Research article

A survey of protective cushion usage in individuals with spinal cord injury while traveling in a motor vehicle and on a commercial airliner

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Objective: While there are specific recommendations for pressure relieving cushions when seated in a wheelchair, there is a paucity of information regarding prescribed wheelchair cushions for persons with spinal cord injury (SCI) when traveling and not in their wheelchair seat. A questionnaire was designed to ascertain if individuals with SCI who are primarily wheelchair users utilize a prescribed wheelchair cushion when traveling in a motor vehicle (MV) or on a commercial airliner, as not utilizing one may be a causative factor in developing pressure ulcers.

Design and setting: Survey design in an outpatient SCI rehabilitation setting.

Participants: Full-time wheelchair users, with chronic (>1 year) SCI.

Results: Forty-two participants completed the survey, with a mean age of 39 years old and time post-injury of 10.4 years. All subjects used a prescribed wheelchair cushion when seated in their wheelchair. Twenty-seven subjects reported transferring to a MV seat (59.5% of sample), with 25 (92.6%) reporting not using a prescribed wheelchair cushion when sitting directly on the MV seat. For subjects who traveled on an airplane ($n = 23$ –54.8%), 19 (82.6%) reported that they do not sit on a prescribed specialty cushion.

Conclusion: Persons with chronic SCI, who are primary wheelchair users, utilize prescribed wheelchair cushions when sitting in their wheelchair, but most do not utilize a prescribed wheelchair cushion when seated in a MV (if they transfer out of their chair) or on a airplane seat. Studies to determine the pressures over the bony prominences on their travel surfaces may need to be undertaken to see whether the pressures are appropriate, as they may be a source of skin breakdown.

Keywords: spinal cord injury, pressure ulcers, cushions, prevention, survey

Introduction

Despite advances in many aspects of care, pressure ulcers remain one of the most common and serious complications affecting persons with spinal cord injury (SCI). It has been estimated that 50–80% of persons with SCI will, at some time after their injury, develop a pressure ulcer.^{1–5} Pressure ulcers may interfere with mobility and community reintegration, can lead to a loss of independence, more serious medical complications, and result in profound economic and psychosocial consequences that may negatively impact quality of life.^{1,6}

Pressure ulcers most commonly occur at the ischial tuberosities (IT) due to the pressures associated with sitting, followed by the sacrum, in those with chronic SCI.^{1–3} A major focus of rehabilitation healthcare providers who serve this population is to educate the patient (and caregivers) to prevent the development of pressure ulcers. This includes education regarding etiology, risk factors, and proper positioning; prescribing appropriate equipment including pressure relieving cushions; and performance of timely and effective weight shifting. Prescribed wheelchair cushions are recommended for all full-time wheelchair users with SCI when sitting in a wheelchair.^{1,7} The primary purpose of the cushion is to reduce excessive pressure over the bony prominences

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and thereby aid in the prevention of pressure ulcer formation.^{7,8} However, there is no information in the literature that we could find regarding the use of prescribed wheelchair cushions during automotive or commercial airline travel in SCI individuals or the incidence of pressure ulcer development from sitting on these standard seats.

Based on clinical observation, our SCI team recognized that many persons with SCI were not utilizing pressure reducing cushions when traveling and seated in a motor vehicle or on a commercial airline seat and often was a possible cause for the development of pressure ulcers. While not mentioned in the literature directly, it would seem appropriate that pressure reduction at all times that the person is seated should be undertaken, not only when seated in the wheelchair.

This pilot project was undertaken to survey persons with SCI who utilize a wheelchair as their primary means of mobility. The primary purpose of this survey was to determine whether those individuals at risk for the development of pressure sores (i.e. persons with SCI who are primarily wheelchairs users) are using a prescribed wheelchair cushion while traveling in a motor vehicle (as the driver or passenger) or in a commercial airliner. For this study, we were not looking to make a direct association between the development of pressure ulcers and the use (or lack thereof) of specialty cushions while traveling.

Methods

Persons with chronic SCI, defined as duration of injury >1 year, presenting to an outpatient rehabilitation facility were asked to complete a questionnaire (Fig. 1) that was approved by the Institutional Research Board. Inclusion criteria to complete the survey included using a wheelchair as their primary means of mobility and being between the ages 18 and 75 years old. Participants who could not write the responses on their own completed the questionnaire verbally with an approved study personnel who recorded their responses. Descriptive analysis was performed to answer the main focus of this survey.

Results

Forty-three persons met the criteria for participation in this study; however, for one subject the data were incomplete. Mean age of the remaining sample ($n = 42$) group was 39.3 (± 12.86) years with a range of 20–71 years. Eighty-six percent were male, with a mean time post injury of 10.4 years (range of 1–42 years post injury). Of the group, 22 participants had tetraplegia and the remaining 20 had paraplegia; 40% of the sample reported having

a complete injury, 53% an incomplete injury and the remainder (7%) unsure. All of the participants reported the wheelchair being their primary means of mobility.

