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RESEARCH PAPER

Assessment of Factors Affecting Building Construction Workers When Working at Height

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Abstract
Falls from heights are the leading cause of fatal incidents in the global construction industry. Despite various efforts to mitigate this risk, such accidents remain the most frequent in the sector. This study aims to assess the factors influencing construction workers when working at height. To achieve the study's objectives, a sample of 97 employees with expertise in working at height was selected. Data were collected using a self-administered questionnaire, employing both simple random and purposive sampling techniques. The collected data were analysed using SPSS. The study identified four key factors affecting construction workers when working at height: Safety Checks and PPE Factor, Overloading Factor, Organisational Failures Factor, and Personnel Factor. The findings suggest that to enhance workers' health and safety, contractors should implement specialised programs to raise awareness of height-related risks at construction sites. Additionally, employers must ensure that workers wear appropriate personal protective equipment (PPE) in compliance with workplace health and safety policies. This research is limited to the building construction industry in the Akuapem South Municipality and Ga South Municipality, located in Ghana's Eastern and Greater Accra Regions. The findings are particularly relevant to the Ghanaian building construction industry, where studies on working at height are limited. This paper contributes to the existing body of literature on height-related safety in Ghana's construction sector.

Keywords: Working at height, factors for working at height, building construction, construction.

1. INTRODUCTION

The construction industry is widely regarded as one of the most hazardous and deadly workplaces due to the numerous incidents that have injured and harmed workers over the years (Sharma and Kumar, 2020). Health and safety (HS) practices are increasingly considered essential tools for minimising and eliminating these risks. According to Eze (2020), ensuring a safe and healthy working environment for site employees requires identifying the causes of accidents and implementing effective solutions to prevent or reduce their recurrence. Aghimien et al. (2019) argue that health and safety challenges are a key aspect of the social dimension of sustainable construction projects. In Ghana, the construction industry employs approximately 600,000 people, representing about 7% of the working population, according to a 2015 labour force study by the Ghana Statistical Service (GSS). However, this figure may be an underestimate, as it does not account for undocumented or unauthorised workers (Boadu et al., 2020). Despite being a cornerstone of economic development, the construction sector is also known for its high-risk environment and long history of accidents that endanger workers (Senouci et al., 2015). Eze et al. (2018) describe the construction industry as the backbone and driving force of the economy. However, despite its significant contribution to economic growth and development, the sector has a disproportionately high rate of workplace accidents and fatalities compared to other industries (Chen et al., 2020). Due to the industry's complexity, sensitivity, and shortage of skilled personnel with adequate education, reducing the rising number of accidents has become increasingly challenging (ASK Environment, Health, and Safety, 2017). The International Labour Organisation (ILO, 2015) reports that the construction industry accounts for over 30% of all workplace fatalities worldwide. Similarly, Hamalainen et al. (2017) highlight that occupational accidents are prevalent in many developing countries, including Ghana, with construction-related accidents being particularly common. According to the Health and Safety Executive (HSE), the majority of fatalities in the construction sector result from falls from significant heights. Working at height remains one of the leading causes of workplace fatalities and major injuries, often involving falls from ladders, rooftops, and scaffolding. However, with proper planning and supervision, these risks can be mitigated (Connor, 2022). HSE (2018) data indicate that falls from height accounted for 23.4% of fatal accidents in the construction industry in both the United States (US) and the United Kingdom (UK), with a similar trend observed in Australia. Given the high risks associated with working at height in construction, it is essential to conduct a study to assess the key dangers faced by workers in this environment. However, research specifically focused on health and safety in relation to working at height remains scarce in most developing countries, including Ghana. This gap necessitates targeted research to understand the unique dynamics of working at height in the Ghanaian construction industry. Critical issues such as supervision, resource availability, and compliance with safety measures play a significant role in ensuring worker safety. Addressing these challenges is crucial for improving the efficiency and sustainability of the construction industry. This study aims to assess the hazardous factors that affect construction workers when working at height. The findings will be valuable for construction practitioners responsible for monitoring health and safety regulations, particularly in enforcing the use of personal protective equipment (PPE) for height-related work. Additionally, the study's outcomes can assist the government in formulating policy guidelines to enhance safety practices in the Ghanaian construction sector. The findings may also help policymakers fast-track the enactment of health and safety legislation for the building construction industry, ensuring more efficient and effective safety measures. The primary objective of this study is to identify the key variables that put workers in the building construction industry at risk when working at height.

