1.6. Job Specific Factors Related to Safety

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1.6. Job Specific Factors Related to Safety

Human error is often considered a primary contributor to injury rates, risky behavior, and negative safety engagement at work. However, human errors are caused by a wide array of factors such as fatigue, lack of situational awareness, decreased attention spans, divided attention, or poor well-being. Thus, many controllable job specific factors in the workplace can directly affect the causes of human errors. Altering these job-specific factors in line with evidence-based practice may significantly reduce safety incidents related to human error. Specifically, job specific factors are specific circumstances, industry demands, or required parameters existing in the workplace that have the potential to affect individual employee safety and overall safety culture. These factors are a reality within any workplace as they often accommodate the necessary requirements of company operation and production. Job specific factors such as shift schedules, time pressures, and employee breaks affect the fatigue (both mental and physical), well-being, and overall safety of all individual employees within the workplace. In this section, we will identify job specific factors evident in existing safety research and discuss empirical evidence of their relations to safety behavior and safety engagement.

The question that guided our scoping review was: "how do factors specific to one's job affect his or her safety in the workplace?"

Method

Search Strategy. A scoping search of the literature was undertaken using the following key words:

1. Career pattern (Career development, employment status, seniority, job experience level, job knowledge, occupational tenure, occupational mobility, reemployment, employee turnover, job security, occupational status
2. Work schedule (work scheduling, work rest cycles, workday shifts, work week length)
3. Work location (work site, commuting (travel) , geographical mobility (explode), transportation, remote site)
1. Safety engagement (see General Methods section).

The searches were undertaken from April to June, 2015.

Screening strategy. The screening process was similar to other topics such that articles were excluded for publication date (e.g., published before 2010), irrelevant records (e.g. non-English), irrelevant medium (e.g., book reviews, letters to editor, etc.), irrelevant safety domain (e.g., sexual risk taking, gambling, etc.), or other irrelevant content based on the inclusion/exclusion criteria listed in Table 1. The inclusion and exclusion criteria were kept broad in that we did not specify the types of research methods to be included or excluded in order to capture as many research articles on the topic as possible. Due to the high overlap between articles included in this search and those included under 3.6. Social-psychological factors in the workplace, many articles originally included during screening were ultimately covered in chapter 3.6. only (e.g., job insecurity, job tenure, job satisfaction, etc.).

Table 1. Job Specific Factors Inclusion/Exclusion criteria for topic

Include the article if:	Exclude the article if:
• Shift work and safety • Night shift and safety • Older workers/seniority and safety • New workers and safety • Daylight savings time and work injuries • Temp workers and safety • Sleepiness and safety • Full-time work and safety • Part-time work and safety • Employee turnover and safety • Rest breaks and injury • Work hours/schedule and safety • Tenure and safety • Overtime and safety/accidents • Work location and safety (remote site) • Employment status and safety • Commuting and safety • Working time and injuries • Contract workers and safety	• Focuses on health not safety • Shiftwork and sleepiness/physical illness (not safety) • Transportation accident/Traffic accident not related to job factors • Work injury compensation

Results

Description of included articles. A brief summary of all articles including the location, population studied, main issue addressed, comparison group, and primary outcomes is provided in Appendix G. The following is an overview of included articles.

Table 2. Job Specific Factors Number of Articles by database searched

Database	**Articles found from search**	**Articles Selected for Review**	**Final article selection**
ABI/INFORM Complete	1420	9492	36
Academic Search Complete	444		
CBCA Complete Business	265		
CINAHL	565		
EMBASE	842		
MEDLINE	1400		
ProQuest Dissertations & Theses Global	829		
PsycINFO	1227		
Scopus	1234		
SocINDEX	297		
Sociological Abstracts	658		
Web of Science	311		

Table 3. Job Specific Factors Number of articles by type, country, and population

Type of Publication:	Country of Publication:	Population Studied:

- 6 systematic lit reviews
- 2 scoping lit reviews
- 2 meta-analyses
- 1 theoretical lit review
- 25 original research articles
  - 12 surveys
  - 6 database analyses
  - 5 interviews
  - 2 experimental designs
	- 8 USA
	- 3 Japan
	- 3 Norway
	- 2 Australia
	- 2 Canada
	- 2 Taiwan
	- 2 UK
	- 1 Iran
	- 1 Turkey
	- 1 Philippines
	- 1 Brazil
	- 1 Belgium
	- 1 Netherlands
	- 1 Finland
	- 1 Denmark
	- 1 Nigeria
	- 1 Switzerland
	- 1 Zimbawe
	- 1 Malaysia
	- 1 China
		- 7 Nurses
		- 5 Miners
		- 4 Processing, manufacturing and/or construction
		- 2 Police officers
		- 2 Drivers
		- 1 Sailors