Participants reported that a variety of wheelchairs were utilized as their primary means of mobility (Fig. 2). All of the participants utilized a prescribed wheelchair cushion when seated in their wheelchair. Fourteen subjects (33.3%) reported being primarily drivers, 22 (52.4%) reported being passengers, and 6 (14.3%) reported being both a driver and a passenger. Of the 42 survey responders, 27 (64.3%) of the subjects reported transferring to a motor vehicle seat and 15 (35.7%) subjects reported always traveling in their wheelchairs (with their cushion). Of the 27 subjects who transferred to a motor vehicle seat, 25 (92.6%) reported not using a specialty cushion when sitting on the motor vehicle seat.

Twenty-three subjects reported traveling on an airplane and 19 (82.6%) reported not sitting on a prescribed specialty cushion with only four (17.4%) subjects reporting using a specialty cushion when traveling by commercial airline.

The survey also asked questions regarding whether subjects previously underwent pressure mapping, had a history of pressure ulcers and their practice of weight shifting in a motor vehicle. Pressure mapping technology uses a thin sensory layer that is situated atop any surface for the purpose of attaining a reading that corresponds to the magnitude of pressure distribution applied to that surface. Clinicians use pressure mapping technology for the purpose of designing and then prescribing a specialty cushion to individuals with SCI that provides effective pressure relief to regions underneath bony surfaces. Of the 42 participants, 21 (50%) reported that they had been pressure mapped in their own wheelchair cushion in their own wheelchairs. Two participants (4.7%) did not respond and only one participant reported being pressure mapped in their car seat. Twenty-five subjects (59.5%) stated that they had a history of pressure ulcers and three of those participants related that development of the pressure ulcer specifically from sitting either on a motor vehicle seat (two subjects) or from an airline seat (one subject).

Of the participants who transferred onto the vehicle seat, 55.5% reported a history of pressure ulcer (15 of the 27 respondents), whereas 66% of participants who did not transfer reported developing a pressure ulcer. In terms of performing weight shifts, there was also no significant difference, as 66.7% of the participants who sat on the motor vehicle seat versus 60% of the participants who sat on a prescribed wheelchair cushion reportedly performed them.

Please answer the following as best as possible:

1. Age _____
2. Gender: Male ☐ Female ☐
3. Injury Level: _____
4. Length of time post injury (in years): _____
5. Complete Injury: ☐ Incomplete Injury: ☐ Unsure: ☐
6. Education Level: did not graduate HS: ☐ HS graduate: ☐ College Graduate: ☐
7. Ethnicity (optional) _____

Questions:

1. Is the wheelchair your primary means of mobility: Yes ☐ No ☐
2. What kind of wheelchair do you have? Manual ☐ Power ☐ Both ☐ Other ☐
3. What kind of vehicle do you ride/drive? Sedan ☐ Van ☐ SUV ☐ Other ☐ _____
4. Are you primarily a driver or a passenger? _____
5. Is your vehicle: Modified ☐ Unmodified ☐
6. Do you drive/ride primarily from the wheelchair or the vehicle seat? _____
7. If you sit on the vehicle seat, do you use a cushion? Yes ☐ No ☐ (If no, skip to #9)
8. If you use a cushion, is it the same one from your wheelchair or a different one? _____
9. Do you perform weight shifts when in a vehicle? _____ (if no, skip to #11)
10. If yes, how often? _____ (skip to #12)
11. If no, why not? _____
12. Do you travel by plane? _____
13. When traveling by plane, do you use a cushion on top of the plane seat? Yes ☐ No ☐ (if no, skip to #15)
14. If you use a cushion on the plane, is it the same one from your wheelchair or a different one? Same ☐ Different from wheelchair cushion ☐
15. Do you perform weight shifts on the plane? Yes ☐ No ☐ (If no, skip to #17)
16. If yes, how often? _____ (Skip to #18)
17. If no, why not? _____
18. Have you ever been pressure mapped?
 - a. On your wheelchair cushion? Yes ☐ No ☐
 - b. In your car vehicle seat or cushion in the car? Yes ☐ No ☐
19. How do you enter into your vehicle?
 - Transfer Board ☐ Lateral transfer ☐ Other ☐
20. If yes, what kind of assistance do you require? _____
21. Do you have a history of skin breakdown/pressure ulcers? Yes ☐ No ☐

(If no, you have completed the questionnaire -> see bottom)
22. If yes, how many have you had since your injury? _____
23. If yes, did any of these occur from traveling on a motor vehicle or on a plane?
 - ☐ Yes in car (If yes, please see #24) ☐ Not from a car (See bottom)
 - ☐ Yes in plane (If yes, please see #25) ☐ Not from a plane (See Bottom)
24. How many pressure ulcers have you developed from sitting in a car?
 - Amount of ulcers? _____
 - Over what period of time? _____
25. How many ulcers have you developed from sitting on a plane?
 - Amount of ulcers? _____
 - Over what period of time? _____

Figure 1 Sample questions from the survey.

