

# A cohort study for the impact of activity-limiting injuries based on the Canadian National Population Health Survey 1994–2006

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## ABSTRACT

**Objective:** To examine the prevalence and factors affecting activity-limiting injuries (ALI) in individuals and in the Canadian population; to estimate the short and long term impact on health status and well-being because of ALI in Canada from 1994 to 2006 using the Canadian National Population Health Survey (NPHS).

**Design:** The NPHS is a randomised longitudinal cohort study with biennial interviews, with information on age, sex, education, marital status, income, residence, height and weight to self-perceived health status, healthcare utilisation and medication use in addition to ALI.

**Setting:** The study population was a random sample of male and female participants 20 years and older from 10 provinces and three territories in Canada.

**Primary and secondary outcome measures:** Logistic regression models were used to assess the potential impact of ALI on individuals and on the Canadian population. The interviews 2 years before and 2 years after the ALI were compared to examine long-term effects, and the McNemar test option in SAS was used for the matched analysis.

**Results:** The immediate impacts of ALI were pain, disability and disruption of regular life. Long-term effects in patients were chronic pain and increased medical doctor visits. Population impact included a considerable increase in healthcare access and cost. The odds ratios (OR) for the 20–39 age group compared with those 60+ was 2.2; 95% CI 1.8 to 2.7, while the OR associated with male participants was 1.4; 95% CI 1.1 to 1.6. Individuals consuming nine or more alcoholic drinks per week were also significantly more likely to report an ALI (OR, 1.5; 95% CI 1.3 to 1.8).

**Conclusions:** The findings from this study illustrated the immediate and long-term impact of individuals and population level injuries in Canada. Injury control policies should aim to prevent the number of injuries, fatalities as well as the consequences among survivors.

## ARTICLE SUMMARY

### Article focus

- The research aim of this cohort study are: to detect whether there are potential associations between activity-limiting injuries (ALI) and related socio-economic status; to measure if impact factors exist after ALI; to compare if there are any significant differences before and after ALI.

### Key messages

- Increasing trends were observed in obesity, limited activity, poor health status, medication use related to ALI.
- The immediate impacts on individuals are pain, disability, disruption of regular life. Population impact included a considerable increase in healthcare access and cost.
- There were significant differences in hospital admission, department emergency and medical doctor visits before and after ALI.

### Strengths and limitations of this study

- There are important strengths in this study, such as its representativeness of the Canadian population and its longitudinal nature. The ‘before and after’ comparisons of the same person allowed for matched analysis at different times. A strength is the extensive and consistent information available on each respondent over the multiple cycles of the survey, such as type of ALI, and the medical care needed. A strength is also the use of ALI as a measurement of injury. Besides strengths, there are limitations such as lack of distinction between intentional and unintentional injuries; self-reported data should be less accurate and would likely lead to an under-reporting of ALI.

## INTRODUCTION

Injuries are a serious public health issue with a major impact on the lives of Canadians. They are leading causes of death and hospitalisation, as well as of disability, loss of productivity

and potential years of life lost (PYLL).<sup>1-4</sup> Sequelae from injuries include activity limitation, functional disability and pain which in turn influence a variety of social, psychological, labour force and economic factors.<sup>5-8</sup> An analysis of emergency department (ED) visits and hospitalisation admissions for Ontario noted that one in four ED visits were injury-related, as were one in every 17 hospitalisations.<sup>9</sup> These data accentuate the importance of injuries to the healthcare system. Other studies have demonstrated the increasing medical doctor (MD) contacts, the use of more medications for pain, more days in hospital, and more hours of home care services.<sup>9-11</sup>

Several studies of traumatic disability have also focused on injuries resulting in hospitalisation,<sup>12</sup> types of injury,<sup>13 14</sup> and serious head injuries.<sup>15</sup> One study reported that half of patients had some limitation in activity for 2 days or more because of injury, and patients treated in the clinic were somewhat more likely to have two or more days of limited activity than were patients treated in the ED.<sup>16</sup>

Injuries are not only largely preventable, but the impact of injuries can usually be lessened. To develop effective policies leading to the prevention of injuries and to reduce the impact of injuries on society, information is needed about individuals with injuries treated in the primary care setting and not requiring hospitalisation but which frequently result in significant functional impairment and to identify those injuries which, by virtue of their contribution to disability, would be targets for prevention programmes.

