




Factors leading to unsafe behavior in the twenty first century workplace: a review

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Abstract

Work-related injuries, diseases and fatalities have received considerable attention by researchers and have led to a greater awareness about incident causation in the workplace. Most accidents and injuries emanating from workplaces are attributed to workers' unsafe behaviors, which are also a reflection of system deficiency and hazardous work-environment. The purpose of this review was to investigate the factors contributing to workers' unsafe behaviors. A review of 70 major empirical studies on unsafe behaviors was conducted within occupational safety and health research, and thereafter clustered into eight job domains namely: construction, healthcare, informal sector enterprises, manufacturing, mining, energy, agriculture, and multi-dimensional context. The results across these domains were reported and compared, along with their consequences and solutions. The study found that lack of adequate knowledge on safety and health, violation of safety rules, work pressure, stress and non-use of protective equipment were the main factors of unsafe behaviors. Several major solutions to these behaviors were highlighted for consideration by practitioners and policy developers. The outcomes from this review will assist safety managers in understanding how to motivate employees/workers to engage in proper safety practices.

Keywords Unsafe behavior · Organizational factors · Employees' development · Job safety

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1 Introduction

Work-related injuries, diseases and fatalities have received considerable research attention over the past decade. It is estimated that 2.78 million death (Hämäläinen et al. 2017), 160 million work-related diseases, and 313 million non-fatal accidents are recorded annually from different workplaces (Takala et al. 2014). Most accidents and injuries emanating from workplaces are attributed to unsafe worker behaviors, which are also a reflection of system deficiency and hazardous work-environment (Fang et al. 2016; Khosravi et al. 2014; Liao et al. 2017; Liu et al. 2015). Unsafe behavior was defined by Reason et al. (1990) as an intentional violation of standard procedures that may lead to errors. Reason, et al.'s definition emphasizes two types of unsafe behavior: errors and violations. Mason (1997) described unsafe behavior as an individual's likelihood of not following standard safety rules, procedures, instructions, and specified criteria for work imposed the organization. It represents a deliberate deviation from the recommended safety behaviors.

In addition, most unsafe behaviors (errors) are manifest in the form of slip and lapses. Slip, on the one hand, refers to the unwitting deviation of action from intention (Frese and Keith 2015; Reason 2000; Reason et al. 1990). On the other hand, lapses involve memory failure and include errors such as omitted items in a checklist and place losing. Slip and lapses are believed to occur at a largely automatic, skill-based level of processing and are therefore particularly due to monitoring failures by the individual (Reason et al. 1990; Shappell and Wiegmann 2009). Furthermore, an attempt was made to explain unsafe behavior (error) from the perspective of individuals' moral attitudes towards safety based on certain organizational and human error theories (Kirschenbaum et al. 2000). As such, an error leading to an accident may occur when an individual loses control over work procedures due to insufficient/inadequate training, long working hours, and stress/fatigue (Kirschenbaum et al. 2000).

Moreover, workers' unsafe behaviors, derived from violations, are generally due to the departure of planned actions from some satisfactory path towards a desired goal (Lawton 1998; Mesken et al. 2002). Violations are categorized as either rule-based or knowledge-based (Shappell and Wiegmann 2009). Rule-based violations involve either the misapplication of good rules or the application of bad ones, while knowledge-based violations occur when sufficient experience is not available to solve a problem (Shappell and Wiegmann 2009). Based on these, it can be inferred that unsafe behavior is a consequence of workers' violations of standardized procedures, which is also a reflection of a system weakness.

Several previous studies (Fogarty et al. 2017; Fogarty and Shaw 2010; Frese and Keith 2015; Fyhr et al. 2017; Keers et al. 2015; Mickelson and Holden 2018; Patel et al. 2015; Rashid et al. 2014; Sullman et al. 2017) have drawn on a range of constructs related to human error and violation in order to explain unsafe behavior that happens due to cognitive failures (Hobbs and Williamson 2003; Reason et al. 1990). The frequent occurrence of unsafe work behavior due to errors and violations has led many studies to develop various behavior-based models in an

attempt to reduce incidents in the workplace. However, these models have been criticized as being lagging indicators which fail to tackle the causes of incidents occurrence in the workplace. For example, Shappell and Wiegmann (2009) stated that interventions aimed at reducing occurrence of human error have not been as effective as those directed at mechanical failures. Clearly, if accidents are to be reduced further, more emphasis need to be placed on the genesis of unsafe behavior as it relates to accident causation, which may vary from one organizational context to another. Other types of unsafe behavior that have received more attention from organizational decision-makers can be found in different forms in accordance with job specifications and expectations. For example, despite convincing evidence about the occurrence of injuries and fatalities, current review articles have not provided an in-depth understanding of accident causality and possible risk reduction in a job-specific context. Thus, existing evidence on the key causes of unsafe behavior and accidents appear inadequate to respond to the urgent demands for safety reform in both developing and developed countries. This study generally seeks to provide a coherent understanding about the main factors of unsafe behavior in different organizational sectors, targeted at decreasing costs and increasing safety measures among workers. Furthermore, the review build on earlier work in this area (Khosravi et al. 2014) and a recent publication that include safety measures for workers to handle common injuries and accidents in their workplace (Beus et al. 2016), and to extend other similar syntheses. Second, we attempt to further the theoretical knowledge base of changing workers' behavior towards safety practices by providing workable solutions to specific unsafe behavior. We also highlight areas in which knowledge is weak or inconclusive, thus offering research and development agenda for the future. Finally, a timeline indicating relevant studies is provided as a ready reference source of information on unsafe work behavior. Terms such as workers and employees were interchangeably used in this study to describe individuals engaged in unsafe behavior.

