

Current Status and Future Outlook on Occupational Health and Safety Research in Sudan: A Concise Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The concept of occupational health and safety (OHS) describes the strategies, guidelines, and actions typically adopted and implemented to prevent, minimize or manage the risks associated with the health and safety of people and property. Over the years, the rapid growth, development and operation of various industries in developing countries have resulted in numerous accidents, injuries and illnesses. Given the short- and long-term effects of such issues, it is imperative to identify, examine and highlight the potential areas where workplace-related incidences could occur in the industry. Therefore, this paper presents an overview of the current status and future outlook on occupational health and safety (OHS) research in Sudan. The review of the literature indicates that although OHS research is still in its infancy in Sudan, various researchers have examined the nature, sources, and impacts of accidents, injuries, and illnesses that severely compromise workers' health and safety. Furthermore, workers in Sudan are routinely exposed to toxic chemicals, medical wastes, noxious gases, noise pollution and other workplace-related risks that severely affect human health, safety and the environment. However, many employers, workers and government agencies have ample knowledge of OHS and its importance in the workplace. The studies also highlighted the crucial role played by OHS not only on health and safety but also the

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overall organisational performance and operational management in workplaces. Therefore, the design, development, and integration of OHS programmes into the workplace could greatly minimize and eliminate work-related accidents, illness, injuries or death.

Keywords: Occupational health; workplace safety; safety culture; risks; Sudan.

1. INTRODUCTION

Occupational health and safety (OHS) research has received significant attention over the years due to the increasing rate of accidents or work-related illnesses or diseases reported in workplaces around the globe [1]. The concept of OHS refers to the strategies, rules and guidelines established to prevent, minimize or manage the risks in workplaces and ensure the health and safety of people and property [2]. Likewise, OHS aims to foster safe and healthy environments for workers, clients and suppliers who are associated with the selected workplace [3]. According to the International Labour Organisation (ILO), over 2.75 million people around the globe die due to accidents or diseases, whereas over 370 million are afflicted by non-fatal workplace-related injuries every year [4]. As the world voyages through the 21st century, there will be significant growth and development in various sectors of the global economy. In particular, the areas of manufacturing and industrialization are expected to soar geometrically [5] resulting in increased jobs and workplace activities, which are prone to accidents, injuries and even death [6,7]. As a result, many employers, organisations and governments around the world have called for more effective workplace measures to ensure the health and safety of the vast numbers of people that engaged in these sectors [8,9].

Over the years, considerable research has been conducted on the OHS of workers in various countries around the world. In developed economies, there has been significant research work carried out to identify, examine and highlight the causes and effects of workplace accidents, particularly incidents that result in injuries and deaths [10]. However, less attention has been paid to OHS research in developing countries despite its socio-economic, environmental and technical impacts on the workplace [11-13]. The lack of effective measures for OHS in developing countries can be ascribed to various factors such as the high costs, time constraints and technical know-how required to establish effective OHS programs. However, it is critical to have effective OHS

programmes particularly in high skilled, capital intensive, and socially impactful areas such as the oil, gas, and manufacturing industries rapidly springing up in developing countries.

The recent discovery of significant oil and gas reserves in Sudan presents significant opportunities for the nation to fast-track socio-economic growth and infrastructural development. However, the highly specialised nature of the oil, gas and manufacturing industries exposes workers to high risks such as fire, chemicals, toxic gases, heat among others, which could result in accidents, injury, physical disabilities or even death. As one of the signatories of the International Labour Organisation (ILO), Sudan adopted OHS into the nation's legal system in 1967 [14]. Similarly, the nation incorporated a national labour code into the legal system. Among other responsibilities, the code defines the terms and expressions related to OHS programmes in the country. For instance, workers, wages, and accidents are considered an integral part of the national labour laws and guidelines required by employers. Moreover, the code states the responsibilities of employers towards their workers as well as awareness of the relevant hazards present in the workplace. Lastly, the code entails the training and necessary precautions vital to protect workers against industrial accidents and occupational diseases [4].