Description of Identified Factors. Based on a descriptive analysis of the selected articles, six job specific factors that affect safety were identified: shift work and night shifts; overtime and extended hours; fatigue and sleep management; time pressures, and breaks. Other job specific factors, such as safety culture, job tenure, employee demographics, etc. were also evident in the included literature but are discussed under different topics. All definitions of concepts as used in the current literature are provided in Appendix D.

Shift work and night shifts. The majority of articles in this topic (n = 23) were related to shift work and/or night shifts: Amendola, Weisburd, Hamilton, Jones & Slipka, 2011; De Castro, Fujishiro, Rue, Tagalog, Samaco-Paquiz & Gee, 2010; Fossum, Bjorvatin, Waage & Pallesen, 2013; Hanoa, Baste, Kooji, Sommervold & Moen, 2011; Harrington, 1994; Kantermann, Haubruge, & Skene, 2013; Luna, 1997; Muecke, 2005; Musa, 2013; Nakata, 2011; Niu, Chung, Chen, Hegeny, O'Brien & Chou, 2011; Niu, Chu, Chen, Chung, Chang, Liao & Chou, 2012; Parkes, 2012, Rutenfranz, Colquhoun, Knauth & Ghata, 1977; Sanati, Yadegarfar, Naghavi, Mansouri, Sanati, 2010; Smith, Folkard, Tucker & Macdonald, 1998; Torkington, Larkins & Gupta, 2011; Violanti, Fekedulegn, Andrew, Charles, Hartley, Vila, & Burchfiel, 2013; Wagstaff & lie, 2011; Waagem Odeen, Bjorvatn, Eriksen, Ursin, Hollund & Moen, 2010; Wong, McLeod & Demers, 2011; Zencirci & Arslan, 2011. When workers are subjected to shift work (i.e., rotating shifts) it is harder for them to adjust their sleep rhythms which causes fatigue, reduced attention levels, and more stressful work conditions resulting in an increased likelihood of injury (Violanti et al., 2013; Wong et al., 2011; Fossum, 2013; Muecke, 2005; Niu, 2011; Wagstaff & Lie, 2011). Working exclusively night shifts or exclusively day shifts helped workers to improve their sleep quality and improve overall safety during their shift because one's circadian rhythm is more likely to adjust and stabilize if shifts are consistent (Zencirci & Arslan, 2011).

Two studies found that 10 hour shifts (compared to 8 and 12 hour shifts) appeared to be the best

for workers' quality of life (Amendola et al., 2011; Smith et al., 1998). In another study, workers claimed that 14 days working followed by 14 days off (compared to 7 days working and 7 days off) was optimal in terms of stress, coping, dealing with life problems, getting better sleeps, and maintaining/improving relations with family members (Hanoa et al., 2011). Similarly, a database analysis of Norwegian miners, Wage et al., (2010) found that employees who worked a set of 21 consecutive days followed by 21 consecutive days off experienced better health, reduced injury rates, and were happier than those who worked a more balanced schedule. However, another study found that fly-in fly-out workers' well-being was negative despite enjoying the extended style of shift and being home for long periods of time (Torkington et al., 2011). This is because fly-in fly-out workers had negative family relations with life partners and children. For example, life partners of fly-in fly-out workers took on much of the child-rearing which caused stress and loneliness.

Night shifts. A Canadian database analysis of employees in multiple industries found that night shift injury rates have stayed stable between 1996-2006 whereas day shift injury numbers have declined (Wong et al., 2011). Thus, it appears the factors that affect safety during night shifts may vary slightly from those present during day shifts. Indeed, over the past decade, there has been a large magnitude of research that has outlined the negative effects of night shifts. Specifically, injuries are more likely to occur during night shifts when compared to day or evening shifts (De Castro et al., 2010; Fossum et al., 2013; Harrington, 1994; Muecke, 2005; Niu et al., 2012; Parkes, 2012; Sanati et al., 2010; Violanti et al., 2013; Wagstaff & Lie, 2011; Wong et al., 2011), especially between 12:00 am and 10:00 am (Sanati et al., 2010). It is natural for attention capacities to be lower during night shifts due to fatigue. This has the effect of employee carelessness or lack of ability to filter out irrelevant information and concentrate on the job. Thus, there is higher chance of injury as the night progresses. A scoping review of airline workers found that night shift injuries were especially likely when workers were bored or had a light workload (Luna, 1997).

