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Pressure injury prevalence and incidence in acute inpatient care and related risk factors: A cross-sectional national study

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Abstract

The aim of this national cross-sectional study was to explore the prevalence of pressure injuries and incidence of hospital-acquired pressure injuries, and the relating factors in somatic-specialised inpatient care in Finland. The study was conducted in 16 (out of 21) Finnish health care organisations offering specialised health care services. Data were collected in 2018 and 2019 from adult patients (N = 5902) in inpatient, emergency follow-up, and rehabilitation units. Pressure injury prevalence (all stages/categories) was 12.7%, and the incidence of hospital-acquired pressure injuries was 10%. Of the participants, 2.6% had at least one pressure injury at admission. The risk of hospital-acquired pressure injuries was increased for medical patients with a higher age, the inability to move independently, mode of arrival, being underweight, and the absence of a skin assessment or pressure injury risk assessment at admission. For surgical patients, the risk was associated with the inability to move independently, mode of arrival, and lack of skin assessment at admission, while being overweight protected the patients. Overall, medical patients were in greater risk of hospital-acquired pressure injuries than the surgical patients.

An assessment of the pressure injury risk and skin status should be carried out more systematically in Finnish acute care hospitals.

KEYWORDS

cross-sectional study, incidence, logistic model, pressure ulcer, prevalence

Key Messages

- pressure injuries are frequent events that are mostly preventable. They increase both morbidity and mortality and hospital costs, while they reduce the quality of life of patients
- the aim of this national cross-sectional study was to explore the prevalence of pressure injuries and incidence of hospital-acquired pressure injuries, and the related factors in somatic-specialised inpatient care in Finland
- a higher age, inability to move independently, mode of arrival, being underweight, and the absence of a skin assessment or pressure injury risk assessment at admission increased the risk of hospital-acquired pressure injuries for medical patients. For surgical patients, the risk was associated with the inability to move independently, the mode of arrival, and the lack of a skin assessment at admission, while being overweight protected the patients

1 | INTRODUCTION

Pressure ulcers/injuries (PUs/PIs, hereafter called as pressure injuries, PIs) are frequent events, which are mostly preventable. The aetiology of PIs has been described as follows: 'A pressure injury is defined as localized damage to the skin and/or underlying tissue, as a result of pressure or pressure in combination with shear. Pressure injuries usually occur over a bony prominence but may also be related to a medical device or other object'.[1] PIs are injuries of the skin and subcutaneous tissue, which increase both morbidity and mortality.[1-3] PIs reduce the quality of life of patients and, in hospital settings, increase the length of stay (LOS).[4,5] Besides causing harm to the patients, PIs impose a significant financial burden on health care.[6-8] The costs of PIs vary from 1.4% to 4% of the health care costs.[1] The Finnish figures are assumed to be the same, thus corresponding with the monetary value of 295 to 844 M€ in the fiscal year 2018.[9] Treating PIs is even more expensive than PI prevention costs, which can importantly affect hospital budgets.[6] Therefore, to manage cost increases, it is important for hospitals to invest in quality improvement, prevention efforts for hospital-acquired pressure injuries (HAPIs), and the early detection of PIs.[7,8]

The prevalence rate in different countries worldwide varies between 6% and 18.5% in acute care settings.[10] A systematic review[11] of European studies showed PI rates that varied from 4.6% to 27.2% depending on the country, while a systematic review and meta-analysis of African studies showed a point prevalence that varied between 3.4% and 18.6%.[12] Large studies from different countries have found the following prevalence rates: in United States and Canada 9.2%,[13] in Australia 8.7%,[14] in Italy 17%,[15] and in Portugal 5.76%.[16]

When we examine research on PIs in other Nordic countries than Finland, studies show PI prevalence rate to vary from 2% to 18.2%.[17-21] Only two studies[17,19] have reported rates of HAPIs, which vary between 7.6% and 15%. In previous studies in Finland, the PI rate varied from 4.6% to 12.9%[22-24] in acute care settings. However, there are no large PI prevalence study results from Finland.

Older age and comorbidities increase the PI risk.[1] Latimer et al[25] studied over 65-year-old patients with limited mobility and found that every year of age added to the risk of getting PI in 36 hours after hospitalisation. Older age has found to be a PI risk factor also in many other studies.[14,16,17,26-29] Additionally, some studies have shown that the PI risk is greater for men[5,15,16,27] but there are conflicting research findings,[26] as well as studies in which no connection between gender and the PI risk have been found.[17]

Furthermore, being underweight (BMI < 16 kg/m^2) appears to be a PI risk factor.[15] In a previous study,[30] a BMI either less than 18.5 or over 40 was significantly associated with PI prevalence, as was malnutrition. Additionally, a U-shaped relationship between BMI and HAPI has been found, where the likelihood of having superficial or severe PI was highest for patients with a low or high BMI. However, the U-shaped relationship does not increase before the BMI is over 50.[5] Some studies have shown only low BMIs to be a significant risk for PI.[26,28] Additionally, recent studies have identified comorbidities

in patients with a PI. More often found comorbidity was diabetes[15,16,25,26,28,31] and cardiovascular disease or congestive heart failure.[16,25]

In summary, in hospital settings, patients suffer from different diseases, undergo varied treatments, and have varying abilities to function, and these elements expose them to risks of PIs. To prevent HAPIs, practices must include a PI risk assessment and inspection of the skin status as well.[1]

There is no reliable information about the PI prevalence and HAPI incidence in Finnish hospitals because there is no systematic follow-up in use. Earlier studies have been conducted in individual organisations. This study fills the information gap in Finland.

