3. Employees' Individual Characteristics and Safety
3.1. Demographics
3.1.1. Demographics of Miners

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3.1.1. Demographics of Miners

In this section, we looked at demographics of miners and the implications for safety engagement in the mining industry. Demographics relate to the make-up of a population, and it is believed certain populations are more at risk for injury. The question that guided our scoping review was:

What impact do demographics of miners in the mining industry have on safety engagement?

Method

A scoping search of the literature was undertaken using the following key concepts:

1. Demographics – age ("intergenerational relations" or "generational differences" or "age differences" or elderly or adult or "early adulthood" or senior or young or old or baby-boomer or "generation X" or "generation Y" or middle-aged or "young adult" or "young adulthood" or "old age" or "developmental age") OR gender (machoism or feminism or man or woman or gay or lesbian or "sex differences" or homosexual or heterosexual or masculinity or femininity or "sex roles" or "gender variance" or "gender binary" or "gender queer" or "third gender" or "third sex" or "human sex differences" or "sex role attitudes") OR SES ("socioeconomic status" or disadvantaged or income or economic or class or wage or wealth or profit or loss or "occupational prestige" or "economic equality" or poverty or "academic achievement" or "educational background") OR geographical location ("rural environments" or "urban environments" or "inner city" or reserve or towns or suburban or municipal or city or metropolitan or downtown or "built up" or "regional differences" or communities), AND
2. Safety (see synonyms in Methodology chapter).

Search Strategy. Articles were excluded if they were related to the following: outside the normal working age of 15 to 70, compared different ethnic groups, not related to workplace safety issues; or related to working conditions in developing countries. From this search, we selected articles based on the inclusion/exclusion criteria. 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. In our search, we collected articles that were pertinent in this topic area. The broad inclusion and exclusion criteria allowed us to explore the literature in this area more completely, see Table 1.

Table 1. Demographics of Miners Inclusion/Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
• Articles with key terms in the title or abstract • Peer reviewed • Within 5 years • English language articles	• Editorials • Commentaries • Book reviews

Screening Strategy. From the search results, we reviewed the title and abstract of each article to determine its inclusion in the scoping review. Each selected article was read by a team member and information pertinent to the study was extracted. Those not applicable to the scoping review were excluded. The selected articles were reviewed by at least two team members for inclusion in the study.

Results

A brief summary of each article including its location, population studied, main issue addressed, comparison group, and primary outcomes is provided in Appendix G: Demographics of Miners: PICO summary for all included articles. The following is an overview of the included articles (see table 2).

Table 2. Demographics of Miners: Databases Searched and Articles Selected

Database	Articles found from search	Articles Selected for Review	Final article selection
Academic Search Complete	7,104	69	24
DAT	4,164		
Gender Studies	2,032		
Medline	3,066		
PsychINFO	5,219		
Scopus	2,327		
SocINDEX	2,847		
Web of Science	5,578		

Description of Included Articles. Table 3 provides an overview of the types of publications, country of publication, and populations studied.

Table 3. Demography of Miners: Publications, Countries, and Populations.

Type of Publication:	Country of Publication:	Population Studied:
- Secondary analysis of data (7) - Cross-sectional surveys (5) - Mixed methods (3) - Experimental study (2) - Systematic review (1) - Intervention study (1) - Retrospective review (1) - Meta-analysis (1) - Prospective cohort study (1) - Literature review (1)	- North America (10) (USA -8, Canada – 2) - Europe (6) (Netherlands, Russia, Turkey, UK, Spain, Denmark) - Australia (3) - India (1) - El Salvador (1) - Ethiopia (1) - South Korea (1)	- General employees (12) - General population (2) - Steel smelting workers (1) - Pilots (1) - Ambulance workers (1) - Slaughterhouse workers (1) - Farm workers (1) - Psychology students (1)

Description of Identified Factors. A scoping review of the literature resulted in the identification of 24 articles related to demographics and safety. The factors identified were workplace factors, socioeconomic factors, and factors related to gender and age. A description of the articles relating to each factor follows.

Socioeconomic factors. Five articles identified socioeconomic factors related to safety. The articles identified educational level and income, psychosocial work environment, risk for injury, and family size as factors related to socioeconomic status. Two articles were related to education level and income. In a secondary analysis of the Behavioral Risk Factor Surveillance System data in the US, Luo et al (2012) measured the risk of lifetime eye injury based on educational level and income. They found

men with high school or less education were more likely to receive an eye injury than men with greater than high school education; and, they found men who made less than $15000 USD were more likely to receive an eye injury than men who made over $50000 USD. The differences were not significant in women based on socioeconomic status. Akkermans, Brenninkmeijer, van den Bossche, Blonk, & Schaufeli (2013) evaluated job characteristics between young employees and employees with more experience and education. Using the jobs-demands-resources (JD-R) model, and they looked at health, wellbeing, and performance within educational groups. The authors found workers with a lower educational levels had fewer resources, higher work exhaustion, more physical demands, and less job dedication; and these workers required more job reassurance from higher levels.