However, the negative effects of night shifts appear to dissipate when an employee is able to adjust to his or her schedule. Specifically, long periods of working only nights followed by long periods off work (e.g., 14 days on, 14 days off) allows the human body to adjust to this schedule and reduces the effects of fatigue and diminished attention spans. Thus, if night shifts cannot be avoided in the workplace, routine in scheduling is important to reduce the risk of injury. Schedules that allow an employee to be in a set routine for extended periods of time are the best way a company can help employees cope with night shifts, both physiologically and mentally. Periodically working extended hours and constantly switching between day and night shifts (i.e., rotating shift) may disrupt this schedule routine and exposed workers to circumstances that facilitate poor safety attitudes, behaviors, and engagement.

Overtime and extended hours. Seven articles discussed the effect of overtime and extended hours on safety (De Castro et al, 2010; Arlinghaus et al., 2012; Fallis et al., 2011; Caruso, 2014; Musa, 2013; Nakata, 2011; Wage et al., 2010). Extended work hours refers to working more than 48 hours in a week, but can also mean working shifts longer than eight hours (Waage et al., 2010). The majority of articles reported that employees who worked a set of mandatory overtime hours (De Castro, 2010) or who

worked extended hours (e.g., more than 12) in a 24 hour period (Arlinghaus et al., 2012; Fallis et al., 2011; Caruso, 2014; Musa, 2013; Nakata, 2011) experienced higher injury rates than those who did not. This result was amplified when employees were also fatigued (Arlinghaus et al., 2012; Nakata, 2011).

Fatigue and sleep management in the work place. Nine articles were related to fatigue and/or sleep management in the workplace (Fletcher, 2010; Tomoaki, Kubo, Ebara, Takeyama, Inoue, Iwanishi, Tachi, Itani & Kamijima, 2010; Hystad, Saus, Saetrevik & Eid, 2013; Arlinghaus, Lombardi, Willetts, Folkard & Christiani, 2012; Fallis, McMillan, & Edwards, 2011; Garde, Nabe-Nielsen & Aust, 2011; Caruso, 2014; Watling & Smith, 2012; Watling, Armstrong, Obst, & Smith, 2014). Fatigue refers to "a reduction in physical and/or mental capability as the result of physical, mental, or emotional exertion which may impair nearly all physical abilities" (Hystad et al., 2013; pg. 72); it can also be defined as "a biological drive for recuperative rest in the sub factors of sleepiness and mental, physical, and muscular fatigue" (Lombardi et al., 2014; pg. 147). Due to its impact on cognitive failure, fatigue is consistently associated with higher rates of injury (Arlinghaus et al., 2012; Fallis et al., 2011; Caruso, 2014; Musa, 2013; Nakata, 2011). Therefore, fatigue is detrimental to safety and is caused by sleep deprivation, extended work hours, and poor work schedules. Fatigue may occur physically *and* mentally and both are equally as dangerous for increasing injury rates. In general, sleep deprivation causes deficiencies in reaction times, concentration, work performance, individual decision making, and increases risk taking behaviors (Caruso, 2014). These factors may be detrimental to maintaining safety culture. The perceptions of employees towards management regarding how much they value, prioritize, and commit to safety culture was also found to influence the fatigue of workers (Hystad et al., 2013).

Watling and Smith (2012) found a discrepancy between subjective sleepiness and actual sleepiness such that participants in their study reported feeling sleepy even when no physiological evidence was present (e.g., EEG spectral power measures of sleepiness). However, subjective sleepiness had a real influence as participants could enter sleep fairly easily afterward (Watling & Smith, 2012). In a later study, Watling et al. (2014) examined sleepy driving behaviour and found that time urgency and low risk perception was related to self-reported sleepy driving. Thus, even though people can identify sleepiness, they are likely to continue driving if their motivation to do so is high. While these studies did not focus on behaviour in an occupational context, the tendency to under-estimate the risk of sleepiness can be devastating in hazardous environments. However, motivation and risk perception are changeable constructs and thus, intervention can produce favourable outcomes.