2 Method

A literature review of the major empirical studies on unsafe worker behavior in occupational safety and health contexts was conducted. In general, a systematic collation of empirical evidence from different contexts help to minimize biases and address specific questions towards theory development (Fisch and Block 2018; Tranfield et al. 2003). This study can be considered as an archival research based on published research studies. According to Searcy and Mentzer (2003), archival research depends largely on originality of the documents (either primary or secondary) examined. As cited in Zniva and Weitzl (2016), a literature review consists of a systematic, explicit and reproducible procedure to identify, evaluate and synthesize the existing body of knowledge. Consequently, we used frameworks by Tranfield et al. (2003), Moher et al. (2009) (Preferred Reporting Items for Systematic Reviews and Meta-Analyses or PRISMA), and Fisch and Block (2018) for conducting this review.

To aid our understanding on unsafe behavior, first, we performed a comprehensive search of electronic databases to identify relevant articles published in peer reviewed journals. Google scholar databases were used to search for keywords including: ‘*unsafe employee behavior*’, ‘*unsafe worker behavior*’, ‘*dangerous work behavior*’, and ‘*work-place errors and violations*’. The criteria for inclusion in this review were based on: (a) only empirical peer reviewed research on unsafe employee/worker behavior; (b) papers published in English language; and (c) published papers from 1998 to 2018. Based on these criteria, we found that some of the papers were more central and useful than others. Our search led to the identification of 430 studies from searching.

The second phase involved screening and removal of duplicate studies. After the initial screening of titles and abstracts, 250 studies on unsafe behavior were found to meet the eligibility criteria of this review. Third, the evaluation of the studies was conducted bearing in mind the objective and the methodological paradigm adopted for this study. Systematic review papers, meta-analysis studies, and non-peer reviewed research reports were excluded from this review. Consequently, 70 peer reviewed empirical studies published in English between the period of 1998–2018 were identified and used in this review (see Fig. 1).

All the 70 studies which met the inclusion criteria were grouped with regard to certain job domains. This allowed us to identify common themes underlying unsafe behavior. The grouping of previous studies was based on specific population demographics (e.g., mining, manufacturing, construction, healthcare, and agriculture) employed in those studies. A further synthesis of the identified job-contexts was performed to classify similar jobs into one job-domain. For example, studies on rural transport services, artisans, and e-waste workers were grouped under informal sector enterprises (ISE). This classification was based on the criteria established by the International Labor Organization (ILO), which describes the informal sector as units engaged in the production of goods or services on a small-scale. Under ISE, labor relations are mostly based on casual employment, kinship or personal and social relation (ILO 1993; Guha-Khasnobis et al. 2006). Also, other studies based on oil and gas, petroleum drilling and electricity generation plants were grouped under the domain of energy industry. This contextualization is demonstrated in the work of Sovacool and Mukherjee (2011) on energy industry (which include electricity supply, nuclear power, oil and gas). Moreover, we found that some studies were based on certain job attributes/characteristics. Consequently, these studies were categorized as multi-dimensional context (MDC). The clustering of studies on similar job contexts led to the identification of eight job domains namely: construction, healthcare, ISE, manufacturing, mining, energy, agriculture, and MDC. The focus on these domains enabled us to identify gaps, issues and opportunities for further research and understand the unique conditions related to unsafe work behavior.

The overall quality of the 70 studies was assessed by two experts in the field (score from 1–3, low–high) based on: (1) appropriateness of the method, (2) relevance to the context of focus, and (3) whether the findings are credible and valid. We measured the weight of each study by summing scores on each of the three dimensions. The inter-rater reliability (r) for the three dimensions between the two experts ranged from 0.83 to 0.91.

