

Is gender/sex associated with risk and compensation of work-related concussions?

July 2020

Possible explanations for different rates and compensation experiences

Concussions are a leading cause of disability worldwide.¹ Canadian data from Ontario indicates that the rate of concussions, including work-related concussions, is increasing over time.² While the burden of concussions is higher among men/boys, the rate of increase is faster among women/girls. Historically, a higher burden of concussions among men/boys in the population has been attributed to higher risk-taking behaviors and injuries including for severe and traumatic incidents, as well as differences in societal roles including the nature and type of work.^{1,2}

However, sports-related concussion rates are consistently higher for women/girls compared to men/boys within the same sports.³ The gender/sex difference in sport-related concussions has been attributed to sociological or cultural factors (i.e. women/girls more likely to report symptoms, parents of girls more likely to seek care), biomechanical factors (i.e. differences in neck musculature, hormones), and diagnostic differences by health care providers;^{3,4} although other studies find no differences attributable to these explanations.⁵

The purpose of this project was to conduct a gender/sex-based analysis of workers' compensation claims for concussions in the Canadian province of British Columbia (BC), in order to investigate if (1) the risk of work-related concussions within the same occupation, and (2) experiences with the adjudication of concussions for workers' compensation benefits, differed by gender/sex and over time.

Two indicators were selected for the investigation of gender/sex-based differences in work-related concussions among workers in BC:

1. The rate of accepted short-term disability compensation claims for within the same occupation (a measure of risk), and
2. The duration of time to final eligibility decision (a measure of experience with the adjudication of the work-relatedness of concussions).

Approach

This project included all compensation claims in BC with a concussion diagnosis and a claim (injury) date between 2003 and 2017.⁶ All claims included accepted health care only, short-term disability, long-term disability, and fatal claims. Claims for a concussion were defined using the diagnosis code of '850' (International Classification of Diseases v9).



In order to calculate rates of concussion claims for men and women in the same occupations, the analysis included only **accepted short-term disability (STD) claims** for which occupational codes were available (National Occupational Classification, 2006v, 2-digit classifications level), and included workers aged 15 to 64 years for which labour force count data were available. Counts of the number of men and women working in the same occupations during the study period in BC were obtained from Statistics Canada's Labour Force Survey. Rates were calculated as the number of accepted short-term disability claims divided by the number of workers in an occupation, stratified by sex/gender. The rates were age-adjusted in order to make fair comparisons between gender/sex and occupation groups with different age distributions. Rates were also compared over three five-year time periods (2003-07, 2008-12, and 2013-17). The comparison of age-adjusted rates by gender/sex and over time was limited to occupations with at least two concussion claims per 1,000 workers for men or women during the first five-year time period, for stability of rates and comparisons of rates over time. Unadjusted rates were also compared by 10-year age groups given the association between age and concussions.

The analysis of time to a final claim eligibility decision was restricted to accepted claims as the only type of claim coded for injury diagnosis to identify concussions (versus disallowed or suspended claims). Duration to a final accepted claim eligibility decision was calculated as the number of days from initial claim registration date to final accepted eligibility decision date by gender/sex.

Sex and gender

As described in the Canadian Institutes for Health Research's *Gender, Sex and Health Research Guide*, there are no definitive, universally accepted definitions of 'gender' or 'sex'. Gender is usually associated with social constructs (roles, relationships, behaviors) for women and men and sex is usually associated with physical constructs (biology, physiology) for females and males. While gender and sex are distinct constructs, they are also significantly and complexly interrelated. For the purposes of this research, we used the sex variable recorded in the workers' compensation claims data as indicative of the biological construct for males and females as well as being highly correlated with the social construct of gender for men women. In sum, this study investigated 'gender/sex' differences.

Claim definitions

Accepted claims are those adjudicated as work-related and where workers received workers' compensation benefits for health care, lost-wages, and/or long-term disability. Disallowed claims are those adjudicated as non-work related (more likely than not caused by non-work exposures) and where workers do not receive workers' compensation benefits. Suspended claims are those where the adjudication is pending additional documentation or workers withdraw the claim for benefits. Rejected claims were excluded as these represent workers who are not eligible/covered for workers' compensation benefits in BC.