2. LITERATURE REVIEW

2.1. Health and Safety Practices

According to Lingard and Rowlinson (2005), implementing a health and safety (HS) system or practice is a crucial step in ensuring that HS is systematically managed within an organisation. The International Labour Organisation (ILO) defines a health and safety management system (HSMS) as a collection of interconnected and cooperative elements that work together to design occupational safety and health (OSH) policies, set objectives, and achieve those objectives (ILO, 2001). Similarly, Griffith and Howarth (2001), as well as the UK Health and Safety Executive (HSE), define an HSMS as a formal management system or framework that helps organisations manage HS effectively (HSE, 2013). Therefore, HS can be understood as a structured set of guidelines aimed at creating a safe working environment. The development of HS systems began in the 1990s (Hasle and Zwetsloot, 2011). According to Lingard and Rowlinson (2005), initial efforts to prevent negative HS outcomes primarily focused on creating a physically safe workplace. Ladewski and Al-Bayati (2019) state that the activities used to manage an organisation's occupational health and safety performance are referred to as health and safety management practices. Henrich was an early advocate of workplace safety and health in the United States, conducting audits to assess safety policies and procedures (Gilkey et al., 2003). Various attempts have been made to predict the effectiveness of safety management techniques (Vinodkumar and Bhasi, 2010). However, only methods that consistently contribute to a safe working environment, as perceived by both employees and employers, should be implemented (Hanafi et al., 2018). According to Fruhen et al. (2019), management's commitment to safety must be visible to maintain strong safety performance, as employees' adherence to safety laws and procedures is crucial (Vinodkumar and Bhasi, 2010). Employees should actively participate in occupational health and safety training programs to enhance their knowledge and ability to identify workplace hazards (Mazzetti et al., 2020; Teoh et al., 2020) and to reduce workplace accidents (Fruhen et al., 2019; Vinodkumar and Bhasi, 2010).

2.2 Factors Contributing to Accidents/Dangers at Height

The World Health Organisation (2016) defines “human factors” as environmental, organisational, and job-related elements, along with individual qualities, that influence workplace behaviour in ways that can affect health and safety. Understanding human factors involves examining a wide range of modern workplace elements beyond individual behaviours. It is a fascinating study of interconnected components and behaviours that enable measurable improvements through cultural and procedural adjustments (Eku, 2020). Personal factors that contribute to human factors include bad temper, managerial negligence, mental and physical health issues, lack of motivation, insufficient understanding, and inappropriate behaviour among construction workers. These factors often lead to accidents in construction. The ability to work effectively in a team is crucial for safer and more efficient construction projects (Manzoor et al., 2022). Safety at heights, in particular, can be seriously compromised by a lack of understanding and disrespect among team members. Cooperation and effective communication are essential for identifying hazards and mitigating risks (Spillane and Oyedele, 2013). When employees engage in disrespectful behaviour or fail to communicate properly, critical safety information may not be shared, increasing risk-taking behaviours (Aulin et al., 2019) and the likelihood of accidents (Saleem et al., 2022). The failure of management to implement proper health and safety measures can significantly increase the risk of illnesses, accidents, and fatalities. Work-related illnesses and injuries not only affect an individual’s quality of life and ability to work but also impact a business’s productivity, finances, and reputation (Katie, 2017). Many directors and managers fail to recognise their workplace as a hazardous environment and, as a result, do not take the necessary precautions to protect employees (Technical Engineers Group, 2021).

According to Katie (2017), management’s disregard for workplace safety precautions may result in legal ramifications, demonstrating a failure to uphold the duty of providing a safe working environment for employees. Negligence on the part of employers can lead to heavy penalties, extended jail terms, and increased legal fees. Additionally, managerial pressure can influence construction workers’ attitudes toward safety (Goh et al., 2012). One of the primary causes of construction-related illnesses, accidents, and mishaps is the inability to recognise or identify existing or potential hazards. A successful safety and health program must include an active, ongoing process for detecting and assessing such risks (Occupational Safety and Health Administration [OSHA], 2016). According to Anonymous Employee [AE] (2022a), a major obstacle to a construction company’s success is inadequate supervision, particularly on building sites. Supervisors play a crucial role in enforcing proper procedures and work practices to address systemic deficiencies. A lack of supervision can contribute to an ineffective safety culture (Sethunya, 2017). Poor personnel management negatively affects work quality and job satisfaction. If a supervisor fails to manage employees properly, new problems may arise where none previously existed. Ineffective management often leads to skilled workers leaving the company (Professional Development [PD] Training, 2022). Furthermore, poor supervision not only increases the likelihood of accidents but also amplifies their impact and the number of affected workers (Van Sant, 2015). The financial consequences of inadequate safety management at a construction site can be severe. Workplace accidents can lead to increased employee absenteeism, rising healthcare costs, workers’ compensation claims, lost productivity, and business disruptions, all of which can significantly affect an employer’s bottom line (Ross, 2022). Moreover, insufficient training for construction workers on working at heights can be the deciding factor between continued success and eventual failure (ASK Environment, Health, and Safety, 2017). The lack of proper training also creates challenges in promoting or hiring qualified individuals for higher-level positions within the company. There is an increasing gap between employees’ actual skill levels and the skills required to perform their jobs effectively (AE, 2022b). Inadequate health and safety training is a major contributor to the high rate of accidents on construction sites (Tafadzwa et al., 2018). Workers’ unwillingness to adopt new safety measures or change unsafe work habits significantly increases the risk of falls when working at heights. If workers resist using fall protection (Hrica et al., 2020) or misjudge hazards due to ingrained habits (Shuaib et al., 2021), they may continue employing outdated or unsafe practices. This behaviour raises the risk of falls, equipment failures, and other accidents (Health and Safety Executive [HSE], 2023). Mental health issues can also impair workers’ ability to make decisions, focus, and react quickly, skills essential for maintaining safety when working at heights. Jim (2024) states that anxiety and stress can lead to inattention and increase the likelihood of errors. Furthermore, individuals with mental health disorders may struggle to recognise hazards or follow safety protocols, further increasing the risk of accidents (Hennigan and Perry, 2023).