Based on the national codes and requirements of the ILO regulations, the Ministry of Labour in Sudan is responsible for fostering safe environment and working conditions. However, the working environment in Sudan is considered generally poor due to various factors including the lack of proper enforcement by the Ministry of Labour [15,16]. According to Mursy and Mohamed [15], the governmental inspection and enforcement of OHS regulations by the Ministry of Labour in Sudan are gravely lacking. The authors affirm there is a lack of safety strategies, practices, and enforcement by the relevant authorities within work areas. Other studies have reported that workers across various sectors are exposed to hazardous substances and high contamination risks with significant health and

safety repercussions [14,17,18]. However, there are limited studies that have holistically examined the performance, management, accessibility, safety outcomes of OHS found within various work sectors in Sudan. Likewise, the review of the literature shows that OHS research is still in its infancy in Sudan. In line with this premise, this paper seeks to shine a light on the current status and future outlook on the research landscape and trending developments on OHS in Sudan. The paper will also identify and highlight the factors that contribute to poor OHS in Sudan from the literature. The authors envisage that this short review will benefit researchers in industry, academia, and government policy with crucial insights into the present state of OHS in Sudan.

2. CURRENT STATUS OF OHS RESEARCH IN SUDAN

With the rapid rate of industrialization, occupational incidents in industries and manufacturing-related workplaces around the globe will soar. Sudan is expected to experience similar trends due to the rapid growth and developments in the oil and gas industry in the country in the coming years. Hence, there is an urgent need for measures and programmes to acquire reliable data on the OHS status, activities and future outlook of such industries. The existence of empirical records on incidents and records of past events in related sectors could help to prevent future accidents, injuries and deaths from occurring across work settings. To this end, various researchers in Sudan have embarked on various qualitative and quantitative studies on the state of OHS in Sudan.

For example, Humeda and Saeed [19] examined the incidence of noise-induced hearing loss among workers in Khartoum International Airport (KIA) in Sudan. The authors observed that the sound level received by workers was above the acceptable global thresholds. The study also revealed that 55% of employees working within noisy sections of the airport sites were exposed to Noise-Induced Hearing loss (NIHL). Typically, NIHL is a hearing impairment or condition caused by exposure to high levels of the sound [20,21]. It is also described as occupational hearing loss and could be characterised by the loss of perception, in-ear ringing or sensitivity to a narrow frequency range of sound [22,23]. In a related study, Nasr and Sherfaldeen [24] examined the level of noise received by workers in the apron zone of KIA Sudan. The findings

revealed that the noise levels inside the major sections of the apron zone of KIA were above the acceptable threshold. These areas include beneath aeroplanes, aircraft marshalling, as well as loading/unloading, and pushback tractor maintenance. The authors assert that the employees in these zones are prone to hearing loss. Abdelaziz et. al. [25] collected and compared data from 80 employees of a steel manufacturing company and a university to ascertain the levels and impacts of noise on workers in selected worksites. The authors reported that the noise levels received by workers of the steel company were relatively higher than those at the university. The findings highlighted a correlation between NIHL suffered by workers and sound pressure level. Similarly, Ahmed and Awadalkarim [26] explored the noise levels within two textile plants located in Sudan with findings that corroborated the study by Abdelaziz et al. [25].

Furthermore, the extant literature on OHS research in Sudan has also revealed that workers across various areas are exposed to hazardous materials and substances which pose grave risks to their health and safety. Qafisheh et al. [27] examined the OHS of staff/workers of a petroleum station located in Sudan. The findings revealed that the blood, serum and urine of the participants contained high concentrations of lead. The study concluded that the implementation of safety and health measures for the staff of petroleum stations is imperative to improve their health status. Similarly, Ahmed et al. [28] investigated the exposure of workers to hazardous substances within the workplace. The study was aimed at investigating the risk of lung cytological atypical changes in respect to work-related exposure to iron and aluminium. The findings revealed that workers in work areas were more prone to health-related risks of iron than exposure to aluminium in the selected workplace examined in the study. Elamin et. al. [29] also observed that hazardous substances could result in severe health and safety problems. For example, the authors reported that insecticides can suppress the normal functioning of Acetylcholine esterase and elicit symptoms of poisoning among farmers. Other symptoms such as diarrhoea, vomiting and abdominal pain were also observed as health effects associated with exposure to insecticides. Likewise, Suliman et al. [30] conducted a study aimed at measuring the exposure of workers to high levels or doses of hazardous substances. The effect of these substances on the interventional cardiology (IC)

and nuclear medicine (NM) departments located in Sudan was examined in their study. The findings disclosed that the estimated dose level received by workers fell below the recommended annual dose limit. The study observed that the lack of a radiation surveillance program and occupational tools for exposure control are major concerns in the IC and NM departments of the institution examined in the study.

