



## Occupational health and safety in the construction industry: a comprehensive review with emphasis on Nigeria

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### Abstract

The construction industry holds remarkable benchmarks of aptitude and creativity; however, it is among the most lethal industries when it comes to occupational health and safety (OHS). This study incorporates a detailed analysis of the key OHS issues within the construction sector with a special regard for developing countries such as Nigeria. The paper discusses different physical, chemical, biological, and psychological risks within the industry and highlights the importance of compliance with OHS requirements aimed at avoiding mishaps, incidents, and even fatalities. Moreover, it discusses the issues relating to poor training, funding limitations, and project pressures while highlighting the significance of maintaining a strong safety culture, workers' awareness, and compliance in enhancing OHS results. In addition to that, the review also examines current safety measures, identifies gaps, and suggests improvements, drawing on global best practices to inform future policies and strategies. This study serves as a valuable resource for policymakers, construction stakeholders, and employers to minimize health risks and optimize construction workers' productivity and well-being.



## 1. Introduction

The construction industry is known for being vulnerable to occupational health and safety (OHS) hazards, therefore the landscape of these risks is very dangerous and can cause severe injuries, illnesses and even deaths [1]. Among the common hazards are the perpetual dangers of falling, noise, dust, and vibration just to mention a few. Thus, the implementation of the OHS measures becomes an urgent one since it is from them that the base of minimizing these risks starts. Nigerian construction sector has grown in a spectacular way in recent years and it has become a significant contributor to the national Gross Domestic Product (GDP) as it accounted about 3.17% of the GDP in 2020 as per data from National Bureau of Statistics (NBS) [1]. The

burgeoning sector has brought in an influx of construction labour which has made the workers more prone to work-related injuries, diseases, and deaths. Nevertheless, a lot of secrecy covers the existence of OHS practices of construction sites in the country. Contrary to the International Labour Organization (ILO) statistics, the construction sector in Nigeria has a fatality rate which is higher than the world average [1]. This is the same report which indicates the disturbing nature of hazardous working conditions experienced by Nigerian construction workers comprising of noise exposure, vibration, chemical risks among others [2]. This underlines the urgent need for a thorough assessment of OHS hazards and safety practices in the Nigerian construction sites, revealing areas that require immediate attention.

The consideration of occupational health risks and safety regulations within Nigerian construction sites becomes an essential concept, considering the omnipresent dangers involved in the industry. The bad image that the industry has earned for poor OHS practices as verified by the research conducted by Ugwu et al. [1] in 2021 is linked to several factors. First among the factors worth mentioning here is the existing lack of knowledge of occupational hazards among the workers and poor usage of safety measures as noted by Sabitu et al., in their 2009 study [3]. The mismanagement of the construction sector in Nigeria exemplifies the problem and serves as an important cause of the poor state of construction health and safety in the nation [1]. This lack of regulations has led to a spike in workplace related health problems. Consequently, an urgent and appropriate action that will be aimed at addressing the issues and strengthening safety measures is indispensable. This will ensure the good health of construction workers in Nigeria.

Lack of awareness and knowledge on the part of workers and employers is the main barrier to improving occupational health and safety within the Nigerian construction industry [4]. However, the majority of workers continue to be ignorant about the hazards that they are exposed to on daily basis and do not keep any safety measures [3, 5]. The employment of advanced education and training programs directed towards OHS is revealed to be necessary for the construction sector. Moreover, the influence of the public and private sector clients on the safety culture within the construction industry should not also be overlooked. The views and the involvement of clients are a key driver in the overall safety culture in the respective industries. In addition, proper information and customer involvement, stringent safety regulations are undeniably the most sensible way of improving safety in the Nigerian construction sector. The regulations that are currently existing should be tried and tested in an attempt to see whether they are working or not when it comes to the safety of the Nigerian construction workers. Through this cooperation of the government agencies, construction companies and other stakeholders, the process of building safety benchmarks and practices should be initiated and established [6]. Indeed, an admirable move by the Nigerian Federal Ministry of Labour and Employment is the development of a National Policy on Occupational Safety and Health (OSH) [1]. As a result, this innovative initiative strives to uphold stable and safe working environment right across the economy, including its construction industry. The main goal of this legislation is the protection of workers from occupational hazards, and it puts the responsibilities on employers in ensuring health and safety of workplaces.

However, even after realizing these efforts towards OHS development, as it stands, there is still need for an intensive evaluation of the quality of OHS practices in the Nigerian construction sites. The intent of this research is to conduct a broad overview, identify OSH dangers, and offer informed recommendation to counter these dangers by taking a wide prism of safety practices within relevant literatures. This research has implications that complement it and even extend beyond its purely

academic field. The successful outcomes of this study will be a highly valuable gift to the policymakers, the construction stakeholders, and the employers. It will be the guidewire, which will enable the development and application of precedential OHS policies and concepts that will guarantee workers well-being and, at the same time, ease the expenses associated with the cases of occupational accidents, diseases, and fatalities.

### 1.1. Objective of the study

The Literature Review goes on a comprehensive walk through of existing research studies which are based on the multi-dimensional nature of the occupational health hazards that have been encountered in the construction industry. The foremost aim of the study considers the different types of perils that workers face, and their occurrence together with consequences on their health and wellbeing. Tenderness to burgeoning construction of Nigeria is evident as the workers are subject to occupational health hazards at a high rate [7]. Conversely, the review adopts a framework to examine the current OHS policies, laws and regulations that are formulated to govern the operations of the Nigerian construction industry. Also, it provides us with an analytical lens to understand the current level of awareness among construction workers in Nigeria and impediments to the effective implementation of reasoned safety practices.

## 2. Method

A qualitative research approach was employed to delve into prior studies concerning occupational health and safety within the construction industry. Initially, 60 articles were gathered for this study. After meticulous screening and selection procedures, 19 articles were identified as pivotal due to their direct relevance to the study's objectives. Nevertheless, the remaining 41 articles, along with others, were appropriately cited and referenced, as they contributed valuable data to our research. The comprehensive methodologies are elaborated upon in the sections below;

### 2.1. Database selection

To achieve these objectives, a systematic search of relevant literature was conducted using the following academic databases and digital libraries: Google Scholar, PubMed, Scopus, IEEE Xplore, and Web of Science. These databases were chosen for their extensive coverage of OHS research.

