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Measuring Occupational Health and Safety Vulnerability in Alberta



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Contents

Executive Summary	2
Alberta Futures Report.....	5
Background	5
Goals and Objectives	6
Methodology.....	6
Analysis.....	8
Outputs and results	9
Discussion.....	12
Conclusions.....	13
Table 1: Descriptive information on sample.....	15
Table 2: Risks, vulnerabilities and injury concerns, provincial comparisons	16
Table 3: Adjusted Logistic Regression models of areas of vulnerability by province	17
Figure 1: Proportion of vulnerability types by industry group, Alberta	18
Figure 2: Proportion of vulnerability types by workplace size, Alberta	19
Figure 3: Worry about injury and actual injuries (physical, psychological)	20
previous 12 months by OHS vulnerability groups, Alberta	20
Appendix A: Supplementary tables	21
Supplementary Table 1: Hazard and occupational health and safety dimensions	21
Supplementary Table 2: Demographic and occupational labour market distribution	22
Supplementary Table 3: Adjusted logistic regression models, Alberta	23
Bibliography	25

Executive Summary

Introduction

In this report, a newly developed conceptual framework and Occupational Health and Safety (OHS) vulnerability measurement tool is applied to a sample of Alberta workers, and comparisons are made with similar samples of workers from Ontario and British Columbia (B.C.). The vulnerability tool captures information about workplace hazard exposures; measures the presence (or absence) of workplace resources that protect workers against injury (policy and procedures around workplace safety, awareness of rights and responsibilities, empowerment to act); and provides a more detailed understanding of how workplace hazards and a lack of protections contribute to an individual worker's risk of injury. Workers are classified as 'vulnerable' in relation to OHS when they are exposed to hazards on the job *and* have inadequate protections from one or more types of workplace resources.

Here, the OHS vulnerability measure is applied for the first time to Alberta workers, as such, the results of this project provide a baseline assessment of dimensions of OHS vulnerability, from which changes over time can be assessed.

Methodology

Data were collected by a commercial survey provider in the spring of 2018, from a pre-existing panel of working adults who participate in surveys from time to time, along with a small sample collected via random-digit-dialling. Data from 1,026 Albertans were then merged with existing data from a sample of 714 participants from B.C., and 1,203 from Ontario, collected in the fall of 2017.

Outcome variables were then created for: workplace hazard exposure; workplace protections sum of scores (summed responses in three sets of workplace protections questions); workplace protection measures (adequate/inadequate); OHS Vulnerability (yes/no); worry about injury or illness; and four types of outcomes (physical injury, mental injury, did injury require time off work, was injury reported to worker's compensation).

Analysis

Confirmatory factor analysis was used to assess the suitability of the conceptual structure of the three dimensions of OHS protections (awareness, policy and procedures and empowerment). Results confirmed that awareness, workplace policies and procedures, and empowerment to participate in injury prevention are related, but distinct, protection constructs. Following data cleaning and handling of missing data, a total of 2,888 employees (1,010 from Alberta) were available for analysis.

Data from these respondents were then weighted to account for the age and sex distribution of the labour force of each province. Descriptive analyses of study variables were undertaken,

along with multivariable logistic regression models to assess differences in OHS outcomes across provinces. Analyses also examined factors associated with OHS vulnerability in Alberta.

Results and conclusions

A total of 58% of workers in Alberta reported exposure to workplace hazards on a weekly basis. In terms of OHS protections, 42% of workers were defined as having inadequate workplace policies and procedures, 37% were defined as having inadequate empowerment, and 23% were defined as having inadequate OHS awareness. No differences were observed between workers in Alberta and workers in Ontario and B.C. in terms of hazard exposure, inadequate policy and procedures or empowerment. Workers in Alberta did not experience as much inadequacy of awareness as did those in B.C. In terms of OHS vulnerability (the combination of hazards and inadequate protections), 36% of workers in Alberta were vulnerable (exposure to hazards with inadequate levels of one or more protections). Policy and procedure vulnerability (26%) and empowerment vulnerability (26%) were more common than OHS awareness vulnerability (14%).

A total of 28% of workers in Alberta agreed or strongly agreed that they worry about getting injured or ill doing their current job, with 19% reporting a physical work-related injury and 18% reporting a mental work-related injury in the previous 12 months. Of these injuries, 55% required time off work for health care, and 19% were reported to workers' compensation. No statistical differences were observed across provinces in OHS vulnerability, worry about injury or work injury outcomes.

In the province of Alberta, vulnerability varied by industry sector, and within each sector, the proportion of specific types of vulnerability varied. For example, in comparison with other industry sectors, employees in the arts, food and retail trade industries had higher policy and procedure and awareness vulnerabilities, yet their empowerment vulnerability was not high. Conversely, employees in the manufacturing, trade and transport industries had high empowerment vulnerability and low awareness vulnerability. Similarly, the proportion of vulnerability types differed according to workplace size; employees in small workplaces were the most vulnerable, mainly due to differences in policy and procedure and awareness vulnerability, while empowerment vulnerability levels were similar across workplace sizes.

Recommendations

The collection of information on workplace hazards and protections using the OHS vulnerability framework enables the identification of workers at greatest risk of work injury, which can inform primary prevention activities tailored to industry and workplace size. We recommend the ongoing collection of similar information so that prevention targets can be updated over time, and in order to understand changes in different types of OHS vulnerability in general, and within subgroups of the Alberta labour force.

Ongoing data collection would also enable the province of Alberta to focus on reducing OHS vulnerability as a target for prevention activities (as opposed to, or in conjunction with, other

measures such as lost-time workers' compensation claims). The advantage of focusing on leading indicators, such as OHS vulnerability, is that they are likely more dynamic, and are likely to reflect changes in OHS protections within short time periods.

Alberta Futures Report

Measuring Occupational Health and Safety Vulnerability in Alberta

Background

In Canada, work-related injuries are an important public health concern. A workplace culture that encourages improvements in employee health and safety has the potential to reduce negative health outcomes. The performance of a workplace with respect to Occupational Health and Safety (OHS) can be measured by using indicators that have been described as lagging or leading. Lagging OHS indicators are failure-focused and include information that is commonly reported, such as workplace injuries and illnesses, while leading OHS indicators point to areas where positive changes can be made to reduce the likelihood of an incident occurring [1]. Examples of leading indicators are areas subject to preventive efforts, such as workplace hazards and workplace resources that protect workers from injury. In Alberta, leading indicators are health and safety activities that are done on an ongoing basis in order to prevent injury and illness [2].

Alberta's recently revised (June 1, 2018) Occupational Health and Safety Act has set standards for workplace health and safety practices. Changes to the Act include: enshrining worker's rights, e.g., the right to refuse dangerous work; the establishment of roles and responsibilities for all parties at worksites; program and practice changes, e.g., establishing a written health and safety program for employers with 20 or more workers; changes in compliance and enforcement; and information [3].

Under the revised Act there is the potential for improvements to occur in both leading and lagging indicators of OHS [3]. In order to understand the impact of the revised Act, and assess its performance in comparison with other provinces, it is important to have baseline information about leading and lagging indicators of OHS in Alberta and other provinces.