1.1 | Aim

The aim of this national cross-sectional study was to explore the prevalence of pressure injuries (PIs) and incidence of hospital-acquired pressure injuries (HAPIs), and the related factors in somatic-specialised inpatient care in Finland. The objectives were to draw an overall picture of the PI and HAPI situation in Finnish specialised inpatient care, and to model risk factors relating to HAPIs.

The research questions were as follows:

- What is the PI prevalence in somatic inpatient units in specialised health care?
- What is the PI incidence in somatic inpatient units in specialised health care?
- What factors relate to the HAPI incidence in somatic inpatient units in specialised health care?

2 | MATERIALS AND METHODS

This study followed a multicentred, repeated cross-sectional observational study design. The study was conducted in 16 (out of 21) Finnish health care organisations offering specialised health care services. The study organisations are presented in Table 1 (situation at the end of 2019).

On 15 November 2018 and on 21 November 2019, on the annual International Prevent Pressure Ulcer Day, all adults from somatic inpatient units, emergency follow-up units, and rehabilitation units were recruited to participate in the study. The eligible sample included the total number of patients (N = 11 252) in the above-mentioned units (N = 534) on the data collection days. No exclusion

TABLE 1 Description of study organisations

The study organisations, year 2019	Data describing study organisations as a whole in 2019				Beds in study units (prevalence day 2019)
	LOS (mean)	Nursing staff, all	Nurses (RNs)	Beds	
Helsinki University Hospital	4.0	14 310	12 387	2805	1401
Kuopio University Hospital	3.2	2962	1702	556	405
Oulu University Hospital	3.6	4157	2961	829	479
Tampere University Hospital	3.8	4116	2354	1226	687
Turku University Hospital	3.2	4248	2987	981	596
Central Finland Central Hospital	2.4	2209	1908	405	199
East Savo Hospital District	2.9	325	236	97	81
Hospital District of South Ostrobothnia	3.4	1802	1025	365	195
Joint Authority for Päijät-Häme Health and Social Care	3.7	1775	1363	413	259
Joint municipal authority for North Karelia social and health services	4.3	1874	1236	865	224
Lapland Central Hospital	3.0	1359	1034	276	164
Satakunta Hospital District	2.7	1886	1283	381	266
Social and Health Services in Kymenlaakso	3.4	1453	1252	418	113
South Karelia Social and Health Care District	4.1	3335	1244	215	197
Vaasa Central Hospital	3.3	1443	778	320	194
Total	-	48 273	33 750	10 152	5460

Abbreviations: LOS, length of stay, in somatic care; RN, registered nurse.

criteria were set for the enrolment. The enrolment covered 55% of the eligible participants (n = 6160 participants who gave their informed consent).

Two kinds of patient data were collected. (a) The observational data included an assessment of the skin of each registered inpatient who gave consent to participate in the study. The outcome of the assessment was documented on a data collection form, as were the categories and locations of the observed PIs and information on whether the participant had the PI upon admission or not, and whether the PI was medical device-related or not. (b) Participant background information was retrieved from the electronic patient record (height, weight, age [in years], gender, smoking [or use of other tobacco products], mobility, mode of arrival to hospital [eg, emergency], primary diagnosis [or reason for admission], surgical procedure [surgical patients], and potential malnutrition risk). Additionally, information about PI risk assessment and outcome and the assessment of skin conditions at admission were gathered. In addition to the patient-related data, background information for the study units was collected, including the number of beds and number of inpatients on the data collection days, for example.

The potential PIs were categorised by using the quick guide for PI staging by the Finnish Wound Care Society, which follows the guidelines of the international NPUAP/EPUAP pressure ulcer classification system.[1] Each study organisation had their own study coordinator responsible for the data collection. In all study organisations, the same information material and data collection manual were used. Depending on the study organisation, the data were collected by designated nurses or by nurses participating in the patients' bed-side care. No competency testing was conducted.

After the data collection, the information was entered into a data matrix by the organisational study coordinator. The participants' personal identity codes were replaced with artificial codes. Additionally, the information of the participant's actual unit of care was replaced by a unit type classification developed by the consortium for the national benchmarking of nursing-sensitive outcomes. Next, the data matrices were saved in a protected software program designed and administered by one of the study organisations for sharing data sensitive documents. The use of the software requires user identification.

