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Examining the Perception of Site Workers of Their Risk-Taking Behaviours on Construction Sites in Ghana

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Abstract

Purpose – Although many health and safety (H&S) studies have widely examined safety risk perception in the construction industry, few studies have explored how this perception influences site workers' risk-taking behaviours during construction. This study examines how construction site workers perceive and judge safety risks in their risk-taking behaviours for intervention safety policy framework that may encourage safe work.

Design/methodology/approach – The study employed Pictorial-based Q-Methodology, which documented 63 picture scenarios of risk-taking behaviours from building sites and submitted them for validation from H&S inspectors. Thirty-three pictures emerged as having great potential to cause harm. After using these 33 pictures to elicit data from randomised site workers, the study used Frequency Tabulation, Relative Importance Index, and Kruskal-Wallis Test to analyse the collected data. To fully explain the analysed data for deeper understanding, the study conducted Focus Group Discussions with these site workers to share their thoughts on these pictures.

Findings – Two distinctive pictures emerged from these analyses, one showing a risk-taking behaviour likely to contract internal and skin disease and the other likely to fall from height. One of the implications is that construction site workers are unfamiliar with the dangerous contaminants in the materials they use to work, which can potentially harm their skin and internal organs. Hence, they continue engaging in risk-taking behaviours. The other is that they are aware of and can mention catastrophic physical injuries attached to their jobs. However, they continue engaging in risk-taking behaviours because of their safety plights and rely on the favour and mercies of a supreme being as coping strategies to escape from these physical injuries.

Originality/value – This study is original in that it uses picture scenarios of risk-taking behaviours to amass an empirical-based understanding of how site workers perceive and respond to H&S risks during construction. This piece of evidence is missing in the numerous research in this area. Again, the findings contribute to the state-of-the-art literature regarding risk-taking behaviours on construction sites.

Keywords — Construction Site Workers, Risk-Taking Behaviours, Safety Risk Perception; Construction industry; Q-Methodology; Ghana

Paper type: Research paper

1.0 Introduction

Construction site workers' safety risk-taking behaviours are poor working behaviours on sites, such as using defective equipment or tools to work (Adinyira *et al.*, 2020) during construction. These behaviours are contrary to safety rules and regulations, are highly prevalent, and have a great potential to damage properties and cause injuries, illnesses, and deaths on developing construction sites (Musonda and Smallwood, 2008; Chan *et al.*, 2017; Man *et al.*, 2017; Man *et al.,* 2019). Many H&S studies have widely examined and documented varying issues influencing these safety risk-taking behaviours of construction site workers in developing countries ranging from personal and organizational to the behavioural issues of the construction site workers ignoring or accepting safety risks during construction (Furber *et al.*, 2012; Man *et al.*, 2017; Man *et al.*, 2019; Danso *et al.*, 2022).

Despite these documented influences, pieces of H&S literature still urge researchers to increase research to document more influences of these behaviours. One reason is that only a few studies have examined the role of risk perception in explaining the safety risk-taking behaviours of construction site workers (Man *et al.*, 2021). Another reason behind this urge is a backdrop belief that certain constructs, such as culture, can explain how risk perception relates to site workers' risk-taking behaviours during construction. For instance, many H&S researchers believe that culture, including its values and beliefs, may influence the perception, harmony, safety, health, risks, and working relationships of site workers on construction sites in Asia, especially in Hong Kong, Thailand, and Malaysia (Santoso 2009; Chan *et al.* 2015; Mohammad and Hadikusumo, 2019; Khaday *et al.*, 2021). In sub-Saharan Africa, the views and beliefs of many researchers are that the safety risk perception of site workers interacts with their culture and beliefs, and these interactions influence, promote, or motivate site workers to engage in safety risk-taking or unsafe behaviours during construction (Furber *et al.*, 2012; Kheni *et al.*, 2010; Musonda and Smallwood, 2008; Okolie and Okoye, 2012). In these beliefs and views, this study aims to amass empirical evidence to understand and explain how site workers perceive and judge safety risks in the context of their risk-taking behaviours.

Many policymakers and construction H&S researchers, especially those in sub-Saharan Africa, want this empirical-based understanding for safety intervention decisions (Du Plessis, 2001; Danso *et al.*, 2022). For instance, construction site workers' safety risk-taking behaviours in Ghana are high (Adinyira *et al.*, 2020). These safety risk-taking behaviours end up causing accidents, which sometimes lead to the death of construction site workers in the Ghanaian construction industry. Many studies have identified occupational injuries as among Ghana's leading causes of death. For instance, in 2000, construction-related injuries were recorded as a more significant percentage of all occupational-related injuries in Ghana (Amissah *et al.*, 2019). Despite this revelation, little is known regarding the predictive contributing to this burden of occupational injuries among construction workers in Ghana (Amissah *et al.*, 2019). This notwithstanding, Adinyira *et al.* (2020) postulated that there is the potential for safety risk taking-behaviours to play a critical role in such accidents. Currently, in Ghana, very few empirical studies that measure the prevalence and risk factors of accidents are limited to mining, domestic setting, transportation, and manufacturing. Very little is known regarding such risk-taking behaviours in the Ghanaian construction industry. Hence, this study seeks to contribute significantly to the state-of-the-art in this area.

This study used pictures as a strategy to elicit risk perception data to achieve its aim because picture elicitation has become a promising method for studies investigating constructs such as safety risk perception, and the results are accurate and impressive (Schneider *et al.*, 2021; Trillo-Cabello *et al.*, 2021; Kuipers *et al.*, 2022). The novelty of this study primarily rests on how the study was able to use validated pictures to elicit safety risk perception data from randomized site workers in a step-by-step guide. Based on the study's location and its regional context, the study has posed this question to guide and achieve its aim:

> *To what extent do site workers perceive, and judge safety risks and hazards attached to their jobs on construction sites?*

Based on this question, this study examines how construction site workers perceive and judge safety risks in their risk-taking behaviours for intervention policy that may encourage safe work. This study is significant in that an understanding of the risk-taking behaviour of construction workers is essential to enable concerned authorities and construction companies to develop effective safety interventions to reduce construction accidents and fatalities. In addition to contributing to the state-of-the-art global literature on issues regarding risk-taking behaviours on construction sites, the findings also have the potential to expand the knowledge. This expansion covers the concerned authorities and construction companies in countries (especially developing ones) with construction industry settings like Ghana on risk-taking behaviours, which tend to influence health and safety issues of the construction site workforce.

The paper consists of five sections. Section one introduces and discusses the problem that has merited this investigation, while section 2 reviews construction health and safety literature to detail the study's aim and question. Section 3 presents the methods employed for the study. Section 4 presents and discusses the results, while the final section concludes the study.

2.0 Literature Review

The previous section presented a research gap that has given rise to the need for this study. This section reviews construction H&S literature to provide the full details of this identified gap. The section starts the review with H&S issues in Ghana's construction industry. Next, the section presents a brief overview of safety risk-taking behaviours in the construction industry in general, safety risk perception and risk-taking behaviours in the global context, and safety risk perception and risk-taking behaviours on construction sites in sub-Saharan Africa. The section ends the review with lessons for additional research.

2. 1 The Ghanaian Construction Industry and Health and Safety

The construction industry significantly contributes to Ghana's social development and economic growth, such that the industry's current contribution to employment is 7% of the total working population, and the Gross Domestic Product is 13.7% (Boadu *et al.*, 2020). Despite its socio-economic contributions, the construction industry continues to be one of Ghana's most dangerous and ill-reputed industries, with high accident numbers of 216 fatal and 846 nonfatal injuries among construction site workers from 1998 to 2008 (Danso *et al.,* 2015; Kheni *et al.,* 2008). Notably, one of the influences of these many accidents is the construction site workers' safety risk-taking behaviours. Pieces of construction H&S literature also mention safety risk perception as one of the critical influences of these behaviours on Ghana's construction sites (Danso *et al.,* 2022).