Potential solutions for reducing fatigue in the workplace. Fatigue may be partially caused by employees' personal choices (i.e., poor sleep schedule), but it is also enhanced by the environment an organization creates for their employees. Work schedules that require employees to work extended periods but also allow long periods of off-time is one way to reduce fatigue among workers. This will allow a routine to emerge in scheduling and workers will be able to adjust to their schedule more effectively (Arlinghaus et al., 2012; Garde et al., 2011). A brief exercise period also helped to reduce fatigue and injury rates during a simulated night shift (Tomoaki et al., 2010). Specifically, reaction times were better in the second half of the 8 hour shift when participants exercised for a brief time.

In addition, When employees are able to nap at work (i.e., during a night shift), they feel safer and injury rates are statistically decreased (Fallis et al., 2011; Musa, 2013). For example, a series of interviews with Canadian nurses revealed that restorative napping (i.e., a purposeful, brief sleeping period) is effective in reducing fatigue, increasing vigilance, and improving performance on judgment tasks among individuals working extended hours/night shifts (Fallis et al., 2011). Those who did not nap expressed safety concerns as a result of fatigue. Interviews and document analysis with miners revealed that a 20 minute nap followed by a brief buffer time to fully wake up (approximately 10 minutes) was enough for employees to feel refreshed and more comfortable working safely (Fletcher, 2010). Therefore, employees are able to 'refresh' their cognitive resources through restorative napping in such a way that they will think clearer and will be able to focus more on safety.

Watling et al. (2014) also examined six countermeasures for sleepiness while driving and found that swapping drivers, stopping to nap, and stopping the car were considered most effective while opening a window or turning on air conditioning were considered the least effective. Despite this, Watling et al. found that opening a window or turning on air conditioning had the strongest relationship with sleepy driving behaviour and that the associations between sleepy driving and other effective countermeasures were not significant. It is possible that drivers often rely on convenient, easily implemented countermeasures to allow travelling without delay. Thus, employers should be aware of instances where workers use convenient but ineffective countermeasures to combat fatigue and implement effective countermeasures instead.

Perhaps the most important initiative a company can implement to reduce fatigue among employees is to facilitate constant communication between management and employees regarding the topic of fatigue. Workers who felt they could not express their fatigue to their supervisors or managers experienced worsened fatigue and distress (Fletcher, 2010). Clearly, acknowledging the risk and occurrence of fatigue in the workforce, and engaging in continuous, open communication about fatigue is important to help reduce fatigue and resulting injuries.

Time pressures and production focus on safety in the workplace. Four articles explored the relationship between work related time pressures or a similar focus on production and safety (Asfaw, Mark, & Pana-Cryan, 2013; Chimamise, Gombe, Tshimanga, Chadambuka, Shambira & Chimusoro, 2013; Elfering, Grebner, & Tribolet-Hardy, 2013; Hystad et al., 2013). Two studies revealed that putting time pressure on employees (e.g., requiring tasks to be completed within short periods of time and/or setting strict work quotas) was significantly related to increased accident (Elfering et al., 2013) and injury (Chimamise et al., 2013) rates because employees are more likely to focus their cognitive resources on completing the task than on the safety of themselves or those around them. An employee's cognitive attention span is an important factor to consider when assigning job tasks in addition to considering the nature of assigned jobs. If an employee feels he or she needs to complete a task in a short amount of time, he or she will devote more cognitive resources to the task at the expense of safety (Elfering et al., 2013).

Similarly, when employees perceive that their management group values production, efficiency, and cost reduction over employee well-being and safety, they are more likely to be emotionally, physically, and mentally exhausted (Hystad et al., 2013). Interestingly, workers' perceptions of how

management values, prioritizes, and commits to safety influences their fatigue while workers' perceptions of coworkers did not have the same effect. If employees perceive that their company truly values safety over profits, production, and efficiency then they will feel that they are being put first and will be more likely to contribute to a positive safety culture. However, this does not mean that production and profits are unimportant; a database analysis of various American coal mines found that as company profits increased, the amount of injuries experienced within the company decreased (Asfaw et al., 2013). Thus, devoting time and money to reducing injuries does have a positive effect.

Breaks. Four articles were related to work breaks and safety (Lombardi, Jin, Courtney, Arlinghaus, Folkard, Liang & Perry, 2014; Tucker, 2003; Musa, 2013; Niu, Chung, Chen, Hegeny, O'Brien & Chou, 2011). In a theoretical review of various employees, Tucker (2003) did not find evidence that breaks are directly responsible for reduced risk of injury because injuries are context dependent. Contrarily, results of Musa's (2013) scoping review indicated that rest breaks are key to preventing injuries during extended work hours. Similarly, Chinese researchers Lombardi et al. (2014) interviewed injured workers who were admitted into a hospital and found that taking a break of any duration during a day shift was related to reduced injury rates and delayed time between injuries. However, this effect was not found for night shifts.

