Medical conditions as risk factors for pressure ulcers in an outpatient setting

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Abstract

Objectives: the purpose of this study was to evaluate the likelihood that the presence of certain medical conditions in older ambulatory patients are associated with the risk of developing a new pressure ulcer.

Design: a cohort study.

Setting and subjects: a large outpatient record database from the United Kingdom called the General Practice Research Database.

Methods: the frequency of disease was reported as simple percentages and the associations between the medical conditions and the development of a pressure ulcer as instantaneous rate ratios.

Results: we studied 75,168 older individuals. Pressure ulcers occurred in 1,211 individuals. The medical conditions that were significantly associated with the development of a pressure ulcer after adjustment were: Alzheimer’s disease, congestive heart failure, chronic obstructive pulmonary disease, cerebral vascular accident, diabetes mellitus, deep venous thrombosis, hip fracture, hip surgery, limb paralysis, lower limb oedema, malignancy, malnutrition, osteoporosis, Parkinson’s disease, rheumatoid arthritis, and urinary tract infections. Angina, hypertension, and pneumonia were inversely associated with the development of a pressure ulcer.

Conclusions: it is important that physicians recognise that patients with many medical conditions may be at higher risk for pressure ulcers so that even in the ambulatory care environment appropriate prevention and detection strategies can be directed towards the patients who are most likely to benefit.

Keywords: pressure ulcers, risk factors, epidemiology, aged

Introduction

Pressure ulcers are wounds of the skin and deeper soft tissue that occur in areas of bony prominence usually on individuals who are immobile [1, 2]. Most pressure ulcers occur in nursing intensive settings, such as acute and long-term care, but they do also occur in home settings [3–6]. Pressure ulcers are expensive to treat, can result in diminished quality of life, longer hospitalisations, and increased morbidity and mortality [7–14].

Most studies on pressure ulcers have focused on residents of acute care or long-term care facilities. For these patients, immobility is consistently the most important risk factor for developing a pressure ulcer [3, 4, 15]. However, pressure ulcers also occur at home. In fact, the yearly prevalence of pressure ulcers in an UK population of older people was from 0.31–0.70% and the incidence was from 0.18–3.36 per 100-person years [16]. Both rates increased with advancing age. However, very little has been reported on risk factors for the development of a pressure ulcer in this type of population.

Traditionally, pressure ulcer risk factor evaluation has focused on medical signs and symptoms, such as immobility and incontinence. A more meaningful and practical approach for general practice physicians might be to describe risk factors for the development of pressure ulcers using medical conditions such as diabetes or cerebral vascular disease. There are several reasons that this approach might be superior in an outpatient setting. First, physicians commonly describe sick patients by
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their diseases (e.g. in the medical record and in communication with other physicians). Second, it is likely that the presence of medical conditions could significantly increase the risk of a patient developing a pressure ulcer. Perhaps, by identifying these medical conditions prior to hospitalisation, prevention methods could be initiated early to those most likely to benefit.

The purpose of this study was to evaluate the likelihood that the presence of certain medical conditions in older ambulatory patients followed in the General Practice Research Database (GPRD) is associated with the risk of developing a new pressure ulcer [16–18].

Methods

Study population

We studied a 10% random sample of patients aged 65 years and older registered to a general practitioner (GP) in the GPRD between 1988 and 1996. The GPRD is a computerised medical records database obtained on a regular basis from the patient’s GP, who uses a standardised collection tool supplied to them by General Practice Research Company [17, 18]. At the time of this study, the GPRD included 542 practices in the UK.

Subject eligibility

Patients were eligible for entry into our study if: (i) the patient received care from a GPRD-participating GP between 1988 and 1996; (ii) the patient was 65 years of age or older; and (iii) the patient did not have a history of nor developed a pressure ulcer during the first 6 months after their initial registration with their GP. We have previously validated this approach and our ability to ascertain who had a pressure ulcer consistent with a Shea/NPAUP stage II or greater pressure ulcer [16].