All data were cleaned and entered in IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp: Armonk, New York) for analysis. Figure 1 shows the construction of the research data. Before the analysis, further data cleansing

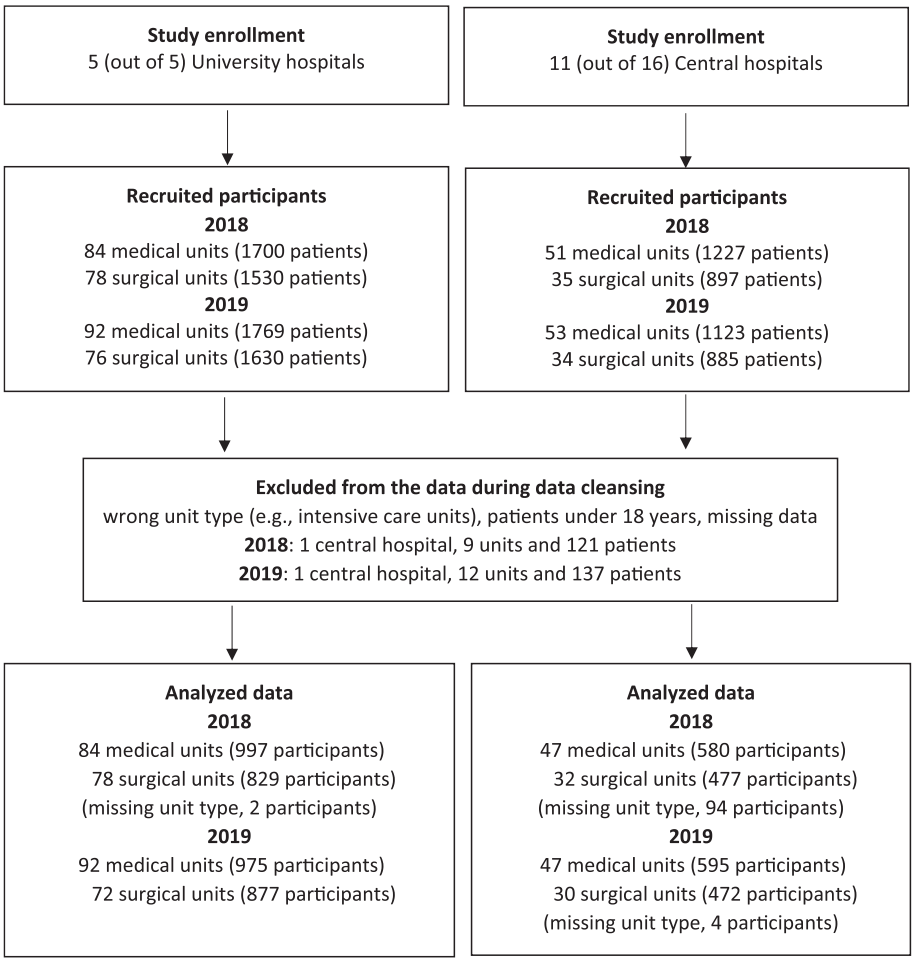

FIGURE 1 Research data and data cleansing

was performed. Data on participants from wrong unit types (mother-child [n = 7], intensive care [n = 19], day surgery [n = 39], psychiatry [n = 1], operating department [n = 1]), participants under 18 years (n = 11), and missing data (one hospital) were excluded.

The research data covered 15 hospitals, 503 units, and 5902 participants. The 503 units were classified into 19 different unit type categories. For the analysis, the data were divided further into two groups: surgical patients (including patients in women's units) and medical patients (including rehabilitation patients). There were 280 medical units, of which the most common were as follows: general medical units n = 105 (37.5%), neurology n = 39 (13.9%), cardiology n = 33 (11.8%), and oncology/haematology n = 32 (11.4%). Of the 223 surgical units, the most common types were gastroenterology/urology n = 53 (23.8%), orthopaedic n = 44 (19.7%), general surgery n = 32 (14.4%), and thoracic and vascular surgery n = 19 (8.5%).

A total of 5902 patients were included in the study (range by organisation n = 62 [1.1%]-n = 1387 [23.5%]). Of the participants, 3020 (51.3%) were men, and the mean age was 65.5 years (SD 16.5). About half (54.2%, 3147/5802) of the participants were treated in the medical units, and half of the participants were admitted to the hospital for emergency care. The most common primary diagnoses were circulatory system-related (n = 872, 14.8%), neoplasms (n = 805, 13.6%) and injury, poisoning, and certain other consequences of external causes or accidents (n = 591, 10.0%). When exploring the background variables by medical and surgical patients, significant differences were found in relation to age group, mobility, and mode of arrival, for example. In medical patients, a bigger portion was in the age group over 80 years (724/3115, 23.3%) than in surgical patients (365/2611, 14.0%). Medical patients used more wheelchair or were bedridden (527/3130, 16.8%) than the surgical patients (364/2643, 13.8%). Further, of the medical patients, 15.1% (470/3109) were admitted to hospital as elective cases, while the corresponding portion in surgical patients was 48.3% (1276/2644). Table 2 shows the participants' demographic data.

The PI prevalence or HAPI incidence was calculated for all PI/HAPI categories and just for categories II to IV ([number of patients with a PI or a HAPI per assessed (ie, all) patients of study] * 100). HAPI is defined as PI recorded during the hospital stay. If a nurse had recorded that the PI had occurred before admission, but the patient's skin condition had not been assessed at admission, PI was classified as HAPI. For patients with more than one PI or HAPI, the most severe category was used for the analysis.

Descriptive statistics such as frequencies and percentages were used to analyse the participants' demographic data. Cross-tabulation and a Pearson's chi ($\chi 2$) test and Fisher's exact test were used to analyse univariate associations between variables and HAPIs (including all categories). For the analysis, the risk scores of the Braden scale were classified into three categories: ≤12; high risk, 13 to 14; moderate risk; and ≥15; low risk.

