Prevalence of pressure ulcer and associated risk factors in middle and older age medical inpatients in Norway

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TITLE

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Contributions

Tove Elisabet Børsting and Christine Tvedt share the first authorship.
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ABSTRACT

Aims and objectives. The objectives of this study are to describe the prevalence of pressure ulcers among middle and older aged patients in a general medical hospital in Norway and to describe the associations between pressure ulcers and potential risk factors additional to the Braden risk score.

Background. Degrees of mobility, activity, perfusion and skin status are risk factors for development of pressure ulcer. Nurses' clinical judgements combined with risk assessments tools are effective to detect pressure ulcer risk.

Design. Cross-sectional study

Methods. The study was performed as part of a research project conducted between September 2012 and May 2014 in a general hospital in the capital of Norway. Registered nurses and nursing students collected data from all eligible patients on 10 days during the students' clinical practice studies. The Braden Scale was used to measure pressure ulcer risk, and skin examinations were performed to classify the skin area as normal or as indicative of pressure ulcer according to the definitions by the National Pressure Ulcer Advisory Panel. Comorbidities were collected by patient's self-report. This analysis focused on the 255 inpatients at the medical wards ≥ 52 years of age, most of whom had more than one comorbidity.

Results. The prevalence of pressure ulcers was 14.9% in this sample. Higher age, underweight, diabetes and worse Braden scores were factors associated with pressure ulcer, and pressure ulcer was most frequently sited at the sacrum or heel.

Conclusion. Adding age, weight, and diabetes status to pressure ulcer risk assessment scales may improve identification of patients at risk for pressure ulcers.

Relevance to clinical practice

- Knowledge about strengths and limitations of risk assessment tools is important for clinical practice
- Age, weight and diabetes status should be considered for inclusion in risk assessment tools for pressure ulcers in medical wards

Key words. Pressure ulcer, Braden risk score, acute care, clinical judgement, risk assessment

What does this paper contribute to the wider global clinical community?

- This paper describes the prevalence for pressure ulcers among middle and older aged patients with comorbidity who are admitted to a medical department
- This paper identifies older age, underweight and diabetes as risk factors for pressure ulcer in patients admitted to medical wards

INTRODUCTION

In a Norwegian cross-sectional study at six somatic hospitals, the prevalence rate for pressure ulcer was 18.2 % (Bredesen *et al*. 2015). This number is within the wide range of prevalence rates that have been reported in other studies, where prevalence of pressure ulcer varies

between 9 and 22% (Vanderwee *et al*. 2007, Gallagher *et al*. 2008, Kottner *et al*. 2009a, VanGilder *et al*. 2009, Gunningberg *et al*. 2011, Moore & Cowman 2012). However, we find this prevalence rate to be relatively high considering the potential to prevent pressure ulcer (Vanderwee *et al*. 2007, Moore *et al*. 2013, Baath *et al*. 2014, Bredesen *et al*. 2015). Pressure ulcers can cause substantial burden to patients, including pain, disability and prolonged length of stay in hospitals (Hopkins *et al*. 2006, Spetz *et al*. 2013). The presence of pressure ulcer has impacts on daily living and quality of life (Gorecki *et al*. 2009), and from an economic perspective, it is considered more expensive to treat than to prevent pressure ulcers (Spetz *et al*. 2013). Since 2011, the Norwegian Patient Safety Programme has drawn attention towards prevention of injuries and pressure ulcers, and instruments to assess risk for pressure ulcer have been introduced in numerous settings such as acute care hospitals, home care and nursing homes (Moore & Cowman 2014, Bredesen *et al*. 2015). Early detection of patients who are vulnerable to pressure ulcer is vital, and it is recommended that the first skin assessment should be performed within 8 hours of hospital admission (NPUAP *et al*. 2014). Hence, one approach is to introduce risk assessment tools that enable early detection of patients at risk for pressure ulcers. When combined with educational and team efforts, the implementation of assessment tools has been associated with reductions in the incidence of pressure ulcers(Sullivan & Schoelles 2013, Swafford *et al*. 2016). Thus, it is recommended that risk assessment tools should not be used alone but always in addition to and together with nurse observation and assessment (NPUAP *et al*. 2014).

