

## The Association Between Pressure Ulcer Development And Patient Comorbidities In Varied Care Settings: A Review Of The Literature

Review Article

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### Abstract

Pressure ulcers can be described as localized injury to the skin which can develop in the patients placed in various types of care setting. The comorbidities, or underlying diseases of the patients, are thought to be strong risk factors for the development of pressure ulcers. The purpose of this paper is to review the previous literature investigating the association between patient comorbidities and pressure ulcer development. The author classified the literature into five categories by the type of care setting, namely, the nursing home, hospital, perioperative, rehabilitation, and home settings, and summarized the study results for each. The author found a large dispersion in the results according to design and sample size, even within the same settings. Nonetheless, half or more of the studies found that diabetes mellitus had a close association with pressure ulcer development in all of the settings while cardiac, renal, and respiratory diseases were also found to be associated with many of the settings. The author surmises that recognition of such comorbidities could serve as an important step towards improving pressure ulcer prevention.

**KeyWords:** Cardiac Disease; Comorbidity; Diabetes Mellitus; Pressure Ulcer; Renal Disease; Respiratory Disease; Underlying Disease

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### Introduction

A pressure ulcer (PU) is defined as “localized injury to the skin and/ or underlying tissue, usually over a bony prominence, as a result of pressure or pressure in combination with shear” [1]. In addition to such mechanical forces, however, patient comorbidity or an underlying disease may also contribute to PU development. Several clinical guidelines for PU prevention refer to comorbidity as a risk factor for PU development, citing, for example, diabetes mellitus [1-4], circulatory disease [1], spinal cord injury [2,4], hip fracture [4], cerebrovascular disease [4], etc. In addition, risk assessment scales for PU prevention such as CBO[5], Spinal Cord Injury Pressure Ulcer Scale (SCIPUS)[6], SCIPUS-A[7] and Waterlow [8] include factors related to patient comorbidities such as diabetes mellitus, and pulmonary and cardiac diseases.

PU's can develop in patients placed in any types of care setting. The aim of this paper is to review the previous English-language

literature investigating the association between patient comorbidities and PU development. The author classified the literature into five categories according to the type of care setting, namely the nursing home, hospital, perioperative, rehabilitation, and home settings, and further examined the kind of PU-related comorbidity in each of these settings.

### Nursing Home Setting

Nursing homes constitute representative long-term care settings for the immobile or inactive elderly population. The previous literature dealing with the association between comorbidities and PU development in nursing homes is summarized in Table 1. To the author's knowledge, seven studies have been published to date on this subject [9-15], three cohort studies [10,13,14] and four cross-sectional studies [9,11,12,15], all of which utilized large databases at multiple facilities. It should be noted that six of the seven studies cited[9,11,15] concluded that diabetes mellitus was associated with PU development. Moreover, in some studies, hip fracture [13], Parkinson's disease [9], and peripheral vascular disease were also listed as risk factors, while other studies showed inverse results [9,11,12,14].

### Hospital Setting

Inpatient hospital care ranges from acute or intensive care to chronic or geriatric care. Accordingly, hospitalized patients may present many types of comorbidities in association with PU development. As shown in Table 2, we found three cohort studies [18-20], three cross-sectional studies [16,21,22], one cross-sectional/cohort study [17], and one case-control study[23], or a total of eight studies dealing with PU-related comorbidities in the hospital setting. Three of these studies[21-23] utilized a large inpatient database derived from multiple facilities. On the other hand, six [16-20] utilized relatively small samples from single hospitals including two teaching hospitals[16,19], two chronic care hospitals [17,18], and one medical ICU in a public hospital [20]. In four of the studies [17,21-23], diabetes mellitus was described

**Table 1. Nursing home setting**

Study	Study design	Participants	Study setting and database	Country	Comorbidities in associated with PU development	Comorbidities not associated with PU development
Spector, 1994 [9]	Cross-sectional	2803	699 nursing homes in NMES IPC 1987	United States	Diabetes mellitus, Parkinson's disease	Hip fracture, stroke
Brandies et al, 1994 [10]	Cohort	4232	78 nursing homes belonging to National Health Corp	United States	None	Diabetes mellitus
Brandies et al, 1995 [11]	Cross-sectional	2011	270 nursing homes in MDS 1990	United States	Diabetes mellitus	Alzheimer's disease, hip fracture, peripheral vascular disease
Spector and Fortinsky, 1998 [12]	Cross-sectional	15121	843 nursing homes in MDS+ 1994	United States	Diabetes mellitus	Parkinson's disease, hip fracture, stroke
Berlowitz et al, 2001 [13]	Cohort	14607	109 nursing homes in MDS 1997	United States	Diabetes mellitus, hip fracture, peripheral vascular disease	None
Berlowitz et al, 2001 [14]	Cohort	13457	108 nursing homes in MDS 1998	United States	Diabetes mellitus	End-stage disease, hip fracture, peripheral vascular disease
Casimiro et al, 2002. [15]	Cross-sectional	827	50 geriatric facilities	United Kingdom	Diabetes mellitus	None

**NMES IPC (Institutional Population Component of the National Medical Expenditure Survey):** A nationally representative sample of residents in nursing homes.