In this report, a conceptual framework of OHS vulnerability, developed at the Institute for Work and Health (IWH), is applied to a sample of Alberta workers, and then compared with similar samples from Ontario and British Columbia (B.C.). The vulnerability tool captures information about workplace hazard exposures; measures the presence (or absence) of workplace resources that protect workers against injury; and provides an understanding of how workplace hazards and a lack of protections contribute to an individual worker's risk of injury [4]. The tool measures four dimensions of OHS vulnerability with 27 items. These dimensions are: 1) Exposure to hazards in the workplace (nine items); 2) Policies and procedures around workplace safety (seven items); 3) Awareness of health and safety rights and responsibilities

(six items); and 4) Empowerment to participate in injury prevention (five items). The tool classifies workers as ‘vulnerable’ when they are exposed to hazards on the job *and* have inadequate protections provided by one or more workplace resource types. This classification method was developed in a previous study which found that workplace hazard exposures in combination with a lack of protections to help manage risk are associated with more injuries and worry about workplace injury than the sum of the effects of the two conditions in isolation [5]. While the OHS vulnerability measure has previously been applied to samples in Ontario, B.C. [4] [5], and other jurisdictions [6] [7], to date it has not been applied to a sample of Alberta workers.

Goals and Objectives

The objectives of this report are to:

1. Examine four types of OHS vulnerability (overall, policy and procedure, awareness and empowerment) in a sample of workers in Alberta;
2. Compare OHS vulnerability and work injury outcomes (physical or mental injury in the past 12 months, did injury require time off work, was injury reported to compensation) among Alberta workers with similar samples of workers in Ontario and B.C., and consider the extent to which occupation or industrial factors account for differences; and
3. Examine the proportion of workers who are vulnerable, and the type of vulnerability across workplace size and industry groups in Alberta and examine the relationship between dimensions of vulnerability and work injury outcomes.

A secondary objective of this report is to establish a baseline of OHS vulnerability and outcomes in Alberta, from which the impact of Alberta’s revised Occupational Health and Safety Act can be observed and measured over time.

Methodology

Survey administration

Data for this study were collected by a commercial survey provider (EKOS research associates) in May and June of 2018, from a sample of adults (18 years or over) working 15 hours or more per week at organizations with five or more employees. Most of the participants (75%) were obtained from a pre-existing panel of Albertans who have agreed to participate in surveys from time to time (15% response rate), and the remainder were obtained via random-digit-dialling (7% response rate). The data from 1,026 working Albertans were then merged with data collected in November 2017 from a sample of 714 participants from B.C., and 1,203 from Ontario.

Creation of OHS Vulnerability Outcome Variables

OHS vulnerability is defined as exposure to workplace hazards, in combination with inadequate levels of one of three types of worker protections. These are described in detail below.

Workplace hazard exposures: Exposure to nine different workplace hazards were assessed and respondents were categorized as ‘exposed’ to hazards if they experienced two or more hazards weekly or every day, or if they were exposed to one of the following weekly or daily: ‘manually lift, carry or push items heavier than 20 kg at least 10 times during the day’; ‘interact with hazardous substances such as chemicals, flammable liquids and gases’; ‘work at a height that is two metres or more above the ground or floor’; or ‘experienced bullying or harassment at work’.

Workplace protections: Three types of workplace protections were assessed. These are workplace policies and procedures (seven questions); awareness of OHS rights and responsibilities (six questions); and empowerment to act to prevent injuries (five questions). All questions were asked on a scale from 1=strongly agree to 4=disagree. Responses to each of these questions were used to define adequate versus inadequate protections. Respondents were categorized as ‘inadequate’ within a protective dimension (policies and procedures, awareness, or empowerment) if they disagreed or strongly disagreed with one or more of the statements within each set of questions about a workplace protection type, i.e., respondents were required to endorse all questions within a dimension to be considered as having adequate levels of that protection. Protections were also examined using continuous scores, the results of which can be found in Supplementary Table 1 in Appendix A.

OHS Vulnerability: Dichotomous (yes/no) outcomes of workplace vulnerability were developed as follows: 1. Policy and procedure vulnerability indicates ‘exposed’ to hazards and ‘inadequate’ workplace policy and procedure protections; 2. Awareness vulnerability indicates ‘exposed’ to hazards and ‘inadequate’ awareness of OHS rights and responsibilities; 3. Empowerment vulnerability indicates ‘exposed’ to hazards and ‘inadequate’ sense of empowerment to act to prevent injuries; and 4. Overall vulnerability indicates ‘exposed’ to hazards combined with ‘inadequate’ OHS policy and procedure protections, and/or awareness of OHS rights and responsibilities and/or sense of empowerment to act to prevent injuries.

Worry about work related injury or illness and experiences with workplace injury in the past 12 months were included as additional measures of OHS.

Worry about injury or illness: Respondents were asked to agree or disagree with the statement ‘I worry that I will end up getting injured or ill doing my current job’. Respondents who agreed or strongly agreed with this statement were defined as being worried about being injured, and a dichotomous variable was created (yes/no) to reflect this.

Workplace injury: Dichotomous (yes/no) workplace injury outcomes were included as lagging OHS indicators. These were: ‘In the last 12 months have you sustained a physical injury or

illness due to your work?'; 'In the last 12 months have you sustained a mental or psychological injury or illness due to your work?'; 'did this injury or illness require you to take time off work or receive health care from a medical professional such as a doctor, physiotherapist or psychologist?'; and 'did you report this injury to the workers compensation board in your province?'

Covariates

In order to increase the accuracy of the logistic regression models, a range of important covariates were included. The demographic covariates included were: sex (male, female); age group (under 35, 35-44 years, 45-54 years, 55 years and up); location of birth (Canada, outside Canada); and education (high school or less, less than bachelor's, bachelor's, post graduate). Also considered was the mode of data collection (online panel, phone panel, random-digit-dial).

The occupational and workplace covariates included were: employment relationship (permanent, not permanent); workplace size (5-19 persons, 20-99 persons, 100-499 persons, 500 or more persons); hours of work (less than 35 hours, 35 hours or more); occupational groups (1=management, business, finance, administration, natural, applied science, 2=health, 3=law, education, social services, community or government services, 4=arts and culture, recreation and sport, sales and services, 5=trades, transport, equipment operation, natural resources, agriculture, manufacturing, utilities); and job tenure (1=six months or less, 2=seven-11 months, 3=one to less than three years, 4=three years or more). For the Alberta specific analyses, industry type was used instead of occupational group (1=primary industries, 2=manufacturing, trade, transport, 3=service industries and other, 4=education, 5=health, 6=arts, food, retail, 7=public administration).

Analysis

The first step in the analysis was to confirm the conceptual structure of the three dimensions of OHS protections (awareness, policy and procedures, and empowerment) with Confirmatory Factor Analysis (CFA). This was undertaken in order to ensure that the three dimensions of OHS protections were distinct from each other, as assessed by the items included in the OHS vulnerability measure. Briefly, the models for the entire sample and for each province all had excellent goodness-of-fit as assessed by multiple indices indicating that the vulnerability measure, as originally proposed, was suitable for this study (detailed results are available from report authors on request).