One article related socioeconomic status to psychosocial work environment. In a secondary analysis of data from a household survey in Spain and Denmark, Moncada et al. (2010) found a relationship between psychosocial work environment and socioeconomic status. The researchers reported poor psychosocial working conditions tended to cluster in lower socioeconomic status occupations. One article related socioeconomic status to risk for injury. In a prospective cohort study of farms in Saskatchewan, Pickett et al. (2011) found no relationship between socioeconomic status and risk for injury. They identified risk for first injury was correlated with longer working hours on the farm, and they suggested interventions should be aimed at operational rather than economic factors.

One article looked at family size as a socioeconomic factor related to safety. In a cross-sectional study of solid waste collection workers in Ethiopia, Bogale, Kumie, and Tefera (2014) found workers with large families (those having 5 or more children) were more likely to become injured on the job. They postulated this may be due to concern for their family distracting them while at work or the inability of workers with large families to afford personal protective equipment. The majority of respondents in this study were female.

Gender. Eight articles were identified related to gender and safety. The topics included risk perception, fatalities, risk-taking, and workplace safety. One article reported on differences in risk perception. In a study of men and women from three municipalities in El Salvador, Becker (2011) investigated gender differences in risk perception. They found no significant difference between the way men and women ranked hazards within their communities regardless of how differently they viewed the hazards. One study reported on pilot fatalities. In a secondary analysis of the National Transportation Safety Board's (NTSB) accident data, Bazargan and Guzhva (2011) investigated how a pilot's gender may be related to accidents caused by pilot error and fatal accidents. They found no differences in gender related to pilot error, but they did find female pilots were less likely to be involved in fatal accidents. The authors noted the difference between male and female pilots involved in fatal accidents is decreasing as time goes on, though it is still significant.

Three articles reported on differences in risk-taking between men and women. Nielsen et al. (2015) examined the impact of masculinity and gender identity on risk taking behavior, attitudes towards safety, and occupational accidents. They found a high score on the male role norms inventory was associated with a high level of safety violations and reduced reporting of safety oversights; and, a high score on the sex role inventory was associated with a higher propensity to report safety oversights. They

suggested norm-based aspects of masculinity were more suitable for analyzing associations between masculinity and safety outcomes than trait-based theories. In an experimental study of the role of testosterone in risk-taking, Ronay and Von Hippel (2010) found high testosterone males were more likely to take risks when they had low power and less likely to take risks once they had power. The authors found the inverse relationships with low testosterone males. They found low testosterone males were likely to take subsequent risks once they gained power; and the authors postulated these men would be unlikely to hold power because of this relationship. Ertac and Gurdal (2011) researched the amount of risk men and women were willing to take on behalf of a group as compared to individual risk taking. They found women were less likely to engage in risk-taking on behalf of the group than men were, and they found men who wanted to lead took on more risk on behalf of the group than others. For both men and women, individual risk taking was higher than risk taking on behalf of a group.

Three articles reported on workplace safety and gender. Gyekye and Salminen (2011) examined the influence of gender on perception of workplace safety in Ghanaian industrial workers. They found women were more positive about workplace safety than men and had a lower accident frequency rate. However, Gyekye and Salminen found women were better supported by their supervisors; they were provided with safer equipment; and they received more praise, encouragement, and extra training as compared to men. Harrison et al. (2013) described the experiences of women aged 55 to 75 with mobility impairments related to workplace injuries and workers' compensation. They found women with gradual and cumulative injuries had difficulty gaining workers' compensation benefits, and age was a contextual factor in relation to these injuries often leading to leaving the workforce. Harrison et al. reported barriers to workers' compensation including lack of knowledgeable adjustors and doctors, minimal voice in treatment options, disrespect, and unclear return-to-work guidance. In this study, fewer than half the participants received monetary compensation for their injuries. In a secondary analysis of data from the US Behavioral Risk Factor Surveillance System, Luo et al (2012) found men had a significantly higher risk of eye injury than women independent of educational level or income.