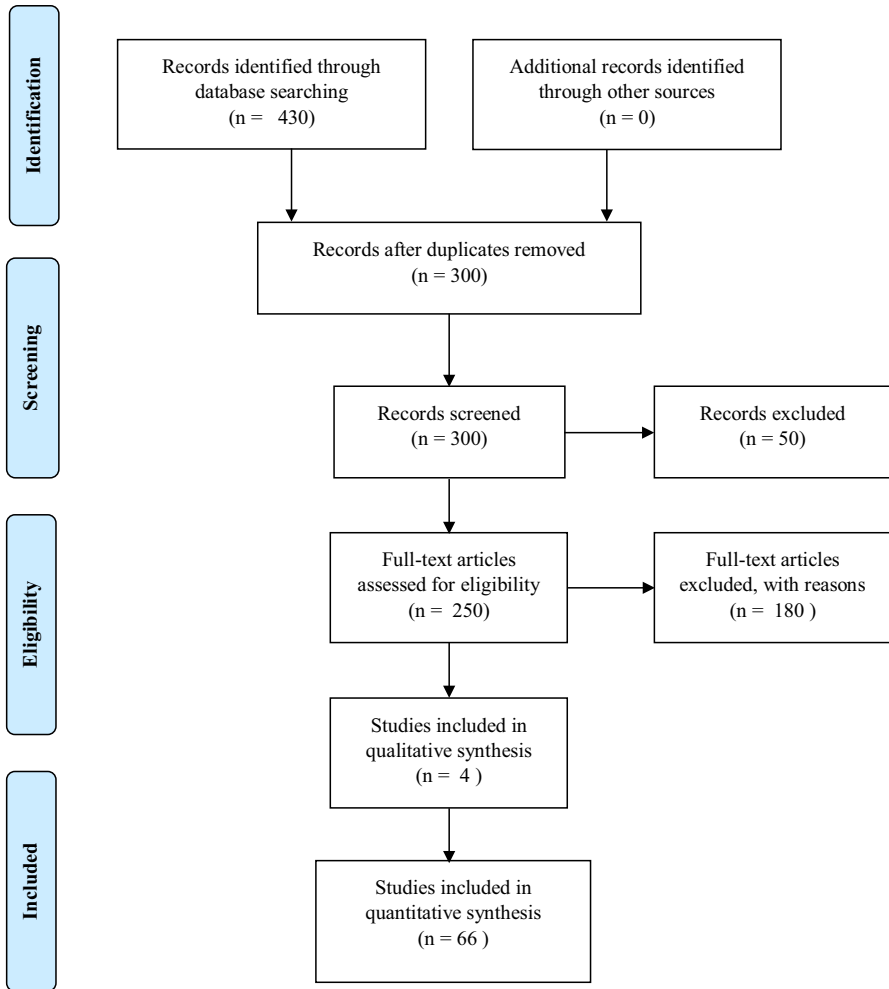


Fig. 1 The PRISMA flow diagram for this study

3 Results

This study sets out to investigate the factors that lead to unsafe behavior with the aim of identifying specific safety related issues and measures in a domain-specific context. Our literature search led us to identify 70 potential empirical studies (see Table 1), that examined unsafe behavior in: construction industry (20%), healthcare sector (17.2%), ISEs (11.4%), mining industry (11.4%), manufacturing industry (7%), energy industry (7%), agriculture sector (7%), and MDC (19%). The following subsection describes the different factors in terms of errors and mistakes that workers encounter, along with their consequences and solutions. It is assumed that identifying unsafe behavior factors would help policy makers and managers to take

Table 1 Summary of previous studies on factors and conditions of unsafe behavior across contexts

No.	Article	Purpose	Sector/context
1	Lewis et al. (1998)	Examined the associations between farm-work-related injuries and risk factors	Agriculture
2	Loewenson (1998)	Examined occupational risk patterns among urban informal sector workers	ISE
3	Ji et al. (2005)	Identified non-compliance with glove utilization and hand hygiene among obstetrics and gynecology workers	Healthcare
4	Seo (2005)	Constructed an explicative model of unsafe work behavior among grain elevator workers	Agriculture
5	Nsubuga and Jaakkola (2005)	Assessed the occurrence and risk factors of needle stick injuries among nurses and midwives	Healthcare
6	van Ooteghem (2006)	Analyzed causes of work-related injuries among the working population	MDC
7	Yang et al. (2006)	Analyzed the relationship between working hours and risk of hypertension	MDC
8	Aksorn and Hadikusumo (2007)	Investigated the relationship between decision-to-err factors and unsafe acts among construction workers	Construction
9	Choudhry and Fang (2008)	Investigated why construction workers engage in unsafe behavior	Construction
10	Nouri et al. (2008)	Evaluated workers' safety behavior in gas treatment industry	Energy
11	Kheni, Dainty, and Gibb (2008)	Explored factors that contribute to accidents and mitigating measures among managers	Construction
12	Leung et al. (2010)	Investigated the impacts of stress on injury incidents among construction workers	Construction
13	McGonagle and Kath (2010)	Examined the effects of grocery store workers' work-safety tension and risk perceptions on their job injuries	ISE
14	Çelebioğlu et al. (2010)	Investigated the effects of violent experiences of nursing students in clinical settings	Healthcare
15	Hon et al. (2010)	Investigated the causes of accidents in repair, maintenance, alteration and addition (RMAA) work	Construction
16	Bohm and Harris (2010)	Explored dumper drivers' and experts' risk perception in relation to risk-taking behavior	Construction
17	Sanniquel et al. (2010)	Analyzed the causes of accidents in the Spanish mining sector	Mining
18	Aderaw et al. (2011)	Investigated the causes of occupational injury among textile factory workers	Manufacturing
19	Smith and DeJoy (2012)	Examined the association between socio-demographic and organizational factors and risk of occupational injury	MDC
20	Arcury et al. (2012)	Described how the safety climate of migrant workers is associated with their musculoskeletal discomfort, working while injured or ill, and depressive symptoms	Agriculture
21	Tucker and Turner (2013)	Examined young workers' responses to hazards and unsafe work through the lens of the exit, voice, patience, and neglect typology	MDC
22	Rahmani et al. (2013)	Described the causal factors of accidents and injuries among electricity distribution company workers	Energy

Table 1 (continued)