Some respondents were missing information on one or more of the items used to assess policies and procedures, OHS awareness or empowerment. Given the high inter-item correlations within each of these dimensions, for these respondents, we used the following rules to impute their responses to these missing items. If a participant answered three or more questions in an individual workplace protection section (i.e., policy and procedure, awareness, or empowerment), the average of that participant's answers within the section was calculated,

then used to fill in the missing answers (i.e., 'imputed'). If a participant answered less than three questions in a section, there was not enough information to include them in the study, and they were removed from the analysis. In the seven-item policy and procedure section, missing responses from 437 individual participants were imputed (254 with one missing, 107 with two missing, 66 with three missing and 10 with four missing), in the six-item awareness section, missing responses from 120 individual participants were imputed (77 with one missing, 31 with two missing, and 12 with three missing), and in the five-item empowerment section, missing responses from 124 individual participants were imputed (112 with one missing, and 12 with two missing). Fifty-three participants with too many answers missing for analysis to be completed were removed (10 from B.C., 28 from Ontario and 15 from Alberta).

Following imputation, two respondents with missing hazard data were removed, leaving 2,888 respondents for analysis. Initial descriptive analyses were then completed to describe the sample.

In order to account for differences between our sample and the composition of the labour force in each province, analyses were completed both unweighted, and weighted according to the age and sex of the labour force of each province. The results for the two methods were compared and no meaningful difference was observed. The weighted results are presented in this report.

Descriptive statistics, analysis of variance and chi square (Rao-Scott) tests were run for the variables under study, in order to examine crude differences across provinces. Multivariable logistic regression models were completed to test for differences in OHS vulnerability and worry and injury outcomes by province, after accounting for survey, demographic and labour market compositional differences. One model was adjusted for participant demographics (age, sex, location of birth, education) and survey administration method, a second model was adjusted for occupational variables (employment relationship, hours of work, occupation, length of employment with current employer) and survey administration method, and a third was adjusted for workplace size and survey administration method. Another model included all the adjustment variables. The relationship between OHS vulnerability and industry, workplace size, worry and work injury outcomes were also descriptively examined in the Alberta sample. A final series of regression models with various leading and lagging indicator outcomes was also run using data for Alberta only, with participant demographics (age, sex, location of birth, education), industry, employment relationship, hours of work, length of employment with current employer, workplace size and survey administration method included in the model.

Outputs and results

Table 1 presents descriptive information about the sample, weighted to the age and sex distribution of the labour force of each province. Limited differences were observed in the age, sex and educational composition of samples from Alberta, Ontario and B.C. Differences were

observed in the labour market composition of samples across provinces. Compared to Ontario and B.C., the Alberta sample had a lower proportion of non-permanent employees, part-time workers, and employees in law, education, social service, community and government occupations. We compared these differences with data from the Labour Force Survey (LFS) over the same time period. In the LFS a lower proportion of part-time workers was also observed in Alberta (compared to Ontario and B.C.), however differences in non-permanent employment and across occupations were not observed across provinces (see Supplementary Table 2 of Appendix A for breakdown of employment and work variables across provinces from the LFS at the same time period). Proportionally more of the Alberta sample was collected by random-digit-dial than were the samples from Ontario and B.C.

Table 2 presents the number and percentages of workers at risk for an injury, those classified as vulnerable, those worried about injury, and injury outcomes. More detailed breakdowns of hazards and levels of protections are available in Supplementary Table 1 of Appendix A. Regarding risk due to workplace hazard exposure or inadequate workplace protections, the only statistically significant differences were for awareness, where Alberta and Ontario workers had a lower percentage of those at risk (23% for both provinces) compared to B.C. (31%). Meaningful differences were not observed across other indicators of risk across provinces. Over half of the respondents in each province were categorized as 'at risk' from workplace hazard exposures, with the highest proportion reported by Alberta workers (58%). In this same table, when vulnerability measures were considered, 36% of Alberta workers were categorized as being vulnerable when all three measures were considered together, 26% were vulnerable with respect to policy and procedures and 26% were vulnerable with respect to empowerment. None of these findings were markedly different from the other provinces.

Smaller proportions of Alberta and Ontario workers agreed or strongly agreed that they were worried about being injured in their current job compared to workers in B.C., but this finding was not of statistical significance. Alberta workers also did not differ in a meaningful way from B.C. or Ontario workers regarding lagging indicators (physical or mental injury, time off work or reports to workers compensation), however the proportion of those with a physical or mental injury in the past 12 months was high (28%), and 55% of injured workers in Alberta were required to take time off work because of workplace injury. Of note there was no meaningful difference between provinces regarding reporting of compensation for injuries.

Table 3 shows the adjusted logistic regression models of all areas of vulnerability, injury and worry, comparing B.C. and Ontario to Alberta. After adjustment for all covariates, there were no statistically significant differences between the other provinces and Alberta on any of the measures of vulnerability, and adjustment for covariates did not change outcomes in any meaningful way. While the point estimates may indicate lower risk of injury in Ontario and B.C. compared to Alberta, this finding was not statistically significant.

Figure 1 presents the proportion of different types of vulnerability (policy and procedure vulnerability, awareness vulnerability, empowerment vulnerability and overall vulnerability) across industry sectors among respondents from Alberta only. Different proportions were observed across all industry sectors for each type of vulnerability, however the pattern across industries changed slightly for different types of vulnerability. For example, while employees in the arts, food and retail trade industries had high levels of policy and procedural vulnerability and awareness vulnerability compared to other industry groups, they were not the highest for empowerment vulnerability. Conversely, among employees in the manufacturing, trade and transport industries, the prevalence of awareness vulnerability was relatively low; this industry group had one of the highest rates of empowerment vulnerability.

Figure 2 presents the proportion of vulnerability types across workplace size groups. As was the case with the industry pattern, the relationships between workplace size and different types of vulnerability differ across dimensions of vulnerability. While there is a graded relationship between overall vulnerability and workplace size, with employees from small workplaces being the most vulnerable, these differences are mainly due to differences in policy and procedure vulnerability and awareness vulnerability, with similar levels of empowerment vulnerability observed across workplace size groups.

Figure 3 presents three different injury-related outcomes across combinations of hazards and adequate protection exposures. Outcomes examined include the proportion of respondents who worry about a workplace injury, the proportion who had been physically injured at work in the last 12 months, and the proportion who had a psychological injury they assessed to be work-related in the previous 12 months. As hypothesised under the OHS vulnerability conceptual framework, the lowest rates of each of these outcomes was among workers who were not exposed to hazards and had adequate protections (far left) and the highest rates were observed between workers who were exposed to hazards with inadequate protections (far right). Among this group who are exposed to hazards without adequate protections (i.e. vulnerable workers), more than 45% are worried about getting injured at work, almost 35% were injured physically in the previous 12 months, and just less than 30% were injured psychologically in the previous 12 months. The prevalence estimates in the figure show the independent impacts of hazard exposures and protections. For example, while the two groups at the right of the figure are both exposed to hazards, the group of workers who have inadequate protections worry about injury more than twice as much (20% versus 47%), have prevalence rates of sustaining physical injuries that are three times higher (11% versus 35%), and have prevalence rates of sustaining psychological injury that are 50% higher (19% versus 30%), than those workers exposed to hazards, but with adequate protections. Additional information on the relationship between individual, occupational, and workplace factors and OHS vulnerability and injury outcomes from multivariable logistic regression models for Alberta respondents are presented in Supplementary Table 3 of Appendix A.