A logistic regression was performed to examine the differences between the variables. In the analysis, only variables that were statistically significant in the $\chi 2$ analysis ($P < .05$) were used. For a logistic regression analysis, the data were split for medical and surgical patients. HAPI was a dependent variable including all categories (yes/no). First, the univariate logistic regression for each variable was analysed, and the variables that showed statistical significance were included in further analysis. A multivariable logistic regression model was performed by counting the HAPIs as the dependent variable and mobility, mode of arrival, BMI, evaluation of PI risk at admission, and age as independent variables. The goodness of fit test for the model was >0.05 according to the Hosmer-Lemeshow test in both models. The results were shown as odds ratio (OR) with 95% confidence intervals (CIs).

According to national legislation, in a multicentred research project, only one statement by a research ethics board is needed, and this was obtained from the primary investigator's organisation (HUS/1921/2018; 6.7.2018). After this, permission to conduct the study was given by each study organisation. Participation in the study was voluntary, and written informed consent was obtained from each participant. In case of situations such as acute confusion, written informed consent was asked from the patient's closest relative (or significant other or legal representative). The participants had the right to interrupt their participation at any point and the right to withdraw their consent to participate.[32]

3 | RESULTS

The PI prevalence was 12.7% (747/5902) including all categories and 4.4% (591/5902) including categories II to IV. The overall incidence of HAPI (all categories) was 10.0% (n = 591/5902), and 3.0% (n = 117/5902) including categories II to IV. Of the participants, 2.6% (n = 156/5902) had at least one PI at admission. There was no statistical significance between university and central hospitals for PI prevalence, HAPI incidence, or PIs at admission. PI prevalence and HAPI incidence in university and central hospitals are presented in Table 3.

The PI prevalence (all categories) varied from organisation to organisation from 6.5% (60/1387) to 24.9% (223/897) [X^2, $P < .001$]. HAPI incidence (all categories) varied by organisation from 4.3% (59/1387) to 22.1%

TABLE 2 The background characteristics of all participants with and without HAPI

Variables	All participants n (%)	Without HAPI n (%)	With HAPI, all categories n (%)	*P*-value
Type of hospital				
University hospital	3684 (62.4)	3309 (62.3)	375 (63.5)	.59[a]
Central hospital	2218 (37.6)	2002 (37.7)	216 (36.5)	
Total	5902 (100.0)	5311 (100.0)	591 (100.0)	
Specialty of units				
Surgical units	2655 (45.8)	2455 (47.0)	200 (34.3)	<.01[a]
Medical units	3147 (54.2)	2764 (53.0)	383 (65.7)	
Total	5802 (100.0)	5219 (100.0)	583 (100.0)	
Gender				
Male	3020 (51.3)	2707 (51.1)	313 (53.2)	.33[a]
Female	2866 (48.7)	2591 (48.9)	275 (46.8)	
Total	5886 (100.0)	5298 (100.0)	588 (100.0)	
Age, years				
<40	554 (9.5)	528 (10.1)	26 (4.4)	<.01[b]
40-65	1882 (32.3)	1736 (33.1)	146 (25.0)	
66-80	2258 (38.8)	2011 (38.4)	247 (42.2)	
>80	1128 (19.4)	962 (18.4)	166 (28.4)	
Total	5822 (100.0)	5237 (100.0)	585 (100.0)	
BMI (body mass index)				
Underweight <18.50	194 (3.5)	154 (3.1)	40 (7.1)	<.01[b]
Normal 18.50-24.99	1930 (34.4)	1710 (33.9)	220 (39.1)	
Overweight 25.00-34.99	2923 (52.2)	2673 (53.0)	250 (44.5)	
Obese >35.00	556 (9.9)	504 (10.0)	52 (9.3)	
Total	5603 (100.0)	5041 (100.0)	562 (100.0)	
Smoking				
Yes	966 (16.5)	875 (16.6)	91 (15.6)	.41[a]
No	4504 (77.0)	4037 (76.7)	467 (80.0)	
Total	5470 (100.0)	4912 (100.0)	558 (100.0)	

Note: Chi-square or Fisher's exact tests were calculated between HAPI yes/no and variables.
[a]Fisher's exact test.
[b]Chi-square tests (χ^2).

(198/897) [X^2, $P < .001$]. The prevalence of PIs at admission varied from 1.0% (2/201) to 9.7% (6/62) [X^2, $P = .001$]. Statistical significance was found between medical and surgical units in PI prevalence (all categories) as well as in HAPI incidence (all categories) so that the rates in the medical units were higher (Fisher's exact test, $P < .001$). When exploring separately medical and surgical patients in university and central hospital, there were statistically significant differences between the groups so that medical patients had a higher PI prevalence (all categories) and HAPI incidence (all categories) rate (Fisher exact test, $P < .001$). No statistical significance was found concerning the PI at admission. PI prevalence and HAPI incidence by medical and surgical units are presented in Table 3.