Age. Thirteen articles were identified related to age and safety. The articles included job risk perception, awareness of safety programs, invulnerability, and risk for injury. One article was related to job risk perception. Basha and Maiti (2013) looked at job risk perception and work injuries, and they found risk factors are related to the type of work with some work being more dangerous than others rather than based on age or experience. Basha and Maiti also found as age and experience increases, workers are put into less risky jobs. One article was related to awareness of safety programs. In a cross-sectional survey of general contractors in the United States, Chen, Jin, and Soboyejo (2013) found workers under the age of 30 had poorer awareness of safety programs and workers over the age of 50 had lower incident and safety violation rates during the 17-month study period. The authors termed these relationships as moderate and potential influencing factors. The researchers suggested evaluating workers' safety climate and providing safety education and training to those with poor safety climate (awareness, attitude, and accountability). One article was related to invulnerability. In two Canadian studies, Dueck (2013) investigated invulnerability in young workers and the reporting of hazards in the workplace. The researcher found young workers who felt invulnerable at work were less likely to report hazards than

those who felt vulnerable. Dueck found this related to safety concerns as well.

Ten articles were related to injury rates and risk for injury related to age of worker. In a cross-sectional survey of solid waste workers in Ethiopia, Bogale, Kumie, and Tefera (2014) found a 43.7% injury rate in the last year and a 3% increase in injury rate with age. Most of the injuries reported were musculoskeletal, and most of the respondents (71.2%) were female (Bogale et al., 2014).

In a seven-year retrospective study of Australian workers, Ehsani et al. (2013) found workers aged 15 to 24 were at higher risk for fatalities in the agriculture, forestry, fishing, transport, postal, warehousing, and mining industry than in other industries. The authors also found younger workers had fewer work-related fatalities when compared with all workers. In a systematic review of the research on health and safety in older workers, Crawford, Graveling, Cowie, and Dixon (2010) found older workers were considered to have a lower risk for injury than younger workers. The authors reported as workers age they have slower reaction times but this is offset with more caution. In general, the research found younger workers had more injuries but older workers had more fatalities.

In a longitudinal study of workers in an aluminum smelting plant, Guest, Boggess, Viljoen, Duke, and Culvern (2014) found workers under 30 had the highest injury rate for all injuries but most significantly for injuries other than sprains and strains. The authors suggested older workers were able to work safely despite their age, and younger workers could benefit from attention related to safety culture. In a secondary analysis of US National Household Interview Survey data, Kachan et al. (2013) found no significant difference in risk for injury related to age. In a meta-analysis, Laberge and Ledoux (2011) investigated the factors which might be involved in young people getting injured at work. They found the articles focused on fatigue and sleep, values and attitudes, and safety practices. The authors found young people had less knowledge and were less cognitively mature which could explain their vulnerability to a work-related injury. In a cross-sectional survey study of workplaces around Seoul, Park et al. (2012) asked 785 workers, predominantly male, predominantly under 50, to indicate what they felt would influence elderly workers' industrial accidents. The participants reported a lack of motivation (31.3%) followed by pressure to adjust to the changing workplace (26.4%), a decline in health (19.4%), pressure from work (14.4%), and a decline in cognitive abilities (8.5%) as factors related to aging. The authors also found individuals' confidence and satisfaction both increased with years of work and age of worker.

In a qualitative analysis of secondary data, Piazza (2012) researched workplace injury of older workers in a physically demanding job. The author found no correlation between age and risk of injury or severity of injury. Piazza did find a correlation between length of service and occurrence of workplace injuries. The author suggested on-going safety education and training to offset this risk. In a systematic review of epidemiological literature, Schwatka, Butler, and Rosencrance (2012) found older age at injury was related to higher injury costs but not to the number of injuries sustained. They found the type of injury most frequently researched was musculoskeletal injuries; and they reported a preponderance of musculoskeletal disorder conditions in older workers. The authors suggested older adults add value to an organization, therefore organizations should modify work assignments to meet the physical limitations of the worker. Kim and Lee (2010) found a statistical difference in the way older drivers perceived warning sound related to frequency, tempo, and intensity; and in response time. The researchers found older

drivers were slower to apply the brake and accelerator than younger drivers independent of the characteristics of the warning sound. Kim and Lee suggested safety warning sounds should have a frequency of 3-4 kHz and a tempo of 200 ms for optimum response from older drivers.

Workplace factors. Five articles were identified relating to workplace factors. The factors included use of personal protective equipment, safety training programs, and type of industry. One article was related to the use of personal protective equipment. In a cross-sectional study of solid waste collection workers in Ethiopia, Bogale, Kumie, and Tefera (2014) found workers who did not use personal protective equipment were more than twice as likely to become injured. They reported an injury rate of 43.7% in the last 12 months; and they suggested immediate public attention geared towards occupational health and safety training and the use of personal protective equipment. One article related to safety training programs. In a cross-sectional survey of general contractors in the United States, Chen, Jin, and Soboyejo (2013) found a relationship between workers who received safety training in two forms, and accountability and climate scores. The authors suggested offering training in various formats as well as evaluating the effectiveness of the training. Chen et al. also found workers who consistently worked on the general contractors' worksites had a better awareness of the safety programs. They suggested contractors should build long-term relationships with subcontractors with good safety records.