2. 2 Risk-Taking Behaviours and Safety Risk Perception: An Overview

Construction site workers' safety risk-taking behaviours are working behaviours on sites contrary to safety rules and regulations, such as improper use of or no safety equipment or using defective equipment or tools to work during construction (Adinyira *et al.,* 2020; Man *et al.*, 2017). These behaviours are highly prevalent and are potential threats as they damage properties and cause injuries, illnesses, and deaths on construction sites in Asia and Africa *(Musonda and Smallwood, 2008; Chan et al.,* 2017; Man *et al.,* 2019). One of the causal conditions influencing these behaviours of site workers is their safety risk perception (Furber *et al.,* 2012). Risk perception is the judgement people, like site workers, make about hazardous activities or safety risks on construction sites (Slovic, 1987). Many H&S researchers seek a study that thoroughly examines this risk perception's role in explaining construction site workers' risk-taking behaviours (Man et al., 2021).

2. 3 Safety Risk Perception and Risk-Taking Behaviours in The Construction Industry: The Global Context

Four different H&S studies have emerged on construction sites in Thailand and Hong Kong, and these studies have suggested that safety risk perception and construction site workers' risk-taking behaviours have a relationship (Man *et al.,* 2017; Khaday *et al.,* 2021; Man *et al.,* 2019, 2021). This relationship inversely influences accidents on these construction sites. For instance, Khaday *et al.* (2021) and Man *et al.* (2021) found that the safety risk perception of Thai and Hong Kong site workers has four distinctive dimensions, and affective safety risk perception ranks high among the four. This affective safety risk perception is also called a personal factor, consisting of worries and feelings of site workers about negative risky scenarios or adverse outcomes (Khaday *et al.,* 2021; Man *et al.,* 2021). Discussions on this personal factor suggest that site workers with highly affective safety risk perception or who fear the negative outcome of taking risks tend to engage in no or fewer risk-taking behaviours (Khaday *et al.,* 2021; Man *et al.*, 2021). The implication is that site workers in Hong Kong and Thai construction sites with low affective safety risk perception or who are not afraid of any adverse outcome cause numerous accidents and fatalities on Hong Kong and Thai construction sites (Khaday *et al.,* 2021; Man *et al.*, 2021). To Man *et al.* (2021), this high level of affective risk perception of site workers can be combined with a series of safety training and virtual reality (VR) technology to serve as an effective intervention for reducing the risk-taking behaviours of these site workers. In turn, this combination will reduce the high number of accidents and fatalities on Hong Kong's construction sites (Man *et al.,* 2021). In addition, Man *et al.* (2021) found inadequate safety training as a construction organisational factor that significantly affects site workers' risk-taking behaviours on construction sites in Hong Kong. Before the findings of Man *et al.* (2021), Mohammad and Hadikusumo (2019) had observed that the construction organisations in Asia, especially those in Malaysia, have a safety culture comprising shared similar values and beliefs. These play a central role in the safety behaviours of the employees in the organisations, such as site workers. These mutually shared values and beliefs form a control system to produce a distinctive behavioural standard among any group of people in these organisations, including construction site workers (Mohammad and Hadikusumo, 2019). For decision-makers in these organisations to produce behavioural standards to address risk-taking or unsafe behaviours of site workers, such as non-compliance to safety rules, Mohammad and Hadikusumo (2019) suggested safety training that considers a behavioural change approach based on a culture of beliefs. By these construction organisations adopting this culture belief-based approach, site workers will be encouraged to work safely (Mohammad and Hadikusumo, 2019). Mohammad and Hadikusumo (2019) drew their cultural belief-based suggestion from the studies of Santoso (2009) and Chan et al. (2016). To these studies, values, rituals, superstitions, religion, and belief issues on construction sites in Hong Kong and Brunei are not trivial, but they are essential aspects of culture that may influence harmony and working relationships in the construction environment (Santoso, 2009; Chan *et al.*, 2016). They are also essential aspects of culture that need careful consideration because they can have a constructive working and living environment in a multicultural project (Santoso, 2009).

2. 4 Safety Risk Perception and Risk-Taking Behaviours in The Construction Industry: The African Context

Many researchers have studied risk perception in the construction industry in sub-Saharan Africa. However, very few studies exist with qualitative findings to explain how safety risk perception can influence construction site workers' risk-taking behaviours. These qualitative findings centre on the relationships between safety risk perception, risk-taking behaviours, safety awareness, cultures, and beliefs of construction site workers. For instance, a study mentioned that the perception of construction site workers about safety risks informs these workers to make decisions about safety risks (Musonda and Smallwood, 2008). These decisions, however, influence site workers' risk-taking behaviours (Musonda and Smallwood, 2008). After using observations, reflections, and recordings as research strategies, the study narrated and emphasized that the risk-taking behaviours of site workers are highly prevalent on construction sites in developing African countries like Botswana (Musonda and Smallwood, 2008). The study also narrated construction site workers' working and observable behaviours as site workers not wearing the required hand gloves while using or carrying sharp tools and objects (Musonda and Smallwood, 2008). The others are site workers not wearing hard hats, using hand power tools without eye protection and guards, scaffolding without guardrails or toe boards, and working without physical protection from falling objects (Musonda and Smallwood, 2008). All these poor working and observable behaviours indicate that safety awareness among construction site workers is very shallow (Musonda and Smallwood, 2008).

Okolie and Okoye (2012) have also narrated the existence of a link between safety risks, perception, and cultural variables on Nigerian construction sites. These cultural variables, such as values and beliefs, interface with site workers' attitudes towards safety risks and risk perception (Okolie and Okoye, 2012). With minimal explanations and without the involvement of site workers, Okolie and Okoye (2012) mentioned that these cultural variables may promote unsafe behaviours, perceptions, and attitudes of site workers towards safety on Nigerian sites.

Furber *et al.* (2012) also employed reflections, observations, and interviews to conduct an H&S study on construction sites in Ghana. The researchers found many risk-taking behaviours of site workers ranging from working on a roof structure without safety harness systems to working in deep trenches without earth support. The other behaviours include site workers manually lifting and handling heavy objects, working with wet concrete and mortar without protective materials and working in poor housekeeping environments (Furber *et al.*, 2012). The researchers interviewed and discussed with the site workers to find out why site workers continue to work on dangerous construction sites. Responses suggested that some site workers have a behavioural problem with ignoring or accepting safety risks and hazards attached to their jobs. Others hardly recognize safety risks or hazards associated with their jobs (Furber *et al.*, 2012). The site workers willingly engaged in risk-taking behaviours instead of avoiding or mitigating these safety risks and hazards (Furber *et al.*, 2012). After observing their work procedures, listening to their conversations regarding H&S issues and reflecting on their responses, Furber *et al.* (2012) noticed that site workers engage in risk-taking behaviours of the influences of either the site workers: (a) are unable to perceive safety risks and hazards associated with their jobs; or (b) have a poor understanding of safe work practices and procedures; or (c) have poor knowledge of the H&S legislative requirements; or (d) are not provided with personal protective equipment (PPE); or (e) lack of awareness of risks and dangers associated with their jobs during construction. In these uncertain influences, Furber et al. (2012) narrated and emphasized that site workers engage in risk-taking behaviours by influencing how they perceive risks and hazards. The researchers mentioned a few challenges they faced during their study, including data analysis and discussions (Furber *et al.*, 2012). One of these challenges was the appropriate method to explicitly categorise and communicate the researchers' identified safety risks and hazards to the site workers (Furber *et al.*, 2012). The other was that the researchers were unsure of the accuracy of a coding system they had developed and efficiency in analysing the site workers' words, phrases, or sentences concerning the researchers' identified hazards and risks (Furber *et al.*, 2012). The researchers developed and used descriptive coding that considered the perception of the researchers concerning hazards and safety risks without site workers (Furber *et al.*, 2012). These researchers reported that this descriptive coding, including the numerous methodological problems they faced, presented a situation that made them less efficient in thoroughly investigating how site workers perceive and judge safety risks and hazards during construction (Furber *et al.*, 2012).

