

# Traumatic spinal cord injuries among Aboriginal and non-Aboriginal populations of Saskatchewan: a prospective outcomes study

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**Background:** People of Aboriginal (Indigenous) ancestry are more likely to experience traumatic spinal cord injury (TSCI) than other Canadians; however, outcome studies are limited. This study aims to compare Aboriginal and non-Aboriginal populations with acute TSCI with respect to preinjury baseline characteristics, injury severity, treatment, outcomes and length of stay.

**Methods:** This was a retrospective analysis of participants with a TSCI who were enrolled in the prospective Rick Hansen Spinal Cord Injury Registry (RHSCIR), Saskatoon site (Royal University Hospital), between Feb. 13, 2010, and Dec. 17, 2016. Demographic, injury and management data were assessed to identify any differences between the populations.

**Results:** Of the 159 patients admitted to Royal University Hospital with an acute TSCI during the study period, 62 provided consent and were included in the study. Of these, 21 self-identified as Aboriginal (33.9%) and 41 as non-Aboriginal (66.1%) on treatment intake forms. Compared with non-Aboriginal participants, Aboriginal participants were younger, had fewer medical comorbidities, had a similar severity of neurologic injury and had similar clinical outcomes. However, the time to discharge to the community was significantly longer for Aboriginal participants (median 104.0 v. 34.0 d,  $p = 0.016$ ). Although 35% of non-Aboriginal participants were discharged home from the acute care site, no Aboriginal participants were transferred home directly.

**Conclusion:** This study suggests a need for better allocation of resources for transition to the community for Aboriginal people with a TSCI in Saskatchewan. We plan to assess outcomes from TSCI for Aboriginal people across Canada.

**Contexte :** Au Canada, les personnes d'origine autochtone sont plus susceptibles que les autres de vivre un traumatisme médullaire. Malgré cela, il y a peu d'études sur les conséquences de cet événement. Notre étude visait à comparer les cas de traumatisme médullaire aigu dans les populations autochtones et non autochtones sur plusieurs plans : les caractéristiques initiales des patients, la gravité du traumatisme, la nature du traitement, les issues cliniques et la durée de séjour.

**Méthodes :** Nous avons fait une analyse rétrospective des dossiers de personnes ajoutées au Rick Hansen Spinal Cord Injury Registry (RHSCIR) [Registre des traumatismes médullaires Rick Hansen] entre le 13 février 2010 et le 17 décembre 2016 pour l'établissement de Saskatoon (l'Hôpital universitaire Royal). Nous avons comparé les renseignements de base des patients ainsi que les données sur le traumatisme et la prise en charge afin de cerner toute différence entre les populations.

**Résultats :** Sur les 159 traumatisés médullaires admis à l'Hôpital universitaire Royal pendant la période à l'étude, 62 ont consenti à l'utilisation de leurs données. Parmi eux, 21 s'étaient identifiés comme Autochtones (33,9%) sur le formulaire d'hospitalisation, et 41 comme non-Autochtones (66,1%). Par rapport aux non-Autochtones, les Autochtones étaient plus jeunes, avaient moins de comorbidités, présentaient une atteinte neurologique de gravité comparable et connaissaient à peu près le même tableau clinique. Toutefois, le délai avant leur retour en communauté était significativement plus long (médiane : 104,0 jours contre 34,0 jours;  $p = 0,016$ ). Aucun participant autochtone n'a été renvoyé directement à la maison, alors que 35% des participants non autochtones sont retournés chez eux en quittant les soins de première ligne.

**Conclusion :** Cette étude montre qu'il faut améliorer la répartition des ressources de retour dans la communauté pour les traumatisés médullaires autochtones de la Saskatchewan. Enfin, nous comptons examiner les répercussions cliniques du traumatisme médullaire chez les Autochtones de partout au Canada.