The objectives of this study are to explore the immediate and longer term consequences of injury including physical, psychological, social and occupational functioning. This comprises a longitudinal population health study, which will measure the impact of injuries on individual's and population level health status and well-being because of activity-limiting injuries (ALI) in the Canadian National Population Health Survey (NPHS) from 1994 to 2006 in Canada.

## METHODOLOGY

### Study population

The source population for this study was the NPHS, from 1994/1995 (cycle 1) to 2006/2007 (cycle 7). The study population was designed to be representative of the Canadian population with the exception of persons living on Indian reserves or on Canadian Forces bases.<sup>9 11</sup> The sample design was a multiple cluster,<sup>17</sup> ideal for controlling costs when personal interviews are needed, as was the case for cycle 1 of the NPHS. To cover as much as possible of the Canadian population, separate components of the survey were also carried out in the Territories and in healthcare institutions. In the Territories, a simpler stratified design was used. As well, anticipating the creation of Nunavut, separate strata were formed for each of the future territories, Nunavut and NWT.<sup>17</sup> The sampling frame for the first cycle (1994/1995) originated with the

Canadian Labour Force Survey (CLFS), a multistage, stratified sampling technique which used for all provinces except Quebec for which a provincial sampling frame was used.<sup>17</sup> From the 2000 cycle onward, additional questions were added to the questionnaire, such as more detailed questions on healthcare use after the ALI, with the result that some analyses are restricted to data from 2000 to 2006.

Nearly all respondents were reinterviewed biennially by telephone except for individuals without a telephone, for whom face to face interviews were used. Interviewers were instructed to follow all reasonable strategies to trace people. Response rates were 83.6% for cycle 1, 92.8% for cycle 2, 88.3% for cycle 3, 84.9% for cycle 4, 80.8% for cycle 5, 77.6% for cycle 6 and 77.0% for cycle 7.

To look at ALIs resulting from new injuries, data for cycles from 1996 to 2006 were used; data for 1994 was only used for the 'before and after' analysis (table 1). Data were used from respondents who were willing to share their data for data analysis, who completed all interviews to date, and who achieved the age of 20 before 2006. Since the source population, that is, the total NPHS population, covered more ages than the population analysed for this study, it was possible to add younger persons from the source population to our study population after the cycle at which they reached age of 20 years. Consequently, the study population changed somewhat over the years of the study allowing comparable cross-sectional analysis of populations with the same age range and age distribution.

### Variables

The interview ranged from background questions (age, sex, education, marital status, income, residence, height and weight) to health-related questions (self-perceived health status, healthcare utilisation and medication use). Body mass index (BMI) was calculated as weight in kilograms divided by height in metres squared.<sup>18</sup> A BMI of 30 or over was considered obese. Respondents were asked to rate their health as one of the following five categories: excellent, very good, good, fair or poor and for this study, the lower two categories were combined as poorer health and the top three as good health. Depression and stress were measured by the following questions: "Have you had 2 weeks in a row during the past 12 months when you were sad, blue or depressed?" and "During the past month, about how often did you feel: ... so sad that nothing could cheer you up? ... nervous? ... restless or fidgety? ... hopeless? ... worthless?" A question about number of visits to any type of physician or medical specialist in the past year was dichotomised as: 'five or more visits, versus fewer than five visits'. Alcohol consumption was based on a series of questions on the number of drinks consumed each day over the past 7 days before the interview. For this study, this was expressed as drinking nine or more drinks per week, versus drinking eight or less. In this study, 'alcohol used 5+ at a time' was defined as "How often in the past week have you had 5 or more drinks on one occasion?"

**Table 1** Life style, socioeconomic status and healthcare utilisation of persons with an activity limiting injury before and after the injury, National Population Health Survey (NPHS), Canada, 1994–2006

		Before A (%)	During B (%)	After C (%)	p Value*			N†
					A vs B	B vs C	A vs C	
Risky behaviours and socioeconomic status								
Income	Low	36.3	32.1	28.5	<0.001	<0.001	<0.001	2892
	Obese	17.8	19.7	22.4	0.005	<0.001	<0.001	1780
Physical activity	Inactive	50.4	47.1	48.1	0.001	0.197	0.343	3044
Smoking	Current	19.0	18.5	18.2	0.265	0.384	0.077	1693
Alcohol drinking	9+/Week	9.6	10.7	11.2	0.048	0.535	0.349	3548
Health-related issues								
Limited activity	Yes	18.7	25.5	26.3	<0.001	0.221	<0.001	3657
Health status	Poor	33.1	36.3	39.6	<0.001	<0.001	<0.001	3653
Medical doctor visits	5+/Year	26.5	34.0	29.8	<0.001	<0.001	<0.001	3616
Pain	Yes	13.7	16.8	17.3	<0.001	0.432	<0.001	3657
Stress	Yes	29.7	31.3	29.4	0.104	0.050	0.757	2967
Medication use in past 30 days before interview								
Pain medication	Yes	61.9	70.2	70.8	<0.001	0.489	<0.001	3640
Sedatives/tranquiliser	Yes	5.7	7.2	8.1	0.001	0.055	<0.001	3639
Antidepressants	Yes	4.2	5.9	6.2	<0.001	0.346	0.403	3641