Degrees of mobility, activity, perfusion and skin status have been identified as the most frequent independent risk factors for development of pressure ulcer (Coleman *et al*. 2013, Moore & Cowman 2014). However, no single risk factor, at either the patient or ward level, is sufficient to explain the presence of pressure ulcers (Coleman *et al*. 2013). The impact of risk factors on pressure ulcer may depend on whether the patient is admitted for acute care, long-term care or palliative care (Henoch & Gustafsson 2003). It is recognised that elderly patients, patients with diabetes, and patients who are bedfast are at higher risk for pressure ulcer (Fife *et al*. 2001, Coleman *et al*. 2013, Coleman *et al*. 2014, Sving *et al*. 2014). Moreover, factors such as haematological, nutritional and general health status have been associated with pressure ulcer risk (Brito *et al*. 2013, Coleman *et al*. 2014, Langer & Fink 2014, Skogestad *et al*. 2016). The magnitude of potential risk factors makes it difficult to develop generic risk assessment tools, and few studies add evidence about the preventive impact of risk assessment tools (Moore & Cowman 2014). In a recent meta-analysis, the accuracy and appropriateness

of the Braden and other instruments to assess pressure ulcer risk among the elderly are questioned (Park *et al*. 2016), and it is suggested that clinical judgement may be a more effective way to assess risk and initiate appropriate care than introduction of risk assessments tools (Anthony *et al*. 2008, Compton *et al*. 2008, Saleh *et al*. 2009, Webster *et al*. 2011). The main purpose of the screening tools is to identify patients at risk for pressure ulcers so that preventive interventions can be efficiently targeted to those who most need them. Although risk screening tools themselves are not preventive measures, their use may increase nurses' attention to patients' pressure ulcer risk, contribute to implementation of preventive and early interventions, and thus may be useful in preventing or mitigating pressure ulcer development. Hence, the accuracy of these instruments should be high. The limitations of risk assessment tools to predict pressure ulcers and the need to further develop tools to identify patients at risk should be taken seriously (Webster *et al*. 2011, Coleman *et al*. 2014, Park *et al*. 2016). One step towards further development of such tools may be to study patient characteristics additional to those embedded in the traditional risk assessment tools.

Aims

The aims of this study are to describe the prevalence of pressure ulcers among middle-aged and elderly patients in three general medical wards in an acute general hospital in Norway, and to describe the associations between pressure ulcers and potential risk factors additional to the Braden risk score, specifically the patient's current diagnosis, having comorbidity or weight loss, or being underweight or obese.

METHODS

Design and Setting

This cross-sectional study was performed as part of a research project conducted between September 2012 and May 2014 in a general hospital in Oslo, Norway. The medical wards that were included in this study treat approximately 7800 patients yearly, and provide free services to a specific catchment area of Oslo. The medical wards mainly treated patients with pulmonary, cardiovascular, gastro-intestinal and infectious diseases. Ward personnel followed standard pressure ulcer prevention procedures for all patients, including frequent repositioning, pressure relief and mobilization. Additionally, patients identified as being at

risk for pressure ulcer were provided with a pressure-redistributing surface or alternating pressure air mattress.

Study sample

All in-patients admitted to the hospital by 7 AM on 10 prescheduled days during the study period were asked to participate in a research project at the hospital. Patients who were able to read and understand the informed consent, and were not diagnosed with or considered to have any cognitive impairment, were included. Patients at risk for pressure ulcer are often of advanced age (Sving *et al*. 2014, Gardiner *et al*. 2016). We therefore excluded from the analysis patients whose age was below the 25 percentile, meaning that only patients ≥ 52 years were included (n=255).

Data collection

The data collection was conducted by nursing students from the local university college, by the hospital's nurses and through patient self-reports. Prior to the data collection, the students and nurses underwent training to standardize the performance of the skin examination, pressure ulcer classification and use of the pressure ulcer risk-screening tool. To be able to involve the nursing students, the screening days were scheduled on Tuesdays and Wednesdays during their clinical practice studies at the hospital and were distributed across eight clinical practice study periods. On the 10 prescheduled screening days, the students and nurses performed a skin examination to determine the presence or absence of pressure ulcers and to assess pressure ulcer risk of each participating patient. On the same day, the patients completed a standardized questionnaire that included questions about comorbidities. Other variables were collected by examination of the patients or from the patients' medical records.

