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The relationship between occupational health and safety vulnerability and workplace injury



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1. Introduction

Workplace injury and illness account for a substantial source of sickness and disability burden in working-age populations. For example, injuries and illnesses arising from work cost the Canadian economy an estimated at \$19 billion annually (Gilks and Logan, 2010). In addition to substantial economic costs, occupational injury places an additional strain on workplaces and families, and has the potential to exacerbate existing social and economic inequalities (Benach et al., 2007).

Previous research has been successful in identifying patterns in the uneven distribution of workplace injuries and risk. Groups at higher risk of work-related injury— often labeled "vulnerable workers"—are routinely identified using single demographic or occupational and organizational characteristics. Included under this "vulnerability" rubric are young workers (Breslin and Smith, 2005), new workers (Breslin and Smith, 2006), workers in temporary jobs (Quinlan et al., 2001), recent immigrants (Premji and Smith, 2013; Smith and Mustard, 2010), and those in high-

* Corresponding author. E-mail address: mlay@iwh.on.ca (A.M. Lay). hazard industries (Dembe et al., 2004). Newer research has also begun to examine how the interactions between individual socio-demographic characteristics exacerbate occupational health risks (NIOSH, ASSE, 2015).

The approach of identifying vulnerable workers using isolated characteristics can lead to unfounded presumptions that individual population groups are inherently more risky or accident-prone, and often focuses on behaviour-change and education as primary solutions to workplace injury (DeJoy, 2005). It also provides only limited information that may be used to design primary prevention activities, as it assumes that dissimilar population groups sharing the label "vulnerable" are at increased risk for the same, or very similar, reasons.

This study employs a recently developed conceptual framework and measurement tool that moves beyond defining occupational health and safety (OH&S) vulnerability using population or occupational characteristics, and instead examines how work and workplace characteristics shape an individual worker's risk of injury (Smith et al., 2015). The measurement tool captures information on four dimensions of OH&S vulnerability: (1) exposure to workplace hazards; (2) workplace safety policies and procedures; (3) worker awareness of health and safety-related rights and responsi-

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		Mitigation Resources (Policies and Procedures, Awareness, Empowerment)	
		Adequate	Inadequate
Exposure to Hazards	Not exposed	Not exposed to hazards & adequate mitigation resource	Not exposed to hazards & inadequate mitigation resource
	Exposed	Exposed to hazards & adequate mitigation resources	Vulnerable Exposed to hazards & inadequate mitigation resources

Fig. 1. Conceptual framework of OH&S vulnerability.

bilities; and (4) worker empowerment to act to protect themselves and colleagues. The conceptual framework posits that in isolation exposure to workplace hazards, or poor access to protective policies and procedures, awareness or empowerment places workers at increased risk of injury but that the greatest risk arises for workers who are both exposed to hazards *and* experience one or more deficits in resources to manage these hazards (see Fig. 1). We contend that 'vulnerability' arises from exposure to on-the-job hazards in conjunction with inadequate access to resources (policies and procedures, awareness or empowerment) to mitigate the effects of these risks.

The four dimensions of OH&S vulnerability articulated in the conceptual framework and measured in this study share elements with organizational psychology and safety climate measures that have been associated with safety behaviours, and to a lesser extent, safety performance (Neal et al., 2000; Clarke, 2006). For example measurement of the policy and procedure and empowerment dimensions of OH&S vulnerability include questions previously used to measure aspects of safety climate such as safety communication (Fernandez-Muniz et al., 2007) and management commitment to safety (Griffin and Neal, 2000). Despite these overlaps, the OH&S vulnerability survey used in this study can be distinguished from safety climate measures in a number of ways. First, it focuses on individual worker perspectives rather than the organizational unit originally conceived of by Zohar (1980). Further, unlike many existing OH&S measures that either focus on how hazards or aspects of the work environment (e.g. safety climate) increase or decrease risk of injury, this measure of OH&S vulnerability considers how the *combination* of hazards with inadequate levels of at least one of three distinct mitigating factors is pivotal to increased risk of injury (Leitao and Greiner, 2016). Finally, this measure is designed to measure differing dimensions of vulnerability across many industries while many safety climate measures are specific to an occupational or industry (Gillen et al., 2002; Lu and Tsai, 2008; Lin et al., 2008; Souza et al., 2014).

Previous research using this conceptual framework and measurement tool has demonstrated that different types of OH&S vulnerability are more prevalent among labour market groups who have been previously labeled as vulnerable (Lay et al., 2015). The framework and measurement tool have not yet been linked to the experience of occupational injury. The conceptual model suggests that the presence of inadequate policies and procedures, or awareness, or empowerment will produce an additional risk of injury beyond the risks associated with exposure to hazards, but the actual nature of this combination has not been previously specified or explored. In response, this study has two objectives: (1) to examine the association between our dimensions of OH&S vulnerability and incidence of occupational injury (as well as worry about the possibility of future injury), and (2) to better understand the additive relationship between different dimensions of OH&S vulnerability and occupational injury. To achieve these objectives we use quantitative techniques to understand whether this combination of risks is additive, as suggested by the conceptual framework.

2. Materials and methods

2.1. Data

Data for this study was collected through a survey in April and May 2015 from a sample of working adults (18 years or older) employed at least 15 h a week at firms with five or more workers in British Columbia and Ontario. The majority of participants were recruited by a commercial survey provider from a panel of 90,000 Canadian households who had agreed to participate in surveys "from time to time." A minority of the sample was recruited using random digit dialing (RDD) to allow for a comparison between the panel sample and more traditional RDD sample. Respondents in the RDD sample were less likely to have a post-secondary degree and were more often employed in the trades.

2.2. Measures

2.2.1. Outcome: workplace injury or illness

Four workplace injury outcomes were examined. (1) Individuals were classified as being worried about workplace injury if they strongly agreed or agreed with the statement "I worry that I will end up getting injured or ill doing my job." (2) Participants were considered to have experienced a work-related physical injury¹ if they responded "yes" to the question "In the past 12 months have you sustained a physical injury or illness due to your work?" (3) A similar definition and question were used to identify those who had experienced a workplace mental health injury. (4) Individuals who reported a physical or mental injury in the preceding year were also asked if this event required them to "take time off work or receive health care from a medical professional." Those who responded "yes" are compared to those without injury and those with injuries that did not require time-off or medical attention.

2.2.2. Exposure: OH&S vulnerability

Exposure to OH&S vulnerability was assessed using a 27question survey tool. A full account of the development of the tool can be found elsewhere (Smith et al., 2015). Briefly, the development of the survey tool began with a comprehensive review of peer-review and grey literature and focus groups to identify potential items to measure the each of the four dimensions of vulnerability. The initial list of 97 items was reduced based on review of items' psychometric properties and theoretical considerations. Exploratory factor analyses demonstrated that the items selected as part of the measure captured three, related, but separate mitigating factors (policies and procedures, awareness and empowerment). The dimension of hazards was not included in the factor model as the items assessing hazards would not necessarily be related to each other. As the development work for this measure was conducted in a different sample of workers, prior to undertaking the analyses for this paper we re-confirmed that the measure separately captured the three mitigating factors in this new sample using confirmatory factor analyses (results not presented, but available on request).

¹ Throughout this paper the terms "injury" and "injuries" refer to both injury/ injuries and illness/illnesses.

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