Iran J Public Health, Vol. 54, No.11, Nov 2025, pp.2395-2407

Review Article

Unveiling the Complex Interplay of Individual Factors Influencing Unsafe Behaviors in Industrial Workplace: A Systematic Review

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(Received 14 Jun 2025; accepted 12 Sep 2025)

Abstract

Background: This systematic review aimed to clarify the individual factors that contribute to unsafe behaviors in industrial workplaces.

Methods: An initial search across PubMed, Web of Science, Google Scholar, and Scopus yielded 2,348 articles published between 2000 and 2023. After a rigorous screening process using the PRISMA guideline, 51 studies meeting the inclusion criteria—focusing on individual determinants of unsafe behaviors in industrial environments were selected for in-depth analysis.

Results: The systematic analysis revealed a multifaceted relationship between individual factors and the occurrence of unsafe behaviors. Key themes include the influence of demographic attributes, psychological needs and desires, cognitive factors, and health conditions. The dual-focused approach of addressing both organizational and individual dimensions emerged as crucial for effective safety management. The synthesis of evidence underscores the significance of individual factors in shaping workplace safety. While organizational strategies remain integral, our findings emphasize the complementary role of individual-focused initiatives. A notable gap in the absence of a comprehensive tool for examining all individual factors points toward a crucial avenue for future research.

Conclusion: This review contributes essential insights for organizational leaders, safety managers, and policymakers seeking to enhance safety protocols and create safe and resilient work environments.

Keywords: Behavioral safety; Safety policymaking; Risk perception; Occupational safety; Human reliability

Introduction

Industrial safety: The significant changes in work patterns due to globalization and technological advancements have profound effects on how health and safety are managed in industrial settings. Occupational accidents and diseases can have serious repercussions, resulting in lasting damage not only to the workforce but also to assets, materials, property, the environment, and the

reputation of organizations (1). While industrial growth presents significant benefits, it also necessitates a comprehensive approach to safety that leverages technological innovations to mitigate risks effectively (2).

Occupational accidents: According to the International Labor Organization (ILO), occupational accidents inflict the most significant human hardships and necessitate substantial economic compensations (2, 3). Every 15 seconds, a worker succumbs to occupational accidents, and 153 workers suffer injuries from such incidents. Shockingly, 6,300 workers lose their lives daily due to these accidents (4). These alarming statistics reveal an annual occurrence of 2.3 million fatal accidents and approximately 317 million injury-inducing accidents in industrial settings (5). Due to the significant negative impacts of occupational accidents, it is crucial to conduct a thorough analysis of these incidents to prevent future occurrences. Identifying the root causes enables managers to implement effective preventive measures and controls, thereby reducing the frequency of such accidents (6, 7).

Unsafe behaviors: Research conducted on 100 accidents reveals that unsafe behaviors account for approximately 85% of all incidents (8). unsafe behaviors encompass both intentional and unintentional human actions that fail to achieve desired results or meet expected goals within the organization (9). "In essence, the primary cause of accidents is human behavior, specifically unsafe behaviors (10). Numerous studies in this field have consistently demonstrated a correlation between the frequency of unsafe behaviors and the occurrence of accidents (11). Unsafe behaviors constitute the primary cause of accidents in numerous systems, particularly in complex ones. To prevent accidents, the crucial first step is identifying the factors influencing the occurrence of unsafe behaviors (12). Numerous researchers have explored the various factors influencing unsafe behavior from different perspectives. A psychometric and modeling study, utilizing Bayesian networks in 2022, categorized the factors influencing the occurrence of unsafe behaviors into three broad categories: social factors, organizational factors (including occupational, environmental, and managerial factors), and individual factors (1). In other words, unsafe behaviors serve as a mediating factor between organizational, social, and psychological elements and accidents. Therefore, to mitigate unsafe behaviors and related accidents, it is essential to initially identify deficiencies in organizational, social, and psychological (individual) aspects within an organization. These shortcomings can then be addressed through appropriate strategies, ultimately reducing the incidence and prevalence of unsafe behaviors. The overarching goal of this approach is to enhance the safety level of the work environment by improving the safety performance of employees (13). Social factors, being predominantly beyond an organization's control, are not significantly influenced by management but rather fall within the purview of politicians and governments. In a broad overview of managing unsafe behaviors in industries, three primary factors are typically considered: organizational, occupational, and individual (14). Organizational factors wield the most significant influence on individual and group behaviors. Organizational factors like culture, leadership, structure, policies, and the physical environment create a powerful context that shapes how individuals and groups behave within the workplace. By understanding and optimizing these factors, organizations can cultivate the desired behaviors to drive success (15, 16). To proactively prevent occupational accidents, organizations should cultivate a positive safety culture and climate (17). Hence, effective management systems, when implemented, play a crucial role in controlling and preventing unsafe behaviors, thereby mitigating the occurrence of occupational accidents within an organization. Additionally, job factors can be significantly managed through ergonomic designs, ensuring a balance between job demands and individual capabilities and limitations (18, 19). Individual factors pose a considerable challenge in influencing unsafe behaviors and occupational accidents, given the intricacy of their impact. Individuals bring their attitudes, skills, habits, and personal characteristics into the organization, utilizing them in their roles. Depending on job requirements, these traits can manifest as