Measurements

Skin assessments were classified as normal or indicating pressure ulcer stages I-IV according to the EPUAP classification system for pressure ulcers: I non-blanchable erythema; II partial thickness skin loss; III full thickness skin loss; IV full thickness tissue loss (Beeckman *et al*. 2007). In the present study, pressure ulcer was defined as stages I-IV. The Braden scale was used for pressure ulcer risk assessment (Bergstrom *et al*. 1987). It has been evaluated as a tool of acceptable validity and reliability (Bergstrom *et al*. 1998, Kring 2007, Serpa *et al*. 2011). The tool consists of the following 6 items: sensory perception, moisture, activity, mobility, nutrition, and friction and shear, and is scored on a scale from 1 to 3 or 4. Higher scores

indicate lower risk for pressure ulcer. When the items are summarized, the total score is ranged from 6 (highest risk) to 23 (lowest risk). Total scores below 19 indicate a risk for pressure (Park *et al*. 2016), and thus a cut-off of 19 was used to dichotomize the total Braden score (<19 = mild to very high pressure ulcer risk, 19-23 = no pressure ulcer risk).

BMI was calculated on basis of height and weight. The data was collected from the medical record for the current hospitalization (upon admission) on the day of screening. In this study, underweight and obesity were defined as BMI ≤ 18.5 and BMI ≥ 30, respectively, according to World Health Organization (WHO) categories, and chosen as cut points to examine associations with pressure ulcer (WHO 2016).

Length of stay, age and gender were also obtained from the medical records of the patients. Data on weight loss and diagnoses were obtained by the patients' self-reports. Patients were asked whether they currently had any diseases or conditions (i.e. lasting at least 6 months) categorized in the following 13 groups: pulmonary disease, cardiovascular disease, gastro-intestinal disease, cancer, diabetes mellitus, muscular-skeletal disease, fracture, neurological disease, significant vision loss, significant hearing loss, psychiatric disease, other comorbid condition or cognitive impairment. Patients assessed as having current cognitive impairment were excluded from the analysis because this is an exclusion criterion in the present study. In the present study, the most common diseases were included in the variable "current diagnosis": cardiovascular disease, pulmonary disease, cancer and diabetes mellitus. Patients' who self-reported having more than one disease or condition were classified as having "current comorbidity".

Ethics

The study was approved by the Regional Ethical Committees for Medical and Health Research Ethics (REC South-East) and the hospital management (Reference # 2012/980A). Each patient was provided with written and verbal information about the study, and signed an informed consent form prior to participation. Patients also provided consent to access clinical data from their medical record.

Statistics

Completed questionnaires and results from the pressure ulcer screening were scanned into a research database. Statistical analyses was performed using SPSS version 22.0 (IBM Corp,

Armonk, NY). Frequencies, proportions and means with standard deviations are used to describe the sample characteristics. Middle and older age adults were analysed as a single group. Variables that were significantly associated with pressure ulcer in univariate logistic regression analyses were introduced in a multivariate logistic regression model to examine the associations between the independent variables and presence of pressure ulcer. The level of significance was set to $p<.05$ for all analyses. For logistic regression analyses with a two-sided significance level of 0.05, a sample size of 242 would have 80% power to detect an odds ratio of 3.0 for relatively common risk factors (i.e., prevalence of 50%) and a sample size of 215 would have 80% power to detect an odds ratio of 4.0 for relatively rare risk factors (i.e., prevalence of 10%), assuming a pressure ulcer prevalence rate of 15%.

