

ORIGINAL ARTICLE

# Factors associated with the development of pressure ulcers after spinal cord injury

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**Study design:** Cross-sectional observational study.

**Objectives:** To examine variables associated with the development of pressure ulcers (PU) in subjects with spinal cord injury (SCI).

**Setting:** SCI patients under coverage of the State Welfare Organization of Iran.

**Methods:** Mobile rehabilitation teams gathered data from 20 of the 30 provinces in Iran. There were 8104 SCI patients registered in the database; 7489 patients were included in the analysis. The prevalence of PU in patients aged <10 years was lower than those aged >10; therefore, we used different logistic models for these groups. Likewise, separate models were created for patients who had experienced SCI during the past year versus patients injured >1 year before the evaluation.

**Results:** PU was present in 34.6% of the patients. The variables associated with PU in patients aged <10 years were female gender and the time passed since SCI. In patients aged >11 years, male gender, the time passed since SCI, lower level of education, lack of an intimate partner, quadriplegia and older age presented a significant association with PU. Patients for whom <1 year has passed since SCI, male gender, quadriplegia and older age were associated with PU. And patients for whom >1 year had passed since SCI, male gender, quadriplegia, older age, lower level of education and lack of an intimate partner were associated with PU.

**Conclusion:** SCI patients are a heterogeneous group and the risk factors associated with PU may vary in specific subgroups. Different models are needed to describe PU in SCI patients depending on the patient's age and the time passed since SCI.

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**Keywords:** pressure ulcer; spinal cord injury; age; time since injury

## INTRODUCTION

Spinal cord injury (SCI) is a life-threatening and debilitating injury. SCI patients experience poor health-related quality of life.<sup>1</sup> The prevalence of traumatic SCI in Tehran ranges from 1.2 to 11.4 per 10 000 people,<sup>2</sup> and the annual incidence rate of SCI is 44 cases per 1 000 000 people in Tehran.<sup>3</sup> SCI requires a multidisciplinary approach to manage the potential secondary complications in a satisfactory manner. Pressure ulcer (PU) is a potentially serious complication and about 85% of SCI patients are susceptible to it.<sup>4</sup> During the initial acute hospitalization after SCI, 20–60% of the SCI patients develop PU.<sup>5</sup> Despite recommendations on prevention strategies for PU in SCI, PU continues to be the second most common reason for rehospitalization following SCI.<sup>6</sup> With such a large number of complications related to PU following SCI, we sought to identify the SCI patients who were prone to PU. Although there are several studies on the risk factors of PU in SCI patients,<sup>7–9</sup> there is still a need for more detailed knowledge regarding risk factors of specific subgroups of SCI patients.<sup>8</sup>

The goal of this study is to present the prevalence and risk factors of PU in specific subcategories of SCI patients based on the patient's age and time passed since injury in a population of 7489 SCI patients in Iran.

## MATERIALS AND METHODS

### Study population

The State Welfare Organization of Iran (SWOI) provides support mainly to low-socioeconomic disabled people throughout the country. Between June 2007 and June 2009, several mobile rehabilitation teams, consisting of six members including a physiotherapist, a general practitioner, a psychologist, an occupational therapist, a social worker and a nurse, visited the residences of disabled people in 20 provinces out of the 30 provinces in Iran. The teams performed thorough physical examinations and, if necessary, ordered laboratory tests for all patients. The clinical and demographic data of the patients were recorded. We used this database as the basis of this study.

In the database, 8104 SCI patients were identified. Records of 615 patients were incomplete leading to the exclusion of these patients.

PU was defined as an open sore in an area susceptible to pressure, such as the coccyx, ischium, heel and elbow. The severity of PU was recorded as: stage I (non-blanchable erythema of intact skin), grade II (partial-thickness skin loss involving epidermis, dermis or both), grade III (full-thickness skin loss involving damage to or necrosis of subcutaneous tissue) and grade IV (deep and infected open sore requiring surgery)<sup>10</sup> in the database.

### Statistical analysis

$\chi^2$ -Test was used to assess the association of PU with categorical variables. Logistic regression analysis was utilized for multivariable analysis.