either a weakness or a strength. The influence of individual characteristics on behavior is intricate and substantial, with effects on job performance that may not always be mitigated by job design. While some traits, such as personality, are fixed and unalterable, others, like skills and attitudes, may be subject to change or enhancement (20).

Objective: Due to the lack of a comprehensive program for managing individual factors and the tendency of previous studies to examine these factors separately, this systematic review aimed to synthesize existing research on the role of individual factors in unsafe behaviors and occupational accidents. The primary goal was to explore whether a management plan for individual-related unsafe behaviors, comparable to those for organizational and occupational factors, can be developed. Specifically, the study aimed to (i) identify individual factors influencing unsafe behaviors and accidents, (ii) classify these factors, and (iii) propose recommendations for effectively managing individual factors in recruitment and job assignment processes.

Materials and Methods

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to conduct the study selection process, which involves four key stages: identification, screening, eligibility, and inclusion. Initially, a comprehensive search strategy was applied across multiple databases to identify relevant articles. Subsequently, titles and abstracts of retrieved records were screened using predetermined inclusion and exclusion criteria. Full texts of potentially eligible articles were then assessed for final eligibility. Following this selection, the included studies were synthesized qualitatively to address the research objectives.

Identification stage

A comprehensive literature search was conducted to identify relevant studies published between 2000 and 2023, reflecting recent advances in occupational safety. Four electronic databases—PubMed, Web of Science, Google Scholar, and Scopus—were searched using a combination of keywords related to human unsafe behaviors, individual factors, and occupational accidents. Boolean operators (AND, OR, NOT) were applied to refine the search and exclude irrelevant topics such as traffic accidents and sports-related incidents. The full search strategy was as follows:
(Human unsafe acts OR unsafe behaviors OR human errors OR human failures) AND (accident proneness OR injury proneness OR repetitive accidents OR repetitive injuries OR recurrent accidents OR recurrent injuries OR multiple accidents OR accident liability OR injury liability OR accident propensity OR accident tendency OR accident susceptibility) AND (industrial workers) NOT (traffic accidents OR drivers' behaviors OR sports-related incidents OR public accidents).

Screening and eligibility stage

Titles and abstracts of retrieved records were independently screened by two reviewers based on predetermined inclusion and exclusion criteria. Studies were included if they examined individual factors associated with unsafe behaviors or occupational accidents in industrial settings, were original research articles, and published in English. Exclusion criteria comprised studies focusing on non-occupational accidents or unrelated populations. Duplicate and irrelevant records were removed prior to full-text assessment.

Quality Assessment and Risk of Bias

Two reviewers independently assessed the methodological quality and risk of bias of eligible studies using the ROBIS tool. Discrepancies were resolved through consensus or consultation with a third reviewer. This assessment evaluated study eligibility criteria, selection process, data collection, and synthesis.

Data Extraction and Synthesis

Eligible studies were independently reviewed and coded by two authors. Extracted data included study objectives, design, population, setting, location, country, results, and overall evaluation. Discrepancies were resolved through discussion. A

qualitative synthesis was performed to summarize findings across studies.