\*p Value calculated by McNemar's test.

†Number (N) of persons making up the matched analysis for the before and after analysis.

The variable 'hospital treatment' was described as "Did you receive any medical attention for this injury from a health professional within 48 h?" For example, doctor, hospital emergency room. Quartiles of total household income were calculated for the study population, with the lower two quartiles combined for the low-income category to be compared with the top two as the high-income category. A physical activity index was calculated based on kilocalories per kilogram (KKD) of body weight per day expended. Physically active was defined as energy expenditure of at least 3 KKD; and physically inactive was defined as less than 1.5 KKD. Medication use was elicited by the question: "In the past 30 days, did you take ...?" This was followed by a series of questions, such as "Did you take antidepressants and or anti-stressants?" "Did you take anything for pain?" A 'no' answer to the question "Are you usually free of pain and discomfort?" was taken as indication that the respondent often suffered pain.

The definition of injury in the NPHS data was "In the past 12 months, did you had any injuries serious enough to limit your normal activities?" If more than one injury, the following questions were to refer to the most serious one. A separate question asked respondents a general question about limitations in activity, "Because of a long-term physical or mental condition or a health problem, have you limited in the kind or amount of activity you could do: at home? at school? at work? in other activities?". Otherwise, they should be defined as non-activity limiting.

### Data analysis

For the statistical analysis, SAS V.9.2 (SAS Institute, Cary, North Carolina, USA) was used. Logistic regression was

used to calculate OR with the presence/absence of ALI as the dependent variable, adjusted for age (in single years) and sex. Since the data were collected as a statistical sample of the Canadian population, the 'weight' option was used in all SAS statistical analyses to make the results representative of the Canadian population from 1994 to 2006 in seven cycles of cross-sectional studies. Weights were provided by Statistics Canada according to their sampling procedures. In order to produce a meaningful estimate of the variance for the weighted results, the weights were adjusted using the formula: (average weight=(sample weight/sum of the sample weights) × sample size).

In order to determine the characteristics, life style and health status, medical attention and healthcare utilisation as well as activity limitation and disability, which were impacted by ALI, all new injury cases, that is, those who had not reported an injury in the previous interview were identified. For each new case, data from three cycles were selected (1) the cycle before reporting, (2) the cycle of reporting and (3) the cycle after reporting. Data for the 1994 cycle were used only in this 'before and after' analysis. Only the first recorded ALI report per person was included. The McNemar test option in SAS was used for matched analysis. This study approved by the research ethics committee of Health Canada.

### RESULTS

The numbers of ALI in the study population increased from 755 cases in 1996 to 1006 in 2006. The weighted prevalence of all ALI increased steadily from 10.5% in 1996 to 12.8% in 2006. Those reporting ALI showed increasing trends in obesity, limited activity, poor health

status, people who live in the rural areas and drank more than nine drinks per week, medication use and potential injury sequelae such as pain and stress, but declining trends in lower income, current smoking and immigrants (table 2). The proportion of injuries which resulted in activity limitations were higher for males, and increased more over time than for females (table 3). Furthermore, younger adults (20–49 years) were more likely to report ALI (12.2–14.0%) compared with older (50+ years) adults (8.6–9.8%). Among respondents who reported ALI, the weighted percentages who reported five or more visits to an MD in the previous year decreased from 29.8% in 2000 to 25.3% in 2006, ED visits decreased from 34% to 28.8%, and hospital admission within 48 h after the injury decreased from 6.5% to 4.9% (table 4). The rate of hospital admissions within 48 h for adults aged 50+ years was higher than that of young aged (20–49) group.

The most frequently reported injuries resulting in activity limitation were sprains and strains (42%), followed by fractures and dislocations (20%) and cuts,

punctures and bites (10%; table 5). Only 3.3–5.0% of ALIs were in the category of brain, internal and multiple injuries. Men tended to have more cuts, punctures and bites while women had more scrapes, bruises and blisters. Younger ages tended to have more sprains and strains while older ages more fractures and dislocations.