Inappropriate equipment use or poor selection of fall protection can create a false sense of security and increase the risk of falling (Jacklin, 2024). For example, an excessively long lanyard can extend the fall distance and, despite fall protection, lead to severe injuries (Hrica et al., 2020). Similarly, misuse or failure to inspect equipment for damage can render it ineffective (Bickrest, 2009). Providing workers with the right tools for their tasks is essential (Jacklin, 2024). Improper selection of protective gear or equipment can pose serious risks when working at heights, increasing the likelihood of falls, structural collapses, and worker injuries. If a worker falls while using personal protective equipment (PPE), such as lanyards and harnesses, improperly fitted or inadequate PPE can have severe consequences (Health and Safety Executive [HSE], 2023). Additionally, using unsuitable scaffolding, ladders, or guardrails that do not comply with safety regulations can result in instability, collapse, or an inability to prevent falls (HSE, 2023). To mitigate the hazards of working at heights, it is crucial to select the right equipment, ensure it is well-maintained, and verify its suitability for the specific work environment. Construction sites are inherently hazardous, with potential dangers at every turn. To protect workers and the public from harm, construction sites use signage to reduce the likelihood of accidents and injuries. Construction signs serve multiple purposes, including identifying hazards, directing workers and visitors to designated first-aid stations and emergency equipment, and ensuring site safety and efficient operations (UK Safety Store, 2022). Safety signage is a critical component of any workplace safety program. It conveys important information, reminds workers of potential risks, and helps prevent dangerous behaviour (Graphic Products, 2022). A lack of signage on construction sites can leave workers unaware of potential hazards, exposing employers to serious legal and occupational health and safety risks (The Temporary Fencing Shop [TTFS], 2022). Construction site safety signs not only provide directions but also offer real protection (Talab et al., 2013). Inadequate signage—such as using unclear language, placing signs in incorrect locations, or failing to maintain them—can lead to confusion and increased risks (Graphic Products, 2022). When working at heights, employees should avoid areas with inadequate edge protection whenever possible. Insufficient edge protection significantly increases the risk of falls, which can be fatal (Virtual College, 2022). Ladders, scaffolds, and lifts can lead to severe injuries if there is no safety monitoring system in place (Veunex Safety Solution, 2022). Employers are responsible for ensuring that all necessary safety measures are implemented to minimise the risk of falls, from hazard identification to ongoing site assessments (Veunex Safety Solution, 2022). Many construction companies fail to regularly test fall protection equipment for wear and damage due to a lack of awareness. Regardless of brand or manufacturer, fall protection equipment deteriorates over time with use and exposure, making regular inspections essential (Dillon, 2014).

Personal protective equipment (PPE) plays a crucial role in ensuring worker safety and overall health (Wong et al., 2020). In high-rise construction projects, the provision of PPE is essential for protecting employees (Barro-Torres et al., 2012). Temporary work is the leading cause of accidents that result in severe injuries and fatalities in construction projects (Izudi et al., 2017). Therefore, providing PPE to construction workers is a necessity. The use of PPE such as safety helmets, gloves, boots, hard hats, and face shields is mandated to prevent accidents on construction sites (Hamid et al., 2019). Additionally, safety belts act as a critical preventive measure against catastrophic falls for workers engaged in high-risk tasks.

Although the Occupational Safety and Health Administration (OSHA) has released alarming statistics showing that falls from height remain the leading cause of fatalities in the construction industry, many workers still fail to use the recommended fall protection tools, such as safety harnesses, when working at height (Tim, 2016). Working at heights increases the risk of falling, which can result in fatal accidents if protective equipment is defective or insufficient. PPE for working at height is essential, as equipment such as harnesses, ropes, hard hats, and other protective gear can help reduce risks or minimise the severity of potential injuries (Virtual College, 2022; Sania, 2023). The lack of adequate fall protection remains the most common OSHA violation, indicating that unless the industry undergoes significant changes, companies will continue to face compliance issues (Tim, 2016). According to a report by the National Institute for Occupational Safety and Health (NIOSH) Fatality Assessment and Control Evaluation (FACE) program, falls accounted for 42% of construction industry deaths between 1982 and 2015, with 54% of those fatalities involving workers who did not have access to a personal fall arrest system (Busch, 2019). Coombes (2022) asserts that some construction and demolition workers may engage in dangerous tasks without taking safety precautions or using proper equipment when working at height. These workers may also be unaware of the risks associated with working at elevated levels.