Results

Study selection and general characteristics of the included studies

Overall, 2,348 articles were initially identified through database searches. Following a comprehensive screening process based on relevance and content, 51 articles met the inclusion criteria and were selected for detailed analysis. The data analysis was conducted in three phases: first, summarizing key characteristics of the selected articles; second, extracting research questions to guide the thematic discussion; and third, critically appraising and synthesizing the research findings. Subsequently, these 51 studies underwent further in-depth examination to investigate the influence of various factors on the occurrence of occupational accidents, as outlined in the PRISMA flow diagram presented in Fig. 1.

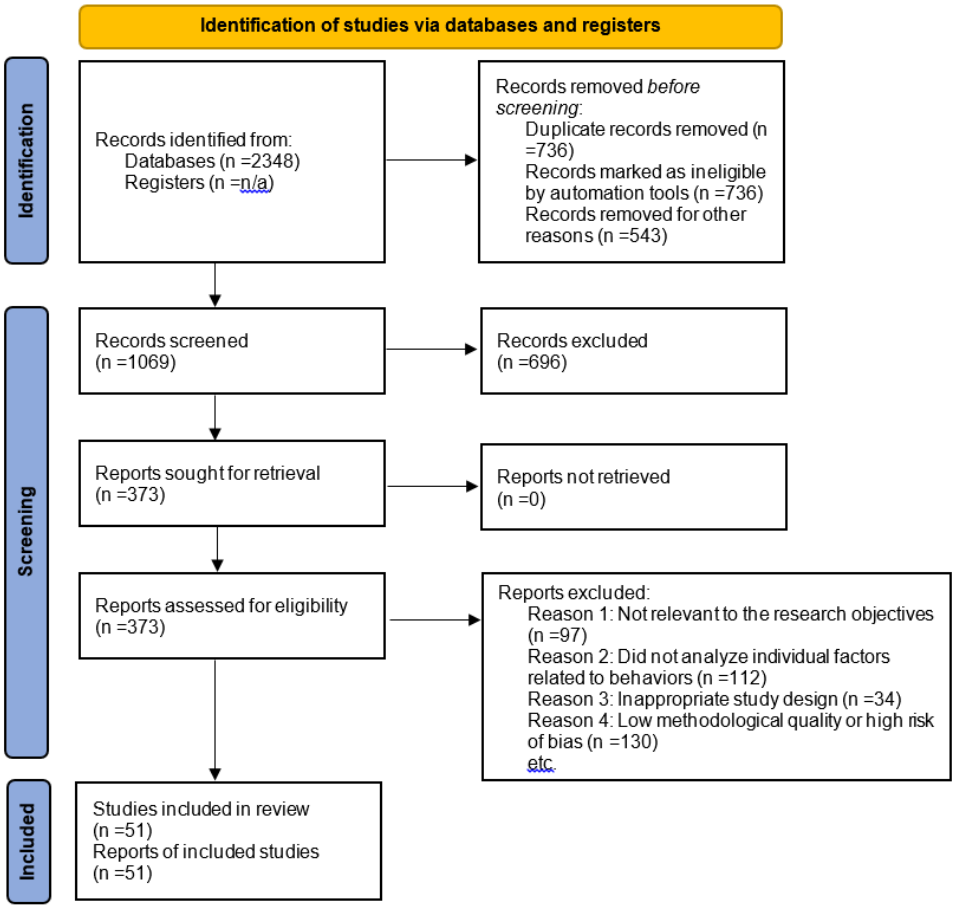

Fig. 1: PRISMA 2020 flow diagram of the structured literature review

The role of individual factors

The analysis of the included studies revealed five main categories of individual factors influencing unsafe behaviors: demographic characteristics, psychological factors, physical and physiological conditions, personality traits, and overall general health. These categories are summarized and illustrated in Fig. 2. These domains collectively represent the multifaceted nature of individual influences on workplace safety and are detailed in Fig. 2. This classification synthesizes findings across diverse studies, highlighting recurrent individual-

level determinants that contribute to unsafe behaviors in occupational settings.