Logistic regression analysis indicated that younger age groups and male participants were more impacted by ALI. Only a few of the other variables showed associations with ALI—immigrants had consistently lower rates of ALI, while people who consumed nine or more alcoholic drinks per week had significantly higher rates (table 6).

Attributes of persons with an ALI were compared in the cycles before and after their injury (table 1). Major behavioural risk factors examined showed a pattern of an increase from the 2 years previous to the ALI to the time of the ALI to a further increase the 2 years after the ALI. A similar pattern was observed for health status and interactions with the healthcare system (table 1).

**Table 2** The percent and univariate analyses of the characteristics related to adult Canadians reporting an activity limiting injury in the National Population Health Survey (NPHS) data, 1996–2006\*

Year	1996	1998	2000	2002	2004	2006	2006/1996	p Value
All	10.5	10.9	11.4	12.6	12.6	12.8	1.22	0.048
Background variables								
Married/common law	71.0	69.3	68.2	66.2	65.7	64.7	0.91	0.063
Low income	40.0	34.2	27.9	26.0	23.5	19.8	0.50	0.039
Completed high school	89.6	89.9	89.3	84.7	84.5	84.5	0.94	0.068
Rural	17.9	20.5	21.0	20.6	19.9	22.0	1.23	0.041
Immigrant	17.5	17.3	16.8	16.2	16.1	15.7	0.90	0.081
Health-related variables								
Current smoking	22.7	21.3	20.4	17.1	17.1	16.0	0.70	0.153
Inactive	58.3	52.9	56.1	48.3	51.0	45.9	0.79	0.098
Obese	18.4	21.2	23.0	24.3	25.0	26.4	1.43	0.001
9+ Alcohol drinks/week	11.0	11.6	11.9	11.8	11.6	14.8	1.35	0.001
Region of residence								
Atlantic	8.8	8.7	8.9	8.8	8.7	8.7	0.99	0.086
Quebec	25.5	25.6	25.9	26.0	26.1	25.9	1.01	0.078
Ontario	36.3	36.0	36.0	35.8	36.1	36.2	1.00	0.101
Prairies	17.0	17.3	17.1	17.4	17.3	17.4	1.02	0.098
British Columbia	12.5	12.4	12.1	12.0	11.8	11.9	0.95	0.156
Outcome related								
Limited activity	17.3	17.8	18.0	22.9	24.5	26.6	1.54	0.001
Poor health status	33.6	33.2	38.0	41.2	42.3	43.5	1.29	0.035
5+ Medical doctor visits/year	24.2	26.3	26.6	27.6	28.3	26.8	1.11	0.056
Pain	12.3	13.7	13.3	15.1	16.4	15.8	1.28	0.039
Stress	26.3	29.2	25.1	27.3	28.3	27.4	1.04	0.083
Depression	6.1	5.8	6.4	6.9	7.1	6.0	0.98	0.158
Medication use in last 30 days								
Pain medication	65.6	67.5	70.1	70.2	70.4	70.6	1.08	0.096
Tranquilizer/sedative	5.1	5.3	6.8	8.1	8.2	10.0	1.96	0.001
Antidepressants	3.6	4.4	5.4	5.9	6.9	7.0	1.94	0.001
Total number†	7313	7529	7717	7875	8085	8324		

\*Univariate analysis was used to compare the trend of activity-linked injuries (ALI) between 1996 and 2006 in the different characteristics; p Value <0.05 means a significant difference between study and control groups.

†Total number of survey respondents used to calculate weighted percentages representative of the Canadian population.



**Table 3** Percentages for activity-linked injuries (ALI) for which were impacted by activity limitation per year, National Population Health Survey (NPHS), Canada, 2000–2006

Years	2000	2002	2004	2006
<i>Injury status</i>				
All				
None	85.5	84.0	84.0	82.2
Activity limiting (yes)	10.8	12.1	11.6	12.0
Activity limiting (no)	3.1	3.0	3.5	5.1
Both	0.6	0.9	1.0	0.8
Males				
None	84.9	82.0	82.2	80.1
Activity limiting (yes)	10.5	13.5	13.2	13.2
Activity limiting (no)	3.9	3.9	3.4	5.6
Both	0.7	0.7	1.3	1.1
Females				
None	86.0	85.8	85.7	84.1
Activity limiting (yes)	11.1	10.8	10.1	10.9
Activity limiting (no)	2.4	3.0	3.6	4.6
Both	0.5	0.4	0.7	0.5
Ages 20–49				
None	83.5	81.7	81.2	79.3
Activity limiting (yes)	12.2	13.9	13.3	14.0
Activity limiting (no)	3.5	3.7	4.3	5.8
Both	0.8	0.7	1.3	0.9
Ages 50+				
None	88.5	87.2	87.4	85.3
Activity limiting (yes)	8.6	9.5	9.5	9.8
Activity limiting (no)	2.6	3.1	2.5	4.2
Both	0.3	0.3	0.6	0.6