Regarding the influence issues of PPE raised by Furber *et al.* (2012), a descriptive study had earlier narrated why almost all the construction site workers in Ghana do not use PPE (Kheni, 2008). According to Kheni (2008), three employers exist on sites, and their safety attitudes and actions influence site workers to engage in risk-taking behaviours. The first group provides insufficient PPEs such that only a few site workers have access to PPEs (Kheni, 2008). The second group provides substandard PPEs, which inflict discomfort. Thus, only a few site workers can use such PPEs during construction (Kheni, 2008). The third group of employers hardly provide PPEs to site workers during construction (Kheni, 2008). For these poor safety actions, it is widespread to find almost all site workers not using PPEs such as safety boots and helmets or hard hats, mask filters, hand gloves, working gear, fall arrest systems and others during construction (Kheni, 2008). To Kheni (2008), all these site workers are vulnerable to various adverse effects concerning occupational health and safety. In addition, these site workers are unlikely to demand quality or complain about the unavailability of PPEs because of their economic conditions (Kheni, 2008). There is a perceived understanding among construction employers that site workers must find ways to safely work while meeting their economic needs (Kheni, 2008).

2. 5 Lessons For Additional Research

This review found knowledge gaps, and it has summarised these gaps as follows: numerous construction H&S researchers have examined and documented the influences of site workers' risk-taking behaviours in developing countries, and these range from personal and organizational factors to the behavioural problems of site workers ignoring or accepting safety risks and hazards attached to their jobs during construction (Musonda and Smallwood, 2008; Furber *et al.,* 2012; Man *et al.,* 2017; Man *et al.,* 2019). Others have also suggested measures to mitigate these influences, such as safety training based on cultures of belief (Mohammad and Hadikusumo, 2019).

Despite all these documented influences and their suggested mitigating measures, extant H&S literature still urges researchers in developing countries like Asia and Africa to increase research attention to document more influences. Two reasons may have occasioned this urge. First, although many studies have examined safety risk perception in the construction industry, few studies have examined the role of safety risk perception in explaining the safety risk-taking behaviours of construction site workers (Man *et al.,* 2021) in developing countries. Hence, the belief is that there could be more factors of safety risk perception, such as safety attitudes of site supervisors and co-workers, that may influence construction site workers' risk-taking behaviours (Man *et al.,* 2017). The other reason behind this urge is a background belief that certain constructs, such as culture, can explain how risk perception relates to site workers' risk-taking behaviours during construction. For instance, some researchers believe that culture, including its values and beliefs, may influence the perception, harmony, safety, health, risks, and working relationships of site workers on construction sites in Asia, especially those in Hong Kong, Thailand, and Malaysia (Santoso, 2009; Chan *et al.,* 2015; Mohammad and Hadikusumo, 2019; Khaday *et al.,* 2021). In sub-Saharan Africa, the views and beliefs of many H&S researchers are that the safety risk perception of site workers interacts with their culture and beliefs, and these interactions influence, promote, or motivate site workers to engage in safety risk-taking or unsafe behaviours during construction (Furber *et al.*, 2012; Kheni *et al.*, 2010; Musonda and Smallwood, 2008; Okolie and Okoye, 2012). In these beliefs and views, this study aims to amass empirical evidence to understand and explain how site workers perceive and judge safety risks in the context of their risk-taking behaviours, given their diverse religious and cultural backgrounds (Kheni *et al.,* 2010; Adinyira *et al.,* 2020). Some construction H&S researchers have suggested a perception survey as an appropriate strategy to collect and address behavioural issues involving safety risk perception (Hallowell, 2010; O'Toole, 2002). To these H&S researchers, a perception survey generally allows employees in organisations, such as site workers, to provide differences in their perception of safety risks and attitudes concerning H&S risks (Hallowell, 2010; O'Toole, 2002).

3.0 Research Method

Construction sites face many safety risk perception problems. Studies that have successfully solved some of these problems involving construction professionals and H&S experts employed photographic images or pictures to collect accurate perception data (Zhang et al., 2015; Trillo-Cabello et al., 2021). Motivated by the accuracy of its results on perception data, this study used Pictorial-based Q-Methodology to amass empirical evidence to understand how site workers perceive and judge safety risks during construction works.

Picture elicitation has become a more promising method and solution to quantitative studies exploring employees' cultures and safety risk perception (Schneider *et al.,* 2021; Trillo-Cabello *et al.,* 2021; Kuipers *et al.,* 2022). This study used pictures to elicit perception data from varying groups of site workers with diverse religious beliefs and cultural backgrounds. Thus, the study anticipates successful and accurate results, just like Zhang *et al.* (2015) and Trillo-Cabello *et al.* (2021). Following these motivations, the study adopted Q-Methodology. The Q-Methodology combines the strengths of quantitative and qualitative research to investigate the judgments, cognitive structures, attitudes, and perceptions to represent the clear and precise views of a defined population (Milcu *et al.*, 2014; Zhang *et al.*, 2015; Kirschbaum *et al.*, 2019; Sneegas, 2020). In Q-studies, safety risk perception researchers primarily reference Q-Methodology as Pictorial-Base Q-Methodology when using pictures or photographs to collect data for their studies (Milcu *et al.*, 2014; Zhang *et al.*, 2015). Pictorial-Base Q-Methodology identifies a population with similar thinking on issues by sorting pictures or photographs related to the issue under investigation (Milcu *et al.*, 2014; Zhang *et al.*, 2015).

Five stages are involved in the Q-Methodology. The first stage is the **concourse**, where Q-Researchers collect statements or views from credible sources, such as opinions, pictures, or objects, to represent the population's views about the issue(s) under investigation (Chang *et al.*, 2019; Sneegas, 2020). The second and third stages involve the selection of **Q-Sets** and **P-Sets**. Q-Sets are validated statements, photographs, or pictures developed from the concourse, while P-Sets are participants who provide statements or view pictures for responses (Gilbert Silvius *et al.*, 2017; Sneegas, 2020). The fourth stage models the view of the P-Set by sorting **(Q-Sort)** and ranking Q-Sets on a predefined Q-Sort grid (Chang *et al.*, 2019). The fifth stage is **Q-Analysis,** where researchers use the PQ-Method programme to analyse the collected data (Kirschbaum *et al.*, 2019). The methodology of this study is presented under these five stages as follows:

3.1 The Pictorial Concourse

Many H&S studies have researched critical scenarios of site workers' risk-taking behaviours that can cause injuries, illness, and deaths on construction sites (Khaday *et al.,* 2021; Perlman *et al.*, 2014). The following are some of the critical scenarios these studies listed: (a) working on the scaffold without railing or unprotected edges; (b) working on an improvised platform; (c) working with exposed electric wires of hand-powered tools; (d) working on a construction site without safety shoes; (e) not wearing protective gloves when gripping chemicals or painting surfaces; and (d) working in a dusty workplace without wearing nose mask (Khaday *et al.*, 2021; Perlman *et al.*, 2014). This study used these scenarios only as credible research sources and took the same or similar pictures from ongoing construction sites in Ghana. The study used these picture scenarios as Q-Sets to elicit perception data from P-Sets after being validated by some experienced health and safety practitioners.

3.2 The Q-Sets

The researchers of this study spotted and took sixty-three pictures of the above-listed risk-taking behaviours scenarios and excluded the repeated and blurred ones, resulting in forty-four picture scenarios. These forty-four picture scenarios were sent to health and safety practitioners in the Department of Factories Inspectorate under the Ministry of Employment and Labour Relations for validation. This department is mandated to carry out health and safety inspections and is endowed with experts to maintain health and safety standards on construction sites in Ghana. A panel of three trained and experienced field safety inspectors helped to validate the 44 picture scenarios. When the researchers of this study sent these picture scenarios for this validation, these three-panel members were the only ranking field inspectors present at the department. The others were out carrying inspections. Moreover, these three inspectors had significant field inspection experience concerning construction health and safety issues. Their years of inspection experience were thirty, twenty-five, and twenty-nine. The validation was done based on the criteria adapted from Weyman and Clarke (2003) and modified. The modified criteria included the following:

1. The health and safety practitioners were to exclude picture scenarios showing the same or similar risk-taking behaviours;
2. Each picture scenario must clearly show actual risk-taking behaviour likely to cause harm or injury; and
3. The health and safety practitioners must also select picture scenarios that will be easier for P-Sets (survey participants) to understand with a quick and straightforward look.