The prevalence of PU in patients aged  $\leq 10$  years was lower than that in older patients (Figure 2); different logistic models were created for these

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two groups. As SCI prevalence of PU was different in the two groups, separate models were created for patients who had experienced SCI during the past year and those in whom more than 1 year had passed since their injury (Figure 3).

Separate models were also fitted for traumatic versus non-traumatic SCI patients. However, as the models were similar for both the groups, we fitted a single logistic regression model for both mechanisms of injury.

Both American Spinal Injury Association Impairment Scale (AIS) A and B are complete motor SCI; AIS C and D are both incomplete motor SCI. Therefore, in our study, AIS A and B did not differentiate from each other. Meanwhile, both AIS C and D are in one group of incomplete motor SCI without differentiation from each other.

The analysis of the data was performed using SPSS for Windows version 13 (SPSS Inc., Chicago, IL, USA). A type I error was set at 0.05 for all tests.

### Ethical approval

The approval of local research ethics committee of the Tehran University of Medical Sciences and verbal consents from all patients were obtained before any evaluation. The patients were informed that nonparticipation would in no way affect their care.

## RESULTS

### Participant characteristics

A total of 7489 patients were included in the study. The median age group was 21–30 years. Male SCI patients outnumbered female patients (male patients  $n = 4996$ ).

Of these patients, 31.2% were 21–30 years old. Among the study subjects, 24.1% were illiterate, 22.1% had secondary school diplomas and 4.4% had university degrees. At the time of injury, 76.8% patients were more than 10 year old and 394 (5.3%) were older than 50 years.

A total of 5897 patients were injured for more than 1 year and 815 for less than 1 year at the time of the study. Cervical, thoracic and lumbar injuries were found in 16.5%, 22.7% and 57.9% of the patients, respectively. Based on the level of injury, 66.8% had paraplegia, 9.6% had quadriplegia, 11.1% had paraparesia and 3.7% had quadriparesia.

Only 3207 of the patients had an intimate partner. Congenital spinal cord lesion was found in 1285 patients and traumatic lesion was found in 4021 patients.

### Patients with PU

The overall prevalence of PU diagnosed for this sample was calculated at 34.6%. Hemiparetic patients experienced lower rates of PU, whereas quadriplegic patients experienced higher rates of PU (Figure 1).

The prevalence of PU in patients under 10 years of age was 17%, which was lower than the incidence of PU in patients aged  $\geq 11$  years (38%; Figure 2).

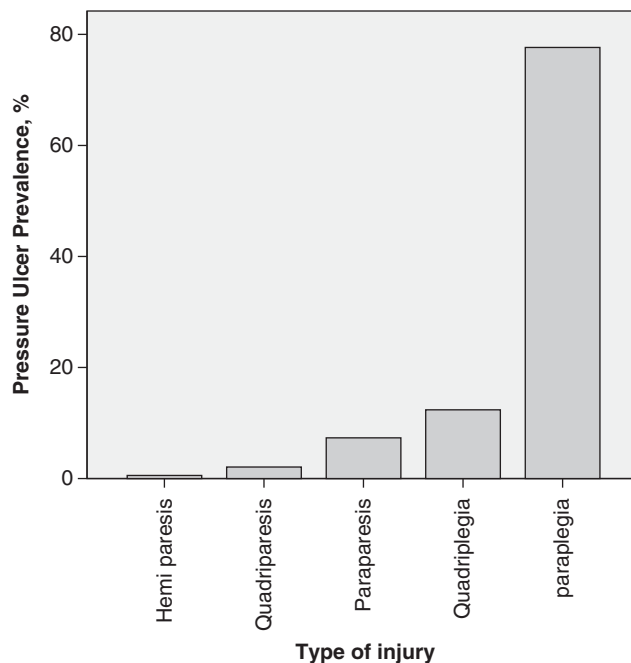
The prevalence of PU in patients <1 year from SCI was 45%, which was higher than the rate in patients injured for >1 year at the time of the study (35%; Figure 3).

