Injuries and Falls in an Aging Cohort with Spinal Cord Injury: SCI Aging Study

Lee L. Saunders, PhD,¹ and James S. Krause, PhD¹

¹Department of Health Sciences and Research, College of Health Professions, Medical University of South Carolina, Charleston

Background: Limited research suggests that additional “subsequent” injuries occur frequently among persons with an existing spinal cord injury (SCI), which may result in further significant complications and added disability. **Objective:** The purpose of this study was to (a) report the 12-month incidence of injuries by age in an aging SCI cohort, (b) report the 12-month incidence of falls, (c) assess the impact of injuries on participation by age, and (d) assess the relationship of age with injuries and falls while controlling for potential confounding factors. **Methods:** Participants (N = 759) responded to questions about injuries and falls resulting in injury in the past year. Demographic and SCI characteristics, binge drinking, and prescription medication use were measured. **Results:** A total of 19.2% reported 1 or more injuries in the past year, and 10.4% reported a fall resulting in an injury in the past year. Among those who sustained 1 or more injuries, 22.8% had at least 1 hospitalization for an injury within the past 12 months. Additionally, 47.6% were limited in their normal daily activities for a week or more due to injury. Prescription medication use was associated with injury in the past year and falls resulting in injury. Equal time between walking and wheelchair use as the primary mode of locomotion was also associated with falls in the past year. **Conclusions:** Future research should investigate circumstances surrounding subsequent injuries to aid in prevention efforts. Additionally, information is needed on whether subsequent injuries further contribute to physical disability. **Key words:** accidental falls, aging, spinal cord injury, wounds and injuries

Limited research suggests that additional “subsequent” injuries occur frequently among persons with an existing spinal cord injury (SCI),^{1,2} which may result in further significant complications and added disability. This includes both unintentional injuries from events such as falls and lesser prevalent intentional injuries from self-harm. The frequency of subsequent injuries is not surprising given that SCI often occurs as the result of participation in high-risk activities; such behaviors may reflect a sensation-seeking personality and these behaviors may continue after SCI. The consequences of injury after SCI may be severe, as SCI is associated with bone density loss³ and osteoporosis,⁴ which elevate the risk of fracture.⁵ Furthermore, injury resulting in bed rest may lead to additional secondary health conditions including pressure ulcers.⁶

Krause^{1,2} investigated injuries in a cohort of persons with chronic SCI and found that 19% to 23% of participants reported at least 1 injury in the

prior 12 months. Those 2 studies found differing results with regard to the relationship of age with injury: One study found decreasing odds of injury with increasing age and the other study found no significant relationship. However, Krause¹ did find a relationship between age and hospitalization due to injury, with increasing age corresponding to increasing risk of hospitalization due to injury.

Falls are one cause of injury. Brotherton et al⁷ identified risk of falls among individuals with ambulatory SCI and found that 75% reported at least 1 fall in the previous year. Additionally, among Veterans who used a wheelchair as their primary mode of mobility, Nelson et al⁸ found that 31% had a fall in the previous year and 14% had a fall-related injury. Recently, Matsuda et al⁹ did not find a significant difference in falls by age group in a cohort of 4 physical disability groups (including SCI), although the peak prevalence for falls was in participants in the middle age range (55–64 years).

Corresponding author: Lee L. Saunders, PhD, Research Assistant Professor, Health Sciences and Research, Medical University of South Carolina, 77 President Street, MSC 700, Charleston, SC 29425; phone: 843-792-8828; e-mail: saundel@musc.edu

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There has been limited research investigating injuries and falls in an aging SCI population or the impact of those injuries on participation. The purpose of this study was to (a) report the 12-month incidence of injuries by age in an aging SCI cohort, (b) report the 12-month incidence of falls, (c) assess the impact of injuries on participation by age, and (d) assess the relationship of age with injuries and falls while controlling for potential confounding factors.

Methods

Participants were identified from outpatient records at 2 rehabilitation hospitals in the southeastern and midwestern United States. Inclusion criteria were traumatic SCI, age of 18 years or older at assessment, 1 or more years post injury at assessment, and without a complete recovery from the SCI (American Spinal Injury Association Impairment Scale [AIS] A-D).¹⁰ Participants were part of a longitudinal study beginning in 1973. The current assessment was conducted between 2007 and 2009. Of 928 persons approached, 759 responded (81.7%).