Figure 2 Wheelchair type utilized by sample.

Discussion

Pressure ulcers are a major cause of morbidity and mortality in SCI and are one of the most common secondary complications all years after injury.⁹ The incidence of pressure ulcers increases with the duration of the SCI.^{9–11} The annual prevalence has been reported to be 31–52% with 31–79% of the SCI population troubled with recurrent ulcers.^{1,9,12–16} Diseases of the skin, including pressure ulcers, were found to be the second most common overall cause of re-hospitalization of persons with SCI for all years cumulative from year 1 to 20, behind diseases of the genitourinary system.¹⁷ Cardenas *et al.*¹⁷ reported that those with ASIA Impairment Scale (AIS) A, B, or C paraplegia were more likely to be re-hospitalized with skin issues than those with any level of tetraplegia or AIS D paraplegia. Approximately 8% of those who develop pressure ulcers will die from related complications.¹⁸

Pressure ulcers are responsible for physical, social, and vocational losses as well as a direct economic cost. While recent cost data on pressure ulcers in the SCI population is difficult to obtain, it has been estimated that the overall cost of care for pressure ulcers are approximately \$1.2–1.3 billion annually with prevention costs about one-tenth of this.^{18–20} The cost to heal ulcers vary by their severity, with less serious ulcers ranging up to \$30 000 and the cost to heal a complex full-thickness pressure ulcer estimated at \$70 000.¹ These costs are higher when taking into account increased attendant and skilled care, long-term hospitalization and post-surgical intervention. Pressure ulcers also have indirect costs including the loss of income, productivity, progress toward rehabilitation and vocational goals, independence, self-esteem, and sense of self-worth.²¹

The first line of treatment of pressure ulcers is prevention. While seated, the IT and sacrum are the areas most prone to developing pressure ulcers, while it is recommended that all persons with sensory and/or motor deficits use a proper cushion and perform weight shifts

while seated in their wheelchair,^{1,7} we were unable to find any literature discussing the use of a prescribed wheelchair cushion when traveling in a car or airplane.

The findings of this survey reveal that all of these participants at high risk for pressure ulcers understand the importance of and utilize a prescribed pressure relieving cushion when seated in their wheelchair as recommended. However, most do not utilize the same precaution when seated in a motor vehicle or when flying on a commercial airliner. Perhaps this is related to no specific recommendations published regarding this specific indication. Because of the small sample, it is difficult to correlate if the patients reporting developing of pressure ulcers overall is related to the use of the specialty cushion when traveling. In addition, professionals site the importance of performing interface pressure mapping for prescribed cushions in the wheelchair, and 50% of participants reported undergoing this procedure, but only one participant reported having this in a motor vehicle.

Another potential reason for an increase in pressure ulcers from sitting in a motor vehicle or commercial airline seats may be the difficulty with performing weight shifts while traveling. Weight shifting education is a topic discussed on a consistent basis with persons with SCI who utilize a wheelchair, both during an inpatient and outpatient program. However, there is nothing in the literature that states weight shifting should be performed when traveling in a car or on an airplane. There was no reported difference in performance of weight shifts whether the participant utilized a specialty cushion or not. When asked if they perform timely weight shifting when traveling in their car 16/42 stated that they do not perform any weight shifting while traveling with reasons such as “I take short trips,” “I have sensation,” and including “being lazy.”

Limitations of this study include not asking the question as to why they did not use a prescribed wheelchair cushion when traveling in a motor vehicle or plane; why they did not perform weight shifts in a car or plane; and we did not look to correlate use, or lack thereof, of a prescribed wheelchair cushion with subsequent development of a pressure ulcer.

Based on this preliminary work, further study should be undertaken to determine the pressures at the IT and sacrum when sitting on a standard car seat or a commercial airline seat relative to the subject's pressures while seated in their wheelchair as well as on a standard seat with a pressure relieving cushion. Based on these findings, education programs may add further recommendations while traveling in a motor vehicle and/or on a commercial airline for full-time wheelchair users who are at risk for pressure ulcers.

Conclusion

This survey revealed that 91% of full-time wheelchair users with SCI who sit in a vehicle seat and 79% of those seated on a commercial airline seat do not use a prescribed specialized cushion while traveling. Further studies should be undertaken to examine barriers to cushion use as well as further studies are needed to determine appropriate pressures while traveling in either a motor vehicle or on a commercial airline seat to appropriately educate patients to prevent pressure ulcer formation.

Disclaimer statements

Contributors All three authors played a pertinent role in the development and completion of the study.

Ethics approval Ethics approval was not required for this survey design study

Conflicts of interest None.

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