### Univariable analysis

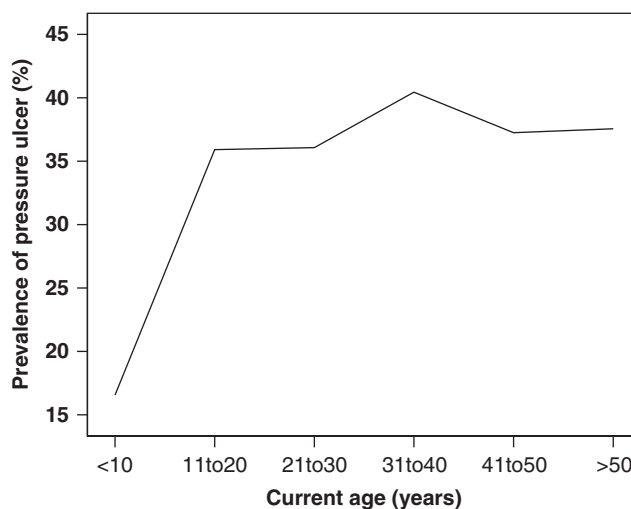
There were statistically significant associations between PU and male gender ( $P < 0.001$ ), lower level of education ( $P < 0.001$ ), having an intimate partner ( $P < 0.001$ ), older age ( $P < 0.001$ ), the time passed since SCI ( $P < 0.001$ ), cause of injury ( $P < 0.001$ ), unemployment ( $P < 0.001$ ), quadriplegia ( $P < 0.001$ ) and paraplegia ( $P < 0.001$ ).

### Multivariate analysis

As the prevalence of PU was different in the following groups, separate models were fitted for each of the following subgroups.



**Figure 1** Prevalence of PU according to the type of SCI. A full color version of this figure is available at the *Spinal Cord* journal online.



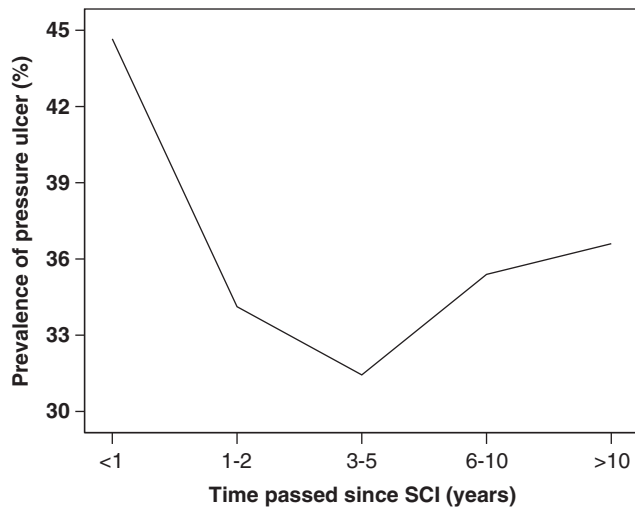
**Figure 2** Prevalence of PU according to the age of patients.

*Patients 10 years or younger.* Male patients and those with injuries of more than a year were less prone to PU (Table 1).

*Patients aged 11 years or older.* Gender and the time passed since SCI were associated with PU. Moreover, lower level of education, quadriplegia, lack of an intimate partner and age were associated with PU in this group (Table 2).

*Patients in whom less than 1 year had passed since SCI.* Male, quadriplegic and older patients were more prone to PU in this group of patients (Table 3).

*Patients in whom more than 1 year had passed since SCI.* Male, quadriplegic, older patients were more prone to PU as were patients with lower level of education, and those who did not have an intimate partner (Table 4).



**Figure 3** Prevalence of PU according to the years passed since the occurrence of SCI.

**Table 1** Variables associated with pressure ulcer in SCI patients aged  $\leq 10$  years

Variables	Coefficient	s.e.	Significance	OR
Male gender	-0.53	0.14	<0.01	0.59
<i>Years passed since SCI</i>				0.01
1-2 years	-0.94	0.34	0.01	0.39
3-5 years	-0.87	0.28	<0.01	0.42
6-9 years	-0.67	0.27	0.01	0.51

Abbreviations: OR, odds ratio; SCI, spinal cord injury; s.e., standard error.

## DISCUSSION

The aim of this study was to determine the prevalence and risk factors of PU in SCI patient subgroups based on their age and the time passed since SCI.