The distribution of time to a final accepted claim eligibility decision for a concussion is skewed to the right, or stated differently, a small proportion of workers have very long decision durations that influence the overall mean duration. An alternative to using the mean duration is to examine the time to

a final accepted claim eligibility decision at different but comparable points of the distribution of time to a decision for men versus women, including at the 10th, 50th, and 90th percentiles of the distribution, and for the interquartile range (25th to 75th or for the middle 50% of claims).

What we found

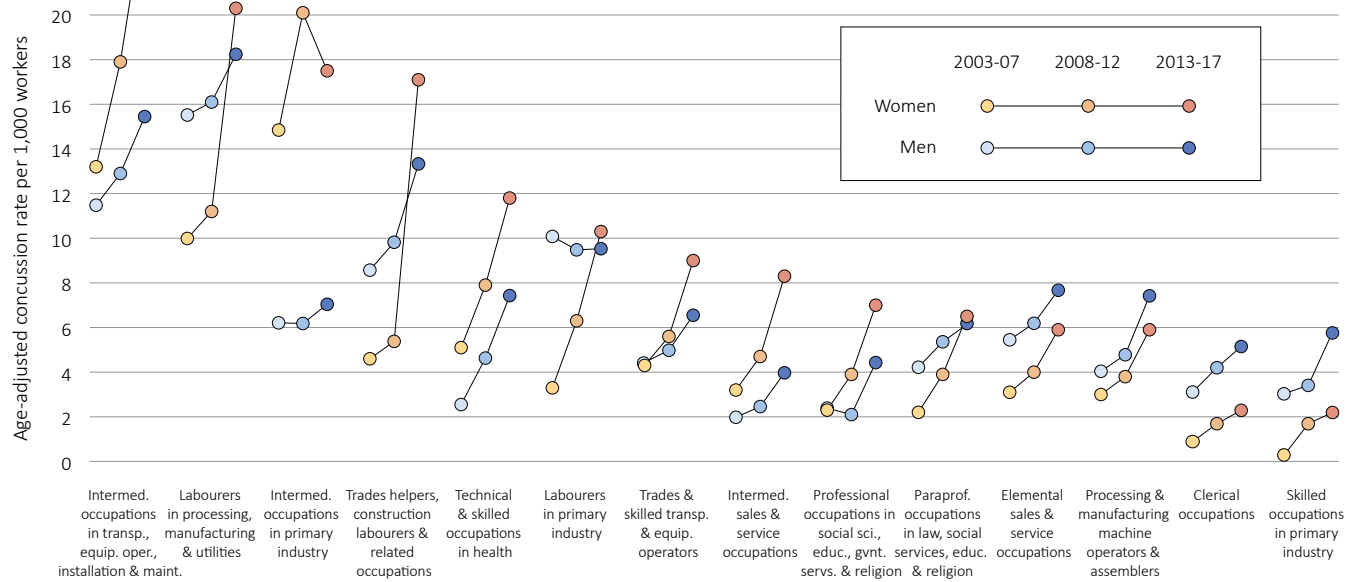
Rates of concussion by occupations

During the study period from 2003 to 2017, there were a total of 23,228 accepted compensation claims for concussions, of which 40% (n=9,337) were among women and 60% (n=13,891) were among men. While the total burden of work-related concussions in terms of absolute numbers is higher among men compared to women, it is important to compare claim rates, or the number of claims per 1,000 workers, within an occupation to investigate gender/sex differences.

Figure 1 shows age adjusted rates of accepted STD claims for concussions per 1,000 workers by occupations among women and men over the three time periods. In the most recent period (2013-17), the highest concussion rates were among women in ‘intermediate occupations in transportation, equipment operation, installation & maintenance’ (24.8 claims/1,000 workers, 95% CI 21.4, 28.2), ‘labourers in processing, manufacturing & utilities’ (20.3 claims/1,000 workers, 95% CI 16.4, 24.2), and ‘trades helpers, construction labourers & related occupations’ (17.1 claims/1,000 workers, 95% CI 13.1, 21.2).