The HAPI rate was highest among participants over 80 years of age (14.7%, 166/1128), bedridden participants (25.2%, 129/511), and underweight participants (20.6%, 40/194). Tables 2, 4, and 5 describe the background characteristics of all participants with and without HAPI. HAPI incidence (all categories) was most common in the following primary diagnoses: Certain infectious and parasitic diseases (A00) 17.6% (60/340), diseases of the genitourinary system (N00) 13.7% (38/278), diseases of the

TABLE 3 Prevalence and incidence of pressure injuries in University and Central hospitals, medical, surgical, and all participants

	PI prevalence (all categories) % (n)	PI prevalence (II-IV category) % (n)	HAPI (all categories) % (n)	HAPI (II-IV category) % (n)	PIs at admission % (n)
All hospitals	12.7 (747/5902)	4.4 (260/5902)	10.0 (591/5902)	3 (177/5902)	2.6 (156/5902)
Medical	15.0 (472/3147)	5.3 (168/3147)	12.2 (383/3147)	3.7 (117/3147)	2.8 (89/3147)
Surgical	10.0 (266/2655)	3.2 (86/2655)	7.5 (200/2655)	2.1 (55/2655)	2.5 (66/2655)
University hospitals	12.9 (474/3678)	4.2 (154/3678)	10.2 (375/3678)	2.9 (106/3678)	2.7 (99/3678)
Medical	15.2 (300/1972)	5.0 (99/1972)	12.3 (242/1972)	3.6 (71/1972)	2.9 (58/1972)
Surgical	10.2 (174/1706)	3.2 (55/1706)	7.8 (133/1706)	2.1 (35/1706)	2.4 (41/1706)
Central hospitals	12.4 (264/2124)	4.7 (100/2124)	9.8 (208/2124)	3.1 (66/2124)	2.6 (56/2124)
Medical	14.6 (172/1175)	5.9 (69/1175)	12.0 (141/1175)	3.9 (46/1175)	2.6 (31/1175)
Surgical	9.7 (92/949)	3.3 (31/949)	7.1 (67/949)	2.1 (20/949)	2.6 (25/949)

Abbreviations: HAPI, hospital-acquired pressure injury; PI, pressure injury.

respiratory system (J00) 13.3% (55/415), and diseases of the circulatory system (I00) 11.5% (100/872).

Table 6 describes the results of the univariate logistic regression analysis by each variable. All variables except gender and type of hospital ($P > .05$) were included in the models. In addition, the type of surgical procedure was associated with HAPIs in univariate analysis in surgical patients (surgical operation OR 4.23 [CI 95%, 1.03-17.36; $P = .045$], investigative procedure OR 7.24 [CI 95%, 1.26-41.52; $P = .026$]) and medical patients (investigative procedure OR 2.71 [CI 95%, 1.17-6.25; $P = .020$]) but did not fit the models.

Malnutrition risk was not significant in the models, although the variable was statistically significant in a univariate logistic regression; surgical patients had an OR of 6.66 (CI 95%, 1.76-25.22; $P < .005$) and medical patients had an OR of 3.14 (CI 95%, 1.70-5.82; $P < .005$). For medical patients in the multivariable logistic regression model, the risk of HAPI was increased by a higher age, the inability to move independently, mode of arrival, being underweight, and the absence of a skin assessment or PI risk assessment at admission. For surgical patients in the multivariable logistic regression model, the HAPI risk was associated with the inability to move independently, mode of arrival, and lack of skin assessment at admission, while being overweight protected from HAPIs. Table 7 describes the results for both models.

4 | DISCUSSION

In this national study, we explored the prevalence of Pls and the incidence of HAPIs, and the related factors in somatic-specialised inpatient care in Finland. The total prevalence of PIs (all categories) was found to be 12.7% and 4.4% for category II and above. The total PI prevalence varied between the study organisations from 6.5% to 24.9%. Correspondingly, the HAPI incidence in this study was 10% (all categories) and 3% for categories II to IV, and it varied from 4.3% to 22.1% by the study organisations. The results do not substantially differ from previous Finnish,[22-24] Nordic,[17-21] European,[11,15,16] or global[12-14] results. The small differences may be explained by the fact that even within the Nordic countries, the health care systems are not similar. Globally, state governance over health care services differs from country to country. For example, in Finland, there are no financial incentive programmes to reduce hospital-acquired conditions such as PIs as the US has.[33] Further, there are no state-wide PI prevention and management strategies as in Australia.[14] Additionally, in Finland, there is no national quality register including indicators such as PI prevalence and HAPI incidence. Thus, care protocols addressing PI prevention, for example, may be missing or may be randomly used in Finnish health care organisations and, consequently, systematic follow-up of indicators describing PI prevalence and HAPI incidence vary between the organisations.

Recently, the consortium for the national benchmarking of nursing-sensitive outcomes has started to collect monthly PI prevalence. Currently, nine organisations and approximately 250 units are participating in PI data collection and benchmarking. The interest in benchmarking is strongly based on Magnet Hospital concept, which focuses on continuous follow-up of nursing-sensitive outcomes. A study by Ma and Park[34] found that units in Magnet hospitals had 21% lower odds of having HAPI than units in non-Magnet hospitals. In a

TABLE 4 The variables of care process of all participants with and without hospital-acquired pressure injury (HAPI)