Research on the OHS of health care workers in Sudan has also received significant attention over the years. The extant literature shows that health care workers are exposed to various occupational and work-related risks. For example, healthcare workers are directly or indirectly exposed to the diseases, illnesses and injuries of patients. Examples of the direct risks or methods include doctors and nurses, whereas the indirect include aiders, helpers, laboratory technicians, and medical waste handlers [31]. Examples of hazards faced by these groups of workers include biological, chemical, ergonomics, physical, and psychosocial [32]. To corroborate this assertion, Mossburg et al. [33] argued that medical workers in Sub-Saharan African countries are at risk of contracting blood-borne illnesses and infectious diseases than workers in developed countries. Hence, Sudanese healthcare professionals are no exception when it comes to exposure to the common medical OHS hazards. Gadour and Abdullah [34] investigated the level of knowledge on the hepatitis B virus (HBV) among health care workers in public teaching hospitals in Khartoum, Sudan. The findings revealed that workers had very high knowledge about HBV, although the study observed that low levels of immunity against the virus existed among the staff. In a related study, Mursy and Mohamed [15] found similar results after collecting data from health care workers vis-a-vis nurses and midwives of public maternity hospitals in Khartoum. The study observed that a low level of HBV vaccination and high rates of needlestick injuries existed among the health workers examined in the study. Furthermore, Hassan et al. [35] admitted that healthcare workers in Sudan are at high risk of contamination with medical waste generated from hospital activities. The authors avowed that lack of waste segregation, lack of waste management policies, and failure to plan are critical factors. Other pertinent issues highlighted by the study include inadequate training which greatly contributes to the hazardous situations among hospital workers that handle wastes generated from health centres.

Patient safety has been identified as another essential area in OHS research that has received much attention over the years. The most vital feature of patient safety culture is its usefulness in the healthcare milieu [36]. The concept of patient safety culture or PSC refers to the culture of an organisation that promotes the safety and wellbeing of its patients. It is typically considered the sum of all the beliefs, norms, and values inculcated in the staff or health workers, which aims to influence their behaviour and actions towards safeguarding the health and wellbeing of the patients at the medical institution [37]. Over the years, there have been numerous studies on the role of PSC in achieving organizational functions in Sudan. For example, Abdalla and Abdalla [38] highlighted the roles played by nurses in upholding patient safety and aiding evidence-based practice (EBP). The authors contend that the promotion of patient safety in the healthcare system hinges on the knowledge of nurses who are well taught and are trained based on a deep-rooted and sound professional nursing program, as also noted by Hassan et al. [35]. Furthermore, Elmontsri et al. [39] studied the state of patient safety in Sudan and other selected Arab countries. The authors emphasized the urgent need to promote patient safety culture as a strategy for improving patient safety in health centres in Sudan. These findings give credence to Wilson et. al. [40] who alluded that unsafe patient care represents a serious and considerable danger to hospital patients in Sudan. Hence, urgent actions must be taken in this area of healthcare delivery to enable the management and staff of health institutions to address the public health and safety problems. The findings showed that 18.4% of the records of adverse events occurred in health institutions in Sudan. Overall, the study highlighted the nature and frequency of the adverse events of patients and health workers in selected hospitals in Sudan.

Other major OHS studies have examined the occupational stress faced by workers in Sudan. The various OHS studies have shown that in Sudan, authors have inquired into workplace stress (such as burnout) as a major factor that contributes to poor job satisfaction and occupational accidents in health care centres in Sudan. Burnout is a mental and physiological condition caused by stress overload, physical exhaustion, and being emotionally overworked [41]. The study by El-Amin [41] examined the nature and frequency of burnout among female academic staff at the University of Khartoum in

Sudan. The author observed numerous burnout cases among divorced and widowed female staff. In addition, the author reported that the burned-out staff showed physiological health and psychological depression symptoms followed by absenteeism when compared to the non-burnout staff. Mohamedkheir et. al. [42] found a relatively high level of occupational stress among nurses working in the ICU of public hospitals located in Khartoum after administering 136 questionnaires to the nursing personnel. The SPSS analysis of the data revealed that workload and problems with supervisors were the most contributory factors associated with stress. The study surmised that perceived occupational stress is significantly influenced by socio-demographic factors, marital status, working experiences, and the type of ICU where the nurses work. Likewise, Alameen [43] investigated the effect of occupational stress on the level of job satisfaction of Doctors in Khartoum using questionnaires. The findings revealed that most doctors in Sudan experience occupational or workplace stress, which could be ascribed to their low salaries and poor working conditions arising. As a result, the doctors experience high levels of burden and the need to work so hard to meet their basic needs. The authors further reiterated that lack of safety measures was a predisposing factor that contributed to occupational stress.