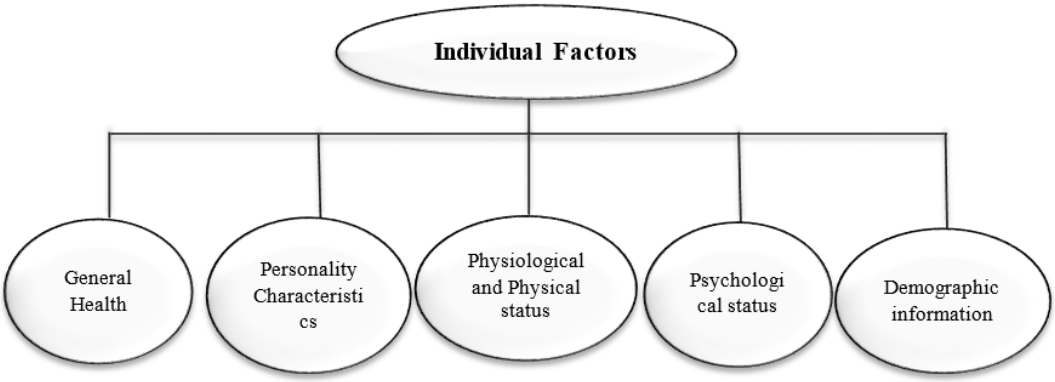

Fig. 2: Classification of individual factors influencing unsafe actions

Demographic information

Twenty-one demographic factors affecting unsafe acts, behaviors, and occupational accidents have been identified (Fig. 3). Among the identified factors, age (21), work experience (21, 22), level of education and knowledge (Education and Knowledge) (22, 23) have the highest agreement among the studies, and most studies have recommended investigating these factors as influencing factors on unsafe behaviors and occupational accidents (24, 25).