After the validation, thirty-three (33) picture scenarios emerged as an appropriate concourse for the study to make progress in eliciting safety risk perception data from P-Sets. The study printed more of these validated pictures to have 264 survey picture scenarios and produced eight (8) sets of Q-Albums with these 264 picture scenarios. The reason for these 264 pictures is that there would be 8 P-Sets at each survey construction site. Each P-Set must have and use a Q-Album containing the 33 validated picture scenarios (i.e., 8 Q-Album x 33 picture scenarios = 264). The study coded the 264 picture scenarios with unique numbers like that proposed by Zhang *et al.* (2015). The numbering did not follow the regular sequential order of 1, 2, 3 and on. This unique numbering differentiated those on the Q-Sheets. The use of the Q-Album is significant because construction site workers in Ghana exhibit low literacy levels (Kheni *et al.*, 2010). Thus, by merely looking at these picture scenarios in the album, they can better capture and accurately judge the depicted risk-taking behaviours in the survey picture scenarios. These judgements would help them to rightly sort the picture scenarios onto Q-Sheet with little explanation rather than if the researchers of this study had presented the risk-taking behaviours in a textual form.

3.3 The P-Sets

The population for this study was D1K1 construction firms in Ghana. The reason for choosing these firms was that when it comes to the classification of construction firms in Ghana, D1K1 firms are the topmost with outstanding financial capabilities (Agyekum *et al.*, 2018). Therefore, one would expect that such top-class construction firms in Ghana must have invested heavily in safety materials for their site workers' well-being and have well-laid-down health and safety management systems. Due to their numerosity in Ghana, it would take much work to settle on a particular number of these D1K1 firms. Hence, the study employed a non-probability sampling technique, i.e., a purposive sampling technique, to select a reasonable number of these firms. With this reasonable number as a target, the study set a selection criterion: the selecting firms for the survey must have three or more construction sites and actively engage in construction activities across Ghana at the time of the study. Three firms emerged from this criterion, and the study selected their construction sites as project survey sites. Each of these three D1KI firms was actively engaged in construction activities at four different sites. Hence, the study gathered data from 12 construction sites owned by these three D1KI firms.

There were different classes of workers within each construction site under study, herein referred to as the P-Sets. Again, this study used a non-probability sampling approach (i.e., purposive) to select the P-sets from these twelve sites operated by the three D1K1 firms under study. The study purposively selected four groups of P-Sets, i.e., masons, painters, carpenters, and electricians, as its general and investigating population because these varying groups of artisans are majority vulnerable to illnesses, injuries, disabilities, and deaths on construction sites (Cotton *et al.*, 2005; Danso *et al.*, 2022). In addition, they are the most skilful construction artisans on Ghana's construction sites (Danso *et al.*, 2022). As these varying artisans are the majority vulnerable on sites, the expectation was that they could better explain their safety situation and answer the survey questions concerning their risk-taking behaviours (Danso *et al.*, 2022). These four groups of P-sets are in each of the 12 active sites under consideration, and each group has numerous sub-workers. For instance, for each of the 12 sites, there are a good number of masons, painters, carpenters, and electricians. The study randomly selected twenty-four (24) sub-workers from these four P-sets. For instance, each of the twelve sites has a masonry group, i.e., 12 masonry groups. The study randomly selected two masons from each site and did the same across all 12 sites (i.e., $2 \times 12 = 24$ masons). The study also did the same randomisation for the remaining three groups of P-Sets (i.e., $2 \times 12 = 24$ painters, $2 \times 12 = 24$ carpenters, $2 \times 12 = 24$ electricians). Hence, the four varying groups of site workers comprising painters, carpentry, and electrical had 24 P-Sets per group. In brief, the study selected 96 P-sets (i.e., 24 × 4 = 96) as the survey participants from the 12 sites operated by three D1K1 construction firms.

3.4 Pictorial Q-Sorting Exercise

The study designed five grided columns of a rating scale that ranged from -2 to +2 (Table 1), and this grided column is consistent with Zhang *et al*. (2015). The selected P-Sets were supplied with Q-Materials and undertook Q-Sorting exercises during the data collection. The materials included a Q-Sheet — five columns grided sheet having a rating scale of – 2, – 1, 0, + 1 and + 2 (Table 1; pictures 1 and 2).

INSERT TABLE 1

This study named these arithmetic numbers as insignificant (-2), minor (-1), moderate (0), major (1), and catastrophic (2) injury potentials, with the moderate injury potentials serving as neutral points. Another supplied material for data collection was label stickers — adhesive papers with numbers written to correspond with the codes on the survey picture scenarios (see pictures 1 and 2). The last supplied survey material was eight Q-Albums developed from the 264 validated picture scenarios (see pictures 1 and 2). Each Q-Album had sixteen pages, with each page having two sets of validated picture scenarios, except the last page, which had a picture scenario. The researchers of this study guided all the P-Sets by demonstrating, explaining, and instructing them with step-by-step procedures of judging and sorting the survey picture scenarios onto the Q-Sheets. The step-by-step procedures were these: First, each P-set critically examined the depicted risk-taking behaviours in the coded survey picture scenarios by looking. Second, each P-set made an independent judgement of whether these depicted risk-taking behaviours would result in an insignificant, minor, moderate, major, or catastrophic injury or harm if an accident occurred. Third, each P-Set matched the codes on the survey picture scenarios to correctly find their corresponding written numbers on the adhesive papers. Fourth, each P-Set carefully removed the matched adhesive pieces of paper from their respective locations on a pad and fixed them to preferred scale-rated columns on the Q-Sheets to represent their thinking and judgment. The researchers of this study repeated these step-by-step procedures and collected risk perception data on all twelve survey construction sites. This exercise at every site was allowed during the one-hour lunch break for site workers. Pictures # 1 and # 2 display Q-Albums, Q-Sorted sheets, and pieces of label stickers.

[INSERT PICTURE 1]
[INSERT PICTURE 2]

Before the sorting began at each of the 12 survey sites, the researchers first demonstrated the step-by-step procedures with in-depth explanations of how P-Sets (site workers) should judge and sort pictures onto the grided sheet (Q-Sheet). With these demonstrations and in-depth explanations, the researchers of this study expected all the randomized P-Sets to sort the survey pictures within their one-hour break quickly and rightly. However, nine (9) of the 96 survey P-Sets wrongly fixed some of the coded adhesive pieces of paper to scale-rated columns on the Q-Sheets. These nine P-Sets comprised electricians = 5, painters = 3, and masons =1. These sheets with wrongly fixed adhesive papers were excluded and discarded during the Q-Analysis to retain 87 Q-Sheets. This numerical value of 87 became the study's final sample size instead of 96 and was also the unit for Q-Analysis.

Table 2 summarises the demographic information of the 87 P-Sets used for the Q-Analysis. The results in Table 2 show that construction carpenters (24, 27.59%) and masons (23, 26.22%) were almost the same in numerical quantities. Painters (21, 24.14%) are slightly more than electricians (18, 20.69%). Of the 87 site workers, 25 (29%) have worked between 11 to 15 years on different sites. 21 (24%) and 15 (17%) of the site workers have worked on sites between 6 to 10 years and 16 to 20 years, respectively. 12 (13%) have worked on sites for over 20 years. The results further show that majority (87%+) of the survey site workers tend to be skilled artisans, with little over 12% as apprentices (Table 2). The total number of survey site workers aged 26 to 30 was 17 (19.5%, Table 2). Those in 31 to 35 years were 14 (16.1%). Those aged 36 to 40 were numerically the same (12, 13.8%) as those between 21 and 25. The highest (26, 29.5%) were those between 41 to 55 years. The lowest (3, 3.4%) were those between 56 and 60 years and those above 60 (3, 3.4%) years (Table 2). Almost all the survey site workers (95.5%) were Christians, and the combined other religions were 4.5%.