**MDS+ (Minimum Data Set Plus):** The expanded version of a national resident assessment instrument specifically for Multistate Nursing Home Case Mix and Quality Demonstration Project.

**MDS (Minimum Data Set):** A valuable tool for assessing the quality of nursing home care containing clinical information describing the health status of all nursing home residents.

**Table 2. Hospital settings**

Study	Study design	Participants	Study setting and database	Country	Comorbidities in associated with PU development	Comorbidities not associated with PU development
Allman et al, 1996 [16]	Cross-sectional	634	Single teaching hospital	United States	Fracture	Anemia, dementia, diabetes mellitus, heart failure, malignancy, pneumonia, renal failure, spinal cord injury, stroke, urinary tract infection
Berlowitz and Wilking, 1989 [17]	Cross-sectional and cohort	301	Single chronic care hospital	United States	Diabetes mellitus, cerebrovascular accident	Dementia, diabetes mellitus, heart failure, fracture, malignancy
Bianchetti et al, 1993 [18]	Cohort	148	Single psychogeriatric hospital	Italy	None	Diabetes mellitus, heart failure, peripheral vascular disease, pneumonia, stroke
Allman et al, 1995 [19]	Cohort	286	Single teaching hospital	United States	None	Chronic heart failure, diabetes mellitus, fracture, paraplegia
Jiricka et al, 1995 [20]	Cohort	85	Medical/ surgical ICU in a single public hospital	United States	None	Diabetes mellitus
Scott et al, 2006 [21]	Cross-sectional	100000	CHARS 1987-2000	United States	Diabetes mellitus, spinal cord injury	Injury, infection
Fogerty, 2008 [22]	Cross-sectional	94758	NIS 2003	United States	Anemia, cerebrovascular disease, chronic heart failure, diabetes mellitus, osteomyelitis, pneumonia, renal failure, respiratory failure, sepsis, urinary tract infection	Not described
Lyder et al, 2012 [23]	Case-control	51842	MPSMS 2006-2007	United States	Cerebrovascular disease, chronic heart failure, chronic obstructive pulmonary disease, diabetes mellitus	None

**CHARS (Comprehensive Hospital Abstract Reporting System):** The annual data from all hospital admissions in the Washington state.

**NIS (Nationwide Inpatient Sample):** A national sample of inpatient discharge data.

**MPSMS (Medical Patient Safety Monitoring System):** A nationwide surveillance system within the hospitalized fee-for-service Medicare population.

as a risk factor for PU development, although the remaining four studies denied this association [16,18-20]. Additionally, anemia [20], cerebrovascular disease[17,22,23], chronic heart failure[22,23], chronic obstructive pulmonary disease [23], fracture [16], osteomyelitis [22], pneumonia[22], renal failure[22], respiratory failure [22], sepsis [22], spinal cord injury [21], and urinary tract infection [22] were mentioned as risk factors for PU development.

### Perioperative Setting

Patients who undergo a lengthy operation are potentially at high risk for PU development because repositioning may not be possible for several hours during the intraoperative and postoperative periods. The author has found 10 studies to date concerning PU-related comorbidities in the perioperative setting [24-33], including nine cohort studies [24-31,33] and one meta-analysis [32](Table 3). Eight of these studies were based on data from a

**Table 3. Perioperative settings**

Study	Study design	Participants	Study setting and database	Country	Comorbidities in associated with PU development	Comorbidities not associated with PU development
Papantonio et al, 1994 [24]	Cohort	136 (cardiac surgery patients)	Single teaching hospital	United States	Diabetes mellitus, respiratory disease	Hypertension, peripheral vascular disease, renal disease
Lewicki et al, 1997 [25]	Cohort	337 (cardiac surgery patients)	Single academic medical center	United States	Diabetes mellitus	None
Schultz et al, 1999 [26]	Cohort	413	Single tertiary care center	United States	Diabetes mellitus	None
Pokorny et al, 2003 [27]	Cohort	351 (cardiac surgery patients)	Single medical center	United States	Heart failure	None
Frankel et al, 2007 [28]	Cohort	820	Surgical ICU in a single teaching hospital	United States	Diabetes mellitus, spinal cord injury	None
Haleem et al, 2008 [29]	Cohort	4546 (hip fracture surgery patients)	Single hospital	United Kingdom	Diabetes mellitus	Malignant disease, Rheumatoid arthritis
Lindholm et al, 2008 [30]	Cohort	635 (hip fracture surgery patients)	Accident and Emergency Departments in six countries	Sweden, Finland, United Kingdom, Spain, Italy, Portugal	Cardiovascular disease, diabetes mellitus, pulmonary disease	Gastrointestinal disease, malignancy, urological disease
Slowikowski and Funk, 2010 [31]	Cohort	369	Surgical ICU in a single hospital	United States	Diabetes mellitus	Renal disease, vascular disease
Liu et al, 2012 [32]	Meta-analysis	2453	Six observational studies	United States (5 studies) and Belgium (one study)	Diabetes mellitus	None
O' Brien et al, 2013 [33]	Cohort	2695	Surgical ICUs in a single teaching hospital	United States	Congestive heart failure, renal failure	Hypertension, liver disease