Discussion

The purpose of this report was to examine OHS vulnerability, worry about injury and work injury outcomes among Alberta workers (i.e., leading and lagging OHS indicators), and to compare results to workers in two other provinces. A secondary purpose was to establish a baseline of OHS vulnerability and outcomes in Alberta, from which the impact of the province's revised Occupational Health and Safety Act can be observed and measured over time. This was accomplished by examining four types of OHS vulnerability, worry about injury and injury outcomes in a large sample of Alberta workers across demographic and occupational groups, comparing them to similar samples of workers in B.C. and Ontario, and identifying the demographic, occupational and workplace characteristics associated with vulnerability among these workers.

Although respondents in Alberta reported exposure to more workplace hazards than did those in the other provinces, they did not differ greatly from Ontario respondents on measures of policy and procedure around workplace safety, and awareness of rights and responsibilities, and did not differ significantly from other provinces on OHS empowerment. Regarding other measures of risk, there were no meaningful differences between Alberta workers and those in B.C. and Ontario, in either descriptive or multivariable analyses. In general, rates of vulnerability were similar to rates of worry about injury, and higher than rates of self-reported injury.

Among workers in Alberta, 26% had policy and procedural vulnerability (exposure to workplace hazards with inadequate workplace policies and procedures), 14% had awareness vulnerability, 26% had empowerment vulnerability, and 36% one or more type of OHS vulnerability. In addition, 28% of respondents from Alberta were worried about being injured, 28% reported experiencing a physical and/or mental injury in the past 12 months, and 55% of these respondents needed to take time off work because of the injury. Although these findings were not statistically different from the other provinces, the proportions are high and indicate areas for preventive efforts to focus, and for ongoing measurement. The effects of legislative changes should be measured to explore the validity of the underlying assumptions of their focus.

The pattern of vulnerability across industry and workplace size provide important information on potential targets for primary prevention activities. Differences in the proportion of different types of vulnerability were observed across both industry (see Figure 1) and workplace size groups (see Figure 2). Importantly, the patterns of different types of vulnerability changed depending on which dimension was examined. The collection of similar information in the future could inform both the topic areas to target for industry or workplace size specific interventions, or the industries or workplace size groups to target for topic specific interventions. Finally, Figure 3 demonstrates the importance of workplace exposures and protections in understanding who is more likely to experience work-related injuries, or to worry about getting injured at work. In the sample of Alberta workers, both hazards and lack of protections had an important impact on

injury risk, which suggests that ongoing surveillance should focus on both dimensions of OHS vulnerability, as defined by the OHS framework.

When interpreting the results, some important limitations should be considered. The sample of workers studied is comparatively older than the Alberta labour force, a by-product of the fixed resources available to conduct a worker-level survey. The difference in age groups between our respondent sample and the Alberta labour force was addressed by recalibrating the sample to the age and sex distribution of the labour force in each province. The sampling method excluded the self-employed, those working less than 15 hours a week, and those in workplaces with fewer than five employees, which was balanced by the inclusion of a wide range of occupational categories, workplace sizes and employment relationships. The limited sample size, low response rate and the use of an existing survey panel might limit the generalizability of the research findings, however, the responses of those collected by random-digit-dialling were compared with those provided by panel respondents in all analyses, and no significant differences were observed between groups on any occasion. It is possible that those who have experienced a workplace injury remembered their workplace hazards and protections differently than those without injury, however this a limitation of all cross-sectional studies.

This study has some unique strengths that are important to acknowledge. The rates of physical injury reported by each province reflect a similar pattern to the statistics reported by the Association of Workers' Compensation Boards of Canada, where the highest rates of physical injury are reported by participants in B.C., followed by Alberta and then Ontario. This is of interest, because the same pattern was observed here, using a different data collection method; it appears then that the injury rates reported in our sample of workers reflects the actual pattern of lost time claims across provinces.

The results of this project provide the Government of Alberta with important information. It provides a comparison with B.C. and Ontario, and an understanding of the importance of hazards and protections in understanding risk of injury. In addition, this project provides unique information that can be used to support the modification of existing and future primary prevention efforts, and baseline measurement in a cost-effective surveillance tool, available for ongoing measurement.

Conclusions

Collecting information on workplace hazards and protections using the OHS vulnerability framework enables the identification of workers at greatest risk of work injury, which can inform primary prevention activities tailored to industry and workplace size. As such, we recommend the ongoing collection of similar information in order to update prevention targets over time, and to understand changes in different types of OHS vulnerability in general, and within subgroups of the Alberta labour force.

Ongoing data collection would also enable the province of Alberta to focus on reducing OHS vulnerability as a target for prevention activities (as opposed to, or in conjunction with, other measures such as lost-time workers' compensation claims). The advantage of focusing on leading indicators, i.e., OHS vulnerability, is that they are likely more dynamic, and likely to reflect changes in OHS protections within short time periods.