Definition of disease

Diseases were classified in the GPRD database using Oxford Medical Information System (OXMIS) codes [17, 18]. Medical conditions were chosen for evaluation as risk factors based on their possible association with pressure ulcer onset, according to clinical judgment (i.e. expert opinion, review articles, book chapters) and published research reports [4, 7, 10, 19–21]. The medical conditions that we analysed were: Alzheimer’s disease, anaemia, angina, asthma, congestive heart failure, chronic obstructive pulmonary disease, cerebral vascular accident (ischaemic, thrombotic and haemorrhagic), deep venous thrombosis, dermatitis, depression, diabetes mellitus, hip fracture, hypertension, liver disease, limb paralysis, lower limb oedema (including lymphoedema), malignancy, malnutrition, myocardial infarction, obesity, osteoporosis, Parkinson’s disease, peripheral vascular arterial disease of the lower extremity, pneumonia, renal failure, rheumatoid arthritis, and urinary tract infection. We also evaluated gender and age. For all medical conditions, patients were considered to have the condition if there was GP documentation of its presence prior to the first coded occurrence of a pressure ulcer.

Statistical analysis

We described the frequency of medical conditions and pressure ulcers using simple percentages. In order to assess the magnitude of the associations between medical conditions and pressure ulcer onset, we used proportional hazards models using both a single independent variable and multiple independent variables. Both unadjusted (single variable) and adjusted (multiple variable) instantaneous rate ratios (RR) are reported with 95% confidence intervals (CI) [22, 23]. The RR are like relative risks except that they compare rates of pressure ulcer development per year of observation rather than simply the proportion of people who develop a pressure ulcer [24]. Fully adjusted models included all medical conditions, gender, and age. To assure the appropriateness of the proportional hazards analyses, proportional hazards assumptions were evaluated and shown to be valid. Correlation matrices of the parameter estimates were evaluated for the full model and excessive collinearity was not present in our models.

All analyses were performed using SAS 8.0 or Stata 6.0. This study was reviewed and given approval by the Institutional Review Board of the University of Pennsylvania and the Scientific and Advisory Board of the Office of National Statistics, UK.

Results

There were 75,168 older individuals in our data set. Pressure ulcers occurred in 1,211 individuals (1.61%). The rate of developing a pressure ulcer increased with age (Table 1). Pressure ulcers were more likely to occur in women than men (Table 2). However, the apparent association between gender and pressure ulcers disappeared after controlling for age and medical conditions (Table 3). The frequencies of medical conditions as reported by the GP in the patient’s chart prior to documentation of a pressure ulcer are listed in Table 3.

The adjusted RRs often differed from the unadjusted RRs by >10% indicating that the unadjusted RR estimates were confounded by the other medical conditions, age, and/or gender [25, 26]. In general, additional analyses showed that most confounding was attributed to age and gender. The medical conditions that were significantly associated with the development of a pressure ulcer were: Alzheimer’s disease, congestive heart failure, chronic obstructive pulmonary disease, cerebral vascular accident, diabetes mellitus, deep venous thrombosis, hip fracture, hip surgery, limb paralysis, lower limb oedema, malignancy, malnutrition, osteoporosis, Parkinson’s disease, rheumatoid arthritis, and urinary tract infections. Angina,
hypertension, and pneumonia were inversely associated with the development of a pressure ulcer.

Several additional evaluations were also conducted. First, we changed our inclusion criteria to require that a medical condition be recorded in the database at least 3 months and then 9 months prior to the onset of a pressure ulcer. The RR effect estimates did not change by more than 10% relative to the original effect.

Table 1. Pressure ulcer incidence, by patient age

<table>
<thead>
<tr>
<th>Age category (years)</th>
<th>No. of subjects</th>
<th>% of total</th>
<th>% with pressure ulcer</th>
<th>Unadjusted RR (95% CI)</th>
<th>Adjusted RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>65–69</td>
<td>27,978</td>
<td>37.2</td>
<td>0.6</td>
<td>Ref cat</td>
<td>Ref cat</td>
</tr>
<tr>
<td>70–74</td>
<td>16,405</td>
<td>21.8</td>
<td>1.0</td>
<td>1.38 (1.11, 1.71)</td>
<td>1.24 (1.00, 1.54)</td>
</tr>
<tr>
<td>75–79</td>
<td>13,324</td>
<td>17.7</td>
<td>1.9</td>
<td>2.82 (2.33, 3.42)</td>
<td>2.20 (1.81, 2.68)</td>
</tr>
<tr>
<td>80–84</td>
<td>9,934</td>
<td>13.2</td>
<td>2.8</td>
<td>4.82 (4.00, 5.82)</td>
<td>3.35 (2.75, 4.08)</td>
</tr>
<tr>
<td>85–89</td>
<td>5,234</td>
<td>7.0</td>
<td>4.2</td>
<td>8.32 (6.82, 10.16)</td>
<td>5.06 (4.09, 6.27)</td>
</tr>
<tr>
<td>90 and older</td>
<td>2,293</td>
<td>3.1</td>
<td>5.4</td>
<td>13.12 (10.41, 16.55)</td>
<td>7.47 (5.82, 9.59)</td>
</tr>
</tbody>
</table>