No.	Article	Purpose	Sector/context
23	Cheng et al. (2013)	Explained the dangers and causes of accidents in the petrochemical industry	Energy
24	Marinaccio et al. (2013)	Investigated how certain socio-demographic and occupational variables contribute to workers' perceived risk of injuries and accidents	MDC
25	Cheng et al. (2013)	Studied why foreign workers experience major accidents in the manufacturing and construction industries	MDC
26	Boniface et al. (2013)	Studied the factors that lead to injuries and fatalities among miners	Mining
27	Chadambuka et al. (2013)	Determined the prevalence of noise induced hearing loss among employees at the mine	Mining
28	Cui et al. (2013)	Explored the causal linkages between a hazardous environment, safety climate, and individual safety behaviors among mine workers	Mining
29	Gutherlet et al. (2013)	Reported how working conditions, hazards, and risks are associated with waste recycling	ISE
30	Chimamise et al. (2013)	Investigated the factors associated with severe injuries at the mine	Mining
31	Angland et al. (2014)	Examined the factors that cause violence and aggression among nurses working in emergency department	Healthcare
32	Han et al. (2014)	Examined the association between production pressure and safety performance among construction workers	Construction
33	Yassi et al. (2014)	Explored the factors that lead to workplace injuries and propose best practices among healthcare professionals	Healthcare
34	Tucker et al. (2014)	Explored the underreported work-related injury among young part-time workers	MDC
35	Wolf et al. (2014)	Studied experiences of emergency nurses who have been physically or verbally assaulted	Healthcare
36	Verma et al. (2014)	Investigated the patterns of incidents in a steel plant in India	Manufacturing
37	Aynalem Tesfay and Dejenie Habtwold (2014)	Assessed the prevalence and determinants of occupational exposure to human immune-deficiency virus infection among healthcare workers	Healthcare
38	Kwame et al. (2014)	Investigated the prevalent hazards/dangers associated with woodworkers	ISE
39	Zheng et al. (2014)	Investigated the prevalence and potential risk factors of nonfatal injuries among agricultural machinery operators	Agriculture
40	Kifle et al. (2014)	Assessed the prevalence of work-related injuries and associated risk factors among iron and steel workers	Manufacturing
41	Zhu et al. (2014)	Examined the impact of lack of sleep on agricultural work-related injuries among farmers in China	Agriculture
42	Dragano et al. (2014)	Investigated safety knowledge in employees	MDC

Table 1 (continued)

No.	Article	Purpose	Sector/context
43	Irumba (2014)	Investigated the causes of accidents among construction workers	Construction
44	Balanay et al. (2014)	Assessed health and safety hazards among working college students in the workplace	MDC
45	Monney et al. (2014)	Assessed the extent of work-related injuries and illnesses, first aid, use of personal protective equipment, fire safety measures and hand hygiene practices among vehicle repair artisans	ISE
46	Ramacciati et al. (2015)	Investigated the experiences of nurses after episodes of violence in the workplace	Healthcare
47	Nordlof et al. (2015)	Investigated safety culture and risk-taking at a large steel-manufacturing	Manufacturing
48	Bronkhorst (2015)	Examined why some healthcare employees behave safely while others do not when faced with work demands and pressures	Healthcare
49	McCaughey et al. (2015)	Examined the relationship between workplace hazard perceptions and psychological strain on employee outcomes	Healthcare
50	Dong et al. (2015)	Examined the relationship between work-related injuries and occupational and non-occupational factors among construction workers in the USA	Construction
51	Graves and Miller (2015)	Examined the association between decreased sleep duration and lifetime occupational injury among working adolescents	MDC
52	Long et al. (2015)	Assessed occupational hazards and injuries among artisanal gold miners in Ghana	Mining
53	Abbasi et al. (2015)	Determined the causes of unsafe worker behavior in occupational groups	MDC
54	Ünsar and Süt (2015)	Analyzed work-related accidents among workers in thermal and hydroelectric plants	Energy
55	Reid et al. (2016)	Examined work related injuries among foreign-born workers in Australia	MDC
56	Olvera et al. (2016)	Examined how motorcycle drivers comply with policy requirements	ISE
57	Jones et al. (2016)	Observed development-related knowledge of complex health and safety issues related to rural transport in sub-Saharan Africa	ISE
58	Nyende-Byakika (2016)	Examined safety measures for preventing accidents in construction site	Construction
59	Armah et al. (2016)	Assessed artisanal gold miners' knowledge of the environmental and health effects of mercury usage	Mining
60	Kvalheim and Dahl (2016)	Examined the causal relationship between safety climate and safety compliance among workers	Energy
61	Giurgiu et al. (2016)	Compared healthcare workers' occupational risk perception and exposures in Moroccan and French hospitals	Healthcare

Table 1 (continued)

No.	Article	Purpose	Sector/context
62	Huang et al. (2016)	Investigated the relationship among risk perception, risk propensity and unsafe behavior decision-making among project managers	Construction
63	Atombo et al. (2017)	Examined perceptions of safety and health among drivers, transport managers, and safety engineers in work-related transport activities in Ghana	MDC
64	Mohammadfam et al. (2017)	Developed a model for managing and improving safety behavior of construction workers	Construction
65	Ayaaba et al. (2017)	Investigated respiratory disorders among gold miners in Ghana	Mining
66	Peretz and Luria (2017)	Examined the antecedents of professional drivers' unsafe behavior on the road	Manufacturing
67	Liao et al. (2017)	Ascertained the psychological mechanisms related to the unsafe behavior of workers	Construction
68	Ohajinwa et al. (2017)	Assessed the prevalence and causes associated with occupational injuries among e-waste workers in Nigeria	ISE
69	Yu et al. (2018)	Examined the relationship between medication environment and the unsafe medication behavior of nurses	Healthcare
70	Ghasemi et al. (2018)	Explained how work pressure can contribute to workers' unsafe behavior	Construction

the necessary measures to reform the current safety standards of workers across job contexts.

3.1 Construction

This review revealed that the construction industry has the most recurring cases of unsafe behavior. A number of studies in this context have identified factors such as lack of adequate knowledge on safety and non-compliance with the established work procedures as the major causes of injuries among workers (Choudhry and Fang 2008; Dong et al. 2015; Hon et al. 2010; Irumba 2014; Nyende-Byakika 2016). In addition, the nature of construction work (physical and dangerous) was found to influence workers' risk perception and their safety behavior (Bohm and Harris 2010; Choudhry and Fang 2008; Hon et al. 2010; Huang et al. 2016; Mohammadfam et al. 2017). As a result, most workers in this context views risk as a necessary part of their job, which influenced their perspective about safety procedures. This study also found that organizational factors such as poor and unsafe work environment, pressure to meet deadlines are among the critical factors that influences workers to behave unsafely (Ghasemi et al. 2018; Han et al. 2014; Hon et al. 2010; Kheni et al. 2008; Leung et al. 2010). In contrast to the perceived 'tough guy' attitude, typically associated with construction work, other psychological issues such as stress and pressure were found to play a key role in workers' unsafe behavior (Choudhry and Fang 2008).