**A** boriginal (Indigenous) peoples account for 5% of the Canadian population (roughly 1.6 million people)<sup>1</sup> and include First Nations, Inuit and Métis peoples. About 16% of the people in Saskatchewan are Aboriginal, a higher percentage than in most other provinces in Canada. Studies have shown an increased prevalence of injuries in areas with relatively large Aboriginal populations. Fines and colleagues reported a substantial increase in the incidence of hospital admission because of injury in areas with larger Aboriginal populations: people in areas with a high percentage of First Nations, Métis and Inuit peoples were 2.68, 2.05 and 1.84 times more likely to be admitted to hospital because of injury, respectively, than people in the general Canadian population.<sup>2</sup> More recently, a study in British Columbia found that Aboriginal people were 1.89 times more likely to experience transport-related injury between 1991 and 2010 than the general BC population.<sup>3</sup> Disparities in health status as well as in Aboriginal populations' access to health care and in the quality of the care available to them have also been well documented. Traumatic spinal cord injury (TSCI) is a particularly devastating type of trauma, requiring substantial acute and chronic care. A Manitoba epidemiologic study of TSCI showed that between 2003 and 2007, the incidence of TSCI for Aboriginal populations was 78.9 compared with 32.2 per million for non-Aboriginal populations.<sup>4</sup> Despite these disparities, outcome studies for TSCI in Aboriginal populations have been limited to qualitative, phenomenologic (i.e., interview based) reports. To the best of our knowledge, there have been no quantitative outcomes-based studies for TSCI in Aboriginal populations in Canada.

The objectives of this study were to compare Aboriginal and non-Aboriginal populations with acute TSCI with respect to baseline participant demographic characteristics, comorbidities, and mechanism and severity of injury; time to surgery, neurologic outcomes, morbidity, mortality and length of stay in acute care and rehabilitation; and time to discharge to community and outcomes at 1 year after discharge (functional independence measures, quality of life scores, secondary health conditions, compensation type, employment status).

## METHODS

Study participants were recruited from the Rick Hansen Spinal Cord Injury Registry (RHSCIR), which prospectively enrolled adults who were admitted with a new acute TSCI to 18 acute care facilities and 13 rehabilitation facilities across Canada. The registry was initiated in 2004 to answer a priori research questions and to facilitate the implementation of best practices. The Saskatoon site of the RHSCIR covers the northern and central

regions of Saskatchewan, as the only tertiary care trauma centre in the province. Ethics approval for this study was provided by the University of Saskatchewan Biomedical Research Ethics Board and the Saskatoon Health Region. Full participant consent is required for collection of the comprehensive data set, which includes data on ethnicity. Data were retrospectively collected for participants enrolled in the RHSCIR at Royal University Hospital (acute care site) and Saskatoon City Hospital (rehabilitation site) between Feb. 13, 2010, and Dec. 17, 2016. The RHSCIR data set has been described elsewhere.<sup>5</sup>

## Participants

The study cohort included patients whose TSCI was of any neurologic severity (American Spinal Injury Association Impairment Scale [AIS] A to D) and at a single neurologic level from C1 up to and including L1 at admission to acute care at a RHSCIR facility as assessed using the International Standards for the Neurological Classification of Spinal Cord Injury (ISNCSCI).<sup>6</sup>

## Participant and injury characteristics

Data analysis included age, sex, preexisting medical comorbidities (assessed as a total count of preexisting health conditions at the time of injury and as a score calculated using the Charlson Comorbidity Index).<sup>7</sup> Self-declared ethnic background was used to stratify enrolled participants into Aboriginal and non-Aboriginal cohorts.

Injury mechanism was obtained from the RHSCIR and classified as fall, sports, transport or assault. Data for neurologic severity (AIS) and level of injury were obtained from the ISNCSCI examination conducted at the time the patient was admitted to and discharged from inpatient care. Neurologic injury was classified as high complete tetraplegia (AIS A, C1–C4), low complete tetraplegia (AIS A, C5–T1), incomplete tetraplegia (AIS B, C or D, C1–T1), complete paraplegia (AIS A, T2–L1), incomplete paraplegia (AIS B, C or D, T2–L1) or conus medullaris or cauda equina syndrome. The accuracy of all ISNCSCI classification data collected were verified using the validated Rick Hansen Institute ISNCSCI algorithm (version 1.0.3),<sup>8</sup> which was built into the electronic data capture system used.

## Management

Time from injury to arrival at the acute care site was analyzed. Data analysis also included initial management during the acute hospital admission (i.e., surgery v. conservative treatment) and, where applicable, time from injury to surgery. Data on acute, rehabilitation and total length of stay (LOS) were also obtained.