*Instantaneous rate ratios as estimated using proportional hazards models.

Table 2. Pressure ulcer incidence, by patient gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>No. of subjects</th>
<th>% of total</th>
<th>% with pressure ulcer</th>
<th>Unadjusted RR (95% CI)</th>
<th>Adjusted RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>44,814</td>
<td>59.6</td>
<td>1.8</td>
<td>Ref cat</td>
<td>Ref cat</td>
</tr>
<tr>
<td>Male</td>
<td>30,354</td>
<td>40.4</td>
<td>1.4</td>
<td>0.78 (0.70, 0.88)</td>
<td>1.01 (0.89, 1.15)</td>
</tr>
</tbody>
</table>

*Instantaneous relative risks as estimated using proportional hazards models.

Table 3. Unadjusted and adjusted instantaneous rate ratios, comparing pressure ulcer rate for those with the medical condition to the rate for those without the medical condition

<table>
<thead>
<tr>
<th>Medical condition</th>
<th>% of total population with medical condition</th>
<th>Unadjusted RR (95% CI)</th>
<th>Adjusted RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alzheimer's disease</td>
<td>3.7</td>
<td>4.46 (3.78, 5.27)</td>
<td>2.01 (1.68, 2.39)</td>
</tr>
<tr>
<td>Anaemia</td>
<td>10.1</td>
<td>1.70 (1.47, 1.97)</td>
<td>1.03 (0.89, 1.20)</td>
</tr>
<tr>
<td>Angina</td>
<td>17.6</td>
<td>0.72 (0.61, 0.84)</td>
<td>0.70 (0.59, 0.83)</td>
</tr>
<tr>
<td>Asthma</td>
<td>9.2</td>
<td>0.95 (0.78, 1.15)</td>
<td>1.05 (0.85, 1.30)</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>13.4</td>
<td>2.28 (2.00, 2.58)</td>
<td>1.39 (1.21, 1.59)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>9.0</td>
<td>1.27 (1.07, 1.52)</td>
<td>1.24 (1.02, 1.50)</td>
</tr>
<tr>
<td>Cerebral vascular accident</td>
<td>13.1</td>
<td>2.18 (1.92, 2.48)</td>
<td>1.57 (1.37, 1.79)</td>
</tr>
<tr>
<td>Deep venous thrombosis</td>
<td>2.2</td>
<td>1.81 (1.38, 2.38)</td>
<td>1.39 (1.05, 1.83)</td>
</tr>
<tr>
<td>Depression</td>
<td>22.3</td>
<td>2.16 (1.54, 3.04)</td>
<td>1.50 (1.06, 2.12)</td>
</tr>
<tr>
<td>Dermatitis</td>
<td>6.1</td>
<td>0.77 (0.60, 0.98)</td>
<td>0.81 (0.64, 1.03)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>7.4</td>
<td>1.71 (1.44, 2.03)</td>
<td>1.75 (1.47, 2.08)</td>
</tr>
<tr>
<td>Limb paralysis</td>
<td>0.1</td>
<td>4.68 (1.75, 12.48)</td>
<td>5.13 (1.91, 13.75)</td>
</tr>
<tr>
<td>Lower limb oedema</td>
<td>17.2</td>
<td>2.17 (1.92, 2.44)</td>
<td>1.37 (1.21, 1.55)</td>
</tr>
<tr>
<td>Hip fracture</td>
<td>2.1</td>
<td>3.63 (2.92, 4.51)</td>
<td>1.46 (1.16, 1.83)</td>
</tr>
<tr>
<td>Hip surgery</td>
<td>3.5</td>
<td>1.73 (1.38, 2.17)</td>
<td>1.42 (1.13, 1.79)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>30.2</td>
<td>0.56 (0.49, 0.64)</td>
<td>0.63 (0.55, 0.73)</td>
</tr>
<tr>
<td>Liver disease</td>
<td>2.6</td>
<td>1.38 (1.02, 1.85)</td>
<td>1.20 (0.89, 1.61)</td>
</tr>
<tr>
<td>Malignancy</td>
<td>10.4</td>
<td>1.91 (1.65, 2.21)</td>
<td>1.73 (1.50, 2.01)</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>0.4</td>
<td>4.87 (3.16, 7.49)</td>
<td>3.06 (1.98, 4.73)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>7.2</td>
<td>0.76 (0.60, 0.96)</td>
<td>0.79 (0.61, 1.01)</td>
</tr>
<tr>
<td>Obesity</td>
<td>2.6</td>
<td>0.85 (0.59, 1.22)</td>
<td>1.02 (0.71, 1.48)</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>2.9</td>
<td>1.85 (1.46, 2.35)</td>
<td>1.43 (1.12, 1.82)</td>
</tr>
<tr>
<td>Parkinson's disease</td>
<td>2.2</td>
<td>4.05 (3.30, 4.97)</td>
<td>2.34 (1.90, 2.89)</td>
</tr>
<tr>
<td>Peripheral vascular arterial disease of the lower extremity</td>
<td>5.1</td>
<td>1.01 (0.80, 1.28)</td>
<td>1.00 (0.78, 1.27)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>21.1</td>
<td>0.86 (0.75, 0.99)</td>
<td>0.79 (0.68, 0.90)</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>1.9</td>
<td>2.18 (1.66, 2.86)</td>
<td>2.30 (1.74, 3.03)</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>18.2</td>
<td>1.75 (1.55, 1.97)</td>
<td>1.19 (1.05, 1.35)</td>
</tr>
</tbody>
</table>