To achieve the International Labor Organization's aim of zero harm in the workplace (www.ilo.org), we are of the view that solutions should be both employee and organizational type. Measures that are employee-oriented include increasing safety knowledge and awareness about the consequences of risky behaviors in the workplace (Bohm and Harris 2010; Dong et al. 2015; Hon et al. 2010; Mohammadfam et al. 2017). This may potentially promote workers' use of personal protective equipment (PPE), and, thus, reduction in risk taking behaviors. Organizations should design jobs in a way that emphasize the welfare of employees by regulating working hours to reduce stress, promote positive co-worker relationships (Ghasemi et al. 2018; Irumba 2014; Leung et al. 2010), and set appropriate remuneration levels within the sector. Also, management should enhance physical work environment conditions by providing protective equipment and comply with general safety and health regulations (Han et al. 2014; Irumba 2014; Kheni et al. 2008; Nyende-Byakika 2016). Furthermore, Liao et al. (2017) highlighted that management should enhance its image as a role model in terms of safety by increasing workers' awareness of risks associated with unsafe behavior.

3.2 Healthcare

Review of previous studies showed that health workers (professionals) are vulnerable to a number of physical and verbal abuse from patients (Angland et al. 2014; Çelebioğlu et al. 2010; Ramacciatì et al. 2015; Wolf et al. 2014). This may potentially lead to an increase in injuries, acute pain, as well as other emotional and

psychological disorders such as fear and vulnerability, guilt, hurt, loneliness, and trauma. Another finding relates to “a culture of acceptance” of violence and aggression among healthcare workers (Wolf et al. 2014). Health workers indicated that their acceptance of violence and aggression was due to feelings of loneliness and lack of support received from the hospital management to deal with aggressive and abusive patients (Ramacciati et al. 2015). In addition, the hospital work environment and job design were found to be the main drivers of violence and aggression from patients, especially in the event of long waiting time, ineffective communication, poor attitude of health workers, and overcrowding (Angland et al. 2014; Çelebioğlu et al. 2010). Both high mental and physical job demands were found to trigger unsafe behavior among healthcare workers (McCaughy et al. 2015). For instance, long working hours (Nsubuga and Jaakkola 2005), work pressure and job insecurity (Bronkhorst 2015) may potentially result in vulnerability to illness or injuries, high mental strain and mistakes. Consequently, some healthcare workers were likely to use hypnotics in order to mitigate the stress associated with their job (Giurgiu et al. 2016). This study also found that the safety of the medication environment (e.g., lapses in rules and procedures, equipment malfunction and relationship with working colleagues) may contribute to the unsafe medication behavior of nurses (Yu et al. 2018). All these have serious implications for workers’ unsafe behaviors and wellbeing of patients.

The consequences of unsafe work behavior in the healthcare sector involves various physical injuries, emotional and psychological trauma among workers. In order to address these anomalies, periodic refresher training of healthcare workers on safe work practices is crucial (Aynalem Tesfay and Dejenie Habtewold 2014; Ji et al. 2005; Nsubuga and Jaakkola 2005; Yassi et al. 2014). Particular emphasis should be placed on communicative skills (Çelebioğlu et al. 2010), cue recognition of high risk situations (Wolf et al. 2014) and reporting of cases of abuse (Ramacciati et al. 2015). This may partially address the culture of acceptance of abuse among workers. Furthermore, organizational systems should be strengthened through the provision of adequate resources such as gloves, PPE (Yassi et al. 2014), provision of electronic boards to direct patients, reduce workload and long working hours (Angland et al. 2014; Giurgiu et al. 2016). In addition, management should institutionalize counseling centers to help manage stress and anxiety of workers who experience abuse from patients (McCaughy et al. 2015). Furthermore, a general improvement to the work-environment in terms of rules and processes, equipment and consumables, and work relationship among colleagues could potentially help reduce or eliminate the unsafe medication behavior of nurses (Yu et al. 2018).

3.3 Manufacturing

In examining the literature on unsafe behavior in the manufacturing job sector, factors such as acceptance of risk, non-compliance with work procedures, risky behavior of co-workers, stress and pressure to meet deadlines were mostly observed (Aderaw et al. 2011; Nordlöf et al. 2015; Peretz and Luria 2017; Verma et al. 2014). Workers might sacrifice safety to meet deadlines, thus leading to severe injuries.

Furthermore, a poor work environment due to excessive noise levels, exposure to fumes and dust and poorly maintained equipment were contributory factors to unsafe behavior (Kifle et al. 2014).

Unsafe work behavior in the manufacturing context also resulted in both physical and psychological injuries. Measures such as frequent training is proposed to help reduce risk behaviors among workers. In addition, manufacturer training programs relating to equipment use and application should be designed to motivate workers to report unsafe work conditions (Nordlöf et al. 2015). Moreover, management should provide regular maintenance of machines and equipment, as well as making relevant safety information visible (Kifle et al. 2014). Furthermore, expression of concern for the overall health of workers could potentially lead to positive relationships among them (Peretz and Luria 2017), and reduce work pressure (Aderaw et al. 2011). These solutions can help eliminate most of the triggers of unsafe worker behavior in this context.