### 2.2. Search terms and keywords

Search terms and keywords used for the literature search were carefully selected to align with the research objectives. The following key phrases were employed in various combinations: "construction site safety," "occupational health hazards," "safety practices," "construction industry," and related variations. Boolean operators (AND, OR) and quotation marks for exact phrase searches were employed as needed.

### 2.3. Search strategy

The search strategy entailed joining the selected words and phrases with Boolean operators that led to the identification of relevant literature. These Boolean operators were employed to fine-tune the search results as well as to bag a wide variety of sources. An example search string used in this study is as follows: (construction site safety OR occupational health hazards) AND building industry.

### 2.4. Inclusion and exclusion criteria

Establishment of criteria for inclusion and exclusion was done to determine the appropriateness of sources. Inclusion criteria were limited to sources published in English, peer-reviewed articles, books and reports which focus on occupational health hazards in the construction industry and safety practices. The exclusion criteria stipulated sources that were published before the year 1990, sources written in other languages apart from English, and studies that did not deal with the OHS practices.

### 2.5. Data collection

A list of selected sources was created in Zotero and stored in a file which included the titles, authors, publication years, and all-important data for every source.

### 2.6. Screening and selection process

The screening process conducted a primary evaluation of titles and abstracts to pull out sources which met the research requirements. Articles with the full text were examined and included into the study by the use of the established criteria.

### 2.7. Data analysis and synthesis

Relevant sources were studied and main results were highlighted. Sources were grouped based on their shared themes, while a narrative approach was adopted to synthesize the literature. Issues, problems and areas of agreement or disagreement were highlighted.

### 2.8. Quality assessment

Although there was no formal quality assessment carried out, the sources were considered in the synthesis on the basis of their research design, methodology, sample size and possible biases taking them into the account in the narrative synthesis.

### 2.9. Reporting and presentation

The findings of the study are presented in the form of a narrative, which incorporate the major themes, significant findings and ways of reasoning from the selected sources.

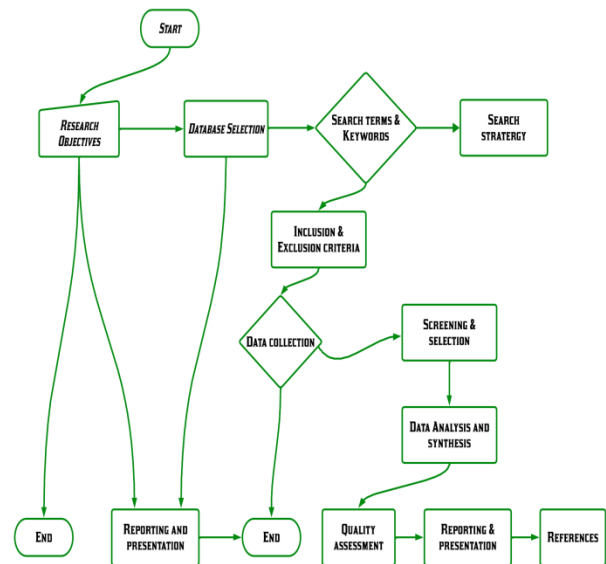


Figure 1. Flowchart of the study.

## 3. Occupational Health and Safety Practices in the Construction Industry

No doubt that OHS practices in the construction industry are the most essential. There are various risks facing construction workers like falls from height, electrocution, exposure to hazardous materials, and accidents involving heavy machines. Such risks can lead to severe consequences from minor injuries up to paralyzing conditions and even death. Construction industry is dynamic and always evolving, which makes it difficult to foresee and avert all potential issues [8]. Moreover, the use of subcontractors and temporary workers can be associated with accountability absence and training inadequacy that leads to work place injuries and accidents [8]. In Nigeria, there are some laws and regulations that were put in place to regulate OHS practices in the construction industry. The Factories Act of 1990 is the Act that applies specifically to all industrial establishments, including construction sites [9]. This Act specifically requires factories to register, inspect, appoint safety officers, and provide safety equipment and first aid facilities [9]. Nevertheless, the implementation and compliance of OHS procedures in the construction industry in Nigeria remain a difficult issue. There is a lack of awareness and compliance with OHS laws among construction workers and employers [9]. Moreover, the agencies controlling OHS laws and regulations oftentimes have inadequate resources and thus weak capacity to conduct inspections and ensure adherence [9].

In order to ensure proper application of OHS rules in Nigeria, it becomes imperative to consider the aspects which hamper their adaptation in the construction industry. These factors include addressing the dynamic and complex nature of construction work, the use of subcontractor and temporary workers, and the costs of implementing and maintaining an OSH system [7, 8]. A different range of research has been carried out before on the major health and safety problems which we are facing in construction sites all over the world. The table 1 given below is a compilation of the landmark

investigations that we covered in the ensuing section. Furthermore, over the course of the study, we will go into details of these issues and give a general opinion about

the complex problems and state-of-the-art solutions on construction site safety and health.