INSERT TABLE 2

3.5 Q-Analysis

Contemporary Q-Risk perception researchers in construction studies usually use non-parametric alternatives such as Kruskal-Wallis to perform Q-Analysis after using pictures or photographs to elicit responses depicting risks and hazards. For instance, Zhao *et al.* (2016) employed Kruskal-Wallis to explore whether discordance in risk perception exists between 4 varying construction professionals of architects, contractors, safety professionals, and engineers. To these researchers, the analysis performed with Kruskal-Wallis accurately tested and helped reach a high level of consensus on risk perception between the architects and constructors (Zhao *et al.*, 2016). Tixier *et al.* (2014) also used Kruskal-Wallis to test the emotional differences in risk perception between graduate and undergraduate students. The researchers suggested through a Kruskal-Wallis test that there was no statistical difference in risk perception between these two distinct groups of students (Tixier *et al.*, 2014). This study also appraises how four distinct site workers (masons, painters, carpenters, and electricians) perceive and judge safety risks during construction. Driven by the high yielded test results (Tixier *et al.*, 2014; Zhao *et al.*, 2016), this study also employed the Kruskal-Wallis Test as one of its analytical tools and obtained high yielded results. In addition, Pallant (2011) mentions Kruskal-Wallis as a robust test that could accurately perform a one-way between-groups analysis of variance. It can also compare the scores on continuous variables for three or more distinct groups of people (Pallant, 2011), such as masons, painters, carpenters, and electricians.

3.6 Focus group discussion

The study conducted Focus Group Discussions (FGDs) with the randomised survey site workers in a native language concerning pictures. The FGDs were conducted by the study this way. At the end of every Q-Sorting exercise, the researchers would ask the eight randomised P-Sets (see section 3.3) to share their views based on the decisions that influenced them to judge and sort the survey pictures onto the gridlines. The study repeated the sharing of these views on the survey pictures at all 12 survey construction sites. By this strategy, almost all the randomised 96 P-Sets shared their views though few remained silent during discussions but were cheering up the outspoken ones. One of the critical reasons for conducting FGDs is that many H&S researchers have suggested that local cultures have a great potential to influence people's viewpoints and perspectives, including the risk-taking behaviours of construction site workers (Milcu *et al.*, 2014; Danso *et al.*, 2022). The other reason is that these discussions may reveal why the construction site workers continue to engage in risk-taking behaviours during project execution. The study used a tape recorder to elicit native language perception data from these discussions. After repeatedly listening to the tape, the researchers transcribed, translated, and documented these data in English. They could do all these because they were fluent in speaking and writing the native language. The repeated tape listening ensured accuracy in transcribing and translating these perception data. To ensure much more accuracy without losing vital perception data, the researchers sent the tape-recorded to the Ghana Institute of Languages and School of Translators, Accra, Ghana, for cross-transcribing and translation. Using the native language in the FGDs resolved the confronting illiteracy challenges among the site workers. Thus, the randomised and survey site workers freely shared their H&S knowledge on the most judged and sorted pictures.

4.0 Results

This section presents the results from the analysed data. For a more straightforward and more profound understanding of the emerged results on the Q-Sets (survey pictures), the section presents the descriptive analyses of judged and sorted pictures with a high frequency of perceived catastrophic and major injury potentials (i.e., frequencies greater than 30) and insignificant and minor injury potentials (i.e., frequencies greater than 30).

4.1 Descriptive Analyses

In brief, the study employed Frequency Counts, Relative Importance Index (RII) and Kruskal-Wallis Test to analyse the collected safety risk perception data.

4.1.1 Q-Sets: Survey Pictures

The study also employed Frequency counts to analyse Q-Sets (survey pictures). Table 3 displays an overview of the frequency count analysis results of all 33 pictures depicting the risk-taking behaviours of site workers.

INSERT TABLE 3

4.1.2.1 Perceived Major and Catastrophic Injury Scale Items

Six of the 33 analysed survey pictures were the most noticeable and frequently counted pictures of perceived major and catastrophic injury potentials (Table 3). Figure 1 graphically shows the number of P-Set who judged and sorted these six noticeable pictures. Table 4 briefly describes the first six pictures perceived as major and catastrophic injury potentials.

INSERT TABLE 4

As revealed in Figure 1, the risk-taking behaviour depicted in picture # 43 (i.e., erecting roof trusses without fall arrest systems, Table 4) scored a remarkably higher frequency value concerning perceived catastrophic injury rating (66). This picture is followed by picture # 13 (i.e., a scaffolder without falling arresting systems, Table 4), with a rating of 56.

INSERT FIGURE 1

Next was picture # 30 (i.e., painting with a scaffold with loose and missing footboards and handrails, Table 4), with a rating of 54. Picture # 32 (i.e., transporting concrete with buckets on the improvised scaffold without PPE, Table 4) emerged with a counting score of 53. Followed was picture # 73 (i.e., a roofer on the scaffold without guard rails, Table 4), with a rating of 45. Picture # 11 (i.e., a moving dumper with a blocking object, Table 4) emerged last with a low-frequency rating of 39. This part of the analysis shows that picture # 43 has emerged in prominence based on its noticeable high-frequency value.

4.1.2.2 Relative Importance Index of Pictures with Major and Catastrophic Potentials

Table 5 summarises scores from the Relative Importance Index (RII). It displays the test results of these six pictures with high-frequency counts.

INSERT TABLE 5

As shown in Table 5, picture # 43 (i.e., erecting roof trusses without fall arrest systems) emerged 1st with a higher RII value of 77.59. Picture # 43 has also emerged first and is significant in this index rating with a high value. It ranks ahead of picture # 30 (RII = 62.1, i.e., painting with a scaffold with loose and missing footboards and handrails), picture # 13 (RII = 57.5, i.e., a scaffolder without falls arresting systems), and picture # 32 (RII = 56.3, i.e., transporting concrete with buckets on the improvised scaffold without PPE).

4.1.2.3 Perceived Insignificant and Minor Injury Scale Items

Table 6 describes the four noticeable pictures from the frequency analysis (see Table 3). In the thinking of the survey site workers, these pictures depict risk-taking behaviours that are likely to result in an insignificant and minor injury or harm if an accident occurs. The full descriptions of these pictures in Table 6 include (a) a concrete mixer operator batching cement without a nose pad and hand gloves (Picture # 37); (b) a carpenter exposed to biological agents such as ants or a snake bite (Picture # 19); (c) a painter sanding a wall surface without mask filter (Picture # 17); (d) painting without mask filter and hand gloves (Picture # 44); and (e) a labourer sweeping dust without nose pad (Picture # 75). Figure 2 visually depicts the frequency counts of these five pictures, while Table 6 presents their relative importance index values.

INSERT TABLE 6, INSERT FIGURE 2, and INSERT TABLE 7

As revealed in Figure 2 about the perceived insignificant and minor injury rating response, the risk-taking behaviour depicted in picture # 44 (i.e., painting without mask filter and hand gloves) scored a higher value (45) compared with picture # 19 (41), picture # 17 (36) and picture # 75 (33). The Relative Importance Index also ranked picture # 44 1^{st} with a low RII value of -47.7 (Table 7). Picture # 44 has drawn attention to its depicted risk-taking behaviour by its emerging value. This significant value has made the picture prominent among the other pictures depicting insignificant and minor injury potentials (Table 7).

4.2 Nonparametric Q-Analysis

This section presents and interprets the Kruskal-Wallis Test results on the perceived major and catastrophic injury scale items and that of insignificant and minor injury scale items. Tables 8 and 9 present these emerging test results.

[INSERT TABLE 8]

[INSERT TABLE 9]

From Tables 8 and 9, the Kruskal-Wallis Test did not find any significant difference in common perception and judgements on the risk-taking behaviours depicted in both pictures # 43 and # 44 across the four varying groups of the P-Sets (picture # 43, $\chi 2$ (3, n = 87) = 3.33, p = 0.344; picture # 44, $\chi 2$ (3, n = 87) = 3.00, p = 0.391). Figure 3 visually shows the positions of pictures # 43 and # 44 when they were counted and ranked to fit this result together with the earlier ones for further discussion. Table 10 also shows the combined test results of these two different pictures, starting from their frequency counts and followed by their relative importance index and their Kruskal-Wallis Test.

[INSERT TABLE 10]

[INSERT FIGURE 3]

From the test results presented in Table 10 and Figure 3, the most consistent interpretation that empirically distinguishes picture # 43 (i.e., erecting roof trusses without fall protection equipment) and picture # 44 (i.e., painting without mask filter and hand gloves) from the other pictures in the group are as follows. With its high-frequency count (76%) as well as a high relative importance index value (RII =77.6) and no significant difference (p = 0.334), picture # 43 has gained high prominence among the survey pictures with its catastrophic injury potential. This survey picture # 43 has also been commonly perceived, judged and sorted by all the survey site workers as having the direst risk-taking behaviour that could result in a catastrophic injury or harm if an accident occurs. By its frequency count (i.e., 46%) and with low relative importance index value (i.e., RII = 47.7) and no significant difference in risk perception (p = 0.391), picture # 44 has also gained high prominence in the survey pictures with its insignificant injury potentials. The survey site workers have also commonly perceived, judged and sorted this picture as depicting a risk-taking behaviour likely to result in an insignificant injury or harm if an accident occurs.