3.4 Mining

Previous studies on mining were mostly concerned about the causal factors that might lead to accidents (Chimamise et al. 2013; Cui et al. 2013; Sanmiquel et al. 2010). Particularly, we found that lack of knowledge on health risks associated with the use of poisonous chemicals (mostly among artisanal and small-scale miners) (Armah et al. 2016) and the use of personal protective clothing and safety practices (Long et al. 2015) as the principal factors of unsafe behavior. From our review, it could be inferred that the very nature and character of the mining industry (e.g., hazardous) can potentially lead to unsafe merging behaviors. The noise caused by explosion of rocks was reported to lead to hearing loss (Chadambuka et al. 2013). In addition, underground miners' exposure to dust and other fumes from the mine was found to contribute significantly to several respiratory infections and lung cancers among miners (Ayaaba et al. 2017). Moreover, other accidents such as falls and falling rocks resulted in severe and fatal injuries (Boniface et al. 2013). Based on these observations, it can be anticipated that the burden of injuries and fatalities in this sector is worrying and calls for stakeholder involvement to address these issues, especially among workers in artisanal and small-scale mining.

Within this context, solutions to the burden of fatalities and injuries can be achieved through management commitment to safety and health. For example, the provision of clinics and health service centers on site (Boniface et al. 2013) can lead to early medical intervention, thereby reducing the rate of fatalities. Also, workers would benefit from hearing conservation programs to help reduce the risk of hearing loss (Chadambuka et al. 2013). In addition, workers may also benefit from standardized working hours, as well as providing appropriate ventilation (Chimamise et al. 2013) to reduce the risk of lung diseases among workers through inhalation of dust and other poisonous gases (Ayaaba et al. 2017). Finally, workers should be trained on the use of PPE and the identification of hazards through counselling sessions (Cui et al. 2013; Sanmiquel et al. 2010).

3.5 Informal sector enterprises (ISEs)

Previous studies on workers in this sector involved unstructured work settings and uninformed coworkers. Previous studies showed that work-tension and high job demands (McGonagle and Kath 2010) are the main factors to unsafe behavior, which normally resulted in injuries among workers. Furthermore, worker non-compliance with safety precautions (Jones et al. 2016; Kwame et al. 2014; Monney et al. 2014), lack of adequate knowledge on safety and health practices (Monney et al. 2014), unregulated working hours (Kwame et al. 2014; Loewenson 1998; Olvera et al. 2016) were found to be the main driver of unsafe behavior in the ISEs. As a result, several consequences such as accidents and injuries, musculoskeletal disorders, exposure to harmful chemicals (Loewenson 1998; Ohajinwa et al. 2017), and other untold hardships have been reported. In addition, poor work organization and unsafe work environment were also identified as critical factors for unsafe behavior among workers (Loewenson 1998). These findings address the safety and health issues related to the operations of ISEs and the need for attention from regulatory authorities.

Unsafe work conditions in this context can be addressed from two main perspectives. First, we propose that individual entrepreneurs should be more concerned about the safety and health of their workers by providing training (Monney et al. 2014; Ohajinwa et al. 2017) to raise safety and health awareness among workers, and ensure effective implementation of safety and health regulations (Kwame et al. 2014). Second, safety and health regulatory bodies should be more concerned about the operations of ISEs and regularize the activities of unregistered enterprises (Gutberlet et al. 2013; Olvera et al. 2016). This will make it easy to enforce safety and health regulations among these enterprises.

3.6 Energy

The energy industry is yet another sector that is prone to fatalities. The literature showed that non-compliance to proper work practices (Cheng et al. 2013; Nouri et al. 2008; Rahmani et al. 2013; Ünsar and Süt 2015) and pressure to meet deadlines and expectations (Kvalheim and Dahl 2016) (in terms of quantity and quality) are the main factors leading to unsafe behavior in this sector. The consequences from these events may often result in negligence, rule breaking and risk-taking behaviors. It can be anticipated that the culture of non-compliance with certain procedures may be due to degree of experience a worker had on the job. Furthermore, unsafe environment (Cheng et al. 2013; Rahmani et al. 2013) and structural deficiencies (Cheng et al. 2013) were found to contribute to accidents and injuries among workers in this industry. In a high-risk industry such as energy, management must develop a more employee-centered practices to reduce work pressure and introduce training on stress management. Furthermore, regular maintenance of equipment and machines (Cheng et al. 2013), making continuous development of safety policy and work procedures (Rahmani et al. 2013; Ünsar and Süt 2015) are critical for promoting safety in high-risk settings.

3.7 Agriculture

With regard to the agricultural industry, factors such as financial difficulties (Zheng et al. 2014), poor state of health (Lewis et al. 1998; Zheng et al. 2014), and contact with harmful chemicals (Lewis et al. 1998) were found to contribute to unsafe behavior. This may be attributed to the improper handling or application of chemicals and workers' lack of knowledge on using pesticides safely. Additionally, a lack of experience on the job was identified as a factor contributing to unsafe behavior (Lewis et al. 1998). Moreover, stress was identified as the leading factor of unsafe behavior. This was mainly due to sleep disorders and the influence of alcohol consumption (Zhu et al. 2014), which, in turn, led workers to experience injuries of varying degrees of severity. Based on these, safety climate should be conceptualized as a higher order factor (Arcury et al. 2012; Seo 2005) to address the major safety and health issues in this context. Also, developing sustainable training programs to train less experienced workers could potentially raise their level of knowledge about safety practices (Zheng et al. 2014).