**Table 1.** Reviewed Studies.

S/N	Reference	Methodology	Findings
1	Ugwu et al. (2021) [1]	The authors employed a case study technique, including site visits and interviews, to evaluate the safety performance of the construction industry in Nigeria.	The major findings related to the industry's lax regulation and direct effect on job security and health.
2	Sabitu et al. (2009) [2]	The authors conducted a questionnaire survey where they gathered data on the level of awareness of occupational hazards and the use of safety measures.	The main findings highlighted the need for improved awareness and adherence to safety measures among welders.
3	Kaskutas et al. (2009) [10]	The study focuses on observation of fall hazard control measures.	Fall hazard control measures are observed to be more prevalent on construction sites of larger contractors compared to smaller contractors.
4	Tunji-Olayeni et al. (2018) [11]	Study of craftsmen in Nigerian construction sector.	Major occupational hazards on construction sites in Nigeria include falls, electrical hazards, and exposure to hazardous substances.
5	Ringen et al. (1995) [12]	Review of literature on safety and health in the construction industry.	Various factors, such as education and training, new technologies, federal regulation, and occupational health delivery, impact safety and health in the construction industry.
6	Jo et al. (2017) [13]	Development and evaluation of a proximity warning and excavator control system	Proximity warning and excavator control systems can help prevent collision accidents at construction sites
7	Bust et al. (2008) [14]	Analysis of challenges and communication strategies for managing health and safety among migrant workers.	Migrant workers in the construction industry pose challenges for managing health and safety, including effective communication of safety messages.
8	Tiwary & Gangopadhyay (2011) [15]	Review of available articles to provide an overview of the problem and identify research gaps.	Unorganized workers in the construction industry face occupational health and social security challenges.
9	Leensen et al. (2011) [16]	Retrospective analysis of noise-induced hearing loss cases in the Dutch construction industry	Noise-induced hearing loss is a significant occupational health hazard in the Dutch construction industry.
10	Wu et al. (2012) [17]	Review of literature on safety critical, digital, and design practices.	Digital design practices in construction have implications for safety, and there is a concern about mindless use of technologies.
11	Gambatese et al. (2005) [18]	Analysis of industry and project barriers through case studies and interviews.	Designing for construction worker safety is viable, but implementation in the United States is hindered by industry and project barriers.
12	Al-Bayati (2021) [19]	Literature review and synthesis of previously published articles.	Construction safety culture and safety climate are important factors in improving occupational safety and health.
13	Loosemore et al. (2019) [20]	The authors used a questionnaire survey to collect data on safety climate from construction workers in Indonesia and Australia.	The study compared the safety climate of the Indonesian and Australian construction industries. The main findings revealed differences in safety culture and practices between the two countries.
14	Kumar et al. (2015) [21]	The authors employed a questionnaire survey to collect data from construction workers and supervisors.	Identification of common material handling hazards and the recommendation of safety measures such as training programs and the use of appropriate equipment.
15	Razi et al. (2023) [22]	The authors conducted a literature review to gather information on the application of AI in construction safety	The main findings highlighted the potential of AI in improving safety through real-time monitoring, predictive analytics, and hazard identification.
16	Lestari et al. (2020) [23]	The authors conducted interviews and surveys to collect data on safety climate and practices in the Indonesian construction industry.	The main findings identified a low locus of control over safety and conflicts between formal and informal safety norms.
17	Molewa et al. (2021) [24]	The authors conducted a cross-sectional study using questionnaires and observations to assess occupational health and safety practices in government mortuaries.	The main results indicated the presence of many occupational health risks and the necessity for enhanced safety measures.
18	Liu et al. (2020) [25]	The authors conducted a systematic review of existing literature on occupational health and safety in the Ghanaian oil and gas industry.	The main results revealed several deficits in the use of OHS management systems and policies within this field.
19	Daba et al. (2022) [26]	The authors made an observation to analyse the occupational safety of janitors in the COVID-19 period.	The key results pinpointed the shortcomings in observation, and occupational safety practices.



### 3.1. Importance of OHS Practices in the Construction Industry

Workers in this field are envisaged to be in the process of experiencing a plethora of dangers encompassed in falls from heights, electrical hazards, exposure to hazardous substances, and accidents occurring with heavy machinery [27]. It is not uncommon that such hazards cause injuries, disabilities or even death. Hence, OHS measures must be implemented and maintained in construction industry to safeguard workers' safety and wellbeing. First of all, it is fundamentally crucial to underline the role of OHS practices in the building sector as it is through the implementation of these healthy and safety practices that many accidents and injuries can be prevented. Thanks to the risk assessment exercises which identify the hazards and implementing safety measures, workers will receive more training in order to decrease the frequency of the accidents on construction sites [28].

The effect of good OHS practices in the construction sector on productivity and quality is equally significant [29]. When workers know that they are safe and have their back on the job, they do the tasks properly and timely. Furthermore, putting in place OHS processes that concentrate on workers' safety builds a good working environment with a culture of safety [29]. This can bring about work satisfaction and worker retention that will improve the quality of work, and the reputation of the construction company [29]. Besides, OHS practices in the construction industry must be seen not only as a practical necessity but also as a legal and moral obligation [30]. Just like Nigeria, many countries have been passing laws and regulations which requires employers to provide a safe and healthy workplace to their workers [30]. Non-compliance with such regulations may lead to legal penalties, fine or even imprisonment. Consequently, OHS practices in the construction industry must be implemented in a proper way to avoid any disasters. These measures avert accidents and injuries, enhance productivity and quality and meet legal and ethical obligations [27, 28]. To gain all these valuable rewards, construction companies should put the workers' safety first and build a culture of safety by all stakeholders, including workers, contractors and regulatory authorities [29, 30].

### 3.2. Challenges to implementing effective OHS practices in construction

The construction industry is characterized by various factors that make it difficult to implement effective occupational health and safety (OHS) practices. The construction projects themselves are usually complicated and keep on changing. They have numerous dynamic sections that need changes and modifications constantly, and because of that it is very hard to identify and assess potential hazards, implement safety measures, and provide workers with appropriate training [1]. Yet another challenge is the

use of multi-skilled and casual workers in the building sector. Frequently, construction projects need a large and broad workforce, such as temporary and migrant workers who could lack the proper training or are not familiar with OHS regulations. This can complicate the assurance that all workers know the OHS requirements and comply with the required safety measures.

Apart from that, the implementation of effective OHS measures in the construction industry is hampered by the concerns of high costs and time [31]. Building contractors frequently have to work under strict deadlines and budgets, which makes it difficult for them to put in place OHS measures [31]. In addition, OHS practices may need extra resources (i.e., training and personal protective equipment) which add to the expense of the project. These impediments can create a real predicament for contractors in terms of giving priority to OHS practices and allocating required resources to execute them successfully. Additionally, due to the absence of regulatory enforcement and oversight, OHS practices implementation in this industry is also being impaired. In some countries, the enforcement might be weak, and construction companies may ignore their OHS responsibilities [18]. Moreover, construction sector might be a victim of corruption thus unethical practices which compromise the implementation of effective OHS measures

### 3.3. OHS laws and regulations in nigeria

The occupational health and safety laws and regulations in Nigeria are meant for the protection of the health and safety of the workers from different industries, including the construction sector [32]. In the federal level, the Nigerian Constitution of 1999 (article 38) is the major law that provides the right of workers to a safe and healthy working environment. The constitution further provides for the formation of the National Council for OHS, which is the one responsible for coming up with OSH policies and regulations in Nigeria [32]. Besides the constitution, some federal laws and regulations guiding OHS in Nigeria are the Factory Act of 1990, the Employees' Compensation Act of 2010, and the National Policy on Occupational Safety and Health (NPOSH) of 2006 [32]. The Factory Act of 1990 establishes the general principles for occupational health and safety in all factories and other work stations and the Employees' Compensation Act of 2010 introduces the system of compensation for workers who were injured or became ill due to their work [32]. The NPOSH 2006 is the comprehensive policy document that guides the implementation of OHS practices in Nigeria, dealing with hazard identification and assessment, risk management, training and education, and regulatory compliance [32].