After institutional review board approval, participants from the previous data collection were sent an introductory letter describing the study and informing them that materials would be sent 4 to 6 weeks later. The study materials included a cover letter describing the study; return of the materials was an indication of implied consent. Individuals who did not respond were sent 2 follow-up mailings and were contacted by phone. Participants were offered \$30 remuneration.

Measures

Injuries were measured by the question: "In the past 12 months, how many different times have you been injured seriously enough to receive medical care in a clinic, emergency room, or hospitalization?" Fall-related injuries were measured by the question: "In the past 12 months, how many falls have you had that resulted in an injury serious enough to receive medical care in a clinic, emergency room, or hospital?" Persons with 1 or more injuries in the past 12 months were also asked, "How many days in the past 12 months did

injuries limit you in the following ways: (1) could not do my normal activities, (2) could not spend the normal time out of bed, and (3) could not get out of my house or go somewhere." Participants could answer each question as no effect, less than a week, 1 to 4 weeks, and 4 or more weeks. For each limitation (normal activities, time out of bed, get out of the house), responses were categorized as a week or more and less than a week. Participants were also asked, "As a result of an injury, did you stay overnight in a hospital for at least 1 injury in the past 12 months?"

Demographic characteristics were also measured, including age at survey, years post injury, sex (male, female), and race/ethnicity (White, non-White). Disability severity was measured through 2 variables: can you walk at all (yes/no) and what is your primary method of getting around (walking/wheeling/both equally). Injury severity was assessed through injury level and ambulatory status. Participants were classified as cervical (C) 1-4, nonambulatory; C5-C8, nonambulatory; noncervical, nonambulatory; and all ambulatory.¹¹ Binge drinking was assessed through the question: "Considering all types of alcoholic beverages, how many times during the past month did you have 5 or more drinks on one occasion." The answer was dichotomized as yes/no. Lastly, we asked participants if they used prescription medication for pain, sleep, or stress/depression, with response options being never, sometimes, weekly, and daily. If participants responded as sometimes, weekly, or daily for any, they were classified as prescription medication users.

Analysis

SAS version 9.4 (SAS Institute, Inc., Cary, NC) was used for all analyses. For descriptive analyses, we used chi-square tests and *t* tests to compare injuries and fall-related injuries by participant characteristics. Age was categorized as 30 to 44, 45 to 54, 55 to 64, and 65 years and older. We used logistic regression to assess the relationship of age with injuries and falls while controlling for potential confounding factors (years post injury, gender, race/ethnicity, mode of locomotion, prescription medication use, and binge drinking). Odds ratios and 95% confidence intervals (CIs) are reported.

Results

Participants were an average of 54.3 (11.9) years old and 27.0 (10.2) years post injury at assessment (**Table 1**). Seventy-two percent were male and 78.9% White. Of participants, 25.9% were ambulatory regardless of injury level. A total of 19.2% reported at least 1 injury in the past year, and 10.4% reported a fall resulting in an injury in the past year. Among those who sustained 1 or more injuries, 22.8% had at least 1 hospitalization for an injury within the past 12 months. Additionally, 47.6% were limited in their normal daily activities for a week or more due to injury.

There were no significant differences in injury in the past year or falls resulting in injury by age group (**Table 2**). Additionally, among persons injured in the past year, no differences were seen in mean number of injuries or overnight hospitalization by age group. However, there were differences by age group in days limited in normal activities, time out of bed, and ability to get out of the house. Participants in the middle age groups were the most likely to be limited in their activities.

When examining differences in injury prevalence by participant characteristics and age group (**Table 3**), we did find significant differences by race for those 30 to 44 years old and 65 years old and older. Among the youngest and oldest groups, non-White participants were significantly more likely to report having an injury in the past year. We also found that those in the youngest group who reported binge drinking in the past 30 days were more likely to report an injury. Lastly, within the oldest 3 groups, individuals who reported using prescription medications were more likely to report an injury in the past year.