3.8 Multi-dimensional context (MDC)

MDC consists of workers performing various job functions. The study found that work-family interference (Smith and DeJoy 2012) was one factor leading to unsafe behavior. The psychological situation of the family was found to contribute significantly to the concentration of workers on the job. Furthermore, inadequate safety knowledge (Atombo et al. 2017; Dragano et al. 2014; Reid et al. 2016) was addressed as another factor influencing unsafe behavior of workers. Some organizational deficiencies such as poor work environment, poorly maintained equipment and improper protective equipment (Cheng et al. 2013) were also found to be significantly associated with the unsafe behavior of workers. These situations gave rise to a number of injuries and fatalities among employees (van Ooteghem 2006). Previous studies also showed that workers may simply ignore or refuse to obey safety regulations (Reid et al. 2016). Also, many other studies (e.g., Yang et al. 2006) reported the negative effect of extended work-hours as a possible cause of the increasing rate of hypertension among employees. The current regulations may not guarantee the health and safety of workers or consider interventions to help reduce work-related stress (Marinaccio et al. 2013). Some previous studies have focused on teen workers' perceptions about their work environments and the ways in which teens believe workplaces can be made safer. It was reported that teen workers experience different injuries and work hazards because of the complexity associated with the work they engage in and inconsistent prior work experience (Tucker et al. 2014; Tucker and Turner 2013). Among the injuries were burns to hands, cuts, risky environment, exposures to noise and extreme cold environment (Balanay et al. 2014; Tucker and Turner 2013). Furthermore, due to lack of agency, fear of being fired, and feelings of helplessness, some young workers choose to ignore hazards (Tucker and Turner 2013). Other unsafe behaviors and injuries reported among part-time workers were

due to reduced sleeping time (resulted from schooling and working at the same time) (Graves and Miller 2015).

It is proposed that legislations on safety and health must be strengthened (van Ooteghem 2006; Reid et al. 2016) to ensure that employers comply with safety laws and, most importantly, protect the vulnerable (e.g., migrant workers). Perhaps, management should consider developing employee-centered programs on health and safety (Dragano et al. 2014) to help resolve the personal problems of workers. This can potentially help addressing the many emotional, work-tension and stress problems (Marinaccio et al. 2013) that confront workers in this context. This include reducing long working hours, especially for teen workers and part-time workers (Graves and Miller 2015; Yang et al. 2006). Furthermore, continuous training and awareness sessions about workplace hazards should be intensified in the educational curriculum (Tucker et al. 2014) to create awareness about workplace safety and health. From these, it can be concluded that certain practices of unsafe behavior may result in certain consequences based on the nature of the job, thereby, addressing the solutions to these consequences can potentially aid the reduction of incidents in the workplace. Table 2 provides a summary of the main factors of unsafe behavior.

4 Final remarks

This review complements the existing body of knowledge on unsafe behavior in the workplace. It also provides a broader way of thinking about unsafe employee behaviors working in different job contexts. In this study, unsafe employee behaviors were grouped into eight job contexts namely: construction, healthcare, manufacturing, mining, energy, ISE, agriculture, and MDC. The results showed that unsafe employee behaviors were mostly found in the construction industry, followed closely by the healthcare sector. It further emerged that most of the studies were centered in developing countries. Based on several empirical studies, this study's major contribution is to serve as a reference point for those interested in doing research on triggers of unsafe employee behaviors.

In the construction industry, lack of adequate knowledge on safety and health practices, intentional violation of recommended safety practices, over confidence, poor work environment, long working hours and job insecurity, risky behaviors of co-workers, and non-use of PPE were identified as triggers of unsafe behavior. As a result, industry workers suffered from various injuries and fatalities. Some of the previously proposed solutions centered on increasing safety knowledge, initiating welfare activities for workers, and deepening workers' safety attitude and behavior. Similarly, we found that the lack of adequate knowledge on safety, culture of acceptance of risk, work pressure, stress, violence and aggression from patients, long working hours, job insecurity, non-use of PPE, and sleep disorders were the main factors influencing unsafe work behaviors of healthcare workers. Each of these would result in physical injuries, infections and contaminations, psychological trauma and emotional disorders. The most commonly suggested solutions were improving the general work-environment, introducing periodic refresher training on cue recognition, and providing adequate PPE. As for the ISEs, lack of adequate knowledge on safety

Table 2 Unsafe work behavior across job contexts

Major factors of unsafe behaviors	Construction	Healthcare	ISEs	Mining	Manufacturing	Energy	Agricultural	MDC
Lack of adequate knowledge on OSH	*	*	*	*	*	*		*
Intentional violation of safety rules	*	*	*	*	*	*	*	*
Culture of risk acceptance		*			*			*
Over confidence	*		*		*			*
Poor work environment	*		*	*	*		*	*
Work pressure	*	*	*	*	*	*	*	*
Stress	*	*	*	*	*	*	*	*
Violence/aggression from clients		*						*
Long working hours	*	*	*	*				*
Job insecurity	*	*						*
Risky behaviors of co-workers	*				*			*
Non-use of PPE	*	*	*	*	*	*		*
Improper safety equipment/discomfort	*		*	*				*
Low management commitment to safety or poor supervision	*		*		*			*
Poor health conditions	*						*	*
Sleep disorders		*					*	*
Incongruent job roles								*
Sedentary lifestyle/eating habits								*
Negligence	*	*	*			*		*