Other OHS research and studies in Sudan have adopted holistic approaches to evaluate safety performance and safety management from accessible safety outcomes found within various work sectors. For instance, Zaki et. al. [44] evaluated safety performance across several industrial sectors located in Khartoum. The study was conducted by collating records of accidents that occurred from 2005 to 2007. The study subsequently measured the frequency–severity index (FSI) and fatal and disabling accident frequency rates (DAFR) of incidences. The results showed that the FSI in Khartoum was lower than that in Bahri and Omdurman cities in Sudan. Furthermore, the findings indicated that the chemical industry suffered more FSI compared to other sectors examined in the study. The authors further discovered that the greatest DAFR was noticed in chemical industries located within Omdurman. In addition, the authors contend that the fatal accident frequency rate in the mechanical and electrical engineering industry was the highest. In a related study, Zaki et al. [44] found that the highest accident rate was represented by caught in

between things. The findings were based on investigations on the triggers, factors, and consequences of occupational accidents in numerous industrial sectors of Khartoum from 2005-2007. The major contributory factors to accidents like amputation, crushing, and broken bones on workers located in Omdurman were machines. The authors recommended the need for the enhancement of occupational safety and health laws and regulations. Adam and Ahmed [45] observed the perception of site engineers for safety culture factors in Khartoum. The study revealed that five factors were positively perceived by the engineer's vis-a-vis management commitment, safety rules, safety priority, physical work environment, and personal appreciation for risk. Moreover, Al-Seed [46] observed that a safety management system was not implemented in construction sites, which accounts for the lack of safety awareness among workers in the construction sites. However, the study emphasised that leaders of construction sites have a mutual agreement about the importance of safety despite their lack of commitment to safety. Fadlallah et. al. [47] studied factors that could determine the risk perceived by gold miners. After principal component analysis, the results revealed that perceived risk was determined by factors such as unemployment, education level, and years of experience. Other crucial factors include the personal experience and characteristics of the hazards in the area of study. Likewise, the findings showed that even though miners had a high perception of risk, it was not reflected in their behaviours due to their persistent risk of injuries and accidents. Eltayeb et. al. [48] probed into the prevalence of work-related musculoskeletal disorders affecting the neck, arm, and shoulder on computer users in Sudan. The respondents were mostly bank and telecommunication workers. After administering questionnaires and upon data analysis, the results revealed that workers were most at risk of work-related musculoskeletal diseases. The results further revealed that the highest incidences were found for neck and shoulder. In an extension of their previous findings, Eltayeb et al. [49] investigated the relationship between work-related physical and psychological characteristics and symptoms associated with injuries to the neck, shoulder, and arm. Like their previous study, data was collected using questionnaires from computer literature workers. After regression analysis, the results revealed that most workers experienced symptoms related to neck injuries and shoulder injuries. The

findings also revealed that the existence of symptoms in the population targeted was substantially predicted by work-related psychological factors. Based on the review of literature, it can be surmised that OHS is crucial to ensure workers, as well as workplaces, are safe.

3. FACTORS CONTRIBUTING TO POOR OHS AND POOR OHS RESEARCH IN SUDAN

According to Reason [50], workplace accidents are caused by numerous factors that could be in the form of man, machine, organization or the environment. The environmental factors can be defined as natural and physical factors which influence workers health [51]. The workplace environment is related to every aspect of the approach, works, and management systems, although it could be based on how the system interrelates with employees and the workplace [52]. Examples of environmental factors include light, wet conditions, temperature. From the extant literature, noise is also a predisposing environmental factor contributing to the occupational incident. Studies by Humeda and Saeed [19], and Abdelaziz et. al. [25] have all attested to this viewpoint.

Several factors can be attributed to the current state of OHS in Sudan. Furthermore, Adam and Ahmed [45] provided empirical insights into the role played by the environment in predicting site perception of managers to risk. The authors concluded that the work environment significantly predicts the perception of risk. The findings of Hassan et al. [35] further validate the assumption that the work environment immensely contributes to the success of any OHS program in Sudan. This was reflected in the poor waste management strategies and poor housekeeping observed among hospital sites examined in Khartoum.

Drawing from the reasons theory of accident causation, another contributory factor to major accidents in the workplace is human error [50]. This approach points at the tendency of humans to make errors by their actions under various conditions and situations [53]. From the relevant OHS research in Sudan, several human factors elements have been identified to have played a role towards the level of OHS. For example, Qafisheh et al. [27] revealed in their study that workers who smoked were more prone to accidents arising from exposure to petroleum.

