



Research article

A qualitative investigation to discover causes of occupational injuries and preventive countermeasures in manufacturing companies

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ABSTRACT

Background and aims: Occupational injury rates are high in developing nations, making it critical to develop preventive measures. The purpose of this study was to determine the causes and preventive measures for occupational injuries in Iranian manufacturing industry.

Methods: Semi-structured interviews with managers and employees were used to obtain data. Inductive content analysis was used to analyze verbatim transcripts.

Findings: The investigation identified six major causes of injuries including improper safety management and three control measures involving supervision and support for safety promotion.

Conclusions: The findings suggest that the managers and employees should make serious efforts to control the identified causes of injuries. It is necessary for occupational health and safety authorities to inspect and enforce safety regulations, as well as for the government to support the implementation of safety plans in the companies.

1. Introduction

Occupational injuries are prevalent worldwide and cost billions of dollars, particularly in developing nations (International Labor Organization, 2013). Numerous characteristics of individuals, occupations, and organizations have been connected to workplace injuries (Khanzode et al., 2012). Economic, technological, employment, and human variables were all identified as contributing to the accidents (Fabiano et al., 2004). Furthermore, research in developed nations indicates that the majority of occupational injuries are the result of risky human behavior, with approximately 10–15% attributed to unsafe equipment and working environment (Choudhry and Fang, 2008). Occupational injuries can be triggered by a variety of factors, including immediate risky acts and conditions, contributing management- and environmental-related factors, as well as employee mental health (Zhao et al., 2012). Differential cause attribution of accidents has the potential to influence managers' decisions about how to improve safety and whether or not companies learn from their failures (Hasle et al., 2009). Because safety policies and working conditions in developing countries differ from those in developed countries, the causes of occupational injuries in these countries will also differ.

According to studies comparing high and low injury rates, organizational policies such as management commitment to safety and safety training have a significant effect on future accident prevention (Chew, 1988; Cohen and Jensen, 1984). Despite the fact that numerous studies have been conducted on the causes of occupational injuries, additional research is required. Because working conditions and labor characteristics vary by industry, the new findings may assist managers in strategically allocating human and financial resources to reduce injuries. Additionally, there is some attribution bias in the safety literature regarding accident causation (Niza et al., 2008). According to Salminen et al. (1992), actors frequently report that external circumstances influence the occurrence of an injury. Individual experiences can shape an individual's perspective on the causes of occupational injuries, and various working groups hold divergent views. As a result, comparing managers' and employees' perceptions of occupational injury causes can help identify discrepancies.

A review of the literature revealed a dearth of information describing the elements that contribute to the incidence of unintentional events in high-risk industries such as manufacturing in Iran (Iranian Social Security Organization, 2017). Additionally, the significant degree of cultural diversity in some Iranian areas, such as West Azerbaijan Province, may

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influence employees' and managers' perceptions of the causes of accidental events. Additionally, the impact of occupational injury in altering an employee's perspective has not been adequately explored in the safety literature. As a result, the current study sought to ascertain managers' and workers' perspectives on the occurrence of unintentional incidents in Iranian manufacturing organizations. This study also considered the perspectives of individuals who had occupational injuries and employees who had not experienced the occurrences.

2. Material and methods

2.1. Design

The purpose of this qualitative study was to ascertain how managers and employees interpret the causes of occupational injuries, as well as how participants' opinions of the events are influenced by their personal injury experiences. Content analysis is a replicable technique for grouping a large number of words in a text using coding principles (Stemler, 2001). The concepts are derived directly from transcripts by open coding, theme establishment, and abstraction inductive content analysis. When a researcher wishes to test an established theory or retest existing data in a new context or category derived from past relevant theory or literature, a deductive technique for evaluating texts is necessary (Cho and Lee, 2014; Elo et al., 2014).

2.2. Participants and data collection

This study included managers (n = 17), safety managers (n = 6), and employees (n = 35) from chemical, electrical, construction material, and food manufacturing firms in Iran's West Azerbaijan region. The interviewees were chosen to represent a range of ages, occupations, and educational levels. They were recruited based on having at least two years of work experience in the companies and an experience of work-related injuries. Safety managers of the companies were contacted, and the necessary approvals to conduct the study were acquired from company managers. We compiled a list of potential participants in consultation with the safety managers. Then, after speaking with them face-to-face and explaining the study's objectives, the interviewees agreed to participate. Participants were recruited based on their personal interests, and no incentives were offered for their participation.