PU prevalence in our study was high compared with McKinley *et al.*,<sup>11</sup> who reported PU prevalence rates ranging from 15.2 to 29.4%, and other studies.<sup>8,12-14</sup> This could be due to the low-socioeconomic status of our study subjects. Studies have shown that patients with lower socioeconomic levels have a higher risk of PU.<sup>15</sup> Another explanation could be the inclusion of patients with early stages of skin changes (from stage I) in this study. The reason that we had this amount of PU in the study sample is the lack of an effective and inclusive home nursing and home medical services in Iran. The only intervention is limited education for preventing PU. These educations and the adherence to it are not still evaluated. Although patients are taught about PU prevention methods, they cannot successfully manage their PU. Besides, when the patient gets PU, his cooperation with medical services decreases, and this ends in poor results and major complications.

We observed that different models are needed to explain the association of PU with risk factors based on the time since SCI and patients' age (Table 5).

In patients aged 10 years or younger, female gender was associated with development of PU in contrast to previous studies that demonstrated that male gender is associated with PU.<sup>6,9,10,14,16</sup> We observed this association in all other study groups; however, the reverse association was detected in patients aged <10 years. Although

**Table 2** Variables associated with pressure ulcer in SCI patients aged 11 years or older

Variables	Coefficient	s.e.	Significance	OR
Male gender	0.3	0.06	<0.01	1.35
<i>Time passed since SCI</i>				<0.01
1-3 years	-0.45	0.11	<0.01	0.64
3-6 years	-0.57	0.1	<0.01	0.57
6-10 years	-0.4	0.10	<0.01	0.67
Over 10 years	-0.50	0.10	<0.01	0.61
<i>Education</i>				<0.01
Primary school	-0.13	0.08	0.13	0.88
Middle school	-0.15	0.09	0.11	0.86
Diploma	-0.35	0.09	<0.01	0.70
Associate degree	-0.70	0.19	<0.01	0.49
Bachelor	-0.95	0.17	<0.01	0.38
Master	-0.87	0.48	0.07	0.42
Doctorate	-21.10	10300.03	0.10	0.00
Quadriplegia	0.26	0.09	<0.01	1.30
Lack of an intimate partner	0.25	0.07	<0.01	1.28
<i>Age, years</i>				<0.01
11-20	0.09	0.09	0.35	1.09
20-30	0.38	0.10	<0.01	1.47
30-40	0.24	0.11	0.03	1.27
40-50	0.23	0.12	0.05	1.25

Abbreviations: OR, odds ratio; SCI, spinal cord injury; s.e., standard error.

**Table 3** Variables associated with pressure ulcer in SCI patients with less than 1 year since SCI

	Coefficient	s.e.	Significance	OR
<i>Age, years</i>				<0.01
10-20	1.65	0.42	<0.01	5.19
20-30	1.63	0.40	<0.01	5.10
30-40	1.66	0.42	<0.01	5.24
40-50	1.69	0.43	<0.01	5.44
Over 50	1.45	0.45	<0.01	4.26
Quadriplegia	0.43	0.21	0.04	1.54
Male gender	0.50	0.18	0.01	1.65

Abbreviations: OR, odds ratio; SCI, spinal cord injury; s.e., standard error.

this may be just a coincidence, another explanation may be the difficulty of keeping the underwear/bed dry in female children with urinary incontinence while boys can be kept dry more easily using a condom device to collect urine.

The time since SCI was associated with PU in all age groups in this study. There are reports indicating a direct association between the time passed since the onset of injury and PU;<sup>9,11</sup> however, the reverse association has been reported as well.<sup>16</sup>

Evaluation of patients aged 11 years and older demonstrated associations between PU and lower level of education, quadriplegia, lack of an intimate partner and age. There is a controversy over the association between age and PU. Most studies have shown that the elderly have an increased risk of PU.<sup>6,17,18</sup> Chen *et al.*<sup>8</sup> showed that during the first 10 years after injury the risk of PU would be steady, but after 15 years the risk would increase.