RESULTS

Of the 255 patients who met the eligibility criteria and participated in the study, 13 did not complete the skin examination and were thus excluded from the analysis. The patient characteristics for the final sample (N=242) are described in Table 1. The sample of 242 patients was evenly split by gender and had a mean age of 71.4 years. Pulmonary and cardiovascular diseases were the most common current diagnoses, and more than 80% of the patients reported one or more comorbidities. Based on the Braden cut-off point of 19, 24.3% of the participants were at risk for developing pressure ulcers. Among these, 37.1% were identified with pressure ulcers.

Table 1 Characteristics of the respondents (N=242)

The prevalence of pressure ulcers in the medical department was 14.9% (Table 2). The early stages of pressure ulcers (stages I and II) accounted for more than 80% of all pressure ulcers, with a prevalence of 12.0% (29/242, 95% CI: 8.5 – 16.7). Since only 2 patients had pressure ulcer stage IV, we merged patients with pressure ulcers stages III and IV into one group (Table 2).

Table 2. Prevalence of pressure ulcers (N=242)

Univariate analyses of risk factors for pressure ulcers stages I-IV showed that older age, longer length of stay and lower Braden risk score (particularly <19) were significantly associated with pressure ulcers (see Table 3). Moreover, having diabetes and being underweight (BMI<18.5) were significantly associated with pressure ulcers (Table 3).

Table 3. Descriptive statistics for risk factors among patients without and with pressure ulcers and associations between risk factors and pressure ulcers in univariate analyses (odds ratios).

Risk factors that were significantly associated with pressure ulcers in univariate analyses were included in a multivariate logistic regression model. In this model, older age, being underweight, having diabetes and having a Braden score <19 were factors significantly associated with pressure ulcers (Table 4).

Table 4. Associations between pressure ulcers and risk factors in multivariate logistic regression analysis. CI = confidence interval. Bolded p-values are statistically significant ($p<0.05$) (n=225).

Among patients with pressure ulcer, the majority had skin abnormalities on their heel(s) or sacrum (Figure 1).

Figure 1. Categories for pressure ulcer site

DISCUSSION

Main findings

The prevalence of pressure ulcers was 14.9% in this sample of medical patients age ≥ 52 years, of whom the majority had more than one comorbidity . Older age, being underweight, having diabetes and having a Braden score <19 were factors associated with pressure ulcers. Pressure ulcer was most frequently sited on the sacrum or heel.

In the present study, the overall prevalence rate was 14.9%, which is within the range of prevalence rates that have been reported in reviews and prior studies in acute general hospitals conducted in Europe and USA (Gunningberg 2004, Schoonhoven *et al*. 2007, Vanderwee *et al*. 2007, Kottner *et al*. 2009b, VanGilder *et al*. 2009, Moore *et al*. 2013, Moore *et al*. 2015). The wide range of prevalence and incidence rates reported may be a result of heterogeneity between the study samples. Even though statistical risk adjustment methods control for patient characteristics to a certain degree, the heterogeneity of the samples may have impacted both the prevalence rates and the identified risk factors (Coleman *et al*. 2013, Park & Lee 2016). The variable timing of the screening day relative to the patient's hospital stay may have also affected the observed prevalence of pressure ulcer. For example, patients for whom the screening day occurred early in their hospital stay would have had less time to develop a pressure ulcer, whereas screening later in the hospital stay may have resulted in an increased prevalence of pressure ulcer. Nonetheless, longer hospital stays are known to be associated with increased risk of development of pressure ulcer (Lyder *et al*. 2012, Cremasco *et al*. 2013), a finding that was also evident in the current study, at least in the univariate analyses. Not surprisingly, the majority of pressure ulcers were stages I and II, and the prevalence of 12.0% of these early stages was quite high compared to the prevalence of stages III and IV (2.9%). The number of pressure ulcers in the latter stages was small, and the overall prevalence is probably the most appropriate way to describe the dataset.