Sub-factors contributing to overloading include improper equipment usage, crane collapses, inexperienced crane operators, and unauthorised operation of equipment. Cranes are considered the backbone of high-rise construction projects. The crane operator is primarily responsible for ensuring the efficiency and operational safety of cranes in accordance with safety regulations (Hamid et al., 2019). Zajicek (2022) asserts that crane operators who lack expertise and training pose a significant risk to construction companies. Additionally, they endanger other workers by increasing crane-related hazards and compromising overall site safety. Hiring incompetent crane operators can lead to various issues, including tipping and overturning accidents, improper load management at heights, load slippage, and collisions with nearby structures (Zajicek, 2022). Contributing factors to crane accidents also include insufficient training, pressure to meet deadlines, and operator negligence (HSE, 2018). Using improper or ineffective equipment is a leading cause of accidents when working at heights. For example, using the wrong type of scaffolding for a project or assembling a scaffolding tower incorrectly can be extremely hazardous. Similarly, misusing a step ladder for unintended purposes poses safety risks (Coombes, 2022). Access equipment, including scaffolding, towers, platforms, and ladders, is inherently unstable and vulnerable to overloading, strong winds, and overreaching, all of which can lead to catastrophic collapses. The stability of such equipment depends on proper maintenance, which must be conducted by professionals in compliance with relevant safety regulations (Health & Safety, 2018).

Overloading a working platform can cause planks to break or fracture, increasing the risk of falls (W.S. Safety, 2021). Scaffolds may collapse due to instability or excessive weight. To prevent accidents, scaffolding must be regularly inspected (Safety Buzz, 2022). In one incident, a worker who had not been adequately supervised and was working alone on a temporary roof scaffold fell, suffering multiple fractures to his right leg and ankle. As a result, the worker's company was fined for violating Regulation 4(1) of the Work at Height Regulations 2005 (Safety and Health Practitioner, 2017).

3. STUDY METHODOLOGY

According to Kothari (2014), a research design is a blueprint that outlines how an investigation will be conducted using the most appropriate research methodology. In this study, a descriptive survey was employed. A descriptive survey identifies and gathers data on the characteristics of a particular problem or issue while also describing phenomena as they exist (Kothari, 2014). This approach was deemed appropriate because it allows data to be quantified and generalised through statistical analysis (Culka, 2018). According to Babbie (2005), this study adopted a quantitative research approach, which involves modifying and quantifying observations to identify and understand the phenomena they reflect. After reviewing the literature, 21 factors were selected for the study. A well-structured questionnaire served as the primary data collection tool, as it allowed for the rapid collection of information from a diverse audience (Fosnacht et al., 2017; Olanrewaju et al., 2020).

The questionnaire was divided into two sections. Section A was designed to collect biographical data, while Section B focused on identifying factors that pose risks when working at height in the building and construction industries. A five-point Likert scale was used to rate these risk factors, with 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. To ensure the reliability and clarity of the questionnaire, four building industry specialists from the research area tested the data collection tools. The pre-test enabled the researchers to refine unclear questions and assess whether any items needed modification. A pilot survey helps researchers improve research themes, determine the most effective approach, and estimate the time and resources required for a more comprehensive study (Adu Gyamfi et al., 2022).

The study population consisted of construction professionals in the Akuapem South Municipality and Ga South Municipality, located in Ghana's Eastern and Greater Accra Regions. Respondents included site foremen, architects, project managers, site engineers, and quantity surveyors. Participants were selected using both random and purposive sampling techniques. Random sampling ensured that all respondents had an equal opportunity to participate, while purposive sampling was used to select individuals who were literate and knowledgeable about the subject matter. The sample size of a study contributes to the generalizability of its findings (Creswell, 2003). Of the 120 questionnaires distributed, 97 were returned, yielding a response rate of 80.83%. This aligns with the conclusion of Asamoah and Duodo (2007) that a sample size of 10% to 30% is appropriate for quantitative research. A reliability test of the data yielded a Cronbach's alpha value of 0.876, indicating strong internal consistency. Data collected from the survey were analysed using descriptive and inferential statistics, including Kruskal-Wallis statistics and Principal Component Analysis (PCA), with SPSS Version 26.

3.1 Data analysis from the questionnaire survey

Principal Component Analysis (PCA) was employed to test the hypotheses formulated for this study. PCA was used to identify the indicators associated with each factor and to reduce the number of observable variables assigned to each component (Gyamfi et al., 2022). The following steps were taken to analyse the PCA data for this research project:

1. Kaiser-Meyer-Olkin (KMO) Measure and Bartlett's Test of Sphericity – These tests were used to assess sample adequacy.
2. Communalities Calculation – This step determined the proportion of variance in each variable that could be explained by the extracted factors.
3. Eigenvalue Determination – Factors with eigenvalues greater than one were retained for interpretation.
4. Component Matrix Generation – This step identified the relationships between variables and components.
5. Component Matrix Correlation Analysis – This assessed how the extracted factors correlated with each other.