5.0 Discussion

Section 4 of this study analysed perception data using 33 validated picture scenarios, of which two picture scenarios emerged first from their respective analyses. This section discusses these two picture scenarios in the context of construction health and safety after the section has briefly discussed the implications of the demographic information of the survey site workers and the concerns that have given rise to this study.

Construction health and safety researchers are to find more influences of site workers' safety risk perception on their risk-taking behaviours. The likely reason is that many researchers have viewed that certain constructs, such as cultural values and religious beliefs, may have relationships with the safety risk perception of site workers. These constructs may also influence site workers to engage in risk-taking behaviours on Asian and African construction sites (Musonda and Smallwood, 2008; Santoso, 2009; Chan *et al.*, 2015; Furber *et al.*, 2012; Okolie and Okoye, 2012; Mohammad and Hadikusumo, 2019; Khaday *et al.*, 2021). This study examined how site workers perceive and judge safety risks in their risk-taking behaviours to suggest safety policies that may encourage safe work.

In achieving this aim, the study used picture scenarios of risk-taking behaviours to elicit perception data from randomized site workers on some selected building construction sites in Ghana. It also elicited demographic data about these workers and employed Frequency Counts and Tabulation, Kruskal-Wallis Test, and the Relative Importance Index to analyse all the collected data.

The demographic test result suggests that almost all (95.50%) survey participants or site workers were Christians. Most (53.81%) of these site workers were masons and carpenters. Many (28.7 %) of these have worked between 11 to 15 years on different project sites, and most (87%+) tend to be skilled artisans. Many (29.9 %) have their ages between 41 to 55 years. Numerous modern H&S researchers call some of the emerged demographic information of this study socio-occupational variables, especially those relating to age and working experience (Trillo-Cabello *et al.*, 2021). Trillo-Cabello *et al.* (2021) found that construction safety experts aged between 33 to 55 usually perceive the highest risks that can cause severe consequences of construction accidents. On the contrary, this study's survey participants are not construction safety experts, but they are skilled artisans with more than 11 years of site working experiences and are more than 41 years of age. With their artisanal skills, long working years of experience in sites, and maturity, these site workers were able to perceive correctly, judge, and discuss the highest risks associated with the risk-taking behaviours depicted in all the survey picture scenarios, especially those in pictures # 43 and 44.

The analyses yielded pictures # 43 and 44 as criteria for marking progress to understand why site workers continue to engage in risk-taking behaviours during construction. Picture # 43 shows risk-taking behaviours that may result in falling from a height of about 3 meters to a concrete floor.

The analyses yielded this picture with a high-frequency count (76%), high relative importance index value (77.6), and no significant difference in perception of its depicting risk-taking behaviours (p = 0.334). This picture gained a high prominence among the other survey pictures with these empirical characteristics. Picture # 44 shows risk-taking behaviour that may result in contracting a skin disease. The analyses also yielded this picture with a high-frequency count (46%), low relative importance index value (47.7), and no significant difference in perceived risk-taking behaviour (p = 0.391). This picture gained a high prominence among the other picture scenarios because of these empirical values and characteristics. In brief, the analyses yielded two prominent scenarios of site workers' risk-taking behaviours that have injury potential, and pictures # 43 and # 44 depict these two prominent scenarios.

[INSERT PICTURE # 43]

[INSERT PICTURE # 44]

Two recent H&S studies have found skin diseases as highly prevalent physical health problems among construction site workers, especially the young ones in the Global South countries such as Ghana, Ethiopia, and others (Frimpong *et al.*, 2022; Lette *et al.*, 2018). Another highly prevalent causal agent of injuries and deaths of construction site workers, as many have reported from other developing countries, is falls from height (Man *et al.*, 2021; Rafindadi *et al.*, 2022). Though these H&S studies have provided profound information about these two prevalent H&S problems, they may need empirical visuals to back up or balance their many textual profound information for a deeper understanding of these two H&S problems — skin diseases and falls from heights.

Through a series of analyses, this study can provide two empirical visuals that reinforce and guide the understanding of how construction site workers are exposed and become vulnerable to the two highly prevalent problems on construction sites — skin diseases and falls from heights. Many modern health and safety researchers have also underscored these highly prevalent problems and suggested safety training and education as control measures to eliminate or reduce these two problems. For instance, in providing strategies that could help minimise occupational diseases such as skin disorders, Lette *et al.* (2018) explored and suggested vocational safety and health training for construction site workers. To prevent fall-from-height injuries, such as traumatic injuries on sites, Robson *et al.* (2020) also explored and suggested mandatory safety training standards for all construction site workers. In their study to assess and reduce the impact of human error on building construction works at height, Li *et al.* (2023) also explored and suggested safety training and education for site management and workers. This safety training and education would provide new methods and ideas for safe work at heights (Li *et al.*, 2023). Selleck *et al*. (2023) also explored and proposed in-field safety training and coaching as the most effective strategies to prevent or reduce working at height hazards and risks on construction sites.

This current study has also contributed its quota by exploring and providing visual evidence and representations of two occupational health and safety risks (OHS) that can guide and provide a profound understanding of why construction site workers engage in risk-taking behaviours. It has also suggested project-specific training to control these behaviours during construction works. The following subsections present discussions on these two OHS risks from the understanding of construction site workers, as test results have suggested.

5.1 Picture # 44: A Risk-Taking Behaviour Likely to Contract Skin Disease

[INSERT PICTURE # 44]

Many modern H&S researchers have informed that construction site workers are more likely to be exposed to lead poisoning during construction because they usually handle or use lead-based materials, including paints (Chowdhury, 2022). They also inform that this lead poisoning results in many severe internal injuries, including cardiovascular defects and bone marrow suppression (Chowdhury, 2022). Other problems include embryotoxicity, high blood pressure, gastrointestinal neoplasia, anaemia, seizures, and kidney disease failure (Chowdhury, 2022). Other modern H&S researchers have cautioned that lead paint causes many physical injuries, such as allergic contact dermatitis — a painful skin disease that mildly irritates or itches at the beginning of injury and later grows into blisters that peel and weep on the skin (Hughes and Ferrett, 2008; Isnin *et al.*, 2012).

One of this study's test results suggested a broad consensus among the survey site workers on the perception of consequential injury effect that may result from a depicted risk-taking behaviour in picture # 44. The picture shows a painter working without a mask filter and hand gloves. Without these respiratory and hand-protective materials, the painter is at a higher risk of getting into physical contact with many paint contaminants, such as lead. The painter is also at a higher risk of getting poisoned with these lead contaminants through inhalation or ingestion. This result implies that all the survey site workers imagined a resulting injury from the painter's risk-taking behaviour and reached a broad consensus that the consequential effect of this potential injury is insignificant. Two noticeable and critical facts can explain this consensus result. First, the survey site workers could not imagine any internal injuries resulting from the painter's risk-taking behaviour. Second, they could not perceive or imagine any physical injuries happening to this painter from his risk-taking behaviour. These two unimaginative interacted as mental determinants and influenced the survey site workers into believing that the consequential injury likely to result from the painter's risk-taking behaviour is insignificant in its effect. This broad consensus among these survey site workers is inconsistent with or does not reflect many health views of researchers such as Lette et al. (2018), Darwis *et al.* (2021), Chowdhury (2022), and Frimpong *et al.* (2022). These researchers have found that many construction site workers are in construction activities that have long exposed them to hazardous chemicals of lead-based materials such as paints or thinner (Darwis *et al.*, 2021; Frimpong *et al.*, 2022; Lette *et al.*, 2018). The toxic effects of these chemicals often cause internal and physical injuries among construction site workers. Internal injuries include high and blood pressure and heart, lung, kidney, and liver problems (Frimpong *et al.*, 2022). The physical injuries cause these paints or thinner chemicals to manifest as skin disorders or complications, and some of their symptoms include irritation or itching, redness, blisters, dryness, and others (Darwis *et al.*, 2021; Frimpong *et al.*, 2022; Lette *et al.*, 2018). While these researchers caution and inform the seriousness of the severe pains of internal and physical injuries caused by these lead-based materials, construction site workers are unaware of these lead-based materials' internal and physical adverse effects. More so, they cannot perceive or imagine the consequential health effects of these materials. However, this broad consensus on the perception of the insignificant injury effect that may result from these lead-based materials to cause harm such as skin diseases is consistent with an existing consensus of varying construction participants in many documented health and safety studies (Lingard and Rowlinson, 2005; Sharma *et al.*, 2008). These varying construction participants believed skin disease is merely an occupational risk with no or minor health effects (Lingard and Rowlinson, 2005; Sharma *et al.*, 2008).