At the participants' places of employment, semi-structured face-to-face interviews lasting an average of 28 min were conducted. The interviews were conducted during their break times. Individual interviews were done in Azerbaijani Turkish by the first author, and the interviewees were asked the following questions: Have you ever been injured on the job? What are your thoughts on the factors that contribute to occupational injuries? How feasible is it to prevent occupational injuries?

2.3. Ethical consideration

The study was approved by the UMSU ethics committee under the code IR.UMSU.REC.1397.260. The purpose of this study was explained to the participants, and they were informed that their involvement was voluntary. The participants were also assured that the data would remain anonymous and confidential. Informed consent was obtained from all participants.

2.4. Data analysis and trustworthiness

All interviews were digitally recorded and fully transcribed. The data were analyzed using content analysis to find relevant constructs. The transcripts were thoroughly analyzed, and important phrases were discovered as codes. The codes derived from the transcripts were written separately, and the conceptually equivalent codes were grouped and given names. By integrating different classes, based on common

concepts, more general categories were created. Finally, the categories were integrated to provide a comprehensive explanation of the injury causes and control measures and were categorized into themes. After that, both authors agreed on the extracted topics. Additionally, triangulation of the participants aided in the incorporation of many perspectives during the data collection process.

3. Results

The sample comprised of 58 individuals (2 females and 56 males) with ages ranging from 24 to 53 years (mean = 39.74). The participants had a minimum of two years and a maximum of thirty years of work experience (mean = 14.89). The majority of employees had completed the 12th grade (42.1 percent) or held an associate degree (34.2 percent). All managers had earned a bachelor's degree from a university. Five of the interviewed managers (M) (21.7 percent) and twenty-two of the workers (W) (62.8 percent) had experienced at least one occupational injury. A total of six major themes related to causes of injuries and three themes related to the control measures emerged from the analysis.

3.1. Causes of occupational injuries

3.1.1. Inadequate safety training

Participants highlighted that a lack of awareness of safety standards by workers, managers, and supervisors, as well as a lack of safety training courses, can all contribute to injuries. According to the respondents, giving work tasks to unqualified individuals jeopardizes workplace safety and accident prevention. Occupational injuries have been ascribed to a lack of safety awareness and poor training quality. One of the interviewed workers explained the effect of inadequate training as:

"Lack of safety information was the primary reason for my injuries... If I knew how to stop the machine, this would never happen." W 1

3.1.2. Lack of compliance with safety regulations

Participants agreed that failing to adhere to safety requirements can result in injury. They cited incompatibility with workplace conditions or non-applicability of safety regulations as justifications for non-compliance. Additionally, they emphasized the importance of safety inspections conducted by entities such as labor inspection bureaus. Participants believed that the government does not place a premium importance on safety, citing bribery and compromising in external safety assessments.

"The government places little emphasis on occupational safety and makes less attempt to enhance it." W 6

In addition, violating safety regulations can result in injury. All equipment and tools should be checked before use, and all work should follow established safety procedures.

"Not managing the equipment prior to beginning the job constitutes a violation of safety laws that may result in injury." W 25

3.1.3. Inappropriate safety culture

According to the participants, firms have a low level of safety culture. They cited a lack of cooperation and engagement in safety matters, a lack of belief in the usage of Personal Protective Equipment (PPE), the limits imposed by safety on job performance, and employers' lack of expertise regarding safety. Some employees believed that wearing PPE is a foppery action and using it has no effect on workers safety. A safety manager stated:

"Some employees do not wear essential PPE on the job. When I asked them about the reason; they indicated that wearing PPE is a fussy action." M 10

Numerous interviewees expressed negative attitudes toward safety, which they attributed to safety issues interfering with their jobs. They referred to injury prevention as a difficult task. According to some workers, the injuries were an unavoidable result of their occupations. Certain workers believed in fate and that accidents occurred as a result of God's will, rendering prevention efforts futile.