**Table 4. Rehabilitation settings**

Study	Study design	Participants	Study setting and database	Country	Comorbidities in associated with PU development	Comorbidities not associated with PU development
Salzberg et al, 1996 [6]	Case-control	219	Single spinal cord injury unit in veterans affair medical center	United States	Cardiac disease, diabetes mellitus, pulmonary disease, renal disease	Urinary tract infection, sepsis
Cakmak et al, 2009 [34]	Case-control	64	Single physical therapy and rehabilitation hospital	Turkey	None	Diabetes mellitus, hypertension
Verschuere et al, 2011 [35]	Cohort	193	Eight rehabilitation hospitals with SCI units	The Netherlands	Pulmonary disease	Cardiovascular disease, spine fracture, urinary tract infection
Wang et al, 2013 [36]	Case-control	5804	UDSMR 2009-2011	United States	Dementia, diabetes mellitus, peripheral vascular disease	Amputation, arthritis, cardiac disorders, pulmonary disorders, spinal cord injury, stroke,

**UDSMR (Uniform Data System for Medical Rehabilitation):** A large nongovernment registry for standardized medical rehabilitation information.

single hospital [24-29,31,33]. Some studies targeted patients who received cardiac surgery [24,25,27] or hip fracture surgery[29,30]. In seven of nine cohort studies [24-26,28-32], diabetes mellitus was identified as a risk factor for PU development. This result was strongly supported by one recent meta-analysis [32] involving six observational studies with a total 2453 patients; when compared to patients with normal glucose tolerance, patients with diabetes mellitus were more likely to develop PUs (odds ratio=2.15, 95% confidential interval: 1.62-2.84). In addition, other comorbidities including cardiac disease [27,30,33], renal failure [33], respiratory disease[24,30,33], and spinal cord injury [28] were also described as risk factors.

### Rehabilitation Setting

Because of restrictions on mobility, patients undergoing rehabilitation are thought to be at extremely high risk for PU development. Table 4 lists four studies, including three case-control studies[6,34,36] and one cohort study [35], investigating PU-related comorbidities at rehabilitation facilities [6,35-37]. Among these, three studies utilized data obtained from a single hospital [6,34] or small number of hospitals [35], while one utilized a large inpatient database [36]. Two studies targeting patients admitted to spinal cord injury units [6,35]. Diabetes mellitus[6,36] and pulmonary disease[6,35] were each found to be risk factors for pressure ulcer development in two studies. Additionally, cardiac disease [6], dementia [36], peripheral vascular disease[36], and renal disease [6] were also listed as risk factors.

### Home Setting

Although most cases of PUs occur in acute or long-term care settings, some also occur in the home setting. The author found one cohort study [37] using a large outpatient record database that investigated the risk factors for PU development (Table 5). This study suggested the following comorbidities as risk factors: Alzheimer’s disease, cerebral vascular events, chronic obstructive pulmonary disease, congestive heart failure, diabetes mellitus, deep venous thrombosis, hip fracture, limb paralysis, lower limb edema, malignancy, osteoporosis, Parkinson’s disease, rheumatoid arthritis, and urinary tract infection.

### Discussion And Summary

PUs can develop in various care settings. In this paper, we categorized the relevant literature published to date on the subject according to five types of care setting. Importantly, patient background, study design, sample size, and risk factor variables varied widely in each study. Moreover, a large dispersion of the results was seen between the studies, even in the same setting. For this reason the author concluded that the outcomes from each study mentioned above are in some instances not amenable to comparison. Nonetheless, among the numerous comorbidities referred to in these studies, diabetes mellitus seemed to present the strongest association, with half or more of the studies in all of the care settings and one meta-analysis pointing to this condition as a risk factor for PU development. With respect to other comorbidities,

Table 5. Home settings

Study	Study design	Participants	Study setting and database	Country	Comorbidities in associated with PU development	Comorbidities not associated with PU development
Margolis et al, 2003 [37]	Cohort	75,168	GPRD 1988-1996	United Kingdom	Alzheimer’s disease, diabetes mellitus, chronic heart failure, chronic obstructive pulmonary disease, cerebral vascular accident, deep venous thrombosis, hip fracture, limb paralysis, lower limb edema, malignancy, osteoporosis, Parkinson’s disease, rheumatoid arthritis, urinary tract infection	Angina, hypertension, pneumonia

**GPRD (General Practice Research Database):** a large outpatient record database from the United Kingdom.

cardiac, renal, and respiratory disorders were commonly found to be risk factors in four of the five care settings: hospital, perioperative, rehabilitation, and home. However, the author could not find a clear difference in the kinds of PU-related comorbidities between settings.

In summary, the findings of previous studies investigating risk factors for PU development underscore the importance of recognizing patient comorbidities in order to prevent PUs. Despite the large dispersion seen between the study results, diabetes mellitus, cardiac disease, renal disease, and respiratory disease were found to be risk factors across a variety of settings.

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