	Overall weighted n (%) (unweighted n=2888)	British Columbia weighted n (%) (weighted n=703)	Ontario weighted n (%) (unweighted n=1175)	Alberta weighted n (%) (unweighted n=1010)
Gender				
Male	1435 (50.8)	344 (50.0)	572 (50.0)	519 (52.2)
Female	1389 (49.2)	343 (50.0)	571 (50.0)	475 (47.8)
Age group				
Less than 35 yrs.	1093 (38.7)	260 (37.9)	439 (38.4)	393 (39.6)
35-44 yrs.	673 (23.8)	162 (23.5)	256 (22.4)	256 (25.7)
45-54 yrs.	578 (20.5)	138 (20.1)	254 (22.2)	186 (18.7)
55 yrs. and over	481 (17.0)	128 (18.6)	194 (17.0)	159 (16.0)
Education				
High school or less	438 (15.5)	101 (14.7)	182 (16.0)	155 (15.6)
Less than bachelor's	973 (34.6)	227 (33.1)	350 (30.7)	397 (40.0)
Bachelor's degree	929 (33.0)	236 (34.4)	371 (32.5)	323 (32.6)
Post graduate degree	476 (16.9)	122 (17.7)	237 (20.8)	117 (11.8)
Country of birth				
Canada	2345 (83.2)	554 (80.5)	939 (82.3)	852 (86.0)
Other	475 (16.8)	134 (19.5)	202 (17.7)	139 (14.0)
Workplace size				
5-19 employees	576 (20.4)	165 (24.0)	197 (17.2)	213 (21.4)
20-99 employees	950 (33.6)	255 (37.0)	348 (30.5)	347 (34.9)
100-499 employees	705 (25.0)	155 (22.5)	321 (28.0)	230 (23.1)
500 or more employees	595 (21.1)	113 (16.4)	277 (24.2)	205 (20.6)
Employment relationship				
Permanent	2464 (87.6)	587 (85.6)	990 (86.9)	888 (89.7)
Not permanent	349 (12.4)	98 (14.4)	149 (13.1)	102 (10.3)
Weekly hours worked				
35 hours or more	2434 (86.2)	572 (83.2)	995 (87.0)	868 (87.3)
Less than 35 hours	390 (13.8)	116 (16.8)	148 (13.0)	126 (12.7)
Time with current employer				
6 months or less	263 (9.4)	57 (8.4)	122 (10.7)	84 (8.6)
7-11 months	130 (4.7)	30 (4.4)	59 (5.2)	41 (4.2)
12 months- <3 years	503 (18.0)	141 (20.6)	181 (16.0)	181 (18.4)
3 years or more	1902 (68.0)	456 (66.6)	772 (68.1)	675 (68.8)
Occupation				
Management, business, admin., science	1001 (35.4)	226 (32.9)	427 (37.4)	348 (34.9)
Health	244 (8.6)	70 (10.2)	91 (8.0)	83 (8.3)
Law, education, social service, community, gov't	527 (18.7)	152 (22.1)	226 (19.8)	149 (15.0)
Art, culture, recreation, sport, sales, services	447 (15.8)	100 (14.6)	201 (17.6)	146 (14.7)
Trade, transp., natural resources, agri, manuf.	467 (16.5)	122 (17.7)	158 (13.8)	188 (18.9)
Other/missing	139 (4.9)	17 (2.5)	40 (3.5)	81 (8.2)
Mode of interview				
Online panel	2038 (72.2)	496 (72.2)	884 (77.3)	658 (66.2)
Telephone panel	417 (14.8)	139 (20.2)	166 (14.5)	112 (11.3)
Random digit dial	369 (13.1)	52 (7.6)	93 (8.1)	224 (22.5)
[€] Following the removal of 53 respondents during imputation. Cells are weighted to the Labour Force Survey age and sex distribution for each province.				

Table 2: Risks, vulnerabilities and injury concerns, provincial comparisons

	Total (n=2,888)		BC (n=703)		Ontario (n=1175)		Alberta (n=1010)		Test for difference across provinces	
	N	%	N	%	N	%	N	%	X ²	p
LEADING INDICATORS, NUMBER AND PER CENT AT RISK										
AT RISK										
Exposed to hazards	1566	55.4	361	52.5	629	55.0	576	57.9	3.34 DF=2	0.19
Inadequate, policy and procedures	1230	43.5	325	47.3	491	42.9	414	41.6	3.66 DF=2	0.16
Inadequate, awareness	703	24.9	214	31.1	261	22.9	228	22.9	12.25 DF=2	0.002*
Inadequate, empowerment	1028	36.4	264	38.4	400	35.0	364	36.6	1.38 DF=2	0.50
VULNERABILITY										
Policy and procedures	737	26.1	179	26.1	300	26.3	257	25.9	0.03 DF=2	0.99
Awareness	397	14.1	114	16.5	145	12.7	139	14.0	3.33 DF=2	0.19
Empowerment	705	24.9	180	26.1	268	23.5	257	25.8	1.44 DF=2	0.49
All	1023	36.2	252	36.7	409	35.8	362	36.4	0.11 DF=2	0.95
WORRY ABOUT GETTING INJURED OR ILL DOING CURRENT JOB										
Strongly agree	210	7.5	50	7.4	89	7.9	70	7.1	6.51 DF=4	0.16
Agree	592	21.1	172	25.2	219	19.2	201	20.4		
Other	2004	71.4	460	67.4	828	72.9	715	72.5		
LAGGING INDICATORS, NUMBER AND PER CENT AT RISK										
INJURIES[€]										
Last 12 months, physical injury	517	18.5	136	20.0	195	17.1	186	19.0	1.75 DF=2	0.42
Last 12 months, mental injury	472	17.2	107	16.2	194	17.4	171	17.7	0.42 DF=2	0.81
Last 12 months, physical and/or mental injury	766	27.2	191	27.9	300	26.3	275	27.7	0.53 DF=2	0.77
Injury required time off work for health care (n=781)	427	56.1	113	59.5	163	54.9	151	55.0	0.78 DF=2	0.68
Reported injury to workers compensation for benefits (n=781)	143	18.8	41	21.8	50	16.6	52	19.1	1.66 DF=2	0.44
[€] numbers do not necessarily add up to 2,888 due to missing data and weighting to the age and sex distribution of the Labour Force Survey of each province. *Statistically significant result.										

Table 3: Adjusted[‡] Logistic Regression models of areas of vulnerability by province

	Province	Adj. for demographics, mode	Adj. for Occup. Variables, mode	Adj. for workplace, mode	Adj. for all covariates
Policy & Procedures	B.C.	1.02 (0.76, 1.38)	0.98 (0.73, 1.32)	0.96 (0.72, 1.28)	1.00 (0.74, 1.35)
	Ontario	1.03 (0.81, 1.30)	1.02 (0.80, 1.29)	1.01 (0.80, 1.28)	1.06 (0.83, 1.35)
	Alberta	Ref.	Ref.	Ref.	Ref.
Awareness	B.C.	1.20 (0.84, 1.73)	1.11 (0.77, 1.59)	1.17 (0.81, 1.67)	1.11 (0.77, 1.60)
	Ontario	0.85 (0.63, 1.15)	0.80 (0.59, 1.08)	0.88 (0.66, 1.18)	0.78 (0.57, 1.07)
	Alberta	Ref.	Ref.	Ref.	Ref.
Empowerment	B.C.	1.06 (0.78, 1.45)	0.96 (0.71, 1.30)	0.99 (0.74, 1.33)	1.01 (0.75, 1.37)
	Ontario	0.92 (0.72, 1.16)	0.88 (0.69, 1.13)	0.86 (0.68, 1.09)	0.89 (0.70, 1.15)
	Alberta	Ref.	Ref.	Ref.	Ref.
All	B.C.	1.04 (0.79, 1.37)	0.96 (0.73, 1.26)	0.96 (0.74, 1.25)	0.99 (0.75, 1.31)
	Ontario	1.00 (0.81, 1.24)	0.97 (0.78, 1.21)	0.96 (0.78, 1.19)	1.00 (0.80, 1.26)
	Alberta	Ref.	Ref.	Ref.	Ref.
Injury	B.C.	0.98 (0.74, 1.29)	0.89 (0.67, 1.18)	0.96 (0.73, 1.27)	0.90 (0.68, 1.20)
	Ontario	0.90 (0.71, 1.13)	0.87 (0.69, 1.09)	0.89 (0.71, 1.12)	0.86 (0.68, 1.09)
	Alberta	Ref.	Ref.	Ref.	Ref.
Worry	B.C.	1.34 (1.00, 1.78)	1.29 (0.98, 1.72)	1.28 (0.97, 1.70)	1.33 (1.00, 1.78)
	Ontario	1.02 (0.80, 1.29)	1.01 (0.80, 1.29)	0.98 (0.77, 1.23)	1.03 (0.81, 1.32)
	Alberta	Ref.	Ref.	Ref.	Ref.