"My injury was caused by two factors: my working conditions and God's will that it occurs... You cannot escape destiny." W 6

3.1.4. Economic problems

The participants stated that economic troubles might not only produce emotional tensions and distractions, but can also make it more difficult to consider shifting hazardous jobs due to the fear of losing a job while being in dire need of money. The respondents explained that tough economic conditions make it difficult for corporations to cover safety expenses. They also claimed that if a person is struggling financially, he will be forced to accept a second job or work longer hours without respite.

"When I am having economic difficulties, I work here but am distracted, which can result in an injury." W 10

3.1.5. Inappropriate safety management

According to participants, the majority of hazardous labor activities in companies were conducted without risk assessment. At times, workers were forced to do their jobs in an unsafe manner. Additionally, they indicated that tasks were completed without obtaining necessary permissions or considering the root causes of safety-related shortcomings. There is a lack of cooperation and coordination among employees in organizations, and often hostile interactions exist between employees and managers.

"Typically, work activities are undertaken without regard for potential safety risks, and without the necessary precautions and coordination between various work units." M 8

Participants believed that managers' role is crucial in promoting safety, the involvement of workers in safety concerns and accomplishing safety goals. They also inferred other risky situations resulting from improper work planning and organization, such as inexperienced personnel, job pressure, work fatigue and depression. Participants stated that some managers intervene to stop safety departments from penalizing their employees, others do not perform their safety responsibilities appropriately. However, safety managers perceived a lack of executive authority to control and coordinate company safety. They added that after the fact accident prevention is the norm in companies. Inadequate preparation, planning, and control procedures were also cited as contributing to injuries.

"Managers do not take the necessary steps to improve safety until an injury occurs. For example, despite having reported the unsafe condition, a machine had an unsafe part that my finger got stuck under and was amputated." W 11

3.1.6. Lack of organizational commitment toward safety

The interviewees believed that there was a lack of commitment to safety in their organizations. The managers of companies fail to allocate funding for safety equipment and training. They explained that the tools they employ are dangerous and defective. A worker expressed the lack of management support that resulted in the existence of unsafe conditions.

"Our massive furnace's automatic spark has been out of commission for about four or five years, and we have to start it with a hand-made torch. When we attempted to start the furnace, the fuel gas exploded and threw

the furnace's gate approximately 40 meters away. It has the potential to kill someone if it collides with them". W 8

Additionally, they stated that production takes precedence over safety. They believed that such a priority arose from the inappropriate opinion of senior managers about production and safety rules.

"There is no problem in our company if the level of safety decreases due to production. However, the rate of production must not be reduced as a result of adhering to safety regulations". M 17

3.2. The methods of injury prevention

3.2.1. Promoting safety culture

The majority of participants emphasized the critical nature of enhancing safety culture and the managers' involvement in fostering it. Companies should encourage employees not to conceal incidents. They should not only record and report injuries and near-misses, but also conduct investigations into their causes in order to avoid similar incidents in the future and learn from past mistakes. Production managers must prioritize safety principles and value the employees under their supervision. Workers feel that a strong safety culture can result in increased compliance with safety regulations.

"When a company's senior manager arrives to worksite without wearing the required PPEs, it should not expect staff to use the PPEs, because this will have a significant negative impact on the workers. ... The safety behavior of managers has an impact on the transfer of good safety culture with minimal cost. The negative impact of this risky behavior is much more than various safety training courses". M 2

3.2.2. Better safety management

Participants felt that managers should be held accountable for adhering to safety regulations within their units, as routine monitoring and inspection can help prevent injuries. Participants suggested rewarding safe workers and punishing dangerous ones. They cited close worker-manager connections, adequate planning for safe work activities, and increased support from safety managers to provide them greater authority to enforce safety rules as strategies for improving safety and reducing injuries.

The participants explained that providing safe equipment can help prevent injuries. A risk assessment is required before actions are performed, and risk reduction measures can reduce the likelihood or the consequences of accidental events. Work pressure was also mentioned as a factor that can lead to negligence of safety rules by workers.