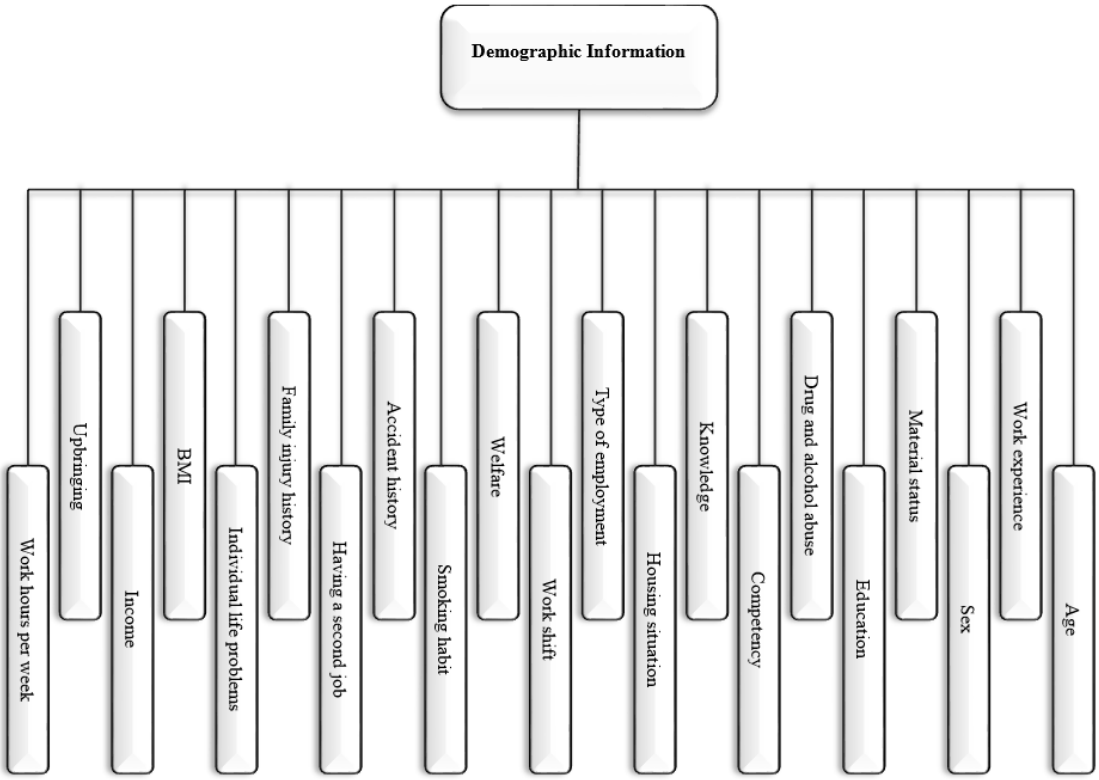

Fig. 3: Classification of demographic factors affecting unsafe actions

Gender (26), marital status (22), monthly income, which is referred to as welfare in some studies (26), individual competence (27), history of smoking (28), alcohol and tobacco use (1), job security (1), work shift and number working hours in the week (22) are the second priority of review. Other factors that were sometimes mentioned in one or at most two studies include: upbringing (29), family injury history (30), accident history (30), body mass index (BMI) (28, 31), life problems. Individual life problems, having a second job and also housing situation (the owner house) (1).

Psychological status

A psychological state refers to the mental or emotional condition of an individual, which can be characterized by various feelings, thoughts, and behaviors. This state can be inferred from patterns of psychophysiological activity, such as brain waves and physiological responses (32). Table 1 provides a comprehensive overview of psychological status and its subsets, presenting the frequency of each factor based on studies. Notably, safety awareness emerges as the most frequently addressed factor in the studies, underscoring the crucial importance of individuals' knowledge and awareness of safety. This finding aligns logically, as individual knowledge and awareness contribute significantly to the development of a safety culture and climate (Safety culture refers to the shared values, beliefs, and attitudes about safety within an organization, while safety climate represents employees' perceptions of the organization's current safety policies and practices (33)), both playing pivotal roles in preventing unsafe acts and occupational accidents. Other frequently studied factors include safety attitude, motivation, and risk perception [Risk perception is an individual's subjective judgment about the likelihood and severity of a hazard, influencing their safety-related decisions (34)], (Table 1).

Table 1: Classification of psychological status and their frequency based on the number of repetitions in the studies

	Main category	Sub category	Frequency
Psychological status	Individual safety perception	Safety awareness	12
		Safety attitude	8
		Risk perception	6
		Risk taking Behavior	2
		safety consciousness	1
		Safety capability	1
	Individuals' psychological needs	Motivation	7
	Individual desires	Increasing income	3
		Mental desire	2
		Saving effort	1
		Saving time	1
		Reducing stress	1
		Helping others	1
	Individual cognitive factors	Failure in management of emotions	4
		Using non-applicable working procedures	4
		Lack of alertness due to mind overload	4
		Failure in implementing skills	4
		Problem solving difficulties	3
		Situational rule disobedience	3
		Difficulties in remembering work-related information	3
		Situational awareness failure	3
		Habitual rule ignorance	2
		Lack of person's resilience	2

Individuals' psychological needs and desires:

While workers are aware of the risks associated with unsafe behaviors, psychological factors such as overconfidence, pride, desire to appear tough, resistance to rules, curiosity, and seeking excitement often lead them to disregard these risks, resulting in safety violations (35).

Individuals' safety perception

Safety comprehension involves attitude, knowledge, awareness, risk-taking, and risk perception. Research shows that better safety knowledge and positive attitudes reduce unsafe behaviors (36-38). Additionally, higher risk-taking increases unsafe actions and workplace accident risks (30, 39). Risk taking is a personality trait (40). Risky people have higher accepted risks and less perceived risk (41). Risk-taking with the personality of people like; Intellectual development is related to genetic and neurological factors (42). There is a significant relationship between emotions (such as fear, anxiety, emotional stress, etc.) and risk-taking behaviors (43, 44). Adventure in particular is positively related to increased risk-taking (45). Risk-taking can be variable in different situations; however, that person can be more risk-taking than others in general (42). Based on many psychological researches; Psychological conditions greatly affect risk signal detection, risk perception, and the risk-based decision process (46).

Individuals' cognitive factors

Cognitive factors, involving processes like transforming, storing, and using sensory input, are crucial individual elements affecting task performance (47). Individual cognitive factors can be categorized as specific cognitive efforts required to perform tasks (48), with individual differences in cognitive capacity playing a significant role. For example, a worker intensely focused on one task may have a reduced capacity to process other stimuli. The following key cognitive factors can impact task performance Fig. 4).