The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity are used to evaluate sample adequacy (Farrington, 2009; Rehbinder, 2011; Agumba, 2013). According to Sarmento and Costa (2017) and Tabachnick and Fidell (2007), the KMO measure ranges from 0 to 1, with a minimum acceptable value of 0.6 for a satisfactory factor analysis. Bartlett's test was applied to assess whether the variances of multiple samples were equal (Sarmento and Costa, 2017), with a significance criterion set at $p < 0.05$ (Agumba, 2013; Field, 2005; Rehbinder, 2011). A commonly accepted guideline for communalities is that values of 0.5 or greater are preferable (Jung and Lee, 2011). However, variables with communalities as low as 0.3 or 0.2 may be considered for elimination from the analysis (Sarmento & Costa, 2017). According to the Kaiser criterion for PCA, a factor is considered retained for interpretation if its eigenvalue is greater than one. The Scree plot, a graphical representation of eigenvalues, indicates the number of significant factors by displaying a noticeable drop or break in the linear graph (Sarmento and Costa, 2017; Field, 2005). Furthermore, upon extraction and rotation, the construct's observed variables generated component matrices. The component matrix illustrates the relationships between each variable and factor while considering other variables (Hoyle, 2012; Gyamfi et al., 2022). The cut-off value for factor loading, as suggested by Hoyle (2012) and Gyamfi et al. (2022), was set at 0.40, indicating the minimum threshold for a component's factor loading to be considered significant.

4. FINDINGS AND DISCUSSION

4.1 Demographic Characteristics of Respondents

Table 1 shows the findings of demographic responses of 97 respondents from the building construction industry gender, age, educational attainment, work history, and employment status.

4.2 Data Analysis

The study examines the factors that pose dangers to building construction workers when working at height. The results of the study are presented in Table 2. The findings revealed 21 variables that measure these risk factors. All variables had a mean score (MS) greater than 3.3, which is above the theoretical mean of 2.5 on the 5-point Likert scale. This indicates that respondents agreed that the identified factors significantly contribute to the dangers of working at height. The results were ranked based on the MS. In cases where multiple variables had the same MS, the variable with the lowest standard deviation was used to determine the ranking.

The Kruskal-Wallis test was conducted to determine the statistical significance of the respondents' responses, as shown in the last three columns of Table 2. The results indicate that none of the 21 items were statistically significant at the 0.05 level of confidence. This finding suggests that there is no statistically significant difference in respondents' perceptions of the factors posing dangers when working at height.

4.3 Factor analysis of factors posing danger when working at height

This study employed Principal Component Analysis (PCA) to reduce the dimensionality of large datasets while preserving most of the original information (Jaadi, 2021). PCA simplifies large sets of variables by breaking them down into smaller, more manageable components. In this study, PCA categorised the 21 variables into four controllable subscales. The adequacy of the sample is crucial for applying PCA. Agumba (2013) recommends using the Kaiser-Meyer-Olkin (KMO) measure along with Bartlett's test of sphericity to assess this. The study's KMO value was 0.776, exceeding the 0.6 threshold required for a robust factor analysis (Sarmento and Costa, 2017). Additionally, Bartlett's test of sphericity produced significant results, as shown in Table 3, with a high Chi-Square value of 2,574.562 at 364 degrees of freedom. A communalities test was also conducted to determine the percentage of variance in each variable that could be explained by the extracted factors. The study's communalities exceeded the threshold value of 0.5, indicating that the extracted factors in Table 3 adequately represent the variables under examination.

Table 1. Demographic Characteristics of Respondents (N = 97)

Variables	Frequency	Percentage (%)
Gender		
Male	68	70.1
Female	29	29.9
Age		
21-30 years	40	41.2
31-40 years	34	35.1
41-50 years	16	16.5
Above 50 years	7	7.2
Educational level		
Technician	23	23.7
HND	30	30.9
First Degree	36	37.1
Master's Degree	8	8.3
Experience of respondents		
Less than 5yrs	19	19.6
5-10	62	63.9
11-15	12	12.4
16-20	3	3.1
21 and above		1.0
Status / Occupation		
Architects	9	9.3
Site Engineer	41	23.7
Project Manager	24	42.3
Quantity Surveyor	23	24.7

Source: Researcher's Fieldwork (2022)

Table 2. Descriptive statistics and Kruskal-Wallis statistics on factors influencing accident while working at height (N=97)