In the regression model focused on injury in the past year (**Table 4**), we found that only prescription medication use was associated with increased odds of injury (odds ratio [OR], 2.43; 95% CI, 1.52-3.91). In modeling falls resulting in injury in the past year (**Table 5**), prescription medication use (OR, 1.98; 95% CI, 1.08-3.63) resulted in higher odds of a fall. Additionally, reporting a primary mode of locomotion to be equal between walking and wheeling resulted in higher odds of a fall compared with only using a wheelchair (OR, 5.85; 95% CI, 2.16-15.86). Non-White race

Table 1. Participant characteristics

Characteristics	Mean (SD) or %
Age, years	54.3 (11.9)
30-44	22.5
45-54	28.5
55-64	28.9
65+	20.2
Years post injury	27.0 (10.2)
10-19	27.4
20-29	39.4
30-39	19.6
40+	13.6
Sex	
Male	71.9
Female	28.1
Race/Ethnicity	
White	78.9
Non-White	21.1
Injury severity	
C1-C4, nonambulatory	8.9
C5-C8, nonambulatory	28.1
Noncervical, nonambulatory	37.1
Ambulatory	25.9
<i>Injuries and falls</i>	
Injury in the past year	
Yes	19.2
No	80.8
Fall resulting in injury in past year	
Yes	10.4
No	89.6
<i>Among those who sustained an injury in the past year</i>	
Overnight hospitalization	
Yes	33.8
No	66.2
Days limited in normal activities	
A week or more	47.6
Less than a week	52.5
Days limited in normal time out of bed	
A week or more	35.7
Less than a week	64.3
Days could not get out of my house and go somewhere	
A week or more	42.0
Less than a week	58.0

Table 2. Injuries and injury-related outcomes by age group

Outcomes	Age group, years				Total (N=759)	P
	30-44 (n=171)	45-54 (n=216)	55-64 (n=219)	65+ (n=153)		
Injury in the past year						.4009
Yes	20.6	22.1	17.9	15.4	19.2	
Fall resulting in injury in past year						.4236
Yes	11.1	11.3	11.5	6.7	10.4	
<i>Among those who sustained an injury in the past year</i>						
Mean (SD) number of injuries	1.49 (1.20)	2.42 (2.43)	2.12 (2.02)	1.96 (1.97)	2.04 (2.01)	.2125
Overnight hospitalization						.3323
Yes	23.5	31.9	43.6	36.4	33.8	
Days limited in normal activities						.0340
Less than a week	68.6	41.3	43.6	65.2	52.5	
A week or more	31.4	58.7	56.4	34.8	47.5	
Days limited in normal time out of bed						.0304
Less than a week	80.0	50.0	61.5	73.9	64.3	
A week or more	20.0	50.0	38.5	26.1	35.7	
Days could not get out of my house and go somewhere						.0035
Less than a week	80.0	43.5	48.7	69.6	58.0	
A week or more	20.0	56.5	51.2	30.4	42.0	

Table 3. Percent reporting injury in the past year by age group

Demographics	Age group, years			
	30-44	45-54	55-64	65+
Sex				
Male	19.1 (22)	22.4 (34)	15.2 (25)	15.6 (17)
Female	23.6 (13)	21.3 (13)	26.4 (14)	15.0 (6)
Ambulatory				
Yes	19.4 (6)	30.4 (17)*	22.0 (13)	13.3 (6)
No	21.2 (29)	18.2 (28)	16.1 (25)	15.5 (15)
Race				
White, non-Hispanic	17.2 (23)**	22.0 (35)	16.7 (29)	12.7(16)**
Non-White	33.3 (12)**	22.2 (12)	22.7 (10)	30.4 (7)**
Binge drinking				
Yes	31.3 (15)**	13.5 (5)	9.7 (3)	16.7 (1)
No	15.0 (18)**	23.9 (42)	19.4 (36)	15.5 (22)
Prescription medications (pain, depr, slp)				
Yes	23.6 (26)	27.5 (41)**	21.6 (32)**	19.2 (19)**
No	15.3 (9)	9.5 (6)**	10.1 (7)**	6.5 (3)**

Note: Values given as n (%). depr = stress/depression; slp = sleep.

*P = .0572. **P < .05.