ISEs informal sector enterprises, MDC multi-dimensional context

and health practices, deviation from following the recommended safety practices, over confidence, poor work environment, work pressure, stress, long working hours, non-use of PPE, lack of management commitment to safety, and negligence were the common factors of unsafe behavior. Workers were found to be victims of workplace incidents and poor emotional wellbeing. Some proposed solutions include training on safety and health and strengthening regulatory bodies to ensure compliance with safety rules. In the manufacturing industry, aspects related to the lack of adequate knowledge on safety and health practices, intentional violation of recommended safety practices, culture of risk acceptance, poor work environment, work pressure, stress, risky behavior of co-workers, non-use of PPE, and low management commitment to safety were the most frequent factors associated with unsafe behaviors. The proposed solutions were centered on increasing safety knowledge and institutionalizing maintenance of machines and equipment. The influencing factors of unsafe behavior in the mining industry were mostly associated with the lack of adequate knowledge about safety and health practices, poor work environment, work pressure, stress, long working hours, non-use of PPE and improper safety equipment or discomfort with its use. Thus, it was proposed that clinics should be provided on site to cater for early treatment of injured workers, improve work environment and increase awareness on safety and health. In the energy sector, factors such as lack of adequate knowledge on safety and health practices, intentional violation of recommended safety practices, work pressure, stress, non-use of PPE, and human errors due to negligence were the most dominating factors. Understanding of safety policies and management was found to be important for workers' health in this growing sector. The factors related to unsafe behaviors in the agriculture sector were intentional violation of recommended safety practices, poor work environment, working pressure, stress, long working hours and poor state of health. Solutions to these conditions were mostly centered on increasing safety knowledge and provision of safety equipment. As for the factors of unsafe behavior in MDC, conditions such as lack of adequate knowledge on safety and health practices, culture of risk acceptance, poor work environment, work pressure, stress, long working hours, job insecurity, non-use of PPE and improper safety equipment or discomfort with its use, and sleep disorders were mostly reported. In addition, increasing safety knowledge and strengthen regulatory bodies were proposed in order to monitor the activities of employers' and workers' organizations.

In conclusion, this review highlights many recent developments in unsafe behavior in different job-contexts, which should be of practical use for safety managers, researchers and safety program evaluators. From the above discussion, inadequate knowledge or training on safety and health practices appears to be the main factors of unsafe behavior across all job types. This calls for research attention to focus on how to cognitively motivate workers to be aware of the dangers associated with non-compliance with the best safety and health practices at the worksites. Stress was also identified as a major factor of unsafe behavior across all job types. Within this globalized context, it appears that stress resulted from work overload is inevitable, yet its contribution to the failure of occupational safety and health management systems cannot be underestimated. This was noted within the healthcare sector, where workers are subjected to abuse from patients. The psychological and emotional effects of

these factors are often submerged under the culture of risk acceptance, and the effect becomes more noticeable in workers' commitment to their jobs. This study suggests that the management/employers may need to show more concern towards the welfare of their workers. This can be achieved by establishing small counseling centers and allow counseling professionals to help manage stress levels and the personal or emotional problems of workers. In addition, we propose that management should create an organizational climate that encourage inputs from all group members concerning safety issues. This will not only foster higher levels of identification with organization's safety management system, but also strengthen employees' motivation to achieve safety goals, reduce workplace incidents and turnover intentions, and increase productivity.

Figure 2 shows the timeline of development in studies on unsafe behaviors across all job types. From the figure, it can be said that earlier research studies on occupational safety and health were more concerned about the organizational triggers of accidents than about the individual factors. That explains why minimum empirical studies were found between 1998 and 2007. However, we found an increase in empirical research studies on unsafe worker behaviors from 2008



Fig. 2 A timeline of studies on unsafe behavior

to date, which gives an indication of a growing research attention in this field. Yet, studies are still lacking on exposing context specific problems and solutions to unsafe conditions for some population subgroups. In addition, empirical research on safety and health in the energy and agriculture sectors/industries were very low.

5 Implications for management research

Through a comparative overview of the unsafe behavior literature, this review contributes to the literature by pinpointing how differences in factors of unsafe behavior, consequences, and solutions are discerned across eight job contexts. This review brings progress for different aspects of safety culture and safety management, recognize the corresponding obligation in safety management, and understand the solutions for certain types of unsafe behaviors and working conditions. This includes jobs where there are low levels of role clarity, high managerial work demands, pressure to work overtime, and high exposure to hazards.

6 Limitations and future works

This study was limited to exploring the presence of unsafe behavior in eight job domains. The empirical differences between the demographic characteristics of workers are beyond the scope of this paper. More precisely, examining whether safety practices vary according to workers' sex, age, and financial situation was not established in this paper. Several other aspects that might clarify the influence of unsafe behavior on populations living in different continents, such as Asia, Africa, and Europe were not considered in this review. This study also did not examine the cognitive mechanisms that lead to unsafe behaviors and other causes of accidents across work paradigms. Several other measures of unsafe behavior relate to how often workers ignore safety regulations and procedures were not covered in depth due to the limited evidence from experimental studies. Another limitation in this review was noted with regard to the distribution of studies into job-contexts in which the identified studies were skewed towards high-risk or hazard prone jobs to the neglect of other job contexts (e.g., clerical, administrative and corporate). Most of the included studies in this review were based on quantitative methodology, which gives a little insight into prevention programs of unsafe behavior.

Based on these limitations, this study recommends that future research should fill the methodological gap by employing qualitative methods to explore the "whys" behind unsafe employee behaviors. It also recommends understanding the role of demographic and related attitudinal variables of workers in performing risky behaviors.

Compliance with ethical standards

Conflict of interest Joana Eva Doodoo declares that she has no conflict of interest. Author Hosam Al-Samarraie declares that he has no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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