Variables	MS	SD	Rank	Chi-Square	Sig.	Decision
Ignorance from management	4.28	0.910	2	1.367	0.850	Accept
Mental and Health Problems	3.82	1.010	17	2.297	0.681	Accept
Unwillingness to change the way a task is carried out	3.89	0.659	10	2.015	0.733	Accept
Lack of understanding and misbehaviour towards team members at construction site	3.81	0.635	18	1.345	0.854	Accept
Incorrect protection or equipment choices	4.19	0.858	4	5.357	0.253	Accept
Inadequate planning and hazard assessment	4.25	0.693	3	6.439	0.169	Accept
Inadequate supervision	4.11	0.815	5	5.288	0.259	Accept
Insufficient training for the task	4.11	0.762	6	6.676	0.154	Accept
Insufficient display of safety signs	4.32	0.700	1	3.261	0.515	Accept
Improper supervision of installation of working at height equipment	3.89	0.690	11	4.885	0.299	Accept
No on-site monitoring system of workers while working at height	3.89	0.805	12	6.307	0.177	Accept
Lack of inspection of using fall arrest systems	3.89	0.815	13	2.183	0.702	Accept
No safety harness during working at height	3.93	0.753	9	4.292	0.368	Accept
Lack of equipment for working at height	4.08	0.799	7	1.686	0.793	Accept
Lack of fall arrest system PPE while working at height	3.85	0.712	16	4.682	0.322	Accept
Lack of fall restraint PPE for working at heights	4.07	0.869	8	2.982	0.561	Accept
Incorrect use or set-up of PPE equipment while working at height	3.85	0.667	15	7.783	0.100	Accept
Unskilled crane operator	3.86	0.692	14	5.165	0.271	Accept
Improper supervision of working at height equipment	3.69	0.712	20	3.190	0.536	Accept
Putting more loads on working platforms	3.80	0.671	19	5.239	0.264	Accept
Crane carries more than unusual loads	3.38	1.065	21	4.183	0.382	Accept

Table 3. Communalities of working at height variables

Variables	Communalities	
	Initial	Extraction
Ignorance from management	1.000	0.818
Mental and Health Problems	1.000	0.869
Unwillingness to change the way a task is carried out	1.000	0.850
Lack of understanding and misbehavior towards team members at construction site	1.000	0.866
Incorrect protection or equipment choices	1.000	0.650
Inadequate planning and hazard assessment	1.000	0.843
Inadequate supervision	1.000	0.888
Insufficient training for the task	1.000	0.858
No warning signs	1.000	0.557
No safety location sign plans	1.000	0.782
No on-site monitoring system of workers	1.000	0.819
No location tracking of workers	1.000	0.847
No safety belts during working at height	1.000	0.892
Lack of durable equipment for working at height	1.000	0.828
Lack of PPE according to the guidelines of safety parameters	1.000	0.738
Inadequate PPE for working at heights	1.000	0.797
Incorrect use or set-up of equipment, including PPE	1.000	0.764
Unskilled crane operator	1.000	0.817
Operating equipment without authority	1.000	0.814
Improper use of equipment as a sub-factor	1.000	0.886
Crane collapsed	1.000	0.858
Safer design	1.000	0.901
Using appropriate working at height PPEs	1.000	0.825
Using alternative construction methods	1.000	0.813
Using specific tools and equipment	1.000	0.793
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.776	
Approx. Chi-Square	2574.562	
Bartlett's Test of Sphericity df	364	
Sig.	0.000	

Extraction Method: Principal Component Analysis.

According to the Kaiser criteria, factors with eigenvalues greater than one should be retained for interpretation (Sarmento and Costa, 2017). As shown in Table 4, the four identified components accounted for 76.855% of the total variance among the factors.

Table 4. Total Variance Explained for factor posing danger when working at height

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	10.180	40.719	40.719	10.180	40.719	40.719	8.531
2	5.310	21.240	61.959	5.310	21.240	61.959	4.311
3	2.370	9.479	71.438	2.370	9.479	71.438	3.378
4	1.354	5.418	76.855	1.354	5.418	76.855	2.367

Extraction Method: Principal Component Analysis.

Table 5 presents the component matrix, which shows the correlation between each component and each variable. The first factor contains eight items, the second contains four, the third contains five, and the fourth contains four. According to Pedhazur and Schmelkin (1991) and Agumba (2013), the loading factors for each variable exceeded the recommended threshold. Components 1, 2, 3, and 4 consisted of twenty-one (21) items that were practically significant; therefore, they were retained as observed variables to evaluate the factors posing risks when working at heights. Additionally, as shown in Table 6, the correlation among the four components is higher than the recommended cut-off value of 0.3. This indicates a significant correlation between the four parameters.