[‡]Demographics: age, sex, location of birth, education; Occupational: part time/full time, temporary/permanent, occupational group, tenure; Workplace: workplace size; Mode: how survey was administered

Figure 1: Proportion of vulnerability types by industry group, Alberta (N = 988)

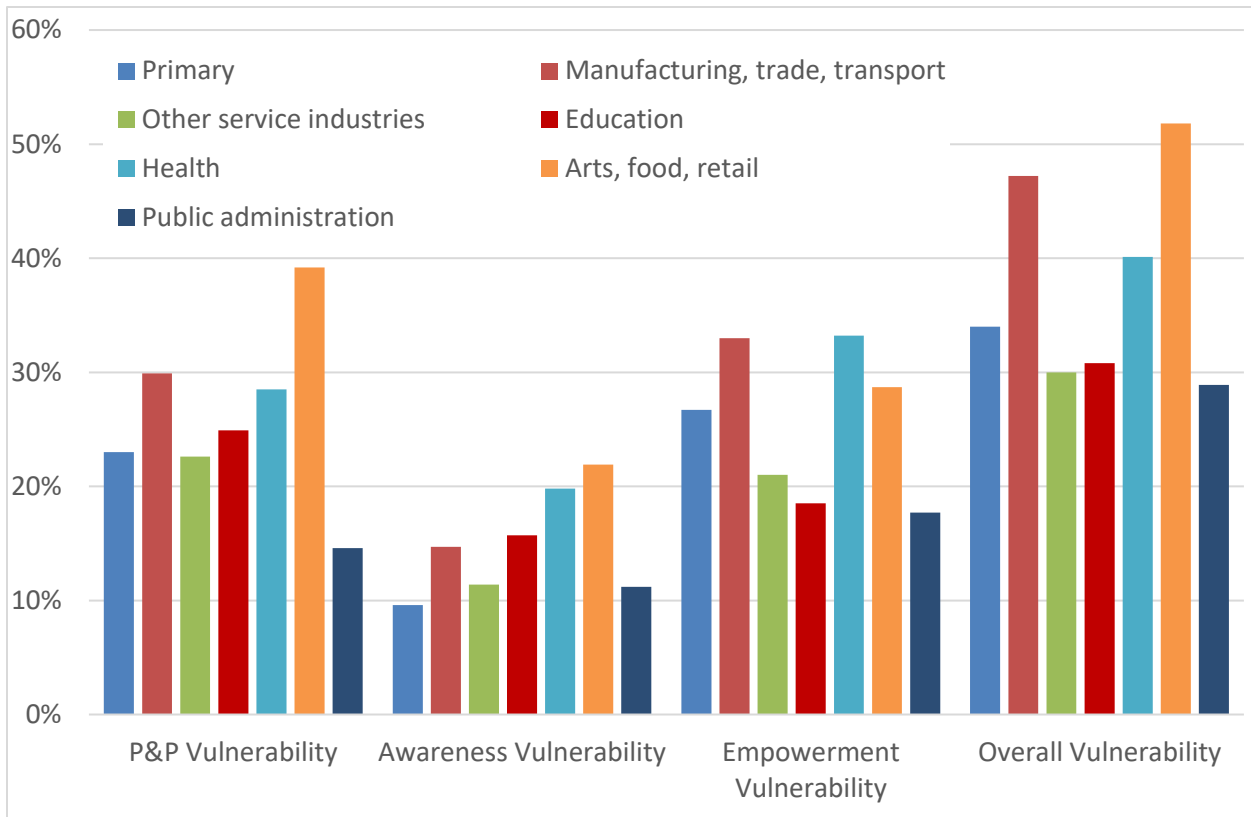


Figure 2: Proportion of vulnerability types by workplace size, Alberta (N = 988)