*Instantaneous rate ratios as estimated using proportional hazards models.

Each variable adjusted for all other variables in the table and for age and gender.
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estimates. Second, we showed that the proportional hazards assumptions were satisfied. Third, we demonstrated that no two-way interaction terms were statistically significant and that their inclusion did not affect the estimates of the effects of the medical conditions on pressure ulcer rates. Fourth, excluding patients who were likely to be residents of long-term care facilities did not change the RR estimates by more than 10%.

Discussion

Several medical conditions were significantly associated with the risk of developing a pressure ulcer (Table 3). Many of these associations between medical conditions and pressure ulcer risk make sense. In fact, some of these conditions (diabetes mellitus, malnutrition, advancing age, and peripheral vascular lower limb arterial insufficiency) are commonly thought to be associated with a diminished capacity for wound repair [27–30]. Also, some of these conditions have been previously identified as risk factors for pressure ulcers in acute care and long-term care settings [4, 7, 15, 21, 31, 32]. Finally, it should be noted that Alzheimer’s disease, malnutrition, limb paralysis, Parkinson’s disease, and rheumatoid arthritis increased the likelihood that an individual would develop a pressure ulcer by a factor > 2, which is often used as a cutoff for strong proof of causation when there is a dichotomous exposure [33, 34].

Berlowitz et al. [32, 35] have recently derived a risk-adjustment model for the development of pressure ulcers in patients residing in US nursing homes. The population studied by Berlowitz et al. [32, 35] (long-term care residents) was sicker than the GPRD population (mainly ambulatory care patients cared for by a GP). However, both studies evaluated diabetes mellitus, peripheral vascular disease, history of hip fracture, and oedema as risk factors for pressure ulcers. The fully adjusted odds ratios reported by Berlowitz et al. [32, 35] were similar to our fully adjusted rate ratios. The fact that similar results were obtained in these two studies, which used populations with differing levels of severity of comorbid disease, in different care settings, and in different countries supports the generalisability of these findings.