Older age was associated with pressure ulcer in the present study, as in many others (Sving *et al*. 2014, Gardiner *et al*. 2016). However, systematic reviews reveal that the evidence is inconsistent (Coleman *et al*. 2013). It is assumed that the increased medical complexity, the risk of iatrogenic skin injuries and comorbidity among elderly patients might explain the inconsistency of findings regarding age and pressure ulcer (Bry *et al*. 2012, Coleman *et al*. 2013, Campbell *et al*. 2016). The present study confirmed that having diabetes is associated with pressure ulcer (Coleman *et al*. 2014). Knowing that the prevalence of diabetes is higher among elderly patients, diabetes may function as a confounder in analyses of the association between age and pressure ulcers (Coleman *et al*. 2014). However, in the current multivariate analysis, both older age and diabetes were found to be independent risk factors for pressure ulcers. The same complex relationship might be found for other risk factors such as nutritional status and skin integrity, which are also associated with both old age and pressure ulcers (Baumgarten *et al*. 2006, Brito *et al*. 2013, Langer & Fink 2014, Ahn *et al*. 2016, Skogestad *et al*. 2016).

Several prior studies have found that being underweight is associated with pressure ulcer risk (Fife *et al*. 2001, Compher *et al*. 2007, Kottner *et al*. 2011), and some found that obesity reduced the risk of pressure ulcers in elderly hospitalized patients (Baumgarten *et al*. 2006, Compher *et al*. 2007). In the present study, we found that being underweight was associated with pressure ulcer, while obesity was not significantly associated with pressure ulcer. However, the lack of significant findings related to obesity should be interpreted with caution due to the relatively small sample size and fairly low rate of pressure ulcers in the present study. Any relationship between overweight and the development of pressure ulcer is likely to be complicated, and pressure ulcers may manifest differently because of different skin structure and different bony prominences on the body (Kottner *et al*. 2011). Given that there are few other studies on the topic, additional studies are warranted. Nonetheless, our findings add to the inconsistent evidence regarding associations between BMI and pressure ulcer (VanGilder *et al*. 2009, Park & Lee 2016). One explanation for the inconsistent findings might be a nonlinear relationship between BMI and pressure ulcers. Categorizing BMI into groups is one way to evaluate potentially non-linear relationships, but even though there are standard BMI cutpoints, they are not necessarily the best cutpoints for a given population or outcome of interest. The contradictory findings might also indicate that BMI interacts with nutritional status or severe disease due to factors such as increased weight because of oedema or sudden weight loss because of cancer.

The distribution of pressure ulcer sites described in the present study is in accordance with the literature, showing that the majority of pressure ulcers were found at the sacrum and heel (NPUAP *et al*. 2014). It is suggested that bony prominences and internal muscle tissue composition may interact with BMI as a risk factor for pressure ulcer (Sopher *et al*. 2010, Kottner *et al*. 2011, Sopher & Gefen 2011). Kottner et al. found that thin patients were at higher risk for pressure ulcer at the sacrum, while BMI had no association with pressure ulcer on the heels (Kottner *et al*. 2011). Their recognition that aetiology and ulcer development differs based on site is another important implication for the evaluation of risk assessment tools (Kottner *et al*. 2011). Moreover, BMI may influence how patients are positioned, and thus influence when and where pressure ulcers occur (Gillespie *et al*. 2014).

Our results did not support studies that have identified associations between comorbidity and pressure ulcer (Bry *et al*. 2012, Gardiner *et al*. 2016, Smit *et al*. 2016). This might be

explained by the fact that nearly 80% of the patients included in our study reported comorbidity, and potential selection biases cannot be ruled out. Diabetes is recognised as a risk factor for pressure ulcers in several prior studies (Nixon *et al*. 2006, Rademakers *et al*. 2007, Coleman *et al*. 2013, Coleman *et al*. 2014), and this association was also evident in the present study. Cancer, and pulmonary and cardiovascular diseases were also evaluated in the current study, but were not found to be associated with pressure ulcers. In contrast, other studies have reported associations between comorbidity and development of pressure ulcer (Bry *et al*. 2012, Cremasco *et al*. 2013). Given that the patients in the study by Cremasco *et al*. were intensive care patients, unlike the patients in the present study, it is conceivable that the association reflects the severity of the disease rather than the diagnosis itself (Cremasco *et al*. 2013). Current diagnoses and comorbidity were assessed by self-report in the present study, which may differ from information contained in patient medical records. Thus, conclusions cannot be drawn solely on the basis of the current findings (Amir *et al*. 2011, Gardiner *et al*. 2016, Tayyib & Coyer 2016).