Table 5. Principal Component Analysis of factor posing danger when working at height

Variables	Component loading			
	1	2	3	4
Safety checks and PPEs Factor				
Lack of fall restraint PPE for working at heights	0.838			
Improper edge protection when working at height	0.828			
Insufficient display of safety signs	0.822			
Lack of equipment for working at height	0.822			
No on-site monitoring system of workers	0.818			
Lack of inspection of using fall arrest systems	0.684			
Lack of fall arrest system PPE while working at height	0.647			
No safety harness during working at height	0.622			
Overloading Factor				
Unskilled crane operator		0.914		
Improper supervision of working at height equipment		0.728		
Crane carries more than unusual loads		0.668		
Putting more loads on working platforms		0.639		
Organisational Failures Factor				
Inadequate planning and hazard assessment			0.836	
Insufficient training for the task			0.813	
Inadequate supervision			0.778	
Improper supervision of installation of working at height equipment			0.488	
Personnels Factor				
Lack of understanding and misbehavior towards team members at construction site				0.828
Mental and Health Problems				0.780
Incorrect protection or equipment choices				0.681
Ignorance from management				0.620
Unwillingness to change the way a task is carried out				0.605

Table 6. Correlation Matrix for factors posing danger when working at height

Component	1	2	3	4
1	0.852	-0.334	-0.354	0.351
2	0.434	0.660	0.431	0.282
3	-0.346	-0.521	0.427	0.722
4	0.398	-0.391	0.701	-0.467

Extraction Method: Principal Component Analysis

4.4 Discussion

4.4.1 Component 1. Safety checks and PPEs Factor

Component One of the studies, titled “Safety Checks and PPE Factor,” consists of eight variables: Lack of fall restraint PPE for working at heights (0.838), improper edge protection when working at height (0.828), insufficient display of safety signs (0.822), lack of equipment for working at height (0.822), no on-site monitoring system for workers (0.818), lack of inspection of fall arrest systems (0.684). Lack of fall arrest system PPE while working at height (0.647), no safety harness while working at height (0.622). This component explains 40.719% of the total variation. The lack of fall restraint PPE for working at heights emerged as the key variable for the safety check and PPE factor. This finding aligns with Virtual College (2022), which concluded that the absence of fall restraint PPE increases the risk of falls and can result in fatal accidents. Improper edge protection when working at height was the second-ranked variable, supporting Virtual College’s (2022) assertion that inadequate edge protection significantly increases the risk of falls, making them more likely to be fatal. The insufficient display of safety signs was the third-ranked variable under the safety check and PPE factor. This finding is consistent with TTFS (2022), which highlights that construction sites without proper signage leave workers uninformed of risks and expose employers to serious legal and occupational health and safety challenges. Talab et al. (2013) also noted that safety signs on construction sites not only provide direction but also offer essential protection. Furthermore, Graphic Product (2022) stated that ineffective signage can result from ambiguous language, incorrect placement, or lack of maintenance. The lack of equipment for working at height was ranked fourth, aligning with Tim (2016), who noted that inadequate fall protection is the most common OSHA infraction. This suggests that unless the industry undergoes a significant transformation, compliance issues will persist. Additionally, the study found that there is no on-site monitoring system for workers at heights. This supports Veunex's Safety Solution (2022), which states that serious injuries can occur from ladders, scaffolds, or lifts when no safety monitoring system is in place. The study also uncovered a lack of inspection of fall arrest systems. This finding is consistent with Dillon (2014), who observed that fall protection equipment on many work sites is not inspected frequently enough for wear and damage. Many construction companies fail to recognise that all fall protection equipment deteriorates over time with use and exposure, regardless of the brand or manufacturer.

4.4.2 Component 2. Overloading factors

Component Two of the study, titled "Overloading Factor," consists of four variables: Unskilled crane operator (0.914), improper supervision of working-at-height equipment (0.728), crane carrying more than usual loads (0.668), and overloading working platforms (0.639). This factor accounts for 21.240% of the total variance. Unskilled crane operators were ranked as the top overloading factor that creates risks when operating at heights. This finding aligns with Zajicek's (2022) hypothesis that unskilled crane operators can pose a significant liability for construction companies. They expose other workers to crane hazards such as load slides, collisions near plant facilities, and mismanagement of loads at heights, thereby increasing the risks associated with crane safety. According to HSE (2018), timetable pressure, lack of training, and operator incompetence all contribute to crane-related accidents. Furthermore, the study reveals that improper supervision of working-at-height equipment was ranked second under the overloading factor. This finding is supported by Safety and Health Practitioner (2017), which argued that inadequate supervision of temporary roof scaffolds contributes to worker accidents, leading to severe injuries such as multiple leg and ankle fractures. Additionally, the study found that overloading working platforms is a significant work-at-height risk. Placing excessive weight on a working platform may cause planks to crack or break, a finding consistent with W.S. Safety's (2021) assertion that such practices are hazardous when working at heights. According to Safety Buzz (2022), scaffolds may collapse due to instability or excessive load. A construction company was fined for violating the 2005 Work at Height Regulations after a worker accident resulted from these unsafe practices.