## DISCUSSION

Based on NPHS data, more than 10% of the adult Canadian population annually experience an ALI, with the proportion increasing from 10.5% in 1996 to 12.8% in 2006. According to the definition of ALI as activity-limiting injuries, all people with ALI experienced a certain amount of disruption of their daily activities with the impact varying according to the type and severity of their injury and depending on their customary type of activity.<sup>19–22</sup> About 20% of ALIs were fractures and dislocations, many of whom necessitated a period of altered activity. Older people were more likely to report fractures than the younger age groups. The most common injuries were sprains and strains, the impact of which also varied a great deal depending on type and severity.<sup>23–24</sup> An important impact of injuries is on the workplace through absenteeism and on the family through the disruption of customary activities.<sup>25–26</sup> Besides the impact of injuries on every day activities, there was also an impact on the healthcare system.<sup>27</sup> In our data, in 2000, about two thirds of people with ALI sought some kind of medical care. The evidence was presented showing that the impact of ALI might be even more far-reaching, as seen by the higher levels of medical care, and continued pain remaining 2 years after the ALI were reported.

Other researches on injuries have used a variety of definition of injuries, based on different sources of information. Questions in the NPHS were able to put these other measures in perspective. For example, some studies used hospital-based data,<sup>28</sup> but the present study showed that only about 5% of ALI were resulted in a hospital admission within the first 48 h after the event. Assuming that all injury cases that require hospitalisation were within the activity-limiting rubric, it is clear that studies using only hospital data would include only a small portion of data on important injuries.<sup>29</sup> However, the hospitalised injury cases will be the more severe ones which are responsible for a disproportional share of the healthcare cost and disability.<sup>25</sup> Other studies have used ED visits as a unit of measurement.<sup>9</sup> The present study showed that less than one third of ALI cases went to an ED to obtain treatment. Again, the latter were the more severe injury cases or those needing specialised treatment, for example, casts on fractures, and thus had a greater impact on daily life and cost. Another source of data commonly used has been mortality data. Although deaths are definitely activity-limiting, obviously, none were included in this study. Fatal injuries reflect a different range of injuries than those for ALI. For example, in an US study, firearm-related injuries were 22% of all injury deaths, second only to traffic accident related injuries, but firearms amounted to less than 1% for non-fatal injuries.<sup>11</sup> Thus, different measuring units for measuring injury rates will target different slices of the spectrum of injuries and provide different results. ALI are of special public health importance, but are not sufficiently studied.

Another level of impact resulting from ALI would consist of impact on the healthcare system. Approximately 60% of people with ALI obtained medical care of some type. Of these, approximately one third of persons with ALI went to ED to experience the often long wait before receiving treatment. Back at home the patient would not only experience the pain and disability of the ALI, but also the need to negotiate the healthcare system, such as making appointments with physicians, specialists, physiotherapists, etc, finding transportation, often needing someone to accompany them.<sup>30–33</sup> Even though the proportion of the population with ALI increased over the years 2000–2006, decreases were seen in the use of primary care and in the hospital ED visits as well as in the hospitalisation. This decrease in healthcare use could be an indication either of greater difficulty in accessing healthcare, or that the nature of ALIs has moderated over the years. Berdahl *et al*<sup>34</sup> found variation by ethnic group and sex, both in the reporting of work-related injuries and in the seeking of medical care and the change in ethnic composition over the years could also be a factor in the NPHS data.<sup>34–36</sup> In any case, ALI are suffered by a large proportion of the population annually, and a majority of these seek medical treatment whether it is primary care, ED or hospital care. Clearly, this entails a large cost to the healthcare system and any prevention would not only improve quality of life of the putative victims but also would result in significantly lower healthcare costs.