**Table 4 Variables associated with pressure ulcer in SCI patients with more than 1 year since SCI**

	Coefficient	s.e.	Significance	OR
Male gender	0.26	0.06	<0.01	1.29
<i>Education</i>				
Primary school	-0.092	0.083	<0.01	0.91
Middle school	-0.13	0.10	0.18	0.89
Diploma	-0.34	0.09	<0.01	0.71
Associate degree	-0.67	0.20	<0.01	0.51
Bachelor	-1.07	0.19	<0.01	0.34
Master	-0.77	0.48	0.11	0.46
Doctorate	-21.04	10684.61	1.0	0.00
Lack of an intimate partner	0.21	0.07	<0.01	1.23
<i>Age, years</i>				
11–20	1.00	0.15	<0.01	2.72
20–30	1.10	0.14	<0.01	2.95
30–40	1.41	0.15	<0.01	4.11
40–50	1.24	0.15	<0.01	3.47
Over 50	1.25	0.15	<0.01	3.48
Quadriplegia	0.22	0.10	0.02	1.25

Abbreviations: OR, odds ratio; SCI, spinal cord injury; s.e., standard error.

**Table 5 Risk factors associated with pressure ulcer in different groups of patients**

Time passed since occurrence of SCI		Patients' age (years)	
≤ 1 year	> 1 year	≤ 10	≥ 11
Male	Male	Female	Male
Age	Age		Age
Quadriplegia	Quadriplegia		Quadriplegia
	Lack of an intimate partner		Lack of an intimate partner
	Lower education		Lower education
		Years passed since SCI	Years passed since SCI

Studies have shown that being single is associated with a higher risk of PU.<sup>6,14</sup> In our study, this association was seen in patients older than 10 years, and in patients whose SCI was more than 1 year. Over time, the financial resources of patients may be depleted and family members become the main source of care. Therefore, lack of an intimate partner may affect the care provided to patients, especially in communities with insufficient insurance coverage. This effect may explain the emergence of the association between being single and PU in subgroup of patients with more than 1 year interval since SCI.

Some studies have shown that subjects with a lower level of education have a higher risk of PU.<sup>6,16</sup> In our study, this association was seen in patients older than 10 years and those more than a year since SCI. Lower level of education is generally associated with lower socioeconomic status and limited access to health information and resources,<sup>15,19</sup> but it takes some time for educational status to affect the care provided to patients. On the other hand, it is not possible to

verify causation in a cross-sectional study. Lower level of education may simply reflect worse health conditions that prevented patients to advance in school. There is no accurate data on the income of SCI patients. However, these patients are not rich and need the support of "The State Welfare Organization of Iran (SWOI)". This support was limited to the preparation of wheelchair, free but limited rehabilitation and sometimes small amount of salary.

Conflicting reports have described the association of completeness of SCI injury with PU. One study reported that paraplegic subjects are more prone to PU than quadriplegic patients<sup>20</sup> and another reported the reverse.<sup>6</sup> In our study, being quadriplegic was associated with PU in all patients except children. Quadriplegic children may benefit from mindful care by parents, which prevents PU despite their disability.

### Limitations

This study was unable to determine the risk factors for the development of PU. Instead, it detected the association of PU with demographic factors. Moreover, the temporal order of exposure and outcome is not clear in this cross-sectional study.

Clinical data on the location, severity and number of ulcers, and information on the treatment of PU and treatment outcome was not available. Unavailable National Pressure Ulcer Advisory Panel (NPUAP) staging is another limitation of the study.

The database was assembled from SWOI that supports disabled people from low-socioeconomic status; hence, our data cannot be generalized to all SCI patients.

This large group of SCI patients is classified into complete (AIS A and B) and incomplete motor (AIS C and D). Unavailable subgroups of A, B, C and D are limitations of our study, separately.

### CONCLUSION

Knowing the risk factors of PU may allow the recognition of patients at risk of PU, an issue of practical importance to the health of SCI patients.

SCI patients are a heterogeneous group and the risk factors associated with PU may vary in specific subgroups. According to our data, different models are needed to explain the occurrence of PU in SCI patients according to the age and time passed since SCI. Further studies may establish more specific patient classifications based on these factors to accurately identify patients at risk of PU.

### DATA ARCHIVING

There were no data to deposit.

### CONFLICT OF INTEREST

The authors declare no conflict of interest.

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