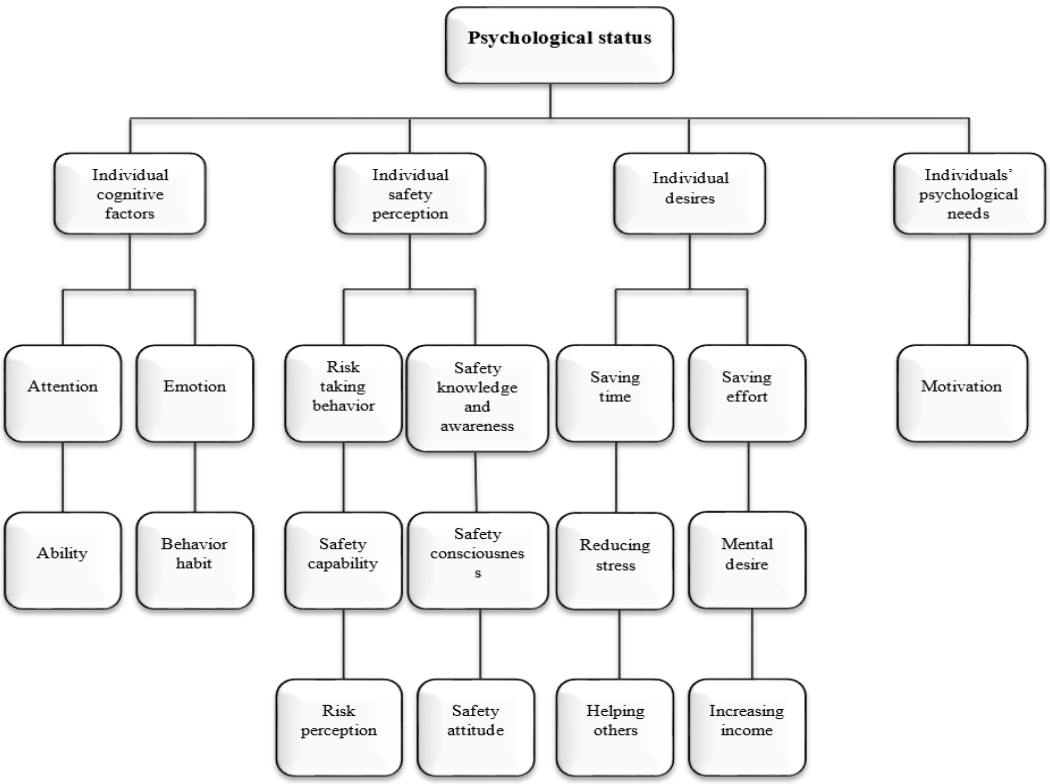

Fig. 4: Classification of Psychological factors affecting unsafe actions

Individuals' physiological and physical status, including vital signs, strength, mobility, and endurance, reflects their overall health and functioning (49). Having a disability or a specific disease are reported as factors that elevate the probability of human error (1, 50). Highlighting the physical and physiological condition of individuals in evaluating the alignment between their capabilities and job demands is a pivotal aspect in the discourse on managing and controlling unsafe practices (19, 51).

Individuals' Personality characteristics

Personality traits define how individuals think, feel, and interact, and can be assessed through various frameworks to understand personal differences (52). Berger defined personality as stable behavioral patterns and internal processes. The Big Five model identifies five main traits: neuroticism, extraversion, openness, agreeableness, and conscientiousness (53). The Big Five Factor model of personality is recognized as an effective framework for comprehending the relationship between personality traits and individuals' behavior. (54). A significant relationship between personality traits, risk-taking and performing unsafe acts has been reported (55-57). While views vary, there is agreement that personality traits relate to unsafe behaviors in industrial settings (55, 58, 59). Fig. 5 presents a full classification of individual characteristics, organizing key personality traits into comprehensive categories.