In our study, several conditions (angina, hypertension, and pneumonia) were inversely associated with the development of a pressure ulcer. In addition, there was a trend toward an inverse relationship between the onset of a pressure ulcer and a history of a myocardial infarction. While the reasons for these associations are not obvious, more than 10 years ago Guralnik et al. [19] reported somewhat similar results. The investigators evaluated a limited number of risk factors and noted that patients with a previous history of heart disease were less likely to have developed a pressure ulcer than those without heart disease (OR 0.3 95% CI 0.1, 0.6) [19]. The Guralnik et al. [19] study was different than ours in that patients self-reported their illnesses. In addition, their definitions of heart disease included angina, myocardial infarction, and congestive heart failure. We reported these illnesses evaluated separately.

The reason that individuals with certain medical conditions may be associated with a decreased likelihood of developing a pressure ulcer can also be explained by other factors. One potential explanation is that these medical conditions are associated with a decrease in patient longevity. However, adjustment for patient age did not negate these effects. In fact, a secondary analysis showed that the number of person-years of follow-up was similar for individuals with these conditions and a pressure ulcer and those without these conditions and a pressure ulcer. It is also possible that individuals with these medical conditions got better medical care, which prevented the pressure ulcer. However, to the best of our knowledge receiving medical care for these illnesses should not influence the risk of developing a pressure ulcer. Another possible explanation is that patients with these conditions had more frequent physician interactions and that the GPs were too busy to record their pressure ulcers in the GPRD database. While this is possible, we believe it is unlikely, because illnesses such as diabetes and congestive heart failure, which can be severe and require close medical follow-up, were associated with an increased rate of pressure ulcer development.

Finally, another plausible explanation for why these patients were less likely to develop a pressure ulcer is that the medications that these patients received as a consequence of having one of these illnesses prevented the onset of a pressure ulcer. For example, during the time period of 1988–1996 beta-blockers were commonly prescribed to patients with a history of angina, hypertension, and myocardial infarction, but not to patients with congestive heart failure. We conducted an exploratory analysis evaluating the association between beta-blocker use and pressure ulcers. The RR for the fully adjusted association of any beta-blocker use was 0.70 (95% CI 0.58, 0.86). However, the adjusted RR for hypertension, myocardial infarction, and angina (i.e. medical conditions that are often treated with a beta-blocker) did not change by more than 10% [25, 26]. The RRs for these conditions, adjusted for all the variables including beta-blocker use, were 0.70 (95% CI 0.60, 0.81), 0.79 (95% CI 0.59, 1.02), 0.70 (95% CI 0.60, 0.83). However, to do this evaluation properly would require a different study design (e.g. propensity score study) and a larger data set with information on drug use with respect to dose, duration, and formulation. In this preliminary investigation, we could not explain the decreased likelihood that a patient with hypertension and angina had for the development of a pressure ulcer, but we may have, within the limitations of this data set, demonstrated that beta-blockers also offer a similar effect.

There are several limitations to this study. Since this is an observational study, there may have been a systematic difference between those who did and did not have particular medical conditions. It is possible that patients who developed a pressure ulcer were more likely or less...
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likely to have medical conditions misdiagnosed. This is not likely given the large number of diverse medical conditions that we analysed. In addition, some medical conditions that we analysed increased the likelihood that an individual would develop a pressure ulcer while others (often unexpected) decreased the likelihood. Furthermore, many types of information bias could influence the validity of our results. For example, if the GP's tendency to record a medical condition in the patient's GPRD record was influenced by prior knowledge that the patient was at risk for developing a pressure ulcer. However, the GPs who entered patient data into the GPRD were not aware of our study. Furthermore, we do not know of any reason (e.g. use of pressure ulcer risk assessment tools) why the GPs would have treated ambulatory patients differently based on determining who was at risk for a pressure ulcer. Finally, as with all observational studies unmeasured confounding could be present and responsible for the associations that we noted.

In summary, patients with some medical conditions (angina, hypertension, and pneumonia) were less likely to develop a pressure ulcer. We are currently uncertain as to the biologic reason that this may be true and encourage further investigation into these potential associations. More importantly, in patients 65 years of age and older several medical conditions were associated with the development of pressure ulcers. It is important that physicians recognise that patients with these conditions may be at higher risk for pressure ulcers so that appropriate prevention and detection strategies can be directed towards the patients who are most likely to benefit.

Key points
- Older patients seen in general practice do develop pressure ulcers.
- Many medical conditions are associated with the development of a pressure ulcer.

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References


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