"When we're pressed for time at work to meet a deadline, nobody cares about safety rules". W 7

3.2.3. Supervision and support for safety promotion

The participants affirmed that the government should support manufacturing firms with a good safety performance in purchasing fire vehicles, ambulances, and give loans to implement safety-control plans. They also highlighted the assistance of occupational health and safety (OHS) authorities for workers to form unions, and the strengthening labor councils, as well as the need for managers to attend at injury court sessions. They emphasized the consultative role of the OHS authorities in providing guidance on the purchase of safety equipment.

"The government must implement safety control plans following pilot studies in a number of manufacturing companies. If the results are positive, the plans should be implemented in other companies". M 1

Participants believed that enforcing safety regulations and conducting regular and ongoing safety inspections were considered as useful methods to prevent injuries. The participants stated that routine OHS

authorities' inspections of workplace safety will help reduce injuries. They complained about safety enforcement and sought more and better safety inspections.

"The government is not interested in improving the safety situation in companies and thus makes no serious efforts to promote safety". M 19

3.3. Differences in viewpoints

Both managers and workers cited economic problems, inappropriate safety management, inadequate safety training, and poor safety culture as contributing factors to accidents. According to workers, occupational injuries were attributed to a lack of organizational safety commitment, coworker's unsafe acts, lack of safety inspection by OHS authorities, and lack of competency of the appointed people for jobs. On the other hand, managers believed that factors such as safety regulations and failure to enforce them, safety costs, high production priority over safety, and inappropriate attitude of workers towards safety contribute to accidents.

The participants who experienced injuries highlighted the role of organizational commitment to safety as an important factor in the occurrence of injuries. They also expressed more potential causes for injuries than the interviewees with no prior accident experience. The last group had consensus on the role of inappropriate safety training, a lack of safety management, a negative safety culture, and unsafe actions in causing injuries.

The findings suggested that there were similarities and variations between the perspectives of workers and managers. Both groups believed in the positive impact of training, the importance of workplace safety, the promotion of safety culture, better supervision of safety from inside and outside the companies, and improved safety management to prevent the injuries.

The workers pointed to factors such as competency and economic problem solving. Conversely, managers proposed the need for support from OHS authorities to prevent injuries. The financial costs of improving safety and lack of the authorities' support to reduce them result in low level of safety compliance in companies. Most managers stated that their companies' safety efforts were adequate. They criticized OHS authorities' supervision and thought that better supervision would encourage companies to invest in safety.

4. Discussion

The findings of this study reveal that lack of safety training, inappropriate safety culture, lack of commitment to safety, economic problems, safety legislation, and inappropriate safety management all contribute to occupational injuries. We discovered that enhancing safety culture, supervising and supporting safety promotion, and strengthening safety management were all proposed countermeasures to preventing workplace injuries. There appears to be an attribution bias in the view of workers and managers regarding the responsibility of the accidents.

Occupational injuries have been attributed to lack of safety training. Safety training has been shown to improve safety performance (Cohen and Jensen, 1984; Huang et al., 2012). Effective safety training can minimize unsafe behaviors (Haslam et al., 2005), increase safety compliance (Casey et al., 2018), and decrease injuries (Lai et al., 2011). Notably, trainings should be well-designed for all organizations levels, since without it, not only will workers be unable to work safely, but supervisors will also be unaware of their responsibility for safety and the need of monitoring it.

Inappropriate safety culture is indicated as another influencing factor. This study corroborates earlier research indicating that safety culture values have an effect on safety behavior and performance (Martínez-Córcoles et al., 2011; O'Toole, 2002). Ghahramani's research found a detrimental safety culture influencing the effectiveness of occupational health and safety assessment series (OHSAS) 18001 in the Iranian

manufacturing firms (Ghahramani, 2016a, 2017). Given that safety culture is a critical factor in reducing occupational injuries (Hale and Hovden, 1998), and that cultural improvements are necessary to reinforce safety in conjunction with technical interventions (Pronovost et al., 2009), it is recommended that activities aimed at improving safety culture be integrated into companies' efforts to improve safety.