The highest rates among men were in the same occupations but were not as high as for women in ‘intermediate occupations in transportation, equipment operation, installation & maintenance’

Figure 1 | Age-adjusted rates of accepted STD claims for concussion per 1,000 workers, women and men, by occupation and over time



Note: Occupations with a rate of at least two claims per 1,000 workers for women and/or men in the earliest time period are shown. Occupations are sorted by the rate for women in the most recent time period. Occupations are based on 2-digit National Occupational Classification 2006 codes.

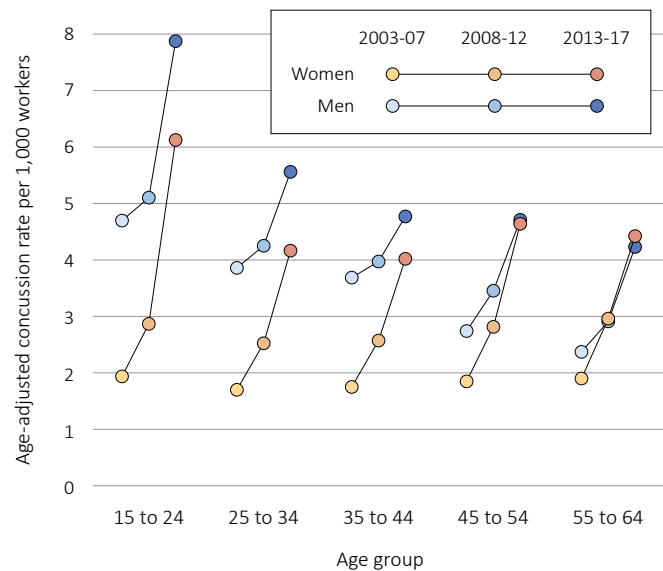
(15.5 claims/1,000 workers, 95% CI 14.6, 16.3), 'labourers in processing, manufacturing & utilities' (18.2 claims/1,000 workers, 95% CI 15.6, 20.8), and 'trades helpers, construction labourers & related occupations' (13.3/1,000 workers, 95% CI 12.0, 14.6).

Women also had a high rate of concussion claims in 'intermediate occupations in primary industry' (17.5 claims/1,000 workers, 95% CI 11.6, 23.5) but with the largest difference in rates compared to men (7.0 claims/1,000 workers, 95% CI 5.7, 8.4).

There were four occupations where men consistently had a higher concussion rate compared to women over all three time periods: 'elemental sales & service occupations', 'processing and manufacturing machine operators & assemblers', 'clerical occupations', and 'skilled occupations in primary industry'. There were four occupations where women consistently had a higher concussion rate compared to men over all three time periods: 'intermediate occupations in primary industry', 'intermediate occupations in transport, equipment operation, installation & maintenance', 'intermediate sales & service occupations', and 'technical & skilled occupations in health'.

The rate of concussions increased for both men and women across all 25 occupations over time from the first to the last five-year comparison periods (results shown for occupations with at least two claims per 1,000 workers only). However, women had a greater rate of increase compared to men, and in particular for the last five-year period. Of note, there was a shift over time from higher rates of concussions among men to higher rates among women (due to a higher rate of increase among women over time) in

Figure 2 | Age-adjusted rates of accepted STD claims for concussion per 1,000 workers, women and men, by age group and over time



the following occupations: 'labourers in processing, manufacturing & utilities', 'labourers in primary industry', trades & skilled transportation & equipment operators', 'trades helpers & construction labourers', and 'professional occupations in social sciences, education & education services & religion'.

Rates of concussion by age groups

Rates by 10-year age groups also showed that work-related concussions increased over time for both men and women within all age groups (Figure 2). While the overall rate was higher for men than women within each age group, the rate of increase was greater for women than men over time, with rates starting to converge by gender, especially for the older age groups. For example, the rate of work-related concussions increased over the study time period by more than 300% for women, compared to approximately 70% for men, aged 15 to 24 years. Similarly, the rate increased over the study period by more than 250% for women, compared to

approximately 70% for men, aged 45 to 54 years. As a result, the rate of concussion claims among women and men in the older age groups was comparable for the most recent five-year period at approximately four to five claims per 1,000 workers.