Even though we found associations between pressure ulcer and the Braden score, the criticism of such instruments should be taken seriously (Park & Lee 2016). Risk assessment tools may be a useful supplement to nurses' clinical observation and skin assessment, but it is suggested that risk assessment tools alone are insufficient to detect pressure ulcers (Compton *et al*. 2008, Webster *et al*. 2011, Cremasco *et al*. 2013, Moore & Cowman 2014, Campbell *et al*. 2016). In this study, more than a third (36%, n=13) of the 36 patients identified as having an existing pressure ulcer had a Braden score that indicated no pressure ulcer risk. This finding confirms that existing risk assessment tools alone are not enough to reliably identify medical inpatients at risk of pressure ulcer.

The introduction of tools to assess risk has contributed to a reduction of pressure ulcers in some studies (Sullivan & Schoelles 2013, Mallah *et al*. 2015, Swafford *et al*. 2016), and two mechanisms might explain this reduction:

- early identification of patients "at risk"
- attention among health professionals towards prevention of pressure ulcers

The increased attention towards patient safety in general and pressure ulcer in particular, may have encouraged nurses to use and develop their clinical competency to detect pressure ulcers. Screening programs that involve the use of risk assessment tools may be useful, but might be

targeted towards subgroups of patients. It has been suggested that risk factor studies with homogenous patient groups might be a useful approach to identify specific risk factors (Coleman *et al*. 2013). Seen from a clinical point of view, pressure ulcer risk factors for particular patient groups may be of higher value than the more generic risk factors embedded in risk assessment tools. This way, resources might be allocated to care for patients at actual risk of pressure ulcers and to tasks that are more critical. The objectives of the present study were not to identify such groups. However, the complex nature of pressure ulcers is emphasized, and future research is needed to address important questions of this kind.

Strengths and limitations

In the present study, we have identified risk factors for pressure ulcers among medical patients with more than one comorbidity and age ≥52 years. The size of the study sample is acceptable, considering the objectives of the study, which were to describe the prevalence of pressure ulcers and identify potential risk factors. The PU prevalence reported in this study was based on 10 screening days over a 20-month period, and may not be representative of the hospital's overall PU prevalence rate. The sample may also not be representative of the general population of hospital inpatients due to the exclusion of patients with cognitive impairment. Furthermore, the results might not generalize to different patient groups since the sample is relatively homogenous. The sample homogeneity is, however, one of the strengths of this study considering that the sample represents a large proportion of the population that is admitted to hospitals.

The cross-sectional design did not allow for investigation of patients who were at risk for pressure ulcer at the time of screening and developed pressure ulcer later during the hospital stay. Moreover, reliable data regarding when a pressure ulcer started was not available, and this may have limited the degree of observed association between skin assessment findings and Braden scores. It is crucial to emphasize these methodological challenges for two reasons. First, the cross-sectional design prevents the determination of causality, and second, factors of significance leading to the development of pressure ulcer could not be identified.

The cut-off points for the Braden scale and BMI were chosen since these categories have been used in similar studies. However, it cannot be ruled out that these cut-off points are inadequate for the present study.

CONCLUSION

This study adds to the body of research that aims to identify risk factors for pressure ulcers. In this sample of medical inpatients who were mostly of older age and had multiple chronic diseases, the pressure ulcer prevalence was 14.9% across 10 screening days in a 20-month period. For this group of medical patients, older age, being underweight and having diabetes were associated with increased risk of pressure ulcer, even after accounting for Braden risk score. Adding these additional patient risk factors to standard risk screening tools may improve identification of patients at risk for pressure ulcers.

Relevance to clinical practice

Our results add to the knowledge about risk assessment tools for pressure ulcer and indicate that adding information about patient age, weight and diabetes status may improve pressure ulcer risk assessment. This information may have an impact on risk assessment procedures in clinical practice, and potentially more accurate identification of patients at risk for pressure ulcer.