4.4.3 Component 3: Organisational Failures Factor

The component three of the study named organisational failure factor contains four variables: Inadequate planning and hazard assessment (0.836), insufficient training for the task (0.813), inadequate supervision (0.778), improper supervision of installation of working at height equipment (0.488). This factor explains 9.479% of the total variance. Inadequate planning and hazard assessment were rated highly as key organisational failure factors. This finding aligns with OSHA (2016), which states that accidents, illnesses, and injuries at construction sites are primarily caused by a failure to recognise or identify hazards. Insufficient training for the task was the second-highest rated variable under the organisational failure factor. This finding is consistent with ASK Environment, Health, and Safety (2017), which asserts that a lack of training for construction workers on working at heights can be the difference between maintaining success and experiencing failure. Similarly, Tafadzwa et al. (2018) hypothesised that the high incidence of injuries on construction sites is due to inadequate health and safety training among construction employees. Inadequate supervision was ranked third among organisational failure factors. This finding supports Sethunya (2017), who emphasised that supervisors play a crucial role in enforcing proper procedures and work practices to address systemic deficiencies. Ineffective supervision can contribute to a weak safety culture. However, Professional Development Training (2022) countered that poor staff management not only affects work quality and workplace satisfaction but also drives away skilled workers.

4.4.4 Component 4: Personnels Factor

Component four was named personnel factor and this factor include lack of understanding and misbehavior towards team members at construction site (0.828), mental and health problems (0.780), incorrect protection or equipment choices (0.681), ignorance from management (0.620), and unwillingness to change the way a task is carried out (0.605). This factor explains 9.479% of the total variance. Lack of understanding and misbehavior towards team members at construction sites emerged as a key factor under the personnel factor. This finding is consistent with Spillane and Oyedele (2013), who emphasise that cooperation and effective communication among team members at construction sites are essential for identifying hazards and mitigating risks. Additionally, Aulin et al. (2019) supported this by stating that when employees treat one another disrespectfully or communicate poorly, important safety information may not be shared, which can increase risk-taking behaviours. Mental and health problems were ranked second among the personnel factors, aligning with Jim (2024), who highlighted that stress and anxiety can lead to a lack of awareness and increase the likelihood of mistakes. Hennigan and Perry (2023) further argued that individuals experiencing mental health issues may be less able to identify risks or follow safety procedures, leading to an increased risk of accidents. Incorrect protection or equipment choices ranked third under the personnel factor. This resonates with Jacklin (2024), who argued that inappropriate equipment use or poor fall protection selection can give individuals a false sense of security and increase their risk of falling. Hrica et al. (2020) pointed out that an excessively long lanyard, for example, can extend the fall distance and, even with fall protection, result in significant harm. HSE (2023) argued that selecting scaffolding, ladders, or guardrails that are not suitable or do not adhere to safety regulations can lead to instability, collapse, or failure to prevent falls. Ignorance from management ranked fourth in assessing the impact of the personnel factor. This result is consistent with Katie (2017), who hypothesised that inadequate health and safety measures from management can significantly increase the risk of illnesses, accidents, and fatalities, as well as harm a company's productivity, finances, and reputation. The Technical Engineers Group (2021) supported this claim, noting that managers and directors may perceive their work environment as safe and fail to take the necessary precautions to protect employees. Additionally, Katie (2017) argued that management's disregard for safety precautions could result in legal penalties, as the employer has neglected their legal obligation to provide a safe workplace for employees.

4.4.5 Practical and Social Implications

The study suggests that, to safeguard the health and safety of employees, contractors should offer orientation and toolbox talk programs focused on working at height at construction sites to raise workers' awareness of its dangers. Additionally, employers must ensure that employees wear appropriate personal protective equipment when working at height, in accordance with health and safety policies. Educational institutions can develop curricula on health and safety, with a specific focus on safety when working at height.

4.4.6 Limitations

This research is limited to working at height in the building industry within the Akuapem South Municipality and Ga South Municipality in Ghana's Eastern and Greater Accra Regions.

5. CONCLUSION

Given the significant role the construction industry plays in the delivery of sustainable construction projects, one of the key components of the social dimension is the social aspect of health and safety issues. To reduce the frequency of accidents related to construction activities, health and safety practices must be effectively implemented. The goal of this study was to evaluate the risks associated with working at heights in the construction sector. The study identified four factors that put building construction workers at risk when working at heights: the Safety Checks and PPEs Factor, Overloading Factor, Organisational Failures Factor, and Personnel Factor. The factors affecting safety checks and personal protective equipment (PPEs) include the absence of fall restraint PPE for working at heights, inadequate edge protection while working at heights, insufficient display of safety signs, a lack of equipment for working at heights, and the absence of an on-site worker monitoring system. The study's findings on overloading factors include unskilled crane operators, inadequate supervision of equipment used for working at heights, cranes carrying loads heavier than usual, and placing additional loads on working platforms. The study found that poor planning and hazard assessment, inadequate task training, and inadequate supervision were the primary organisational failure factors. Key personnel factors identified by the study include mental and health issues, inappropriate protection or equipment choices, and a lack of understanding and misbehaviour towards team members on construction sites. The building construction sector may find this study valuable. This paper contributes to the body of knowledge regarding working at height in the Ghanaian building construction industry, as there is limited research on the subject. It is crucial for stakeholders in the building construction industry to pay attention to these findings to reduce fatalities related to working at height on construction sites. The study recommended that the government ensure the passage of construction health and safety bills into law to enable the formulation of various policies for accident prevention, including those related to working at height.

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