**Table 4** The per cent of persons reporting specific healthcare use among those reporting an activity-linked injuries (ALI) by age group and sex, National Population Health Survey (NPHS), Canada, 2000–2006\*

Year	2000	2002	2004	2006
<b>All</b>				
Number of ALI	865	932	913	1005
MD visits (5+/year)	29.8	27.1	27.3	25.3
ED visits	34.0	28.5	31.0	28.8
Hospital admission in 48 h	6.5	5.4	5.5	4.9
Other	2.7	4.3	3.1	5.2
Any	66.6	60.0	61.5	59.3
None	33.5	40.1	38.5	40.7
<b>Males</b>				
Number of ALI	394	460	463	482
MD visits (5+/year)	26.6	26.5	24.7	23.6
ED visits	34.5	27.4	30.8	29.7
Hospital admission in 48 hours	9.5	4.5	4.6	4.1
Other	4.1	4.0	2.9	5.3
Any	65.2	57.8	58.4	58.5
None	34.8	42.2	41.6	41.5
<b>Females</b>				
Number of ALI	471	472	450	523
MD visits (5+/year)	32.6	27.7	30.5	27.3
ED visits	33.6	29.9	31.3	27.8
Hospital admission in 48 h	4.0	6.4	6.6	5.7
Other	1.5	4.7	3.4	5.1
Any	67.7	62.4	65.2	60.2
None	32.3	37.6	34.8	39.7
<b>Age 20–49</b>				
Number of ALI	588	601	564	590
MD visits (5+/year)	29.1	27.7	28.5	24.3
ED visits	34.3	27.6	28.7	27.3
Hospital admission in 48 h	6.2	4.1	2.9	3.6
Other	2.5	4.1	3.1	7.3
Any	65.8	59.3	3.2	58.9
None	34.2	40.7	39.7	41.1
<b>Age 50+</b>				
Number of ALI	277	331	349	415
MD visits (5+/year)	31.5	25.8	25.3	26.9
ED visits	33.6	30.6	34.9	31.1
Hospital admission in 48 h	7.3	8.1	9.9	6.9
Other	3.2	4.9	3.2	1.9
Any	61.4	59.3	63.5	59.9
None	31.8	38.6	36.6	40.1

ED, emergency department; MD, medical doctor.

Another type of impact would be long-term changes after the injury. The ‘before and after’ data available in the NPHS consisted of comparing the cross-sectional data from the interview cycle before the ALI with the data of the cycle reporting the ALI and with the next cycle after the ALI. While the interviews for each respondent could be linked for the ‘before and after’ cycles it was more difficult to determine which changes in attributes in the year of the ALI or subsequent years were sequelae of the ALI. For example, it might make sense that the increasing obesity of people with ALI be linked to after-effects, for example,<sup>37</sup> because of inactivity resulting from the ALI but, in fact, similar changes were happening in the overall population. Given these

caveats, we can note that no changes were found for smoking and little change in excessive alcohol use. Most likely to show long-term effects because of ALI were visits to medical doctors and ongoing pain. People with ALI showed increasing likelihood of visiting a MD at least five times during the year which continued for the subsequent cycle. Similarly pain increased in the cycle with the ALI and remained high over the years. Although this is weak evidence, it confirms work on long-term effects of other researchers<sup>38 39</sup> and again emphasises the impact of ALI in the population.

Injuries have been found to lead to loss of productivity, medical costs, compensation costs and long-term health problems and disability,<sup>40–42</sup> which were confirmed by the

**Table 5** The type of activity-limiting injury (ALI) as a proportion of all ALI National Population Health Survey (NPHS), Canada, 1996–2006

