<0.0001
	Moderate amount	287	−0.84	0.32	−1.48 to −0.20	0.0099	
	A little or not at all	174	0				
Attitudes (APuP[c] total score)		518	0.26	0.04	0.19 to 0.34		<0.0001

Significance of the model $F(8.509) = 15.50$, $p < 0.0001$.

Model 100*R-square = 19.6%.

[a]Significance of beta coefficient.

[b]Significance of the determinant.

[c]APuP: Attitude towards Pressure ulcer Prevention instrument.

prevention practices in both primary and specialised care, and to identify what factors determine nurses' knowledge levels. Our study reinforces the previous evidence [7,8,11,16,19] that there is a need to strengthen nursing staff knowledge of PU prevention. Special attention needs to be paid to nursing staff knowledge of PU classification and PU preventive activities related to repositioning and pressure relief devices based on both our own and previous [8,16,19] findings.

In accordance with previous studies [19–21], we show that attention needs to be paid to the knowledge levels of those nurses working in positions that require lower levels of education – especially practical nurse (vocational level) education – and those nurses who less frequently attend additional training. However, based on previous evidence [12], there is uncertainty about what kind of training would be the most beneficial to support nursing staff's PU prevention knowledge. Our study complements previous knowledge and shows that besides the amount of training, attention needs to be paid to the training provider as well. The knowledge of the participants varied (23.77 vs. 25.01 PUPK total scores) if the participant already participated once in additional training provided within their own organisation vs not participating in any additional training at all. Participation in training outside their own organisation required two or more instances of participation in order to achieve the same benefits. The rationale behind this result might be that a homogenous group with similar knowledge needs can be collected for the training provided within an organisation and thus can be better tailored to meet the knowledge needs of the participants. Randomised controlled trials comparing these two types of training and confirming this result are needed.

Our findings, as well as previous results [21], support the role of experience and specialisation in wound care on nursing staff PU prevention knowledge. Our results also show that the knowledge of the participants varied based on the years of work experience after graduation and the frequency of working with PU prevention. However, it must be noted that of the factors related to nursing staff experience only current position and frequency of taking care of patients with PUs remained independent determinants of the participants' knowledge. We show that those participants caring for patients with PUs weekly (25.10) or monthly (24.70) had better knowledge than those who care for patients with PUs more rarely (22.96 PUPK total scores). This result suggests that weekly or monthly frequency of caring for patients with PUs could assist in maintaining nursing staff knowledge levels. In our study, the ward managers had the highest knowledge levels (26.42 PUPK total scores), which is in contrast to previous results. Previously, it has been shown that those not working in clinical settings have lower knowledge levels [21]. Our result may be explained by the fact that in Finland some of the ward managers work in clinical settings in addition to performing their administrative duties and, therefore, often have a high level of education (post-baccalaureate degrees).

Our results highlight that no expectations can be made about nursing staff PU prevention knowledge based on the type of unit (primary or specialised care) the participants are working in. Instead, we show that besides the current position and frequency of caring for patients with PUs, the

attitudes of the nursing staff towards PU prevention and the self-evaluation of additional training needs about PU prevention independently determined knowledge levels. Another important notion is that the participants' self-evaluated PU prevention skills correlated with their measured knowledge levels. The self-evaluation of the participants could thus be used as one factor to assist in recognising those individuals who are in need of additional PU prevention training. Our results also strengthen the previous understanding [9,10] that besides educating nursing staff about PU prevention, it is important to support positive attitudes towards PU prevention as well. Influencing one's attitudes is a challenging task and also requires attention in the research field. Further effectiveness studies on interventions focusing on this area are needed.

As discussed, four factors (current position, frequency of taking care of patients with PUs, self-evaluated additional training needs and attitudes towards PU prevention) remained independent determinants of the participants' PU prevention knowledge. However, the R-square of the model was rather low (19.6%), which refers to a low explanation rate. PU prevention knowledge is a multidimensional concept, as is often the case with other similar phenomena, and thus rarely achieves high explanation rates. Still, the reason for this phenomenon might be the lack of relevant predictors. This is something that needs to be considered when interpreting the results. Another issue that should be considered is the clinical significance of the results, as statistical significance alone is not sufficient to improve and change clinical practices [30,31]. In this study, all those statistically significant determinants of nursing staff PU prevention knowledge could also be considered clinically significant. However, due to the following limitations our results should be interpreted with caution.

Limitations of the study

The study has some limitations. First, the response rate was low, as has been found in other electronic surveys compared to paper surveys [32], which may have caused selection bias. Related to the current occupation, this study included 4% ward managers, 47% registered nurses and 44% practical nurses. There is no precise information on the nursing staff who did not answer, as they also did not respond to the background variables. A drop out analysis would have been relevant, but it could not be performed with our data. Therefore, it is possible that the respondents may only partly represent the professional profile of nurses in the area, and thus, the results may not be generalisable to the entire population.

There are some reasons for the low response rate in this study. The data for this study were collected as part of a larger study that included three instruments (PU prevention knowledge, attitudes and practices). In addition, the electronic form did not allow participants to pause responding and continue later. Therefore, it is possible that response rate was low due to nurses' lack of time, low motivation or lack of support from the ward managers. Nurses are likely to have prioritised patient care before prioritising responding to the study. The initial response time was set at two weeks. In order to increase the response rate, nurses were given an additional two weeks to respond. The response rate could also have been improved by sending a link directly to all nurses. However, sending an email to 1975 nurses would have been expensive and time-consuming.

It should still be noted that the number of respondents to our study was high considering the average number of participants in quantitative studies studying PU competence. An average of 308 respondents (min. 26, max. 1806) has participated in competency studies in various countries since 2009 (e.g. [9,19,33,34]). Our study also involved two hospital districts with a central hospital. In Finland, hospital districts are similar in terms of care provision and the competence of nurses. Another strength of our study was that it represented both specialised and primary health care.

Secondly, the generalisability of the results may also be somewhat affected by the fact that the organisations involved in the study provide PU training to the nursing staff. However, the training was voluntary and not all of the nursing staff participated in it. Of those participating in the study, approximately 58% and 80% reported not participating in any PU training within or outside their organisation during the past two years, respectively.

In addition, the PUPK test used in this study was judged to be valid using item-to-total correlations and the Kuder–Richardson coefficient for the entire test. The instrument theoretically contains seven domains; however, only one of these entities may be considered in the future because of low coefficients of the sum variables. Thus, further testing is needed. The reporting of the study was supported by the STROBE guidelines to ensure that all relevant information was included.

Conclusions

In conclusion, this study shows that further attention needs to be paid to nursing staff knowledge about evidence-based PU prevention practices with a special focus on those nurses working in positions that require lower levels of education and those who rarely take care of patients with PUs. The self-evaluated training needs of the nursing staff can be utilised as criteria when recognising those individuals who are the most in need for additional training. The training should not only provide information, but also evidence-based interventions that are shown to be effective in supporting nurses' positive

attitudes towards PU prevention. The limitations of the study should be considered when generalising the results.

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CONFLICT OF INTEREST

The authors explicitly state that there are no conflicts of interest in connection with this article.

AUTHOR CONTRIBUTION

Elina Haavisto (EH), Marita Koivunen (MK) and Pauli Puukka (PP) designed the study. EH and MK conducted data collection and management. Heidi Parisod (HP), PP and EH led the analysis. HP, Arja Holopainen (AH) and EH led drafting of the report and drafted it in collaboration with the other authors. All authors read and approved the final report.

ETHICAL APPROVAL

Ethical approval was obtained from the Ethics Committee of Satakunta Higher Education Institution (20.12.2018).

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