While at the state level each state in Nigeria has its own OHS laws and regulations, which are generally based on federal laws and regulations but with additional specific requirements and regulations of the state [32]. For instance, Lagos State has its own Occupational Safety and Health Law of 2012 which

institutionalizes the Lagos State Safety Commission and specifies the OHS requirements for the state [32]. Nevertheless, the fact that Nigeria has a legal framework in the sphere of OHS that includes laws, regulations, and policies both at the federal and state level does not absolve it from the challenges which involve awareness, understanding, enforcement, and compliance [32, 33].

### 3.4. Types of Occupational Health Hazards in the Construction Industry

Realizing the reality and implications of occupational health hazards in the construction industry will help develop prevention measures and policies. This include different hazards that are present in the industry, influencing factors, and measures to counteract these hazards. Construction site workers face various health hazards that can be grouped into physical, chemical, biological, and psychosocial hazards [34] as discussed below

#### 3.4.1 Physical hazards

Physical hazards found in construction industry can lead to major threats to workers' health and safety. Hearing loss and impairment induced by noise exposure are among the most widespread physical risks in the construction industry [35]. Vibration exposure is also a physical risk that can cause long-term harm to the hands and arms in the form of the hand-arm vibration syndrome [35, 36]. Furthermore, heat stress and cold stress are major physical hazards in construction that can result in heat exhaustion, heat stroke, hypothermia and other such disorders [35].

The ergonomic risk factors including the repetitive motion injuries and awkward postures are the most critical of the construction workers' risks [37]. Muscle fatigue and strain injuries can develop gradually through the tasks that call for prolonged and repeated motions, like using power tools or performing painting works [38]. Moreover, working in such difficult postures or maintaining uncomfortable positions, like bending or stretching all the time leads to musculoskeletal disorders. It is very important that proper investigation of physical requirements of body activity in the workplace is carried out in order to identify workers' ergonomic risk. A wearable inertial measurement unit sensing system has been tried in construction to prevent musculoskeletal disorders, showing the increasing interest in using technology for ergonomic risk assessment and prevention [39].

The problem of the seasonal effects on construction workers is a vital issue, as excessive temperatures during summer and winter can cause cold stress and heat stroke, respectively. Aside from that, when it rains, or snows, there is the risk of slipping, tripping and falling [39]. Earlier studies indicate that the most widespread hazards in construction are physical, ergonomic and seasonal. For instance, a study undertaken at Gambian construction sites found that physical hazards were the most frequently reported

hazards among workers [8]. Apart from that, a study by Mihić in 2020 [40] highlights the importance of occupational health and safety preventive measures to tackle such health issues and protect workers. She also proposed a categorization of hazards in construction that includes self-induced hazards, peer-induced hazards, and global hazards [40]. This classification system is subdivided into physical, ergonomic, and seasonal hazards which may be present in construction work environments.

#### 3.4.2 Chemical hazards

The construction sector, which abounds with chemical hazards, puts workers at high risk of exposure to harmful substances including asbestos, lead, and solvents [41]. The asbestos exposure particularly is dangerous in that it causes serious respiratory illnesses, such as mesothelioma and lung cancer [41]. Similarly, lead exposure may result in lead poisoning which involves brain damage and nervous system damage [41]. Also, volatile solvents are responsible for allergic reactions of skin and breathing system [41]. The concept of chemical hazards is not only related to construction industry. Disastrous chemical accidents have been recorded in a number of spheres, including the chemical production itself, in which human error as well as operational problems pointed as the one of the primary reasons for these disasters [42].

Ensuring the recognition and elimination of chemical risks will be vital to guarantee the workers safety in the construction industry. Nevertheless, researches show that the workers fail to identify a high number of risks [43]. This underlines the significance of better training and awareness on hazards recognition on the part of construction workers. Besides the direct threats to workers' health caused by chemicals, the improper handling of industrial waste can be also of environmental concern [44]. Proper waste treatment processes must be utilized to keep the environment free from contamination and to reduce the unpleasant effects of industrial waste.

#### 3.4.3 Biological hazards

The presence of and exposure to living organisms such as mold, bacteria, viruses, and other infectious agents can lead to number health problems, including respiratory issues, allergic reactions, and infections [45,46]. Mold toxins are among the most widespread biological hazards in the construction industries as evidence by many studies [32]. Bacteria and viruses are also a significant risk, which may lead to infections, illnesses, and other health problems [40]. These risks can come from different sources which may include building materials as well as the working environments itself. For instance, mold can develop in wet or inadequately ventilated regions such as basements or areas which are subject to water damage [46]. While bacteria and viruses may be found in the contaminated water or surfaces and can be transferred by the

workers very fast within the construction site [47]. This entails that employer in the industry must be aware of these risks and take preventive actions in order to prevent an exposure to them which can be accomplished by proper ventilation, use of personal protective equipment, and by ensuring regular cleaning and disinfection of work areas [46, 47]. Furthermore, regular training and education on the biological risks and hazards on workers' health and safety can help in preventing them [48].

#### 3.4.4 Psychosocial hazards

Construction workers are quite vulnerable to stress, violence, harassment and other related problems in the industry. Workers on construction sites are prone to violence and abuse from their fellow workers, supervisors or even the members of the public [49]. It has been found out that the psychosocial factors including stress and violence can play a very big role in affecting the health the workers. A study conducted on married or cohabiting workers in the construction industry and spouse or partner revealed that employment and alcohol problems are linked with an elevated probability of partner violence [49]. This means that the psychosocial factors, like alcohol misuse and job insecurity, could increase the chance of violence between partners.