Interview cycles	1996	1998	2000	2002	2004	2006
N*						
Number of ALI	755	786	865	931	911	1006
	wt%					
ALL						
Brain, internal, multiple	4.9	3.3	5.8	3.2	3.9	4.3
Fractures/dislocation	20.6	21.2	19.9	20.3	22.2	24.9
Burns	5.3	3.3	4.3	2.8	4.3	3.7
Sprains, strains	42.0	42.3	42.4	47.3	42.8	42.2
Cuts, punctures, bites	10.2	15.5	11.8	11.6	11.1	9.7
Scrapes, bruises, blisters	7.7	6.9	7.8	4.8	7.1	6.3
Other	9.3	7.5	8.0	10.0	8.6	8.9
Total	100.0	100.0	100.0	100.0	100.0	100.0
Males						
Brain, internal, multiple	5.4	2.8	5.0	2.4	4.1	4.5
Fractures/dislocation	21.3	21.5	21.5	20.3	21.0	26.1
Burns	5.8	2.4	3.9	3.5	4.6	2.7
Sprains, strains	39.6	42.6	40.5	47.2	41.7	39.8
Cuts, punctures, bites	12.2	17.4	16.7	13.9	13.6	13.1
Scrapes, bruises, blisters	6.2	5.2	5.7	4.4	6.2	5.8
Other	9.5	8.1	6.7	8.3	8.8	8.0
Females						
Brain, internal, multiple	4.3	3.9	6.4	3.8	3.6	4.2
Fractures/dislocation	19.8	21.0	18.5	21.6	23.6	23.3
Burns	4.5	4.1	4.7	3.6	4.0	4.8
Sprains, strains	45.0	41.9	44.1	46.0	44.3	44.9
Cuts, punctures, bites	7.8	13.3	7.7	9.1	7.9	6.0
Scrapes, bruises, blisters	9.5	8.9	9.5	6.4	8.2	7.0
Other	9.1	6.9	9.1	9.5	8.4	9.8
Age 20–49						
Brain, internal, multiple	4.8	3.3	4.9	3.1	3.7	3.0
Fractures/dislocation	17.4	19.8	22.5	17.4	18.2	22.9
Burns	5.5	3.3	4.1	3.5	5.0	4.8
Sprains, strains	43.8	47.2	42.8	51.3	50.9	46.3
Cuts, punctures, bites	10.9	15.5	11.5	10.7	9.4	9.4
Scrapes, bruises, blisters	8.5	5.0	7.5	4.5	4.4	4.6
Other	9.1	5.9	6.7	9.5	8.4	9.0
Age 50+						
Brain, internal, multiple	5.4	3.4	7.6	3.4	4.2	6.3
Fractures/dislocation	30.8	24.9	13.8	26.4	29.0	27.9
Burns	4.3	3.0	4.9	1.4	3.3	1.9
Sprains, strains	36.2	30.2	41.7	39.0	29.1	35.8
Cuts, punctures, bites	8.1	15.2	12.5	13.4	13.7	10.3
Scrapes, bruises, blisters	5.1	11.7	8.5	5.4	11.7	9.1
Other	10.1	11.6	11.0	11.0	9.0	8.7

\*Number of ALI in study population.

wt%, weighted percentages making rates representative of the Canadian population.

present results for the Canadian population. Many injuries can be prevented and a better understanding of all aspects of injuries will lead to better ways of prevention or the minimising of their effects. However, collaboration and cooperation is needed.<sup>43</sup> The European Union has committed itself to reducing number of traffic fatalities from 45 000 to 25 000 by 2010, which as several reports point out, will require strong measures against use of alcohol<sup>44–47</sup> and illicit and medicinal drugs before

driving.<sup>48</sup> A difficulty in injury prevention is the multifaceted aspect of injuries. For example, a fall may have many causes, such as unsafe working conditions or slippery stairs at home. Each of these issues would require different approaches to prevention. Similar diversities are found for most other types of injuries. With all difficulties inherent in devising effective interventions, prevention is still the best approach to lower the tremendous impact of ALI on the Canadian population.

**Table 6** OR and 95% CI of activity-limiting injuries (ALI) by life style and socioeconomic status, adjusted for sex and age, National Population Health Survey (NPHS), Canada, 1996–2006