This part of the consensus analysis has emerged as a definitive source of empirical evidence, suggesting that the awareness level about lead-based construction materials such as paints or thinners is shallow among construction site workers. This consensus test result has also emerged as crowning proof to suggest that construction site workers are not fully aware of the internal health problems these lead-based construction materials may cause. They need to be made aware of some of the physical effects of these materials on their skins. On these bases, it is worth pointing out that all these unawarenesses combine to influence construction site workers in developing countries like Ghana to engage in risk-taking behaviours such as working without respiratory and hand-protective materials.

5.2 Picture # 43: Risk-Taking Behaviours Likely to Cause Fall from a Height

[INSERT PICTURE # 43]

After a series of interviews with construction workers, many described and mentioned various fatalities and injuries that can result from falls from height. These ranged from instant death, skull fractures or brain damage to injuries to the spine, shoulder, hip, lumbar, arm, hand, or leg. Others were broken legs, wrists, or feet. These fatalities concur with that reported in the literature (Lingard and Rowlinson, 2005; Hasle et al., 2009). These survey site workers could mention and describe all these because they are aware of them, they could easily imagine their occurrences, and they were the most frequent type of fatalities and injuries on construction sites in the developed and developing countries (Hon and Chan, 2013; Schramm and Abreu, 2021).

One of the results also shows a broad consensus among the survey site workers on the perception of a catastrophic injury that may result from depicted risk-taking behaviours in picture # 43. This picture shows two carpenters engaged in the erection of timber roof trusses without any fall arrest systems. Without these systems, the two carpenters are at a higher risk of falling from a height that may harm their body parts. This test result implies that all the survey site workers imagined all the possible resulting injuries from these two carpenters' risk-taking behaviours and reached a broad consensus that the consequential effect of these injuries could be catastrophic. Three critical facts can fit together to explain this consensus by drawing insights from the responses of construction site workers in previous surveys (Hon and Chan, 2013; Schramm and Abreu, 2021). First, the survey site workers strongly identified themselves with the two carpenters in the picture since they also engaged in risk-taking behaviours during construction. Second, they all imagined falling from more than 3 meters to a concrete floor. Third, being aware that the consequential effect of falling from such a height is catastrophic, some survey site workers ascribed the meaning of this catastrophic effect to instant death, skull fracture or brain damage. At the same time, others also ascribed the meaning of this effect to be injuries of the spine, shoulders, hands, hips, lumbar, arms, or legs. From these ascriptions, it is worth mentioning that construction site workers can quickly imagine and are aware of the various fatalities and injuries that could lead to all instant catastrophes on sites, especially those relating to falling from heights.

The study conducted Focus Group Discussions with the survey site workers to share their views based on the decisions that influenced them to judge and sort picture scenarios onto the gridlines. In sharing their views on these picture scenarios, especially picture # 43, most of the site workers imagined falling from a height, mentioned the various injuries that could be sustained by those in the picture scenarios, and compared their present safety plights with those in the picture scenarios. They passionately narrated the following to suggest their views:

> *"Like our managing director (MD), the MD of these two carpenters wants a huge amount of profit from that building project at the expense of the safety of these carpenters. Hence, this director deliberately refused to buy and supply safety materials such as helmets, mask filters, working gears and fall arrest systems to these carpenters. Just as we know that these carpenters are likely to experience various server injuries such as brain damage or skull fracture, the two carpenters are also aware of the various risks attached to the roofing of buildings. However, God says that those unwilling to work will not get to eat. So, since it is no fault of these two carpenters to work in that unsafe manner, the Almighty God is protecting them from falling from that height, and they will not fall by God's grace and mercies. On our site here, most of us pray daily to God before work begins, and after work, we thank the Almighty God for His protection. By our prayers, God strengthens us to work daily and helps us survive risks and accidents on this project site."*

Other survey participants have also passionately narrated this:

> *"The carpenters in the picture are in dire safety situations like us on this site. When we must roof buildings, paint, or do concrete works on a height like the one in the picture, most of us employ prayers and experience to overcome the likely risks and hazards".*

Some participants have also narrated this as the reason:

> *When we look at this picture, the safety challenges these two carpenters face are like the challenges over here. God knows very well that our boss and supervisors do not care for our health, safety, and well-being on our site here. Therefore, the Almighty God favours us by defending and protecting us from dangers during construction, including falling from heights like the carpenters in the picture. He always protects us from getting hurt and sends us home safely to our families. The Almighty God can be trusted for our safety during*

construction because He always offers His protection. Thus, almost all of us here on this site depend on Him. Without God, no single worker will survive on these construction sites during project execution."

From these views, it is worth pointing out that the survey site workers are aware of some catastrophic physical injuries likely to be sustained during construction, especially those from height. Some of this awareness motivated them to sort specific picture scenarios, like picture # 43 on the catastrophic gridline.

A brief insight from their views is this: employers of construction site workers hardly supply site workers with personal protective equipment such as helmets, mask filters, working gear, fall arrest systems and others during construction. The reality is that construction site workers are aware of catastrophic physical injuries likely to be sustained if they refuse to use protective equipment. Being aware of catastrophic injuries, construction site workers often employ protection and trust from a supreme being, dependence on favour from supreme beings, and prayers as coping strategies for overcoming such physical injuries during construction. Their views on the non-provision of pieces of protective equipment are consistent with aspects of Kheni's (2008) and Kheni *et al.* (2010) findings. Implying that the continuances of construction site workers engaging in risk-taking behaviours are primarily influenced by their employers' poor safety attitudes and actions — a poor safety attitude and action comprising non-provision or supply of PPEs, and the inherent quest for excessive profit margins.

6.0 Conclusion

This study examined how construction site workers perceive and judge safety risks in their risk-taking behaviours for intervention policies that may encourage safe work. The study used picture scenarios as novel strategies to amass empirical evidence to understand how site workers perceive and judge safety risks in their risk-taking behaviours during construction works. After a series of analyses, two pictures emerged as prominent scenarios of construction site workers' risk-taking behaviours. These two pictures visually illustrate, reinforce, and represent two often mentioned health and safety risks on construction sites, skin disease and falling from height.

The emergence of these health and safety risks has theoretical and practical implications for the construction industry and its sites. Theoretically, these risks contribute to the ever-increasing state-of-the-art continuances of site workers' risk-taking behaviours on construction sites. One of the practical implications of these two risks is that it is evident that construction site workers are incognisant of the hidden dangerous contaminants in the materials they use to work, which can potentially harm their skin and internal organs. As many international business construction firms move to undertake projects in developing countries like Ghana, they may need to understand this incognisant attitude of site workers and their culturally based coping strategies towards catastrophic physical injuries. This understanding may help them to update their health and safety policies to (re)solve this incognisant attitude. It may help them formulate a policy framework on safety and health training consistent with these culture-based coping strategies and belief-based knowledge. Local business construction firms can also update and formulate their health and safety policies, especially on training, with this understanding to make and encourage safe work on sites. Construction health and safety researchers and policymakers, especially those in sub-Saharan Africa, may also need this understanding for researching and developing a safety policy framework. The other implication is this: these two risks reveal the realities of how construction site workers perceive and respond to health and safety risks with their safety plights during construction in a typical developing country setting (i.e., Ghana). Local construction firms and policymakers may have to develop safety training along these realities.