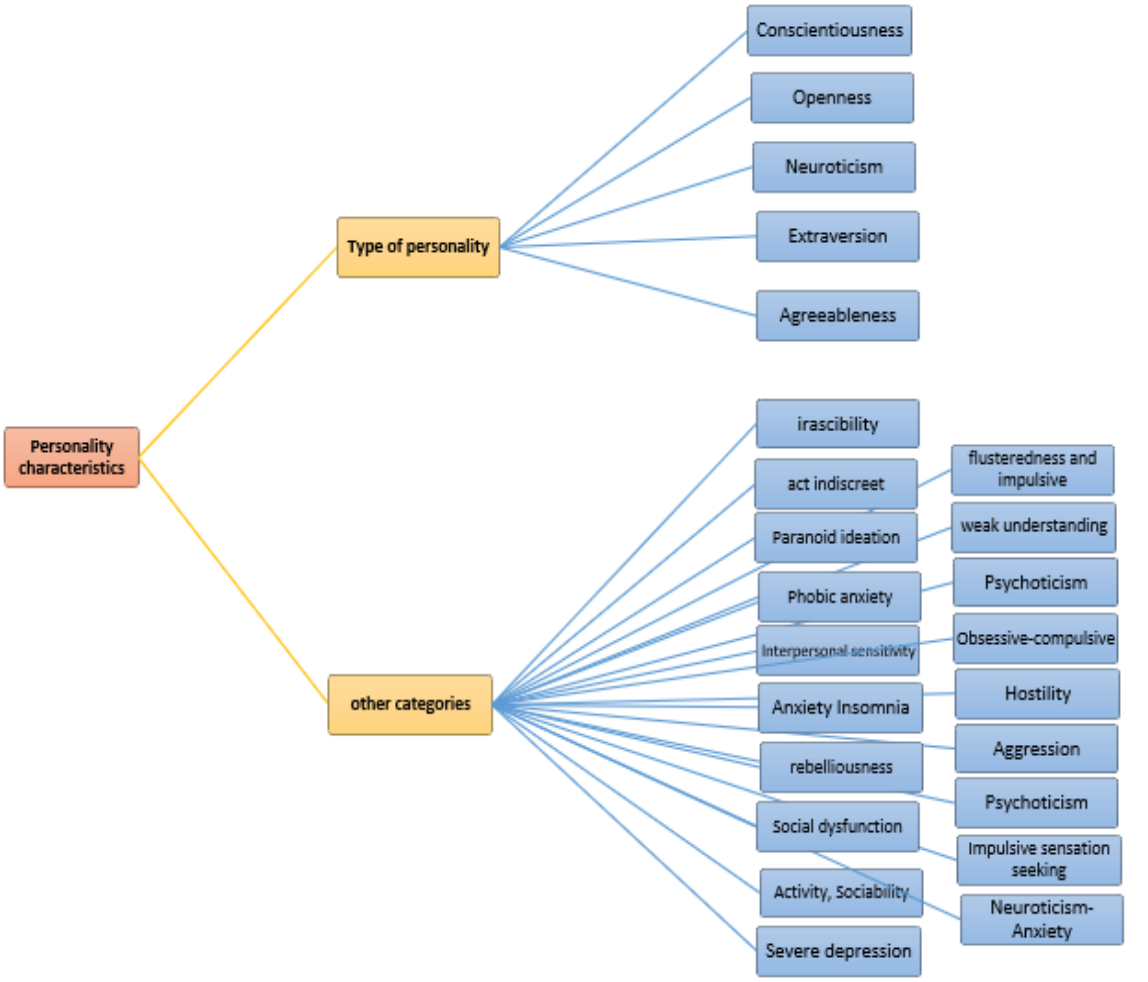

Fig. 5: Classification of personality factors affecting unsafe actions

General health

Health is defined as a state of complete physical, mental, and social well-being and is not merely the absence of disease or infirmity (60). Research studies have consistently revealed a significant relationship between general health and cognitive failures, serving as predictive indicators for accident proneness (61). Hence, it is essential to include the assessment of the individual's general health status as a crucial aspect in planning to control unsafe practices.