		1996		1998		2000		2002		2004		2006	
		OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sex group§	M/F	1.4*	1.1 to 1.6	1.3*	1.1 to 1.6	0.9	0.8 to 1.1	1.3*	1.1 to 1.5	1.4*	1.2 to 1.6	1.3*	1.1 to 1.4
Age groups													
	20–39	2.1*	1.6 to 2.9	1.9*	1.5 to 2.4	1.8*	1.4 to 2.3	2.2*	1.8 to 2.7	1.8*	1.5 to 2.2	2.2*	1.8 to 2.6
	40–59	1.6*	1.1 to 2.1	1.4*	1.1 to 1.8	1.3	1.0 to 1.6	1.6*	1.3 to 2.0	1.3	1.0 to 1.5	1.5*	1.2 to 1.8
	60+ (Reference)	1.0	~	1.0	~	1.0	~	1.0	~	1.0	~	1.0	~
Background variables†													
Married/common law	Yes/no	1.0	0.8 to 1.2	1.0	0.8 to 1.2	1.0	0.8 to 1.2	1.0	0.9 to 1.2	0.9	0.7 to 1.0	0.9	0.8 to 1.0
Income	Low/high	1.1	0.9 to 1.3	1.0	0.9 to 1.3	1.2	1.0 to 1.4	0.9	0.8 to 1.1	1.1	0.9 to 1.3	1.2	1.0 to 1.4
Completed high school	Yes/no	1.2	1.0 to 1.5	1.1	0.9 to 1.3	1.0	0.8 to 1.2	0.9	0.8 to 1.1	0.9	0.7 to 1.0	1.1	0.9 to 1.3
Rural	Yes/no	1.1	0.9 to 1.4	1.1	0.9 to 1.3	0.9	0.7 to 1.1	1.1	0.9 to 1.3	0.8	0.7 to 1.0	1.0	0.8 to 1.1
Non-English	Yes/no	0.9	0.7 to 1.1	0.9	0.7 to 1.0	0.8	0.7 to 1.0	0.8	0.7 to 1.0	0.7	0.6 to 0.9	0.8	0.7 to 0.9
Immigrant	Yes/no	0.6*	0.5 to 0.8	0.7*	0.6 to 0.9	0.8	0.6 to 1.0	0.8	0.6 to 1.0	0.7*	0.5 to 0.8	0.7*	0.6 to 0.9
Health related‡													
Current smoking	Yes/no	1.1	0.9 to 1.4	1.1	0.9 to 1.3	1.2	1.0 to 1.5	1.2	1.0 to 1.5	0.9	0.8 to 1.1	0.9	0.7 to 1.1
Physical inactivity	Yes/no	0.8	0.7 to 0.9	0.8	0.7 to 0.9	0.8	0.6 to 0.9	0.9	0.8 to 1.1	0.8	0.7 to 0.9	0.8	0.7 to 0.9
Obese	Yes/no	1.2	1.0 to 1.5	1.2	1.0 to 1.5	1.1	0.9 to 1.3	1.0	0.9 to 1.2	1.1	0.9 to 1.3	1.0	0.8 to 1.1
Alcohol drink/week	9+/Less	1.2	0.9 to 1.5	1.2*	1.0 to 1.6	1.3*	1.0 to 1.7	1.4*	1.2 to 1.8	1.2	1.0 to 1.5	1.5*	1.3 to 1.8
Alcohol 5+ at a time	Weekly/less	1.3*	1.0 to 1.5	1.4*	1.2 to 1.7	1.4*	1.2 to 1.7	1.2*	1.0 to 1.5	1.3*	1.1 to 1.5	1.3*	1.1 to 1.5

\*Means that there are statistically significant differences compared with control groups.

†For background variables comparison groups, the second listed group for binary variables is the reference group.

‡For health-related comparison groups, the second listed group for binary variables is the reference group.

§For sex group, female groups are the reference groups.

M/F, Male/female.



The NPHS data have important strengths, such as its representativeness of the Canadian population and its longitudinal nature. Because of the longitudinal design, it was possible to identify new ALI, meaning no ALI in the previous interview, and compare risk factors before and after the event, as well as its consequences. The 'before and after' comparisons of the same person allowed for matched analysis at different times. Important also is the extensive and consistent information available on each respondent over the multiple cycles of the survey, such as type of ALI, and the medical care needed. Besides strengths, the NPHS also has limitations. One issue is the lack of distinction between intentional and unintentional injuries. Another issue is that of self-reported data. Part of self-reporting is recall of events. Recall of having had an ALI has been shown elsewhere to be less accurate with increasing time and is also likely to vary with the severity of the injury.<sup>49 50</sup> Both of these would likely lead to an under-reporting of ALI. In spite of its limitations the NPHS gives an invaluable view of the level of serious injury in the Canadian adult population over a 12-year time period.

Another strength of these data is the use of ALI as a measurement of injury. There are various units of measurement in measuring rates of injury in a population. The unit of measurement used in the present study consists of the most serious ALI over the previous 12 months, excluding repetitive strains injuries. The use of ALI means the delimitation of a particular kind of injury in the spectrum of injuries as a concept meaningful to both respondent and researchers. In addition, it identifies a type of injury sufficiently severe to impact a person's regular routine.

## CONCLUSION

The findings from this study quantified the immediate and long-term impact of individuals' and population level injuries in Canada. The immediate impact was pain, disability and disruption of regular life. Long-term effects in patients were chronic pain and increased medical doctor visits for the next 2 years after the ALI. Population impact included loss of productivity and a considerable increase in healthcare access and cost. This study also contributes in particular to injury prevention in social and psychological health services to help injured people make a better recovery and maintain the quality of life after injuries.

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