Time to final claim eligibility decision and number of decisions

Overall during the study period 2003 to 2017, the mean time in days to a final accepted claim decision for a concussion was longer for men (21.1 days, standard deviation (sd) of 93.0 days) than for women (16.5 days, sd 56.0 days) by approximately four days. Of note, the time to a final accepted claim decision for a concussion has been decreasing over time from a mean of 25.4 days (sd=96.5) for women and 29.4 days (s=138.8) for men during the period 2003-07, to 11.3 days (sd=21.9) and 13.6 days (sd=38.2) respectively during the period 2013-17; a decrease of approximately 15 days on average and a notable drop in long duration claims over time with smaller standard deviations (sd) around the mean (Figure 3a).

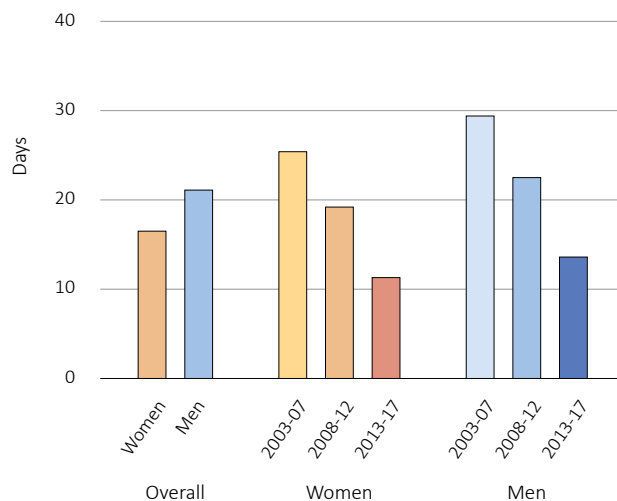
Looking at comparable points on the duration distribution reveals very little difference in the time to a final accepted claim decision between men and women during the most recent five-year time period, including at the 10th percentile (four days for both women and men), 50th percentile (seven days for both women and men), the interquartile range (four to 12 days for women and four to 13 days for men), and the 90th percentile (21 days from women and 22 days for men) (Figure 3b).

What do the results mean?

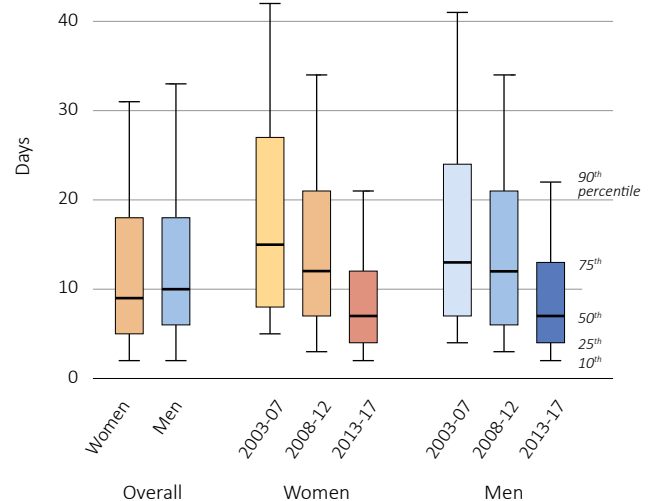
Taken together, the results show an increased risk of a workers' compensation claim for concussions among workers in BC over time, but a higher rate of increase for women compared to men within the same occupations with few exceptions and within the same age groups, and in particular for higher risk occupations. This overall increase and higher rate of increase for women is consistent with trends observed in other jurisdictions, including in Ontario.^{2,3}

Figure 3 | Differences in time to claim eligibility decision for women and men and over time

a. Mean days to final claim eligibility decision



b. Distribution of days to final claim eligibility decision



In the current analyses, there has been a shift over time from higher rates of concussion claims among men in the majority of the 25 occupations studied to higher rates among women in the same occupations. Or stated differently, men had higher rates of concussion claims in 14 of 25 occupations during the earliest study period from 2003 to 2007, but women had higher rates of concussion claims in 19 of 25 occupations during the most recent study period from 2013 to 2017. The difference in the rate of increase for women compared to men was notable for higher risk occupations for concussions during the last five years, such as for labourer and trade occupations.