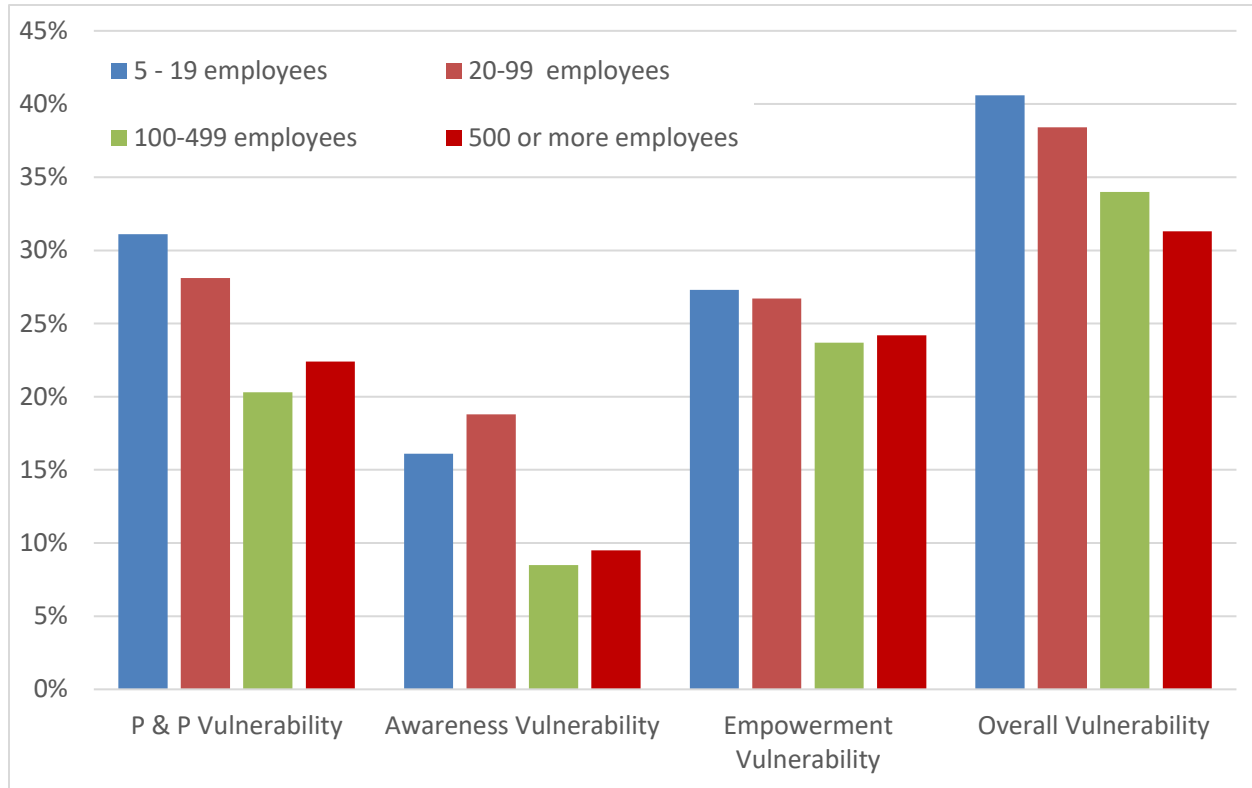
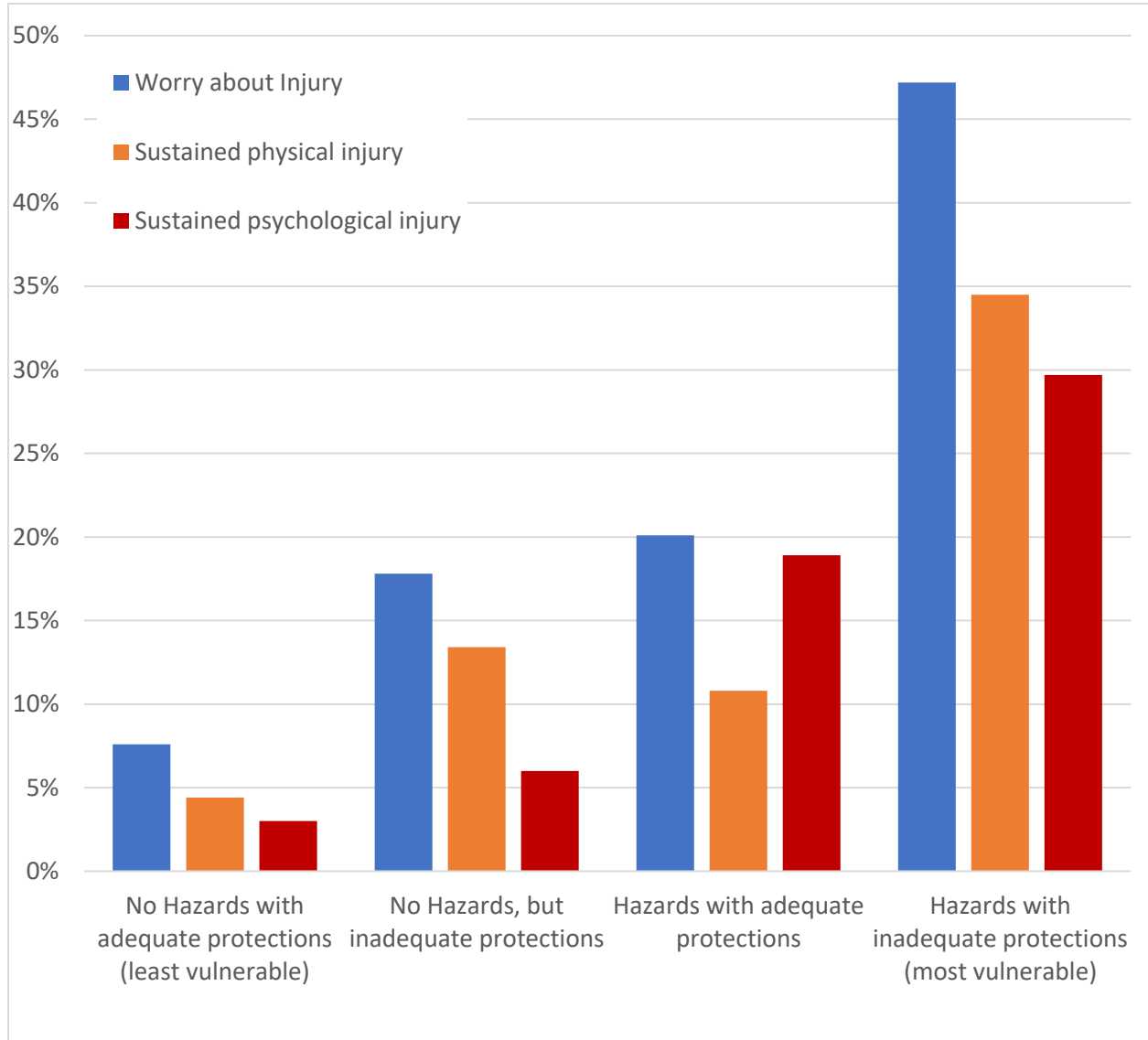


Figure 3: Worry about injury and actual injuries (physical, psychological), previous 12 months by OHS vulnerability groups, Alberta (N = 1,010)



Appendix A: Supplementary tables

Supplementary Table 1: Hazard and occupational health and safety dimensions

		Total sample N=2888	B.C. N=703*	Ontario N=1175*	Alberta N=1010*	Test for difference (p)
Hazards						
Number of exposures	0	478 (16.9%)	130 (18.9%)	213 (18.6%)	136 (13.6%)	Rao Scott 12.7 (0.005)
	1	830 (29.4%)	212 (30.9%)	317 (27.7%)	300 (30.2%)	
	2-3	465 (16.5%)	170 (24.7%)	342 (29.9%)	264 (26.5%)	
	4-9	1052 (37.2%)	175 (25.5%)	272 (23.8%)	295 (29.6%)	
Workplace protections[£]						
a. Policy and procedure sum of scores	Mean	12.9	13.4	12.8	12.7	F 4.8 (0.01*)
	Median	12.6	13.2	12.5	12.1	
	(IQR)	(8-15)	(8-15)	(8-15)	(8-15)	
b. Awareness sum of scores	Mean	9.8	10.3	9.6	9.7	F 9.0 (0.0001*)
	Median	9.3	10.2	9.0	9.1	
	(IQR)	(6-12)	(7-12)	(6-12)	(6-12)	
c. Empowerment sum of scores	Mean	8.6	8.8	8.5	8.6	F 2.8 (0.1)
	Median	8.2	8.6	8.0	8.2	
	(IQR)	(6-10)	(6-10)	(6-10)	(6-10)	

[£] Higher answers for workplace protections indicate greater risk; questions were asked on a scale from 1=strongly agree to 4=strongly disagree thus, sum of scores could range from 7-28 for policy and procedures, 6-24 for awareness, and 5-20 for empowerment*Samples have been weighted to be representative of the age and sex of workers in each province, based on the Labour Force Survey, and calculations completed with SAS 9.4 Survey procedures; they do not add to these numbers.

*Statistically significant result.

Supplementary Table 2: Demographic and occupational labour market distribution - Alberta, Ontario and British Columbia at time of data collection

	British Columbia	Ontario	Alberta
Workplace Size			
Less than 20 employees	36.8%	30.4%	34.2%
20 to 99 employees	35.2%	33.4%	37.1%
100 to 500 employees	19.6%	21.6%	18.6%
More than 500 employees	8.4%	14.6%	10.1%
Employment relationship			
Permanent	87.1%	87.0%	85.5%
Non-Permanent	12.9%	13.0%	14.5%
Weekly Hours worked			
35 hours or more	80.0%	81.6%	84.0%
Less than 35 hours	20.0%	18.4%	16.0%
Time with current employer			
6 months or less	14.1%	13.0%	13.2%
7 to 11 months	6.9%	7.2%	7.4%
12 months to 3 years	21.9%	19.9%	22.2%
3 years or more	57.2%	59.9%	57.3%
Occupation			
Management	6.4%	8.0%	5.7%
Business, finance and administration	16.3%	17.0%	17.1%
Natural and applied sciences and related occupations	7.2%	8.9%	8.0%
Health Occupations	7.9%	6.9%	7.5%
Occupations in law, education, social, community and government services	11.9%	11.5%	12.2%
Occupations in art, culture, recreation and sport	2.6%	1.9%	1.4%
Sales and service occupations	27.3%	25.9%	23.8%
Trades, transport and equipment operators and related occupations	14.4%	12.6%	16.9%
Natural resources, agriculture and related production occupations	1.9%	1.2%	3.9%
Occupations in manufacturing and utilities	4.3%	6.4%	3.6%