Also, having a multidimensional approach, researchers have in-depth knowledge of the psychosocial factors that may influence construction worker health and quality of life. Nevertheless, it is worth mentioning that there is a gap in research that deals exclusively with occupational health, hazards, and the psychosocial problems of construction industry workers [15]. This demonstrates an absence of data on the peculiar psycho-social intricacies of construction workers in particular and the requirement for more research in this field [50, 51].

### 4. Safety culture in the construction industry

The safety culture within construction industry is a fundamental element in making the operations of occupational health and safety effective [52]. The concept of safety culture involves a combination of shared values, beliefs, attitudes, and behaviours that reshape the way in which people and organizations approach safety at work [52]. The principal idea behind safety culture is the development of a working space where all workers have alertness on possible risks and are at liberty to report any safety issues without fear of retribution [52]. Having a strong safety culture can produce higher levels of employee stakeholder engagement and proactive approach towards OHS rules, which eventually contribute to a safer workplace. An opposite negative condition of safety culture may result in a situation where employees feel unable to prioritize OHS practices, ending up with non-compliance and increased risk for accidents and injuries. The positive safety culture formation entails the dedication and participation of all the stakeholders

which include the management, supervisors and the workers themselves. It includes the development of safety protocols and procedures, conducting regular safety training, advocating for mutual workers' understanding as well as allocating resources for correct PPE and other equipment use [53]. Some of the major components of safety culture in the construction industry is the extent to which management is committed towards safety, the attitudes and behaviours of supervisors and workers, the presence of resources to implement OHS procedures and the evaluation of the risk level of the operations being carried out. fostering safety culture, can be realized by means of interventions as engaging the workers in safety decisions, enhancing communication and feedback channels, and implementing safety metrics to check progress [29].

#### 4.1. Components of safety culture

The components of safety culture in the construction industry are leadership, communication, employees' participation, hazards recognition, and constant improvement as discussed below;

- The safety culture in the construction industry cannot be sustained without leadership. The leadership creates awareness about the importance of safety and explains the responsibility of a company, managers and supervisors at a construction site [54, 55]. Compliance with regulations and rules can be achieved through transactional leadership whereas workers can be motivated to participate in safety issues with transformational leadership [56, 57].
- Communication plays a vital role in the formation and the continuous establishment of a safety culture. This encompasses a clear safety policies and procedures as well as the detailed explanation to implementing them, it also entails regular safety meeting and training as well as the open channels for reporting safety concerns and incidents [57].
- Employee participation must be a core element of a safety culture in construction industry. Employees will have a greater sense of obligation, responsibility, and devotion towards the success of safety initiatives when they play an active role in safety planning and decision-making [54, 58].
- Hazard recognition relates with identifying possible dangers ahead of time and undertaking safe measures to avoid possible accidents. This includes routine safety inspections, hazard assessments, and also encouraging workers to report safety problems or hazards they noticed.
- Perpetual improvement involves an ongoing process that requires routinely reviewing and amending safety guidelines and procedures to check their efficiency and relevance. Similarly, reviewing the occurrence reports and risk

statistics to look for patterns and ways of enhancement will be also taken into account [5].

#### 4.2 Importance of safety culture in promoting OHS practices

The primary role of safety culture in the facilitation of occupational health and safety practices in the construction industry cannot be overlooked. A positive safety culture involves a strong commitment to safety, open communication, continuous learning, and a proactive approach to hazard identification and control [59]. It has been proved through studies that a positive safety culture is a vital attribute that propels the OHS practices and reduces accidents and injuries in the working environment [60]. When there is a commitment between workers and management to safety, then employees are more likely to follow safe working methods, use of PPE, and report for hazards and near-miss incidents. Moreover, a positive safety culture nurtures teamwork, mutual respect and trust, which are fundamental for communication and cooperation in the workplace [60]. In contrast, a negative safety culture can lead to poor health and safety practices. Workers may develop careless behaviours or cut corners if they believe that their employers do not put safety first [60]. In terms of hazard reporting and control strategies, trust and open communication are inevitable. As a result, a positive safety culture is one of the most important strategies in OHS practices for the construction industry.

#### 4.3 Factors influencing safety culture

Many aspects that impact safety culture in the construction industry could be visible and at the same time complex [58, 61]. Involvement and participation of the workers, leadership commitment to safety, communication and feedback systems, training and education, and the existence of clear and consistent safety policies and procedures are been identified as the most important factors [62, 63, 64]. Safety culture of a construction organization depends on the commitment of its leadership to safety. Leaders who pay attention to safety and demonstrate their intention to OHS practices provide example to workers and create a culture of safety all through the organization [57, 60, 65]. Moreover, employee engagement in safety decision-making forums and empowering them to play an active role in safety initiatives can help create a positive safety culture [57, 61].

Good communication and feedback systems are also an important factor that contribute to a good safety culture. Open communication between workers and management can aid in quick identification and solution to safety concerns [57, 62]. Regular input from workers on the effectiveness of OHS practice and policy implementation to enhance safety culture is another step to promote a proactive approach toward safety. In addition to that, training and education are also an essential element that make up an effective safety culture [24, 32]. Furthermore, Unambiguous and clear

safety policies and procedures are crucial to the creation of a decent safety culture. Policies and procedures, in this case, should be reviewed and updated continuously to ensure that they address current safety risk and tendencies [57, 63]. When these factors are present and functioning well, they can help to create a culture of safety in the construction industry and reduce the incidence of occupational injuries and illnesses.

#### 4.4. Assessing and improving safety culture

The development of safety culture assessment is essential in the context of promoting the culture of occupational health and safety of workers. Safety culture audits assist in identifying the areas that require improvement and extra attention. This can be accomplished through different approaches including; safety culture surveys, safety audits, safety climate assessments and safety perception surveys.

- A safety culture survey is an instrument that is used to identify the level of safety culture within a company. It is conducted via employee data collection through questionnaires or interviews to diagnose safety culture's weak points and strengths.
- The safety audits cover the reviews of safety management systems, safety standards as well as regulations to check if these are all compliant. It plays an important part in safety monitoring and assessment, and can identify safety gaps and hazards that must be addressed to improve safety culture [63].
- Safety perception surveys are prepared to assess working personnel's perception of safety culture as well as their attitude towards adhering to the safety process. The survey examines employees' levels of safety know-how, the efficacy of safety training, and their opinions on safety [63].