A systematic literature review on shift work among nurses also found that mental work breaks (i.e., doing something completely different from the job task) and frequent physical breaks significantly reduce fatigue among workers (Niu et al., 2011). Thus, breaks may improve safety through reduced fatigue, reduced time pressures, relieved strain, and decreased stress. In addition, communication and socialization between co-workers is also important in creating and maintaining a positive safety culture. Often this socialization occurs during breaks taken during work time; thus, break times are also important to form group cohesion, trust, and a sense of belonging among co-workers which indirectly affects safety culture (Musa, 2013).

Discussion

In the literature, it was evident that the highest risk of injury occurs during night shifts or when employees are required to work extended hours. Thus, routine in shift type and moderate work hours appears to be a key factor in human adjustment to otherwise injury prone shifts.

Future directions. All reported findings should be confirmed within the context of Saskatchewan mining companies. Although the majority of evidence suggests that injuries are most likely to occur during a night shift, this may not be the case within the mines sites of Saskatchewan. It is proposed that further research is conducted in order to compile and analyze injury report data so that it may be compared to the general trends seen in psychological research. By doing so, the research team may conclude with confidence whether the findings of the literature search generalize to Saskatchewan mining companies and suggest strategies to reduce the negative effects of night/rotating shifts based one existing literature. Existing injury rates may also be compared across current shift schedules used at Saskatchewan mine sites to determine which shift types are associated with least injuries. This research has the potential to impact the scheduling of mine workers to control and reduce the effects of fatigue and divided attention. Within this research, different shift lengths, hours, and time off should be explored.

Recommendation. Companies should seriously consider the risk of fatigue among their employees as the reviewed literature consistently shows that fatigue is detrimental to safety. It is important to note that fatigue is both physical and mental in nature and both are equally as dangerous when working in an environment that requires full attention. If an employee is fatigued, he or she is more likely to devote diminished cognitive resources to the job task resulting in limited cognitive resources devoted to safety. Based on the current scoping review, the following are recommended to reduce worker fatigue in the mining industry:

- **Routine shifts (vs. rotating shifts).** Schedules that allow an employee to be in a set routine for extended periods of time is the best way to psychologically and mentally cope with night shifts. Periodically working extended hours and constantly switching between day and night shifts (i.e., rotating shift) may disrupt workers' routines and expose them to circumstances that facilitate poor safety engagement. Thus, these shifts are associated with a greater chance for injury due to human error.
- **Extended sets when night shifts are necessary**. If it is necessary for employees to work both night and day shifts, it is best for them to work each type of shift for extended periods of time rather than frequent rotations. If not already in use, the 14-days-on-14-days-off shift, which is recommended in the literature, may be temporarily implemented for some workers in order to assess the adjustment, fatigue, and attention effects of affected employees. Extended periods of 'off-time' after long periods of work is necessary to reduce chronic fatigue.
- **Breaks, napping, and exercise.** To reduce fatigue, companies may also facilitate mental and physical breaks from work tasks, exercise breaks, or brief (e.g. 20 minute) naps. In addition to addressing fatigue, breaks also relieve strained cognitive resources, decrease stress, and facilitate socialization among coworkers which indirectly promotes a strong safety culture.
- **Acknowledge fatigue and sleep deprivation in the workforce**. Open communication between management and workers is key to identify any problems with fatigue and to contribute to a positive safety culture. Workers who felt they could not express their fatigue to their supervisors or managers experienced worsened fatigue and distress. It is important to raise awareness of the risks of sleepiness when operating equipment or working in hazardous environments as individuals are often motivated to continue driving when sleepy.
- **Allow effective means of reducing worker fatigue (vs. relying on convenient means).** Sleepy drivers often use convenient strategies to stay awake (e.g., opening a window) despite recognizing them as least effective compared to other strategies (e.g., stopping the vehicle). Thus, employees should be made aware of workplace measures in place to limit fatigue (e.g., breaks, task switching, exercise, etc.).
- **Limit perceived time pressures when assigning tasks**. In addition to the nature of assigned jobs, an employee's cognitive attention span is an important factor to consider when assigning job tasks. If an employee feels he or she needs to complete a task in a short amount of time (i.e., experiences time pressure), then that employee will devote more cognitive resources to the task at the expense of safety.

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