Variables	All participants n (%)	Without HAPI n (%)	With HAPI, all categories n (%)	*P*-value
Mode of arrival				
Emergency care	2901 (49.6)	2595 (49.2)	306 (52.5)	<.01[a]
Elective	1765 (30.2)	1671 (31.7)	94 (16.1)	
Other	1187 (20.3)	1004 (19.1)	183 (31.4)	
Total	5853 (100.0)	5270 (100.0)	583 (100.0)	
The primary diagnoses (ICD-10)				
Diseases of the circulatory system (I00)	872 (15.7)	772 (15.5)	100 (17.8)	<.01[a]
Malignant neoplasms (C00)	805 (14.5)	733 (14.7)	72 (12.8)	
Diseases of the nervous system (G00)	229 (4.1)	218 (4.4)	11 (2.0)	
Certain infectious and parasitic diseases (A00)	340 (6.1)	280 (5.6)	60 (10.7)	
Symptoms and abnormal clinical and laboratory findings (R00)	533 (9.6)	476 (9.6)	57 (10.2)	
Injury, poisoning, and certain other consequences of external causes (S00)	591 (10.7)	534 (10.7)	57 (10.2)	
Diseases of the respiratory system (J00)	415 (7.5)	360 (7.2)	55 (9.8)	
Diseases of the digestive system (K00)	525 (9.5)	480 (9.6)	45 (8.0)	
Diseases of the musculoskeletal system and connective tissue (M00)	535 (9.6)	496 (10.0)	39 (7.0)	
Diseases of the genitourinary system (N00)	278 (5.0)	240 (4.8)	38 (6.8)	
Diseases of the skin and subcutaneous tissue (L00)	89 (1.6)	79 (1.6)	10 (1.8)	
Endocrine, nutritional, and metabolic diseases (E00)	86 (1.6)	81 (1.6)	5 (0.9)	
External causes of morbidity and mortality (V01)	71 (1.3)	66 (1.3)	5 (0.9)	
Mental and behavioural disorders (F00)	42 (0.8)	38 (0.8)	4 (0.7)	
Diseases of the ear and the eye (H60)	67 (1.2)	64 (1.3)	3 (0.5)	
Pregnancy, childbirth, and the puerperium (O00)	67 (1.2)	67 (1.3)	0 (0.0)	
Total	5545 (100.0)	4984 (100.0)	561 (100.0)	
Surgical procedure during hospitalisation				
Yes	2124 (36.0)	1955 (36.8)	169 (28.6)	<.01[b]
No	3778 (64.0)	3356 (63.2)	422 (71.4)	
Total	5902 (100.0)	5311 (100.0)	591 (100.0)	
Risk of malnutrition				
No	626 (63.6)	606 (65.5)	20 (33.9)	<.01[b]
Yes	358 (36.4)	319 (34.5)	39 (66.1)	
Total	984 (100.0)	925 (100.0)	59 (100.0)	

Note: Chi-square or Fisher's exact tests were calculated between HAPI yes/no and variables. ICD-10; International Statistical Classification of Diseases and Related Health Problems.

[a]Chi-square tests (χ^2).

[b]Fisher's exact test.

further analysis, they found that the significant effect was because of the unit's work environment rather than the Magnet status alone.[34]

Of the participants, 2.6% (n = 156) had at least one PI at admission, and most (45.5%) of them were admitted to hospital as emergency cases. Further, admission through emergency care was associated with a higher risk of HAPIs for medical patients. Additionally, other modes of arrival, for example, a transfer from another health care facility, increased the odds of HAPIs 2-fold both in surgical and medical patients (Table 7). In a previous study by Gardiner et al,[35] transfer from another health care facility

TABLE 5 Mobility and nursing assessments of all participants with and without hospital-acquired pressure injury (HAPI)

Variables	All participants n (%)	Without HAPI n (%)	With HAPI, all categories n (%)	*P*-value
Mobility				
Independent	3832 (65.2)	3584 (67.8)	248 (42.1)	<.01[a]
Need of assistance to move	1136 (19.3)	987 (18.7)	149 (25.3)	
Wheelchair	394 (6.7)	331 (6.3)	63 (10.7)	
Bedridden	511 (8.7)	382 (7.2)	129 (21.9)	
Total	5873 (100.0)	5284 (100.0)	589 (100.0)	
PI risk assessment < 8 hours after admission				
Yes	1121 (19.0)	1070 (20.1)	51 (8.6)	<.01[b]
No	4781 (81.0)	4241 (79.9)	540 (91.4)	
Total	5902 (100.0)	5311 (100.0)	591 (100.0)	
Assessment of skin status < 8 hours after admission				
No	4156 (70.4)	3626 (68.3)	530 (89.7)	<.01[b]
Yes	1746 (29.6)	1685 (31.7)	61 (10.3)	
Total	5902 (100.0)	5311 (100.0)	591 (100.0)	
PI risk at admission				
High risk	67 (7.3)	62 (7.1)	5 (11.4)	.10[a]
Medium risk	181 (19.7)	168 (19.2)	13 (29.5)	
Low risk	671 (73.0)	645 (73.7)	26 (59.1)	
Total	919 (100.0)	875 (100.0)	44 (100.0)	

Note: Chi-square or Fisher's exact tests were calculated between HAPI yes/no and variables.
[a]Chi-square tests (χ^2).
[b]Fisher's exact test.

increased the risk of HAPIs 3-fold compared with admission as an emergency case or admission from home.