Achieving the safety culture in the construction industry needs the engagement of all the stakeholders involved from both upper management workers to the lower-level workers. It encompasses development and utilization of safety policies and practices, provision of periodic safety training, and creation of an environment for free exchange of safety related information [66]. In addition, routine safety meetings, safety walk-throughs, and safety drills will play a role in embedding safety culture [67]. In addition, the use of safety incentives and recognition programs can also promote and reinforce safe behaviour [68].

#### 5. Workers' awareness and adherence to OHS practices

Workers' awareness and compliance to Occupational Health and Safety practices are important in maintaining safety and health in the construction industry [69]. The industry is widely recognized as one of the most dangerous industries, characterized by an exceedingly high risk of workplace accidents and



illnesses. Hence, OHS compliance by the workers is vital in preventing workplace accidents, injuries, and fatalities [69]. However, many factors affect workers' knowledge and adherence to safe working practices in the construction sector, some of which are:

- Workers' knowledge of the hazards they are exposed to at their workplace. When workers are familiar with the possible risks and hazards, they are more likely to follow the OHS rules to prevent themselves from injuries [70, 71].
- Availability of Personal Protective Equipment (PPE) is one of the important factors which can influence workers' compliance to Occupational Health and Safety practices. PPE including hard hats, safety glasses, gloves, and boots can shield workers from hazards [71].
- Another basic factor that significantly shape workers' adherence to OHS measures is the work environment [71]. An uncluttered and organized workplace is less prone to hazards and is much easier to use safely. While, a cluttered and chaotic environment accelerates the probability of accidents and harm [70,72].
- Education and training of personnel is one of the key success factors in health and safety of workplace [58]. Individuals who were adequately trained in work place hazards and the appropriate way of using PPE are likely to observe OHS practices [70, 73].
- Recurrent training and instruction may achieve the same objective of ensuring the safety of the workers by updating work safety procedures and laws, resulting in increased compliance among workers [73].
- The highest attitude of management toward adopting OHS will result in employees sticking to OHS practices [28,70]. When the management underlines the importance of OHS measures and offers the proper resources and assistance, workers will be more likely to act in accordance with OHS practices [65].

### 5.1. Impact of Training and Education

Education and training should be given due priority if OHS practices in the construction industry are to be promoted and improved [74]. It has been repeatedly proven that workers who get occupational health and safety training and education are more likely to observe safe practices and procedures, resulting in a marked decrease in the number of accidents, injuries, and illnesses [74]. Effective training and education programs in construction industry should include wide range of topics such as hazard identification and risk assessment, safe work practices and procedures, emergency preparedness and response, and proper use of PPE and other safety measures [75]. It is critical to tailor the training content to various workers' specific needs, be it supervisors, managers, or new hires [75]. Moreover, regular training and education programs should be frequent; otherwise, they will not

properly reflect current OHS laws and regulations, best practices in the industry, and emerging hazards and risks [73]. Employers should create the possibility of actual training and practice, like simulations and drills, so that workers know how to implement what they have learned in real situation [73].

### 5.2. Barriers to workers' adherence to OHS practices

- Inadequate training and education pose a serious obstacle to the proper implementation of OHS practices by workers in the construction sector. However, although a certain number of employees may have the required knowledge and expertise to recognize and rectify possible risks, they can still become non-compliant with OHS regulations [18, 47].
- Proper communication is vital for the workers to grasp the meaning of OHS practices and the hazards they encounter during work. A lack of communication can cause misinterpretations and, in turn, lead to the non-conformity of employee's OHS practices.
- Cultural and language barriers might also affect the workers' compliance to safety policies at work. The peculiar thing about the construction industry is that it has a lot of different people, hence the language barrier can prevent effective communication and understanding of the OHS practices [76]. At the same time, cultural differences can be responsible for forming workers' attitudes towards occupational health and safety practices, leading to noncompliance [76].
- Missing incentives and motivation are another dominant barrier to the OHS adherence by the workers. Employees may view OHS incorporation as an extra duty that impedes their work output. Besides the demotivation caused by this understanding that the employer does not value health and safety, there is also lack of motivation.
- Inappropriate lack of OHS policies and procedures compromise workers' ability to stick to OHS practices [73]. Employers can sometimes have no clear guidelines on how to report hazards, in addition to not supplying the adequate personal protective equipment. Without proper policies, regulations on OHS, workers will hardly follow the safety practices.

### 6. Effectiveness of OHS measures in the construction industry

Successful occupational health and safety steps are vital for ensuring that workers in the construction industry are off harm and safe [19]. This is intended to address incidents, injuries, diseases, or deaths that may arise due to their work activities. Assessing the efficiency of OHS measures in the construction sector involves monitoring the incidents and injuries that

occur on sites. This data analysis helps the relevant parties in discovering trends and repeated patterns that might show areas of concern or open up opportunities for improvement [28]. Furthermore, compliance with the regulations is one of the aspects in examining the efficacy of the implemented OHS measures [77]. In Nigeria, the Federal Ministry of Labour and Employment has its OHS regulations, including the Nigerian National Building Code, which provides a set of particular requirements for the safety of construction sites [78].

The total safety culture in an organization, which contributes to assessing the effectiveness of OHS measures, is another crucial aspect [19]. A resilient safety culture will evoke a proactivist when it comes to safety and will empower workers to detect and report any possible hazards. These can be achieved through regular training and education, proper communication of safety policies and procedures, and continuous improvement [19]. Closing the gaps as well as determining the areas that need improvement is also significant for strengthening the effectiveness of OHS measures. This includes conducting frequent safety audits and inspections to detect dangers and places that do not meet requirements, as well as soliciting input from employees and other stakeholders. This feedback can help develop tailored interventions and targeted initiatives to fill the identified gaps and ultimately increase safety levels [77].

Technology advancement served as one of the several innovative strategies for improving the efficiency of OHS measures and overall safety outcomes at work [79]. For instance, drones can be used for site inspections and monitoring to identify potential hazards on the spot. In addition to that, the replication of best practices from other industries, for example lean manufacturing helps in identifying opportunities for improving safety outcomes [80]. That is why, the effectiveness of OHS measures have to be assessed in order to enhance its performance in protecting workers.