## Discharge destination and 1-year outcomes

Discharge destination was categorized as inpatient rehabilitation facility, private residence, other inpatient facility or morgue. Change in functional status between discharge to the community and 1-year follow-up was assessed by the Functional Independence Measure (FIM).<sup>9</sup>

## RESULTS

During the study period, 159 patients with acute TSCI were admitted to the Saskatoon acute care or rehabilitation site, of whom 62 (39%) provided consent for comprehensive data collection and were included in this study. Data on participant and injury characteristics, treatment and outcomes are summarized in Table 1. Twenty-one participants (34%) self-identified as being Aboriginal, while 41 (66%) were non-Aboriginal. Of the latter, 40 participants self-identified as “white” and 1 self-identified as “Asian.” A majority of both Aboriginal (71%,  $n = 15$ ) and non-Aboriginal (78%,  $n = 32$ ) participants were men. Aboriginal participants were younger than the non-Aboriginal cohort on average (mean age 36.0 v. 49.8 yr,  $p = 0.010$ ); there was no sex difference between the Aboriginal (71% male) and non-Aboriginal (78% male) cohorts ( $p = 0.56$ ). On average, non-Aboriginal participants had more comorbidities, which was probably a by-product of the fact that this cohort was older. Comorbidities are summarized in Table 2.

The mechanism of injury differed between the 2 cohorts. In the non-Aboriginal population, transport- and fall-related injuries were most common, followed by sports-related injuries (39%, 37% and 22% of participants, respectively); none of the non-Aboriginal participants presented with an assault-related TSCI. Transport was the most common cause of injury in the Aboriginal cohort (38%), followed by assault, sports and falls (29%, 19% and 10% of participants, respectively) (Table 1).

Neurologic injury severity and level at admission were similar in the 2 cohorts. Incomplete tetraplegia was the most common type of injury in both Aboriginal (38%) and non-Aboriginal (37%) participants. Neurologic classification data were not available for

**Table 1. Participant, injury, treatment and outcome variables**

Variable	No. (%) of participants*		p value†
	Aboriginal $n = 21$	Non-Aboriginal $n = 41$	
Age, yr, mean	36.0	49.8	0.010
Sex, male	15 (71)	32 (78)	0.56
Mechanism of injury			0.003
Transport	8 (38)	16 (39)	
Fall	2 (10)	15 (37)	
Sports	4 (19)	9 (22)	
Assault	6 (29)	0	
Neurologic condition at admission			0.51
High complete tetraplegia	2 (10)	3 (7)	
Low complete tetraplegia	2 (10)	0	
Incomplete tetraplegia	8 (38)	15 (37)	
Complete paraplegia	2 (10)	6 (15)	
Incomplete paraplegia	0	3 (7)	
Cauda equina or conus medullaris syndrome	1 (5)	4 (10)	
Unknown	6 (29)	10 (24)	
Surgical management			0.31
Yes	15 (71)	35 (85)	
No	6 (29)	6 (15)	
Time from injury to admission, h, median‡	8.0	7.0	0.38
Time from injury to surgery, h, median§	26.0	25.0	0.37
Time from admission to surgery, h, median¶	20.0	15.0	0.20
Discharge destination (from Royal University Hospital)			< 0.001
Private residence	0	15 (37)	
Inpatient rehabilitation	15 (71)	20 (49)	
Other inpatient facility	6 (29)	4 (10)	
Morgue	0	2 (5)	
Time in rehabilitation, d, median	93.0	56.5	0.35
Time to community discharge, d, median	104.0	34.0	0.016
Neurologic condition at discharge			0.21
High complete tetraplegia	2 (10)	1 (2)	
Low complete tetraplegia	1 (5)	0	
Incomplete tetraplegia	5 (24)	7 (17)	
Complete paraplegia	0	4 (10)	
Incomplete paraplegia	5 (24)	8 (20)	
Cauda equina or conus medullaris syndrome	1 (5)	1 (2)	
Unknown	7 (33)	20 (49)	
FIM score at discharge, mean (no. of participants)	100.1 (17)	98.3 (25)	0.91
FIM score at 1-yr follow-up, mean (no. of participants)	96.3 (7)	112.3 (11)	0.24
FIM score change, mean (no. of participants)	6.9 (7)	7.3 (10)	0.77

FIM = Functional Independence Measure.  
 \*Unless indicated otherwise.  
 †Calculated using Fisher exact tests (age, surgical management, mechanism of injury, neurologic condition at admission, neurologic condition at discharge, discharge destination from Royal University Hospital), pooled Student  $t$  tests (time from injury to admission, time from injury to surgery, time from admission to surgery, time in rehabilitation, time to community discharge), Pearson  $\chi^2$  tests (sex) or Wilcoxon rank-sum tests (FIM at discharge, FIM at 1-year follow-up, FIM score change).  
 ‡Outliers removed (values > 129 h,  $n = 5$ ).  
 §Outliers removed (values > 219 h,  $n = 5$ ).  
 ¶Outliers removed (values > 160 h,  $n = 3$ ).