Likewise, Fadl [54] highlighted the role played by two important human elements in defining the state of safety in thermal power plants located in Sudan. These elements are employee compliance with PPE and ignorance of car parking. The study reported that PPE compliance was poor whereas the level of workers ignorance towards the safety of power plants was high. Other studies such as Mohamedkheir et al. [42] identified that the experience level of workers is an important human element and contributory factor that improves OHS outcomes in Sudan. In the same vein, Mossburg et al. [33] reported the role played by workers poor knowledge and attitudes towards occupational hazards. The authors concluded that lack of knowledge was a causal factor that led to exposure to blood borne disease among nurses in hospitals. Several factors can be attributed to the current state of OHS research in Sudan. Due to the scarcity of literature on OHS research from Sudan, this study takes research in general as an indicator of research productivity in OHS. According to Hussen and Mohammed [55], non-existing pre-planned policies for research and an absence of coordination between research producers and consumers have generally marred the academic research culture in Sudan. The authors also reiterated that poor funding for scientific research in Sudan has played a significant role in the current state of research in the country. This is reflected in the national allocation to research in the country. The authors enthused that only 0.02% of the national outcome is allocated for scientific research. Other factors that have contributed to the current research state in Sudan as highlighted by Hussen and Mohammed [55] include brain drain and unequipped university laboratories. Mayada et al. [56] underscores that the shortage of employed staff in the public research and educational institutions, and the admission of fee-paying students who failed to qualify for direct admission are factors that have contributed to deterioration of academic research in Sudan. Furthermore, Saeed and Fadlallah [57] agreed that teaching burden reduces the weight of research activity of university faculty members. The authors also stressed on the importance of collaboration between the industrial sectors and higher education institutions to produce realistic research, which include value for the development of the national economy. Another contributory factor that has generally impacted on the state of research in Sudan is brain drain [55]. As mentioned by Abdall [58], competitive salaries, professional research opportunities and

better living conditions in neighbouring countries has prompted the migration of Sudanese academic staff. The author noted that mass emigration has hindered the country's investment in education, hence the resultant decline in research output. In summary, it can be inferred that the most prominent reasons for the current state of OHS research in Sudan range from economic to professional factors.

4. FUTURE OUTLOOK ON OHS RESEARCH IN SUDAN

Despite the numerous challenges, the OHS of workers and workplaces in Sudan remains an important consideration of employers, organisations and the government in the country. To address the earlier outlined challenges, it is crucial to establish a safety culture (SC) in Sudan. The establishment and implementation of a positive SC will help to promote the health, safety and wellbeing of workers in various workplaces in the country. Furthermore, SC will improve the current set of beliefs, norms, and values held by staff, workers and management of firms in Sudan. As stated by various researchers, the current status of OHS in Sudan is in its infancy and needs to be nurtured with effective policies, guidelines and regulations that will safeguard workers health and safety in the workplace. Likewise, the future of OHS in Sudan will require proper structures to periodically assess the safety performance and safety management of firms in Sudan. The objective will be to effectively evaluate the safety measures and outcomes in the various work sectors. The periodic evaluation of accidents, injuries or death records can help OHS personnel to predict, prevent, and respond to future incidences in the workplace. Similarly, it is imperative that budgetary allocations set aside for OHS research in Sudan need to be increased. This will not only reduce the incessant number of academics leaving the country but will also create a culture where the emphasis is placed on research.

5. CONCLUSION

The paper presented a concise overview of the current status and future outlook on occupational health and safety (OHS) research in Sudan. According to the studies examined, OHS broadly refers to the sum of all the strategies, rules and guidelines established to prevent, minimize or manage the risks associated with the health and safety of people and property in the workplace. However, the soaring population growth and

higher living standards of living are predicted to exponentially increase energy demands and stimulate growth in various industrial sectors. The increase in manufacturing will present workplace-related challenges such as accidents, injuries and illnesses in the workplaces. Given the impending health and safety issues, it is imperative to identify, examine and highlight the potential areas where workplace-related incidences could occur in the industry. This is particularly important in developing countries like Sudan with nascent industries such as oil, gas and manufacturing industries are undergoing rapid growth and development. The review of the literature revealed that numerous researchers have carried out various studies on OHS in the country. The findings also revealed that, although OHS research may be in its infancy, the nation's employers, workers and government agencies are very much aware of its importance in the workplace. This is because OHS is critical to the health and safety of all stakeholders associated with the workplace irrespective of the industry concerned. The development and integration of OHS programmes into the workplace will help reduce the incidence of work-related accidents, illness, injuries or death.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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