Three articles related to the type of industry or occupation. In a secondary analysis of US National Household Interview Survey data, Kachan et al. (2012) found that workers in the Agriculture/Forestry/Fisheries sector had the highest risk for injuries for all age groups. They also found an increased risk in the manufacturing industry for the 18 to 54 age groups as compared to the 55 plus age group. In a retrospective study of risks of dying in Russia between 1994 and 2006, Bessudnov, McKee, and Stuckler (2011) found men who worked in manual occupations were significantly more at risk for dying than managers and professionals. They found the highest risk group included manual workers, manual supervisors and technicians, and lower sales and service workers. The gap in life expectancy between manual workers and professionals was up to 10 years (Bessudnov et al., 2011). Bazargan and Guzhva (2011) investigated how a pilot's experience is related to the occurrence of pilot error and fatal accidents. They found more experienced pilots were less likely to be involved in accidents caused by pilot error but more likely to be involved in fatal accidents. The authors suggested this may be due to the higher risk environment and more challenging work they are engaged in.

Discussion

In this scoping review, we looked at the impact of demographic factors on safety in the workplace. There were 24 articles identified, and from those articles the following demographic factors were identified: workplace factors, socioeconomic factors, and factors related to gender and age.

The first finding of the research was the type of occupation could put a worker at risk for injury. The choice of occupation can be associated with socioeconomic status of the worker. Workers in manual labor occupations were more at risk for injury than those in professional occupations (Bessudnov, 2011), and those workers in agriculture, forestry, fisheries, and manufacturing were at highest risk for injury (Kachan et al., 2012). Those workers at a lower socioeconomic level had a greater risk for injury (Luo et al., 2012) as well as those workers with a large family size, which could be associated with lower

socioeconomic status (Bogale et al., 2014). This finding is not unusual because workers with a lower socioeconomic status would likely choose jobs in manual labor occupations, thus putting themselves at greater risk for injury.

The second major finding is that lack of experience may put workers at risk for injury. This lack of experience is often associated with younger workers. Younger workers tend to suffer less from strains and sprains but more from other injuries (Guest et al., 2014), yet workers from 15 to 24 experienced fewer fatalities as compared with all workers (Ehsani, 2013). However, inexperienced younger workers would be less likely to work in high risk environments. Younger workers are less familiar with safety programs (Chen et al., 2013); and they had less knowledge and were less mature (Laberge & Ledoux, 2011). Pilot error decreases with age, but risk of a fatality increases with age which may be due to the nature of high risk environments (Bazargan & Guzhva, 2011). A few authors provided research on aging and workplace injury. Overall, there was no correlation between aging and increased risk of injury. In high demand workplaces, older adult injury costs were higher but not the rate of injury (Schwatka et al., 2012); and the advantages of having older workers appears to outweigh any decrease in physical or cognitive ability (Park et al., 2012; Piazza, 2012).

The final major finding of this scoping review was that men are more likely to have workplace injuries than women. As we saw earlier, being in manual labor occupations or occupations in agriculture, forestry, fishing, and manufacturing put the worker at greater risk of injury. These occupations may employ more men than women; however, when you compare men and women in the same job, women were less likely to be involved in a fatality (Bazargan & Guzhva, 2011), women felt more supported by supervisors in getting safer equipment (Gyekye & Salminen, 2011), and women were less likely to become injured independent of socioeconomic status or education level (Luo et al., 2012). Risk-taking and testosterone levels were researched as possible reasons for men being more at risk for injury. Masculinity norms were associated with a high level of safety violations (Nielsen et al., 2015), males with high testosterone exposure were also more likely to take risks (Ronay & Von Hippel, 2010), and overall, men were more likely to take risks than women (Ertac & Gurdal, 2011). Thus, being a young, inexperienced male in a high risk occupation would put the worker at a greater risk of injury. This group requires support and education to reduce their risk of injury.

Gaps in the Literature. The research on demographics and safety has concentrated on age and gender rather than on experience and occupation. More research is required to determine if it is really inexperience and type of occupation that has more of an impact than gender, socioeconomic status, and age. Interventions aimed at improving safety training and increasing the amount of training given in high risk occupations may make more of an impact on injury rates than targeting factors which cannot be changed such as age and gender.

Recommendations. Based on the current scoping review, the following are recommendations for the mining industry:

- Increased safety training in high risk occupations using multiple, ongoing modalities.
- Mentoring programs for young and inexperienced workers.
- Women tend to be treated differently by supervisors, with more concern about their safety.

Supervisors should be educated to take equal care with male workers.

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