The use of administrative claims data is limited in providing further explanations for these preceding observations for gender/sex differences in work-related concussions, and the concussion literature is dominated by studies focused on sports-related concussions. However, it is plausible that there has been an increased recognition of work-related concussions over time and perhaps differentially so for women compared to men for an injury that has traditionally been associated with male-dominated occupations, such as among labourer and construction/trade occupations. This may also include an increased recognition of mild concussions beyond those associated with severe and traumatic injuries in male-dominated occupations.

Parallel evidence for sports-related concussions suggests that women/girls are more likely to report concussions and that may explain increasing rates among women entering physically demanding occupations with higher concussion risks, and among younger women entering these occupations today compared to 15 years ago. It is also plausible that there is an increased risk of concussions for women in occupations, such as in construction or the trades, that have not considered a gender/sex-based approach to occupational physical demands, work environments and injury risks. Being of younger and older age may also interact with gender/sex to increase the risk of concussions among women just entering or aging into these occupations.

In the current analyses, there is little evidence of gender/sex differences in the adjudication of workers' compensation claims for work-related concussions based on comparable times to a final accepted claim decision, especially in the last five years, with differences of approximately one day more to a decision for men compared to women for some longer duration claims.

There is a need for more evidence of gender/sex differences in work-related concussions to guide policy and practice. However, the current analyses point to a few occupations with significant changes in the rate of concussions worthy of prevention strategies with a gender/sex perspective, specifically labourers, trades, and equipment operation occupations for younger and older women.

References

1. Mollayeva T, El-Khechen-Richandi G, Colantonio A. Sex & gender considerations in concussion research. *Concussion* 2018;3(1):CNC51.
2. Colantonio A, Mroczek D, Patel J, Lewko J, Fergenbaum J, Brison R. Examining occupational traumatic brain injury in Ontario. *Can J Public Health* 2010;101(Suppl. 1):S58–S62.
3. Laker SR. Epidemiology of concussion and mild traumatic brain injury. *Physical Medicine and Rehabilitation* 2011;3(10S2):S354-358.
4. Dick RW. Is there a gender difference in concussion incidence and outcomes? *British Journal of Sports Medicine* 2009;43(Suppl 1):i46-i50.
5. O'Connor S, Geaney D, Beidler E. Non-disclosure in Irish collegiate student-athletes: do concussion history, knowledge, pressure to play and gender impact concussion reporting? *Physician and Sports Medicine* 2020;48(2):186-193.
6. WorkSafeBC [creator] [2018]. *WorkSafeBC Claim Level Files*. Population Data BC [publisher]. Linked Data Set. WorkSafeBC; 2019.

More information

Please contact Mieke Koehoorn, Partnership for Work, Health and Safety Co-Director, at mieke.koehoorn@ubc.ca with questions about the methods, results or interpretation of this study. General enquiries should be directed to Suhail Marino, Partnership for Work, Health and Safety Director of Privacy and Operations, at suhail.marino@ubc.ca.

About us

The Partnership for Work, Health and Safety (PWHS), between WorkSafeBC and the University of BC, is an innovative research unit that combines rigorous work and health research with effective knowledge translation.

PWHS brings together policy-makers, researchers and data resources from national and international organizations to address current and emerging issues of work-related health in Canada. Our research is aimed at improving understanding of the causes and consequences of injuries and illness, identifying high-risk industries and occupations, and investigating the effectiveness of interventions that improve worker health, prevent occupational illness and injury, and reduce work-related disability.

Our collaboration, based on best practices of knowledge transfer, enables researchers and decision-makers to work together to identify relevant questions, understand data, and produce useful information to effectively inform policy and practice.