Our study showed that mobility was related to Pls for both medical and surgical patients. For bedridden medical patients, the odds of HAPIs were over 5-fold, and for surgical patients, wheelchair increased the odds 4-fold. Earlier research supports the findings.[1,36] Being underweight was a risk factor for medical patients suffering from HAPIs, while being overweight protected surgical patients. These findings are supported by earlier studies where BMI < 19 increased the odds of having HAPI nearly 3-fold,[35] and likelihood of having a PI was highest for low and high BMIs.[5] In the study by Kayser et al, BMIs of 45 and 40 minimised the probability of having a PI.[5] In the current study, there were only 52 participants with BMI more than 35, and the highest BMI value was 74. The factors explaining the protective nature of obesity are unclear.[1]

Older age was additionally a risk factor for medical patients, which can be related to ageing-associated diseases, such as type 2 diabetes and cardiovascular diseases, and patients being less mobile and fragile because of ageing.[37] In an earlier study, for over 65-year-old patients with limited mobility, every year of age added to the risk of getting PI in 36 hours after hospitalisation.[25] In the current study, the timeframe of PI development was not studied. Yet, HAPI risk increased by older age groups both in medical and surgical patients (Table 6), but in multivariate logistic regression models, age was a significant factor only for medical patients (Table 7).

In an earlier study, older patients with multiple comorbidities and admitted for a surgical diagnosis-related groups (DRGs) were at greater risk of a HAPI.[35] In this study, 28.6% (169/591) of the participants with a HAPI had had a surgical procedure. For surgical patients, a surgical procedure increased the odds of having HAPIs 4-fold. However, in multivariate logistic regression models, either for medical or surgical patients, surgical procedure was not a significant variable. Overall, in these data, medical patients were in greater risk of HAPI than the surgical patients, which differs from results by Gardiner et al, for example.[35] This may be explained by the differences between medical and surgical patients in relation to age, mobility, and mode of arrival, for example. Gender was not a significant PI risk factor in this study.

TABLE 6 Characteristics of inpatients in medical and surgical units

Unadjusted Variables	Medical		Surgical	
	P-value	OR [95%CI]	*P*-value	OR [95%CI]
BMI (body mass index)	(n = 2971)		(n = 2550)	
Normal 18.50-24.99 (reference)				
Underweight <18.50	<.001	2.22 [1.39-3.55]	.107	1.72 [0.89-3.32]
Overweight 25.00-34.99	.101	0.82 [0.64-1.04]	.006	0.64 [0.47-0.88]
Obese >35.00	.832	1.04 [0.71-1.54]	.025	0.51 [0.28-0.92]
Age, years	(n = 3115)		(n = 2655)	
<40 (reference)				
40-65	.039	1.93 [1.03-3.60]	.183	1.50 [0.83-2.71]
66-80	<.001	2.75 [1.50-5.03]	.017	2.03 [1.14-3.64]
>80	<.001	3.89 [2.11-7.17]	.004	2.55 [1.36-4.80]
Gender	(n = 3140)		(n = 2651)	
Male (Female = reference)	.933	0.99 [0.80-1.23]	.103	1.27 [0.95-1.70]
Mobility	(n = 3130)		(n = 2643)	
Independent (reference)				
Need of assistance to move	<.001	2.43 [1.86-3.19]	<.001	2.00 [1.39-2.88]
Wheelchair	<.001	2.03 [1.40-2.94]	<.001	4.61 [2.76-7.70]
Bedridden	<.001	5.46 [4.01-7.42]	<.001	4.24 [2.87-6.29]
Mode of arrival	(n = 3118)		(n = 2536)	
Elective (reference)				
Emergency care	<.001	2.59 [1.68-4.00]	.006	1.58 [1.14-2.18]
Other	<.001	3.40 [2.17-5.33]	<.001	3.37 [2.22-5.11]
Type of surgical procedure	(n = 632)		(n = 1824)	
Other procedure (reference)				
Surgical operation	.643	1.20 [0.55-2.61]	.045	4.23 [1.03-17.36]
Minor surgical procedure	.139	2.02 [0.80-5.15]	.241	2.71 [0.51-14.27]
Investigative procedure	.020	2.71 [1.17-6.25]	.026	7.24 [1.26-41.52]
Assessment of skin status < 8 hours after admission	(n = 3147)		(n = 2655)	
No (Yes = reference)	<.001	5.40 [3.69-7.90]	<.001	2.70 [1.82-4.02]
PI risk assessment < 8 hours after admission	(n = 3147)		(n = 2655)	
No (Yes = reference)	<.001	2.97 [2.08-4.23]	<.001	3.20 [1.77-5.78]
Assessment of PI risk/skin status < 8 hours after admission	(n = 3147)		(n = 2655)	
Assessed both (reference)				
Assessed another	<.001	4.61 [2.30-9.23]	<.001	2.57 [1.11-5.951]
Neither assessed	<.001	9.47 [5.01-17.90]	<.001	5.05 [2.35-10.86]
PI risk at admission	(n = 605)		(n = 314)	
Low risk (reference)				
Medium risk	.028	2.38 [1.10-5.16]	.969	0.97 [0.20-4.78]
High risk	.040	2.96 [1.05-8.38]	.998	
Risk for malnutrition	(n = 695)		(n = 289)	
Yes (No = reference)	<.001	3.14 [1.70-5.82]	.005	6.66 [1.76-25.22]

Note: Binary logistic regression (unadjusted) likelihood of having a HAPI relative to not having a HAPI.
Abbreviations: CI, confidence interval; HAPI, hospital-acquired pressure injury; OR, odds ratio.