**Table 2. Participant comorbidities**

Variable	No. (%) of participants*		p value†
	Aboriginal n = 21	Non-Aboriginal n = 41	
No. of comorbidities, mean	1.1	2.5	0.17
Comorbidity classification			
Cardiovascular	1 (5)	6 (15)	
Hypertension	1 (5)	10 (24)	
Lung disease	1 (5)	8 (20)	
Liver disease	2 (10)	0	
Diabetes	2 (10)	8 (20)	
Cancer	0	1 (2)	
Psychiatric disease	3 (14)	9 (22)	
Osteoarthritis	0	8 (20)	
Kidney disease	0	3 (7)	
Connective tissue disease	0	6 (15)	
Alcohol misuse	2 (10)	2 (5)	
Bone fractures	1 (5)	5 (12)	
Previous spinal cord injury	0	2 (5)	
Other	1 (5)	1 (2)	
Unknown	9 (43)	10 (24)	

\*Unless indicated otherwise.  
†Calculated using Wilcoxon rank-sum test.

6 (29%) Aboriginal and 10 (24%) non-Aboriginal participants (Table 1). Time from injury to admission to the acute care site did not differ significantly for the 2 groups: median time to admission was 8.0 hours for Aboriginal participants and 7.0 hours for non-Aboriginal participants ( $p = 0.38$ ). This comparison was completed after the removal of 5 outliers from the non-Aboriginal cohort, all presenting more than 129 hours after injury.

Management strategies differed between Aboriginal and non-Aboriginal participants, with rates of conservative (nonoperative) management being twice as high among Aboriginal participants (29% v. 15%); however, this difference was not statistically significant (Table 1). Where surgery was performed, Aboriginal participants waited a median of 5.0 hours longer from admission for surgical management than non-Aboriginal participants, but this difference also was not statistically significant.

Discharge destination from the acute care site was to an inpatient rehabilitation facility for most participants: 71% of Aboriginal and 49% of non-Aboriginal participants. Home was the second most common discharge destination for non-Aboriginal participants (37%); no Aboriginal participants were discharged home from acute care. Other inpatient facilities, such as home hospitals with various levels of care, were destinations for 29% of Aboriginal and 10% of non-Aboriginal participants. Two non-Aboriginal participants died in acute

care; there were no such deaths in the Aboriginal cohort. Although not statistically significant, there was a trend for Aboriginal participants to have a longer stay at the rehabilitation facility (median 93.0 v. 56.5 d,  $p = 0.35$ ). Neurologic condition upon discharge to community was similar in the 2 groups. These results are summarized in Table 1.

The FIM scores at discharge were similar in the 2 cohorts. Mean FIM scores at discharge were 100.1 and 98.3 for Aboriginal and non-Aboriginal participants, respectively; 4 Aboriginal and 16 non-Aboriginal participants had missing FIM data. One-year follow-up data were available for 7 (33%) Aboriginal and 11 (27%) non-Aboriginal participants. Mean FIM scores at 1-year follow-up were 96.3 for Aboriginal and 112.3 for non-Aboriginal participants. The increasing disparity between these FIM scores may be confounded by the injury severity of the responding participants. Both Aboriginal and non-Aboriginal participants had mild improvement in their total FIM scores (mean improvement of 6.9 and 7.3 points, respectively). There was no statistically significant difference between the cohorts for any of the FIM comparisons.

**DISCUSSION**

Aboriginal Canadians represent one of the fastest growing segments of the population. Disproportionately high numbers of Aboriginal people experience traumatic injuries, including TSCI.<sup>2-4,10-17</sup> This study reveals substantial disparity between Aboriginal and non-Aboriginal participants in regard to LOS and time from injury to discharge to the community following an acute TSCI. This disparity exists even though the 2 cohorts had similar injury severity characteristics and the Aboriginal participants were younger and had fewer comorbidities than the non-Aboriginal participants.

We believe that the disparity between the groups in LOS and discharge to community reflects the lack of community resources for Aboriginal peoples, particularly on reserves. In Saskatchewan, Aboriginal communities are typically in rural locations, which may increase disparities owing to remoteness and the limited access to specialized care and support for people living with TSCI. A qualitative analysis of challenges in TSCI rehabilitation for Aboriginal populations highlighted the lack of accessibility infrastructure as a major barrier to discharge to community and returning home.<sup>18</sup> A more recent survey of RHSCIR participants and their caregivers in Ontario similarly highlighted the lack of knowledge of availability of, or access to, appropriate and sufficient resources in the community as major barriers to living in a home setting. These barriers included lack of funding for, or access to, home-modification support, third-party caregivers and assistive technology.