The current study indicated that commitment to safety influences the occurrence of injuries. The workers cited senior managers' inappropriate support as evidence of a lack of commitment to safety. Although the interviewed managers affirmed their dedication to safety, it is likely that they have been unable to transfer this commitment to their staff. Managers should demonstrate their commitment to safety in their activities (Michael et al., 2005). They should actively be involved in safety inspections, encourage and remind employees to perform their jobs safely, participate in safety committees, design jobs with safety in mind, and financially support safety programs (Lai et al., 2011). Therefore, they should involve in safety practices and encourage people to do their jobs in a safe manner.

The current study indicated that working with dangerous machines for production and unsafe behaviors of employees might contribute to injuries. These findings support earlier injury models (Underwood and Waterson, 2014). Initial steps in developing a safe workplace strategy would include providing training to operators and supervisors on identifying and reporting unsafe conditions, as well as conducting behavioral observations to identify unsafe acts. However, it is essential to remember that senior management support is critical for changing detected unsafe conditions; organizations should provide timely feedback to reporters and have incentive policies in place to encourage them.

Companies and workers' economic situations were identified as contributing factors to injuries. It is evident that the economic crisis has impacted many countries and companies. The affected companies give less priority to OHS activities because of budget restrictions and their main priority will be trying to make ends meet (Thomas and Ganster, 1995). Financial problems might also increase workers' stress. It would facilitate workers' exposure to accidents through consuming their mental capacity and interfering with their concentration (Kanfer and Ackerman, 1989). Economic distress can also have an effect on the enforcement of safety regulations. Participants believed that authorities were ignoring companies' noncompliance in order to avoid increasing pressure on them. Enforcing safety regulations both inside and outside the organizations is important for preventing injuries (Bonafede et al., 2016; Niskanen et al., 2012). Thus, OHS authorities and managers must implement an updated enforcement and supportive strategy in order to minimize injuries.

Risk assessment deficiencies, inadequate safety planning, a lack of coordination and cooperation between workers and managers, and a lack of supervision and control were all highlighted as indicators of poor safety management. These responsibilities are critical for effective safety management and injury prevention. These findings are consistent with the results of recent studies in Iranian manufacturing companies (Ghahramani, 2016b, 2017). Sound safety management can positively affect the safety behavior of employees and improve safety performance (Fernández-Muñiz et al., 2007). Therefore, managers should try to comply with safety regulations and seek additional financial support to make further improvements.

The attribution of accident responsibility to external causes beyond the participants' control demonstrates a defensive attribution in explaining injuries, which is consistent with Niza et al. (2008). Workers believed that unsafe working conditions were caused by negligent employers, while managers believed that workers' irresponsibility was the cause of unsafe working conditions and injuries. This is significant because employees who believe accidents are uncontrollable will not report those caused by unsafe behavior. However, managers' beliefs inhibit managers from learning from accidents (Hasle et al., 2009). In addition, workers expected managers to make greater efforts to prevent injuries, while managers expected the government to take a leadership role in promoting workplace safety. Therefore, in a situation where

nobody accepts responsibility for workplace safety, the government must intervene to improve workplace safety and train workers and managers (Tam et al., 2004).

Accident victims saw the occurrence of the events and their causes more complicated than other participants. The victims expressed a variety of different causes for the injuries. This could be related to their experience and having more knowledge about the events (Gonçalves, da Silva, Lima and Meliá, 2008) and it appears that experience can lead to workers adopting a more holistic perspective on the events' occurrence. It suggests that if their experience is shared with other employees via training courses, they will get a better awareness of workplaces injuries.

5. Study strengths and limitations

The use of a qualitative methodology enabled us to become familiar with participants' impressions regarding weakness of safety systems in preventing occupational injuries. To the authors' knowledge, no similar study has been reported in Iran or even in developing countries. This study indicated that well-known and trivial causes induce incidents in the companies. Thus, government and business leaders must place a greater emphasis on accident prevention. Despite the findings confirming previous studies, accident data are not properly recorded or examined to promote workplace safety. This problem also affects other Iranian companies, even in developing nations. This appears to be a concern for other Iranian industries. In addition, we were able to collect and analyze perspectives from a number of groups by involving managers and employees, both with and without accident experience.