Discussion

This study was conducted to identify the factors affecting unsafe behaviors, as well as to provide suggested solutions for controlling these. Based on the analysis of results by researchers regarding the hiring or recruitment process within organizations to control demographic factors affecting unsafe behaviors, the first crucial factor is age. It is generally advisable to avoid employing individuals under the age of 30 in safety-sensitive positions due to their higher likelihood of engaging in unsafe behaviors, which is often linked to relative inexperience and less developed risk awareness. This recommendation aligns with findings demonstrated that younger workers have a significantly higher incidence of workplace accidents. (62). Similarly, individuals over the age of 50 face elevated risks, especially in roles demanding heavy physical activity, as aging may affect physical capabilities and cognitive processing speed (63). The second significant factor is work experience. Hiring more experienced personnel has been shown to reduce unsafe behaviors, as experience often correlates with improved hazard recognition and adherence to safety protocols. A systematic review, confirmed that experienced workers not only perform safer but also positively influence workplace safety culture by modeling appropriate behaviors and mentoring less experienced employees (64).

Furthermore, this study, in line with prior research, highlights that key individual competencies—managerial skills, leadership, communication, logical reasoning, personal development, and technical expertise—are essential and must be integrated into recruitment and onboarding processes (64). Additionally, these findings, in line with prior research, confirm that a thorough assessment of smoking, alcohol, and substance use histories is essential (65). However, factors such as job security, work shifts, and weekly working hours, while potentially important, are not universally recommended by most researchers. Therefore, their evaluation remains optional.

Among psychological status, analysis reveals that addressing four key factors—knowledge and awareness of safety, safety attitude, motivation, and risk perception—can significantly impact psychological status. Based on the results examining safety knowledge and attitude is recommended to investigate unsafe behaviors in the workplace (66, 67). Considering the significance attributed to safety knowledge, awareness, and attitude, it is recommended to systematically assess all three aspects in planning interventions to reduce unsafe practices in industrial environments. While managers can enhance these elements through training programs, it is crucial to emphasize that, before hiring individuals for safety-sensitive positions, a comprehensive evaluation of knowledge, awareness, and attitude should be conducted (68).

While psychological demands and needs of industrial workers remain underexplored, existing studies recognize their critical role in workplace safety (69). The current study aligns with broader research emphasizing the importance of addressing these factors to ensure a proper safety fit. However, as noted in the literature, practical solutions are not universally agreed upon, highlighting the need for further research to develop effective, context-specific interventions that balance individual needs with organizational safety goals (70). Cognitive ergonomics offers a refined perspective by focusing on how mental demands influence safe behavior and task performance, unlike physical ergonomics. Referring to established ergonomic guidelines is crucial when applying these insights. Optimizing cognitive conditions is key to reducing errors and improving occupational

safety, as supported by numerous industrial studies (71, 72).

Research consistently shows a link between various personality traits and accident-causing behaviors, underscoring personality as a key individual factor influencing unsafe acts. Compared to other studies highlighting psychological factors like self-confidence and pride, this aligns with the broader understanding that personality traits significantly shape safety behaviors. Consequently, incorporating personality assessments into hiring and preventive safety programs enhances risk management by targeting individual differences that affect workplace safety (73).

This study has several limitations common to systematic reviews. Despite efforts to design a comprehensive search strategy, potential selection and publication biases remain due to varying keywords and methodologies. Limiting the analysis to peer-reviewed articles may have excluded some relevant evidence, although dissertations fitting criteria should be captured. The mix of qualitative findings restricts statistical analysis strength, necessitating expert qualitative interpretation. Furthermore, distinguishing accident proneness from unsafe behavior is challenging, and psychological factors warrant further multidisciplinary investigation. Addressing these issues in future research will enhance reliability and depth of findings.

Conclusion

This systematic review highlights the crucial role of individual factors—such as demographics, psychology, health, and personality—in unsafe workplace behaviors. The effective safety management requires a holistic approach addressing both organizational and individual factors, with their integration serving as a key strategy to improve occupational safety.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

This research was funded by the Isfahan University of Medical Sciences, Isfahan, Iran (Grant number 3402372 and ethical number IR.MUI.REC.1402.026. It was extracted from the thesis written by Azim Karimi, a Ph.D. student of Occupational Health and Safety Engineering.

Conflict of interest

Non-declared.

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