Furthermore, fragmented care and isolation in a remote community was also identified as a barrier to providing care at home by people with spinal cord injuries and their caregivers.<sup>19</sup> Jurisdictional disputes between the federal and provincial governments regarding the coverage of community services also substantially affects the ability of Aboriginal people to access services. These disputes and the resulting lapses in timely care resulted in Jordan's Principle for pediatric Aboriginal patients. However, adherence to the principle remains inconsistent, and it does not address the care needs of the adult Aboriginal population.<sup>20</sup>

Although not reaching statistical significance, disparities in Aboriginal participants' access to acute care were also seen. These included longer time from injury to acute care admission as well as longer time from admission to surgery for Aboriginal participants. The former is probably a product of Aboriginal participants being injured in more remote geographic locations, and it is clinically important as earlier presentation to hospital after TSCI allows for earlier diagnosis and definitive management. The longer time from admission to surgery is a concerning trend, given that compared with non-Aboriginal participants, Aboriginal participants were younger, had a similar severity of injury and had fewer comorbidities, which could necessitate delayed surgical management for medical optimization purposes. A previous RHSCIR study showed that elderly participants (aged  $\geq 70$  yr) waited substantially longer for surgery than younger participants (37 v. 19 h), even after adjustment for neurologic level, injury severity and comorbidity status.<sup>21</sup> This was probably related to surgical decision-making in elderly patients, balancing the neurologic prognosis with surgical risks in older patients. Further study of the observed trends in access to acute care in Aboriginal patients, as well as the clinical decision-making in these cases, is necessary to ensure that Aboriginal patients with a TSCI receive acute care equal to that received by non-Aboriginal patients.

Cumulative distribution analysis of the entire Canadian RHSCIR cohort showed that 63.8% of participants were admitted to the acute care site within 12 hours, and 62.0% of participants received surgical management within 24 hours of admission.<sup>22</sup> The median time from injury to admission in our study was 7.0 hours for the non-Aboriginal cohort and 8.0 hours for the Aboriginal cohort, and the median time to surgery (from admission) was 15.0 and 20.0 hours for non-Aboriginal and Aboriginal participants, respectively. Both these measures compare well with the wider Canadian landscape. National measures of acute care access for Aboriginal patients with a TSCI would be helpful to ensure provision of timely acute care for all Aboriginal patients and address regional disparities.

The prevalence of assault as a cause of TSCI in our Aboriginal cohort, and the disparity between the Aboriginal and non-Aboriginal cohorts in this regard, is another important and concerning finding of this study. The rates of assault-related TSCI in the general Canadian population are very low (1.5%–3.2%),<sup>4,13–15</sup> and the higher rate in the Saskatchewan Aboriginal population in this study is cause for concern.

We plan to expand this study to the entire Canadian Aboriginal population, to determine the level of disparity that exists in acute and community TSCI care throughout the country. Further study is warranted into appropriate access to care, mobility challenges, peer support and quality of life after long-term disability in rural areas and Aboriginal reserves. Data from such studies may be used to increase awareness of and education about TSCI in the communities. Community engagement and partnership with Aboriginal Elders are vital to the development of culturally appropriate solutions for TSCI care for Aboriginal people in Canada.

### Limitations

Although the RHSCIR includes all patients with a new TSCI presenting to the acute care centre, consent for collection of the comprehensive registry is required to collect data regarding ethnicity. Given that marginalized groups have historically had lower rates of participation in opt-in studies, our data set may not capture all Aboriginal people with a TSCI or their outcomes. Furthermore, it is not possible to draw complete epidemiologic conclusions regarding TSCI in the province, because there are 2 acute care centres that receive TSCI patients but only 1 centre is part of the RHSCIR. The difference between the Aboriginal and non-Aboriginal cohorts with regard to surgical and nonsurgical management did not reach statistical significance, even though twice as many Aboriginal patients were managed nonsurgically. The study was probably underpowered in this regard. A substantial number of patients were lost to follow-up at 1 year, making it difficult to draw definitive conclusions about the changes in functional status between the 2 cohorts.

### CONCLUSION

In this study, Aboriginal people with a TSCI had a longer hospital LOS and a correspondingly longer time to discharge to community than non-Aboriginal people, even though they were younger, had lower levels of comorbidity and had a similar injury severity. These findings probably reflect disparities in access to community resources. Further study is needed in the Canadian context to quantify these differences, to address them adequately through advocacy for resource allocation for Aboriginal communities.

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