### 6.1. Evaluating the effectiveness of OHS measures in construction

There are various forms of evaluating the effectiveness of OHS programs in construction industry. However, the best method to assess the effectiveness of OHS measures would be to utilize lagging and leading indicators [81]. These lagging indicators include statistics on the number and severity of injuries, illnesses, and fatalities which measure past performance [82]. While on the other hand, leading indicators such as safety inspections, audits, and training records are predictive measures that evaluate the appropriateness of the existing practices in preventing future mishaps. Another tool for evaluating the OHS performance is the application of safety performance metrics [81]. Safety performance metrics are used to track the status of safety-related activities and the efficiency of safety-related programs [81]. Examples of safety performance indicators

include the number of safety training sessions carried out, the percentage of employees who have completed safety training, the percentage of safety inspection carried out and the number of safety report [81].

Besides the lagging and leading indicators and safety performance indexes, the evaluation of the effectiveness of OHS can also be done by considering the workers' perception and attitude toward safety issues on their workplace [82]. Surveys or focus groups can be used to measure the workers' attitude towards safety, their working knowledge of safety practice, their perception of the effectiveness of safety measures [82]. Nevertheless, continuous supervision of OHS measures is absolutely the most essential factor for finding the spots where modification is required to safeguard the health and safety of workers [81].

### 6.2. Identifying gaps and areas for improvement

Identification of gaps and opportunities for improving OHS practices is also vital for the betterment of the overall safety and health of the workers. To identify these gaps and areas for development, a complete and systematic strategy is required, which includes gap analysis and improvement design [80]. One of the common methods is by conducting OHS audit which is a systematic review of the OHS measures on the construction site [80]. The audit will help in finding any issues and areas that need to be adjusted. This in-depth review involves different OSH elements including: hazard identification and risk assessment, PPE administration, training and education, and emergency response mechanisms [80].

Another effective way of pinpointing the holes and delineating the lapses is the use of OHS performance indicators. These indicators give us both quantitative and qualitative measures to track the effectiveness of OHS policies [75]. Some of the OHS performance indicators include; accident and disease rates, compliance with OHS regulations, and the number of hazard reports indicated [75]. Moreover, the employees and their representatives should also be part of the problem finding since it guarantees a productive process. The staff are the greatest source of information on potential hazards and risks in a workplace, and they can give valuable feedback on the adequacy of OHS practices. It is their role to guarantee this and make their concerns known which, in turn, boosts the level of ownership they have in the improvement process [80]. Then it is time to set out and implement the action plan, which must then be assessed. Such plan could require amendments to the existing regulations and standards, organizing new training workshops, the procurement of new equipment and technologies or the designing of new safety programs [80].

### 6.3 Strategies for enhancing the effectiveness of OHS measures

Proper techniques to strengthen the efficiency of OHS in the construction industry can also be thought-

out. Employee's engagement in the formulation and enforcement of OHS policies and procedures stand out as one of the effective approaches to use [83]. This would increase awareness of the safety program and create a safer environment as employees eventually foresee the program as their own. This may be accomplished by having workers directly involved in the steps taken to keep them safe and hence more likely to follow them. Another way of implementing may be through periodic training and education of staff members, leaders, and managers. Education and training enhance workers' expertise and competence to recognize hazards, perform risk assessment and the appropriate use of personal protective gears. Overall, the performance management system should define a specific system of accountability for OHS [84]. This encompasses periodical assessments of Safety Records, audits, inspections, and the creation of safety performance indicators. Accountability will be the key to ensuring individual and team performances are up to pace with the established OHS standards, which in turn enhances attention to safety and compliance. Apart from that, another applicable method is to create incentives for employees who comply with the OHS measures. They can be rewarded for their adaptability and professionalism. However, effective communication is one of the most important factors when it comes to successful implementation of measures OHS [17]. Communication channels should be set up to ensure workers are aware of the risks and corresponding safe procedures and the ability to report safety issues freely. Lastly, technology can be used to increase the efficiency and effectiveness of the OHS activities in the construction industries. Sensor devices and monitoring equipment can be used to detect the occurrence of falls and exposure to hazardous materials. Mobile apps and software tools can instantly provide safety information and facilitate the reporting and investigation of incidents.

## 7. International best practices in OHS practices

The construction industry is an international sector with different types of working environments, cultures and legislations across different countries [85]. Thus, the best practices in occupational health and safety in the construction industry differ widely from region to region. Nevertheless, some countries have been acknowledged for their successful execution of OSH in the construction domain [85]. For example, the United Kingdom (UK) is the country that uses OHS practices in the construction industry effectively through the CDM (Construction, Design and Management) Regulations 2015 [75]. CDM rules stipulate for duty holders who should be accountable to maintain health and safety during the construction phase of a project. The regulations demand the preparation of a Health and Safety file which includes the construction project information and the presence of any hazards [75]. Apart from the UK, there are different other countries who are famous for their best OHS practises;

- In Australia, according to the Work Health and Safety (WHS) Act 2011, employers are required to maintain a workplace that is safe for their employees [18]. Similarly, the Act imposes on employees the obligation of care not to harm their health and that of other workers. The WHS Act also provides a national framework which includes the development of codes of practice for the industries [18].
- In the USA, the Occupational Safety and Health Administration (OSHA) has already put variety of standards in order to regulate the OHS practices on construction industry. These standards include topics like fall protection, electrical safety, and hazard identification and communication. OSHA also developed standard trainings for employees on occupational health and safety practices that are unique to their jobs [86].
- In Singapore, MOM (Ministry of Manpower) has developed WSH Construction Regulations and Guidelines. These are the set of guidelines for OHS practices in construction industry of the country. The guidelines deal with issues including personal protective equipment, noise control, and risk assessment. In addition to that, MOM also requires the appointment of safety officers who should be responsible for compliance with these regulations [87].

It is important to note that other countries also have strong OHS practices in the construction industry. For example, Canada has a well-established OHS regulatory framework [88]. Sweden also has strict OHS regulations and enforcement [89]. Overall, studying and adopting international best practices in OHS can help improve safety standards in the construction industry worldwide.