There is an inherent limitation in the generalization of the findings of qualitative studies due to the descriptive nature and narrow focus. Therefore, future studies are recommended to test the role of identified causes in the occurrence of accidents and to study the effectiveness of proposed preventive measures. Another limitation was there in translation process that there may have been some meanings and interpretation lost in translation from Turkish to Persian then to English. Finally, where it has been a long time since the injuries occurred or coworkers witnessed the accidents, it is possible that participants' judgments may have been influenced by the passage of time and newer experiences.

6. Conclusion

The current study's findings indicate that the identified factors contribute to the occurrence of occupational injuries in the manufacturing companies. The participants ascribed responsibility for injury prevention to external factors beyond their control, rather than recognizing and establishing a clear role and responsibility for themselves. It is vital to control the causes of injuries, and managers of businesses should implement appropriate preventative measures based on the identified causes and participant suggestions. OHS authorities should inspect and enforce safety regulations, and government should provide financial support for the implementation of safety measures aimed at preventing injuries. Workers should get training on safety and their duties, empowering them to play a positive role in injury prevention. Lack of safety training appears to have had a detrimental influence on safety at all levels, and many positive changes can occur in companies by providing proper safety training to managers and employees.

Declarations

Author contribution statement

A. Ghahramani designed the study, participated in the formulation of the grant that funded it, and gathered data.

A. Ghahramani and A. Amirbahmani participated in data analysis and drafted the manuscript.

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Data availability statement

Data will be made available on request.

Declaration of interests' statement

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Additional information

No additional information is available for this paper.

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References

- Bonafede, M., Corfiati, M., Gagliardi, D., Boccuni, F., Ronchetti, M., Valenti, A., Iavicoli, S., 2016. OHS management and employers' perception: differences by firm size in a large Italian company survey. *Saf. Sci.* 89, 11–18.
- Casey, T.W., Krauss, A.D., Turner, N., 2018. The one that got away: lessons learned from the evaluation of a safety training intervention in the Australian prawn fishing industry. *Saf. Sci.* 108, 218–224.
- Chew, D.C., 1988. Effective occupational safety activities: findings in three Asian developing countries. *Int'l Lab. Rev.* 127, 111.
- Cho, J.Y., Lee, E.-H., 2014. Reducing confusion about grounded theory and qualitative content analysis: similarities and differences. *Qual. Rep.* 19 (32), 1–20.
- Choudhry, R.M., Fang, D., 2008. Why operatives engage in unsafe work behavior: investigating factors on construction sites. *Saf. Sci.* 46 (4), 566–584.
- Cohen, H.H., Jensen, R.C., 1984. Measuring the effectiveness of an industrial lift truck safety training program. *J. Saf. Res.* 15 (3), 125–135.
- Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K., Kyngäs, H., 2014. Qualitative content analysis: a focus on trustworthiness. *Sage Open* 4 (1), 2158244014522633.
- Fabiano, B., Curo, F., Pastorino, R., 2004. A study of the relationship between occupational injuries and firm size and type in the Italian industry. *Saf. Sci.* 42 (7), 587–600.
- Fernández-Muñiz, B., Montes-Peon, J.M., Vazquez-Ordas, C.J., 2007. Safety management system: development and validation of a multidimensional scale. *J. Loss Prev. Process. Ind.* 20 (1), 52–68.
- Ghahramani, A., 2016a. Factors that influence the maintenance and improvement of OHSAS 18001 in adopting companies: a qualitative study. *J. Clean. Prod.* 137, 283–290.
- Ghahramani, A., 2016b. An investigation of safety climate in OHSAS 18001-certified and non-certified organizations. *Int. J. Occup. Saf. Ergon.* 22 (3), 414–421.
- Ghahramani, A., 2017. Diagnosis of poor safety culture as a major shortcoming in OHSAS 18001-certified companies. *Ind. Health* 55 (2), 138–148.
- Gonçalves, S.M.P., da Silva, S.A., Lima, M.L., Meliá, J.L., 2008. The impact of work accidents experience on causal attributions and worker behaviour. *Saf. Sci.* 46 (6), 992–1001.
- Hale, A.R., Hovden, J., 1998. Management and culture: the third age of safety. A review of approaches to organizational aspects of safety, health and environment. *Occup. Injury: Risk, Prev. Interv.* 129–165.
- Haslam, R.A., Hide, S.A., Gibb, A.G.F., Gyi, D.E., Pavitt, T., Atkinson, S., Duff, A.R., 2005. Contributing factors in construction accidents. *Appl. Ergon.* 36 (4), 401–415.
- Hasle, P., Kines, P., Andersen, L.P., 2009. Small enterprise owners' accident causation attribution and prevention. *Saf. Sci.* 47 (1), 9–19.
- Huang, Y.-H., Verma, S.K., Chang, W.-R., Courtney, T.K., Lombardi, D.A., Brennan, M.J., Perry, M.J., 2012. Management commitment to safety vs. employee perceived safety training and association with future injury. *Accid. Anal. Prev.* 47, 94–101.
- International Labor Organization, 2013. Health and Safety at Work: Facts and Figures. Retrieved from. https://www.ilo.org/global/about-the-ilo/newsroom/media-centre/issue-briefs/WCMS_206117/lang-en/index.htm.
- Iranian Social Security Organization, 2017. Statistical Report of Work Related Accidents. Retrieved from. <https://www.tamin.ir/News/Item/3417/2/3417.html>.
- Kanfer, R., Ackerman, P.L., 1989. Motivation and cognitive abilities: an integrative/apptitude-treatment interaction approach to skill acquisition. *J. Appl. Psychol.* 74 (4), 657.
- Khanzode, V.V., Maiti, J., Ray, P.K., 2012. Occupational injury and accident research: a comprehensive review. *Saf. Sci.* 50 (5), 1355–1367.