Table 4. Logistic regression of 1 or more injuries in the past year

Characteristics	OR (95% CI)	P
Age, years (vs 30-44)		.7499
45-54	1.07 (0.62-1.83)	
55-64	1.01 (0.56-1.83)	
65+	0.76 (0.39-1.50)	
Years post injury (vs 10-19)		.2642
20-29	1.04 (0.66-1.66)	
30-39	0.75 (0.40-1.38)	
40+	0.52 (0.23-1.18)	
Primary mode locomotion (vs wheelchair)		.6444
Walking	1.05 (0.64-1.75)	
Equal use	1.63 (0.58-4.57)	
Gender (vs male)		.5916
Female	1.12 (0.74-1.71)	
Race (vs White)		.0973
Non-White	1.46 (0.93-2.29)	
Prescription medication (vs none)		.0002
Yes	2.43 (1.52-3.91)	
Binge drinking (vs no)		.6427
Yes	0.88 (0.52-1.50)	

Table 5. Logistic regression of 1 or more falls resulting in injury in the past year

Characteristics	OR (95% CI)	P
Age, years (vs 30-44)		.4199
45-54	0.98 (0.48-2.02)	
55-64	1.18 (0.55-2.53)	
65+	0.59 (0.23-1.48)	
Years post injury (vs 10-19)		.7732
20-29	1.23 (0.66-2.27)	
30-39	0.97 (0.43-2.17)	
40+	0.78 (0.27-2.24)	
Primary mode locomotion (vs wheelchair)		.0021
Walking	1.42 (0.75-2.68)	
Equal use	5.85 (2.16-15.86)	
Gender (vs male)		.8479
Female	1.06 (0.61-1.82)	
Race (vs White)		.0139
Non-White	2.00 (1.15-3.48)	
Prescription medication (vs none)		.0274
Yes	1.98 (1.08-3.63)	
Binge drinking (vs no)		.2874
Yes	0.67 (0.32-1.40)	

was also significantly associated with falls in the past year (OR, 2.00; 95% CI, 1.15-3.48).

Discussion

We found that 19.2% of participants reported sustaining at least 1 injury in the past year, and 10.4% had 1 or more falls resulting in injury in the past year. These results are in line with previous research on injuries.^{1,2} Recent research on fall-related injuries found that 20.3% of ambulatory persons reported a fall-related injury in the past year, but that study did not include participants who were nonambulatory.¹² We did not find an association between age and sustaining an injury or having a fall resulting in injury in the past year. However, there were age differences in participation limitation among participants who had at least 1 injury in the past year. We found that individuals in the middle age groups (45-54; 55-64) were more likely to be limited in their activities, time out of bed, and time out of the house than those in the younger (30-44) or older age groups (65+). In their study of 4 groups with physical disability, Matsuda et al⁹ found that the occurrence of falls peaked in middle age.

In modeling injuries and falls, age and years post injury remained nonsignificant. However, prescription medication use was a significant predictor of both outcomes. This is supported by previous research that showed an association between how often a person used prescription medication and increased risk of injury.^{1,2} Prescription medication use can affect balance, and thus it could contribute to injuries and falls resulting in injury. We also found the primary mode of locomotion to be associated with increased odds of a fall resulting in an injury. Previous research has found a pattern of poor health outcomes for persons who report using a wheelchair and walking equally to get around rather than using either a wheelchair or ambulation as a primary or sole mode of mobility.^{12,13} Among people who are ambulatory, those who use a wheelchair 50%

of the time or less have higher pain intensity, pain interference, and fatigue compared with persons who never use a wheelchair.¹³ However this was not true for persons who wheeled more than half of the time.

Limitations

These results provide valuable information on injuries and falls resulting in injuries among persons with SCI, but there are several limitations. First, all data were self-report, including the outcomes. Although we were not able to verify injuries through medical record, we attempted to limit reporting bias by restricting our questions to the previous year and dichotomizing the responses as yes or no. Self-report of prescription medication use could also be subject to reporting bias, and we attempted to reduce this bias by asking only general information about frequency of use to treat particular conditions. Additionally, we did not have information on the underlying conditions for which the participants were taking medication, and thus could not distinguish the effects of prescription medications on falls versus the effects of the underlying condition itself. Finally, participants were identified through rehabilitation hospitals in the Midwest and Southeast, and thus the results may not represent the experiences of all persons with SCI.

Future research

Future research should investigate the circumstances surrounding subsequent injuries, as the identification of these circumstances will be important in prevention efforts. Additionally, information is needed on whether these subsequent injuries further contribute to physical disability. Finally, research should include individuals from population-based cohorts to extend the generalizability of results beyond individuals identified through large rehabilitation hospitals.

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