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Table 1 Characteristics of the respondents (n=242)

Characteristics	Statistics
Gender, female % (n)	46.7% (113)
Age, mean/median (SD)	71.4/69.0 (12.1)
Underweight (<18.5), % (n)	13.2% (32)
Obesity (>30.0), % (n)	17.8% (43)
Current diagnoses*	
Pulmonary disease, % (n)	26.4% (64)
Cardiovascular disease, % (n)	26.4% (64)
Diabetes, % (n)	9.5% (23)
Cancer, % (n)	16.1% (39)
Current comorbidity (>1 disease), % (n)	78.1% (189)
Braden risk score, mean/median (SD)	20.3/21.0 (2.7)
Braden risk score < 19, % (n)	24.2% (58)
Weight loss, % (n)	39.3% (95)
Length of stay, mean/median (SD)	6.5/5.0 (4.2)

*The diagnostic categories are not mutually exclusive or exhaustive and thus, the numbers do not total to 242.

Table 2. Prevalence of pressure ulcer (N=242)

	Patients with pressure ulcer(s)	
Pressure ulcer classification	% (n)	95% confidence interval
Stage 1	7.0% (17)	4.4% – 11.0%
Stage II	5.0% (12)	2.9% – 8.5%
Stage III-IV	2.9% (7)	1.4% – 5.9%
Total	14.9% (36)	11.0% – 20.0%

Table 3. Descriptive statistics for risk factors among patients without and with pressure ulcers and associations between risk factors and pressure ulcers in univariate analyses (odds ratios).

Patient characteristic	Total n	Patients without pressure ulcers	Patients with pressure ulcers	Odds ratio (95% confidence interval)	p-value
Gender, % female (n)	242	46.6% (96/206)	47.2% (17/36)	0.98 (0.48-1.98)	0.975
Age, mean/median (SD)	242	61.1/63.0 (19.0)	79.2/78.0 (11.2)	1.05 (1.02-1.08)	**<0.001**
Underweight (BMI<18.5), % (n)	238	11.3% (23/204)	26.5% (9/34)	2.83 (1.18-6.81)	**0.020**
Obese (BMI>30.0), % (n)	238	18.1 % (37/204)	17.6% (6/34)	0.97 (0.37-2.50)	0.945
Pulmonary disease, % (n)	225	27.6% (53/192)	33.3% (11/33)	1.31 (0.59-2.89)	0.501
Cardiovascular disease, % (n)	222	27.7% (53/191)	35.5% (11/31)	1.43 (0.64-3.19)	0.380
Diabetes, % (n)	231	8.1% (16/197)	20.6% (7/34)	2.93 (1.11-7.78)	**0.031**
Cancer, % (n)	230	17.5% (34/194)	13.9% (5/36)	0.76 (0.28-2.09)	0.594
Current comorbidities, % (n)	224	86.2% (163/194)	86.7% (26/30)	1.24 (0.40-3.79)	0.711
Weight loss, % (n)	238	37.6% (76/202)	52.8% (19/36)	1.85 (0.91-3.78)	0.090
Length of stay (LOS), mean/median (SD)	242	5.9/5.0 (4.0)	7.8/7.0 (5.0)	1.10 (1.02-1.17)	**0.007**
Braden risk score, mean/median (SD)	242	20.9/21.5 (2.3)	18.0/18.0 (2.7)	0.68 (0.59- 0.78)	**<0.001**
Braden risk score<19, % (n)	242	17.0% (35/206)	63.9% (23/36)	8.64 (4.00-18.69)	**<0.001**

Bolded p-values are statistically significant (p<0.05).

Table 4. Associations between pressure ulcers and risk factors in multivariate logistic regression analysis. CI = confidence interval (n=219).

Predictor	Odds ratio	95% CI	p-value
Age	1.05	1.01-1.09	P= **0.007**
Underweight (BMI<18.5)	4.10	1.42-11.88	P= **0.009**
Diabetes	4.01	1.34-11.95	P= **0.013**
Braden score (<19)	6.89	2.95-16.12	P **=<0.001**
Length of stay (LOS)	1.06	0.98-1.15	P= 0.166

Bolded p-values are statistically significant (p<0.05).

Figure 1. Categories for pressure ulcer location (n=242)