Source: Statistics Canada's Labour Force Survey

Supplementary Table 3: Adjusted logistic regression models for occupational health and safety indicators, Alberta (N=1010)[£]						
	LEADING INDICATORS					LAGGING INDICATOR
	Policy & procedures Effect (95% C.I.)	Awareness Effect (95% C.I.)	Empowerment Effect (95% C.I.)	All vulnerability types Effect (95% C.I.)	Worry Effect (95% C.I.)	Physical Injury Effect (95% C.I.)
Age						
Under 35	1.25 (0.75, 2.07)	2.13 (1.13, 4.00)*	2.77 (1.67, 4.60)*	2.16 (1.36, 3.42)*	1.69 (1.03, 2.77)*	1.28 (0.74, 2.21)
35-44	1.39 (0.88, 2.20)	1.69 (0.92, 3.11)	1.53 (0.94, 2.50)	1.23 (0.80, 1.89)	1.34 (0.85, 2.10)	0.97 (0.57, 1.64)
45-54	1.43 (0.92, 2.24)	1.91 (1.05, 3.47)*	1.67 (1.03, 2.71)*	1.38 (0.91, 2.11)	1.33 (0.84, 2.11)	1.56 (0.95, 2.55)
55 and over	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Sex						
Male	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Female	0.73 (0.49, 1.08)	1.06 (0.65, 1.74)	0.68 (0.45, 1.02)	0.65 (0.45, 0.93)*	0.79 (0.54, 1.18)	0.84 (0.55, 1.29)
Country born						
Canada	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Other	0.88 (0.51, 1.53)	0.64 (0.28, 1.46)	1.08 (0.60, 1.92)	1.35 (0.83, 2.18)	1.46 (0.87, 2.43)	1.08 (0.57, 2.04)
Education						
High school or less	1.44 (0.85, 2.42)	1.16 (0.58, 2.33)	1.70 (0.99, 2.90)	1.74 (1.05, 2.89)*	1.07 (0.62, 1.85)	0.98 (0.53, 1.83)
Less than a bachelor's	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Bachelor's						
Post graduate	0.71 (0.45, 1.11) 0.56 (0.30, 1.08)	0.93 (0.52, 1.67) 1.20 (0.59, 2.45)	0.63 (0.39, 1.01) 0.35 (0.18, 0.69)	0.63 (0.41, 0.95)* 0.38 (0.21, 0.69)*	0.60 (0.38, 0.95)* 0.61 (0.34, 1.11)	0.63 (0.38, 1.04) 0.85 (0.44, 1.63)
Hours work						
Under 35 hours	1.51 (0.82, 2.80)	1.56 (0.75, 3.23)	1.35 (0.74, 2.46)	1.38 (0.77, 2.47)	0.74 (0.40, 1.37)	1.05 (0.53, 2.09)
35 hours or more	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Industry						
Primary	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Manufacturing, trade, transport	1.49 (0.80, 2.75)	1.78 (0.69, 4.54)	1.40 (0.74, 2.66)	1.79 (1.01, 3.16)	0.87 (0.46, 1.67)	1.30 (0.64, 2.64)
Other service industries	1.01 (0.58, 1.74)	1.02 (0.47, 2.22)	0.77 (0.43, 1.37)	0.90 (0.54, 1.50)	0.82 (0.48, 1.40)	0.97 (0.52, 1.79)
Education	1.51 (0.79, 2.89)	1.70 (0.70, 4.13)	1.16 (0.57, 2.38)	1.65 (0.86, 3.16)	0.89 (0.46, 1.75)	2.08 (1.01, 4.29)*
Health	1.45 (0.72, 2.92)	1.95 (0.81, 4.70)	1.90 (0.97, 3.73)	1.83 (0.96, 3.50)	1.68 (0.87, 3.27)	2.29 (1.13, 4.65)*
Arts, food, retail	2.02 (1.01, 4.04)	1.80 (0.73, 4.42)	0.93 (0.42, 2.03)	1.96 (0.99, 3.88)	0.66 (0.32, 1.34)	2.10 (1.01, 4.38)
Public administration	0.72 (0.32, 1.62)	1.06 (0.38, 3.00)	0.78 (0.32, 1.88)	1.08 (0.51, 2.30)	0.67 (0.27, 1.69)	1.57 (0.52, 4.70)
Tenure						
6 months or less	0.46 (0.20, 1.08)	1.47 (0.53, 4.12)	0.62 (0.25, 1.55)	0.68 (0.32, 1.44)	0.92 (0.41, 2.09)	0.43 (0.14, 1.32)

7-11 months	2.00 (0.76, 5.30)	2.74 (1.00, 7.53)	1.90 (0.72, 5.06)	1.59 (0.58, 4.32)	1.50 (0.57, 3.93)	1.38 (0.43, 4.46)
1 year to <3	1.14 (0.68, 1.92)	1.37 (0.72, 2.61)	0.89 (0.52, 1.53)	0.93 (0.56, 1.56)	0.95 (0.57, 1.59)	0.91 (0.51, 1.59)
3 years & up	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Workplace size (# people)						
5-19	0.98 (0.54, 1.76)	1.30 (0.64, 2.63)	0.69 (0.38, 1.27)	0.88 (0.50, 1.52)	0.80 (0.44, 1.44)	1.93 (0.99, 3.79)
20-99	1.05 (0.62, 1.78)	1.77 (0.94, 3.35)	0.91 (0.54, 1.55)	1.01 (0.62, 1.65)	0.93 (0.57, 1.52)	2.09 (1.13, 3.86)*
100-499	0.74 (0.41, 1.35)	0.77 (0.34, 1.77)	0.75 (0.42, 1.35)	0.87 (0.51, 1.48)	0.92 (0.53, 1.59)	1.63 (0.85, 3.11)
500 or more	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Work relationship						
Permanent	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Temporary	1.30 (0.72, 2.34)	0.84 (0.35, 2.02)	0.96 (0.49, 1.86)	1.04 (0.57, 1.89)	0.97 (0.53, 1.78)	1.11 (0.52, 2.36)
<p>[‡]Models adjusted for all variables in the table in addition to mode of survey administration, weighted to the age and sex distribution of the labour force of each province, using SAS survey procedures.</p> <p>*Statistically significant result</p>						

The adjusted logistic regression models for OHS indicators for Alberta, above show:

A pattern of worker vulnerability associated with age, with younger workers more likely to experience all types of OHS vulnerability when compared to the oldest group of workers.

Differences across educational levels, with respondents with lower levels of education being more likely to experience overall OHS vulnerability than were those with higher levels of education.

Differences in overall vulnerability across educational groups were mainly driven by differences in policy and procedure and empowerment vulnerability, with limited differences observed across educational groups for awareness vulnerability.

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