- Lai, D.N.C., Liu, M., Ling, F.Y.Y., 2011. A comparative study on adopting human resource practices for safety management on construction projects in the United States and Singapore. *Int. J. Proj. Manag.* 29 (8), 1018–1032.
- Martínez-Córcoles, M., Gracia, F., Tomás, I., Peiró, J.M., 2011. Leadership and employees' perceived safety behaviours in a nuclear power plant: a structural equation model. *Saf. Sci.* 49 (8-9), 1118–1129.
- Michael, J.H., Evans, D.D., Jansen, K.J., Haight, J.M., 2005. Management commitment to safety as organizational support: relationships with non-safety outcomes in wood manufacturing employees. *J. Saf. Res.* 36 (2), 171–179.
- Niskanen, T., Naumanen, P., Hirvonen, M.L., 2012. An evaluation of EU legislation concerning risk assessment and preventive measures in occupational safety and health. *Appl. Ergon.* 43 (5), 829–842.
- Niza, C., Silva, S., Lima, M.L., 2008. Occupational accident experience: association with workers' accident explanation and definition. *Saf. Sci.* 46 (6), 959–971.
- O'Toole, M., 2002. The relationship between employees' perceptions of safety and organizational culture. *J. Saf. Res.* 33 (2), 231–243.
- Pronovost, P.J., Goeschel, C.A., Marsteller, J.A., Sexton, J.B., Pham, J.C., Berenholtz, S.M., 2009. Framework for patient safety research and improvement. *Circulation* 119 (2), 330–337.
- Salminen, S., Saari, J., Saarela, K.L., Räsänen, T., 1992. Fatal and non-fatal occupational accidents: identical versus differential causation. *Saf. Sci.* 15 (2), 109–118.
- Stemler, S., 2001. An overview of content analysis. *Practical Assess. Res. Eval.* 7 (17), 137–146.
- Tam, C.M., Zeng, S.X., Deng, Z.M., 2004. Identifying elements of poor construction safety management in China. *Saf. Sci.* 42 (7), 569–586.
- Thomas, L.T., Ganster, D.C., 1995. Impact of family-supportive work variables on work-family conflict and strain: a control perspective. *J. Appl. Psychol.* 80 (1), 6.
- Underwood, P., Waterson, P., 2014. Systems thinking, the Swiss Cheese Model and accident analysis: a comparative systemic analysis of the Grayrigg train derailment using the ATSB, AcciMap and STAMP models. *Accid. Anal. Prev.* 68, 75–94.
- Zhao, L., Wang, X., Qian, Y., 2012. Analysis of factors that influence hazardous material transportation accidents based on Bayesian networks: a case study in China. *Saf. Sci.* 50 (4), 1049–1055.