TABLE 7 Multivariable logistic regression likelihood of having a HAPI relative to not having a HAPI, models for medical and surgical participants

Adjusted Variable	Medical (n = 2913)		Surgical (n = 2536)	
	P-value	OR [95%CI]	*P*-value	OR [95%CI]
Mobility				
Independent (reference)				
Need assistance to move	<.001	2.22 [1.65-2.97]	<.001	2.10 [1.45-3.06]
Wheelchair	<.001	2.45 [1.62-3.71]	<.001	4.52 [2.61-7.81]
Bedridden	<.001	5.62 [3.94-8.03]	<.001	3.64 [2.36-5.61]
Mode of arrival				
Elective (reference)				
Emergency care	.004	1.97 [1.25-3.11]	.194	1.25 [0.89-1.77]
Other	<.001	2.52 [1.57-4.05]	<.001	2.56 [1.64-4.00]
BMI (body mass index)				
Normal 18.5-24.99 (reference)				
Underweight <18.49	<.001	2.83 [1.68-4.76]	.345	1.42 [0.69-2.91]
Overweight 25-34.99	.095	0.80 [0.62-1.04]	.035	0.70 [0.51-0.98]
Obese >35	.982	1.00 [0.66-1.53]	.020	0.49 [0.27-0.89]
Assessment of PI risk/skin status < 8 hours after admission				
Assessed both (reference)				
Assessed only skin status 8 < hours after admission	.002	4.11 [1.69-10.00]	.038	2.52 [1.05-6.02]
Assessed only PI risk status 8 < hours after admission	<.001	16.10 [6.65-39.01]	.070	3.02 [0.91-9.97]
Neither assessed	<.001	15.37 [7.12-33.21]	<.001	5.66 [2.61-12.28]
Age, years				
<40 (reference)				
40-65	.055	1.90 [0.99-3.64]		
66-80	<.001	2.28 [1.21-4.28]		
>80	<.001	3.03 [1.59-5.78]		

Note: Hosmer and Lemeshow test: medical $P = .195$ and surgical $P = .558$.
Abbreviations: CI, confidence interval; HAPI, hospital-acquired pressure injury; OR, odds ratio.

Previously gender has been either identified or not as a PI risk factor.[5,15-17,26,30]

The results of the current study suggest that both a PI risk assessment and skin status assessment are important for HAPI prevention. If neither assessment is done, the odds of having HAPIs increases especially for medical patients, whose odds of having HAPIs were 15-fold greater. For surgical patients, the corresponding odds were 6-fold greater. The risk of Pls for medical patients was also significant if only a PI risk assessment was done. Based on the results, both the PI risk assessment and assessment of skin status within 8 hours after admission are of high importance in PI prevention.

It has been argued that the results from individual PI risk factor studies have been over-interpreted. Instead, behind PI development, a complex interaction of several factors can be found, of which three primary risk factors can be identified: mobility/activity, perfusion (including diabetes), and skin/PI status.[36] In this study, multivariate logistic regression models were created for medical and surgical patients. The findings suggest that special attention in the prevention and care of HAPIs should be focused on medical patients who are of an older age, who cannot move independently, who are underweight, and whose mode of arrival is other than elective. They are in danger of acquiring a PI during their acute hospital stay. Concerning surgical patients, special attention should be paid to those who cannot move independently and whose mode or arrival is other than emergency or elective (eg, transfer from other facility). For these patient groups, it is important to carry out both a PI risk assessment and a skin status assessment within 8 hours of hospitalisation

for the early identification of PI risks. These factors were particularly related to the HAPI incidence in this study.

Based on the results, it is recommended that the measurements related to PI prevention (assessment of PI risk, malnutrition, and skin status) should be taken more systematically in Finnish acute care hospitals. Further, systematic documentation of risk assessments and PIs and their categories should be implemented for continuous quality follow-up and reporting. Naturally, quality PI prevention and management is not just follow-up and reporting but includes several evidence-based interventions, which were not in focus in this article.

There are some limitations to this study. First, the study was conducted only in one country, so the results need to be generalised cautiously in a global context. Second, not all the information about the patients or their care processes was available in this study. Just the primary diagnoses were retrieved from the electronic patient records. Secondary diagnoses, such as type 2 diabetes, increase the PI risk, and the lack of this information may have affected the multivariate logistic regression models. Additionally, information about the possible care in intensive care units was not registered, although it obviously has an effect on the development of PIs. Because of the data collection on one prevalence day, the length of hospital stay was not recorded retrospectively. In addition, the risk of malnutrition was documented and available only for 17% of the participants, which had an effect on the analysis carried out. Further, the coverage of PI risk assessment at admission was 19%, and assessment of skin status 30%, respectively. Thus, the findings of this study concerning related factors to PIs are limited. Third, the HAPI definition of this study was tight: 'If a nurse had recorded that the PI had occurred before admission, but the patient's skin had not been assessed at admission, a PI was classified as a HAPI.' This may have affected the registered number of HAPIs. Finally, the data collection was carried out by several individuals. Even though a data collection manual was used together with unified instructions to categorise potential PIs, for example, there may have been misinterpretation, which may have affected the reliability of the data. Although some limitations were noticed, the main strength of this study is the large amount of nationally collected observational data from 15 acute care hospitals, which gives a good and reliable overview of the PI situation in Finland.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

All authors have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data, and been involved in drafting the manuscript or revising it critically for important intellectual content. All authors have given final approval of the version to be published and agreed to be accountable for all aspects of the work.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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