### 7.1 Lessons learned from successful OHS practices in other countries

The experience of others in successfully applying their OHS practices, provides us with the necessary lessons that should help us overcome the challenges in the construction industry. Some of the lessons learned from these best practices include:

- Strong government regulations and enforcement: Effective OSH laws and regulations which are country based have stringent reforms to control construction sector. In general, the rules are usually monitored by relevant government bodies which ensure that companies comply with the standards.
- Collaboration between stakeholders: Introducing an effective Occupational Health and Safety process requires the cooperation of several players like the employers, workers, trade unions and governmental departments. These organizations all blend together to create a safer environment in the construction industry.

- Investment in training and education: Countries that have strong OHS policies implement education and training projects on workers, supervisors, and managers as well [75].
- Use of technology: Through effective OHS practices, the application of technology is fundamental in raising the workplace safety in the construction sector. For example, some countries used to employ sensors and checking systems to detect danger and stop disasters.
- Continuous improvement: Successful OHS practices involve continuous improvement, with companies and government agencies regularly reviewing and updating their policies and procedures to address new and emerging hazards [90].

If Nigeria, can adopt these practices and incorporate the lessons learned from successful OHS practices in other countries, the construction industry in the country can improve its OHS practices and create a safer working environment for workers.

## 7.2 Best practices for promoting OHS practices

There are various good practices for the construction industry to advance OHS practices. These practices have been discovered by research and are based on facts.

- Leadership commitment is one of the most significant best practices for ensuring occupational health and safety in construction [28]. Top management's commitment to OHS procedures sets the tone for the organisation and impacts all workers' conduct. When leaders prioritise and demonstrate their commitment to safety, they convey a clear message to employees that safety is a top concern that must be addressed seriously.
- Employee involvement is another powerful tool for developing and improving OHS practices. The employees tend to be more committed to the OHS programs if they themselves participate in the formulation and application of the programs. This can be through sitting as a member of safety committees, putting the inputs on safety policies and procedures, and being involved in safety training and education [75].
- Hazard identification and risk assessment method is a fundamental element in the application of OHS practices. A hazard identification and risk assessment program that is comprehensive in nature identifies the potential hazards and assesses the risk associated with it. This enables companies to foresee and prevent occurrence of accidents and injuries [30].
- Monitoring and evaluating the safety performance is one more key practice that helps promote OHS practices in the construction environment [65]. Through examining the safety performance indicators, for instance, injury rates, near misses, and reports on hazards, companies can trace the

areas that need improvement and then take the steps to prevent future accidents. In addition, continuous monitoring and evaluation give organizations opportunity to see the changes and respond by making skilful decisions for safety purposes [65].

- Finally, continuous improvement is a key best practice for promoting OHS practices in construction [91]. Organizations need to pay special attention to the continuous monitoring and development of their OHS programmes in order to make sure they are up-to-date and effective in preventing accidents and cases of workplace injuries. This may include organizing regular audits, contacting your employees for their feedback, and learning recent trends related to OHS practices [91].

## 8. Conclusion

This research has led to an informative and intriguing journey through crucial themes associated with OHS in construction sector. During the review, we touched upon the OHS practices, occupational health hazards, safety culture, workers' knowledge and adherence, and international best practices, all of which illuminated the intricate challenges inherent in the construction sector. The findings in this study implicitly indicated for the necessity of raising the safety requirements and practices in the industry. Building industry is considered as one of the most hazardous sectors in terms of occupational health and safety. Within this particular domain, workers are exposed to a diversity of risks including tangible hazards such as noise, vibration, and heat stress. Moreover, chemical perils directly made workers exposed to substances such as asbestos, lead, and solvents. Furthermore, biological hazards, such as mold, bacteria, and viruses, coexisted with psychosocial hazards like stress and harassment, further complicating the risks that construction workers face daily. A thorough awareness of these issues served as the foundation for our collaborative effort to improve workplace safety and health.

The role of OHS practises in the construction sector cannot be emphasised enough. Not only did these practices prevent accidents, but they also had a tremendous impact on the successful completion of projects. Adopting OHS principles is not just a moral requirement, but also a strategic choice for construction companies looking to safeguard their staff and optimise project productivity. As such, OHS practices turned out to be the most important thing that helped to decrease the risk of accidents, injuries, and fatalities in the construction domain. However, this industry faced several problems in properly adopting OHS procedures, including concerns like inadequate training, weak safety culture, budgetary restrictions, and the continual pressure to fulfil project deadlines. Identifying these barriers and addressing the challenges, we gained invaluable insights into the



hurdles that had to be overcome to establish a safer work environment for construction workers.

Represents a crucial yet often underestimated dimension. It encompassed the attitudes, values, and beliefs that shaped safety behaviours. Nurturing a robust safety culture was indispensable for ensuring the sustainability of OHS practices. The awareness and adherence of workers to OHS practices wielded significant influence over the success of safety initiatives. While training and education served as potent tools for enhancing worker awareness, barriers to adherence, such as inadequate safety equipment and financial constraints, remained persistent challenges that necessitated solutions.

Evaluating the effectiveness of OHS measures within the construction industry remained an ongoing imperative. Identifying gaps and areas for enhancement was pivotal for shaping future safety strategies that would bolster the well-being of construction workers. Turning our gaze beyond borders, we ventured into the realm of international best practices in OHS within the construction sector. Examples from countries that had successfully implemented OHS practices offered valuable insights and lessons that the construction industry in other countries could assimilate and adapt.

To sum it off, this literature review stood as a foundational resource for comprehending the multifaceted landscape of OHS within the construction industry. It underscored the paramount importance of prioritizing worker safety, outlined the challenges that demanded our attention, and offered a promising vision for progress through the improvement of OHS practices. Going forward, these insights are needed to find practical applications in the form of strategies and policies, ultimately creating a safer, healthier, and more productive environment for construction workers globally. Moreover, the review also provided an invaluable platform for future research and policy initiatives to build upon.

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### Author contributions

First and second authors conceived the idea, performed the complete works, and wrote the manuscript. Third authors reviewed, proofread, and supervised the work conducted.

### Conflicts of interest

The authors declare no conflicts of interest.

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