This study has some limitations worth noting. First, the survey and focused group discussions were only allowed during the one-hour lunch break for site workers. This strict time put undue pressure/anxiety on the survey participants cowing them into their submissions. One of the key reasons was that the site workers would lose their lunch. To calm the nerves and relax the survey participants during the deliberations, the researchers provided various cooked food and beverages to the survey site workers at the 12 construction sites. Indeed, using the Picture-Based Q-Methodology also excited the site workers and engaged their attention to express themselves freely within the stipulated time. Second, the study was limited to some selected D1K1 construction firms in Ghana. These selected firms were a few out of the lot. There is a tendency that most of the remaining firms are doing things right when it comes to the health and safety issues of their workers. Therefore, future studies could be concentrated on most of the remaining D1K1 building construction firms to unravel the actual scenario of this issue. This actual scenario will help to generalize the findings appropriately. Third, this study based some findings on the site workers' perception of picture scenarios. There are always instances when site workers' perceptions concerning the issues under investigation may need to be corrected. Future studies could employ other data-gathering methods like observation to enforce the findings reported. Further, considering the unique nature of the construction industry in various countries, it has become evident that the findings of this study could only be applied to countries with construction industry settings like Ghana. Hence, further studies could be carried out in countries with different industry settings for a more generalised picture of the issue to be presented.

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Table 1: Q-Sheet, Indicating its Rating Scale

Insignificant		**Minor**		**Moderate**		**Major**		**Catastrophic**
-2		-1		0		1		2

Table 2: Demographic Information

	Frequency	**Percent**
Type of construction trade		
Masons	23	26.43
Painters	21	24.14
Carpenters	24	27.59
Electricians	19	21.84
Total	87	100.0
Number of years worked on construction site		
less than 1 year	1	1.1
1-5 years	13	14.9
6-10 years	21	24.1
11-15 years	25	28.7
16-20	15	17.2
more than 20 years	12	13.8
Total	87	100.0
Trade status		
Apprentice	11	12.6
Skilled worker	76	87.4
Total	87	100.0
Age		
21-25 years	12	13.8
26-30 years	17	19.5
31-35 years	14	16.1
36-40 years	12	13.8
41-55 years	26	29.9
56-60 years	3	3.4
Over 60 years	3	3.4
Total	87	100.0
Religious background		
Christians	83	95.4
Muslims	3	3.4
Traditionalist	1	1.1

Total	87	100.00

Table 3: Frequency Counts of all the Sorted Survey Picture

Variables	Frequency Analysis					
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**	**Total**
Pic # 23	20	11	5	14	37	87
Pic # 14	22	31	8	17	9	87
Pic # 11	12	8	9	19	39	87
Pic # 16	11	14	16	27	19	87
Pic # 37	39	15	14	9	10	87
Pic # 27	17	19	8	17	26	87
Pic # 56	12	32	17	21	5	87
Pic # 46	22	28	15	14	8	87
Pic # 25	20	18	9	30	10	87
Pic # 19	36	21	13	13	4	87
Pic # 65	15	31	15	15	11	87
Pic # 55	11	15	6	14	41	87
Pic # 13	5	9	10	7	56	87
Pic # 39	11	31	16	24	5	87
Pic # 30	4	8	5	16	54	87
Pic # 17	31	18	19	10	9	87
Pic # 44	40	19	16	8	4	87
Pic # 73	8	10	8	16	45	87
Pic # 43	4	3	14	14	66	87
Pic # 9	11	37	11	19	9	87
Pic # 69	8	32	11	25	11	87
Pic # 59	13	22	16	22	14	87
Pic # 29	16	9	19	18	25	87
Pic # 75	29	18	22	13	5	87
Pic # 70	10	21	8	37	11	87
Pic # 32	9	4	7	14	53	87
Pic # 21	16	27	20	21	3	87
Pic # 49	25	33	14	11	4	87
Pic # 41	15	17	16	23	16	87
Pic # 18	3	22	16	33	13	87
Pic # 61	9	16	12	29	21	87

Table 4: A Brief Description of Perceived Catastrophic Injury Scale Items

Pictures #	Description
30	Painting with a scaffold with loose and missing footboards and handrails
13	Fixing scaffold without fall protection systems
32	Transporting concrete with buckets on the improvised scaffold without PPE
73	Working on the roof of a six-storey building with scaffold with loose and missing footboards
11	A moving dumper with a blocking object
43	Carpenters are erecting roof trusses without any forms of fall arrest systems.

Table 5: Relative Importance Index for Perceived Catastrophic Injury Plates

Pictures	N	Mean	RII	Ranking
Pic # 43	87	1.55	77.59	1
Pic # 30	87	1.24	62.07	2
Pic # 13	87	1.15	57.47	3
Pic # 32	87	1.13	56.32	4
Pic # 73	87	0.92	46.00	5
Pic # 11	87	0.75	37.36	6

Table 6: A Brief Description of Perceived Insignificant Injury Scale Items

Picture #	**Descriptions**
37	Batching powdered cement without nose pad and hand gloves
19	Exposed to biological agents
17	Sanding wall surface without mask fitter
44	Painting without mask filter and hand gloves

Table 7: Relative Importance Index for Perceived Insignificant Injury Pictures

	N	Mean	RII	Ranking
Picture # 44	87	-0.95	-47.7	1
Picture # 19	87	-0.83	-41.4	2
Picture # 37	87	-0.74	-36.8	3
Picture # 17	87	-0.60	-29.9	4

Note: the negative RII values indicate low levels of insignificance, where -100 is the most insignificant value.

Table 8: Test Statistics for Perceived Catastrophic Injury Scale Items

	Chi-Square	df	Asymp. Sig.
Picture # 23	0.704	3	0.872
Picture # 11	10.154	3	0.017
Picture # 55	1.890	3	0.596
Picture # 13	0.249	3	0.969
Picture # 30	6.090	3	0.107
Picture # 43	3.327	3	0.344
Picture # 70	3.646	3	0.302
Picture # 73	1.159	3	0.763
Picture # 32	2.467	3	0.481

Table 9: Test Statistics for Perceived Insignificant Injury Scale Items

	Chi-Square	**df**	**Asymp. Sig.**
Picture # 37	7.877	3	0.049
Picture # 17	2.468	3	0.481
Picture # 44	3.005	3	0.391
Picture # 19	10.298	3	0.016

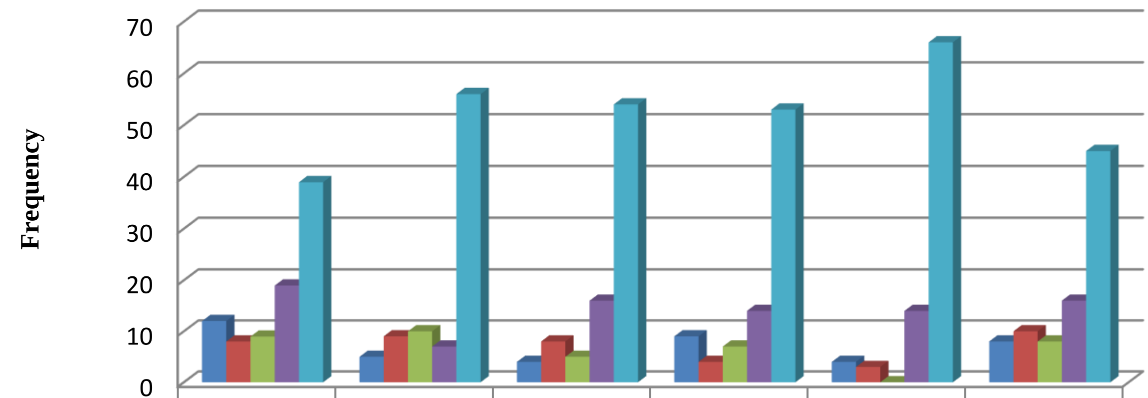
Table 10: Statistical Summary for Pictures 43 and 44

Picture	Statistics						
			Kruskal Wallis				
	Frequency Counts	RII				Perceived Injury Potentials as	
			Chi-Square	df	Asymp.Sig	Insignificant	Catastrophic
43	66 (76%)	77.6	3.327	3	0.344	×	√
44	40 (46%),	47.7	3.005	3	0.391	√	×

Picture 1

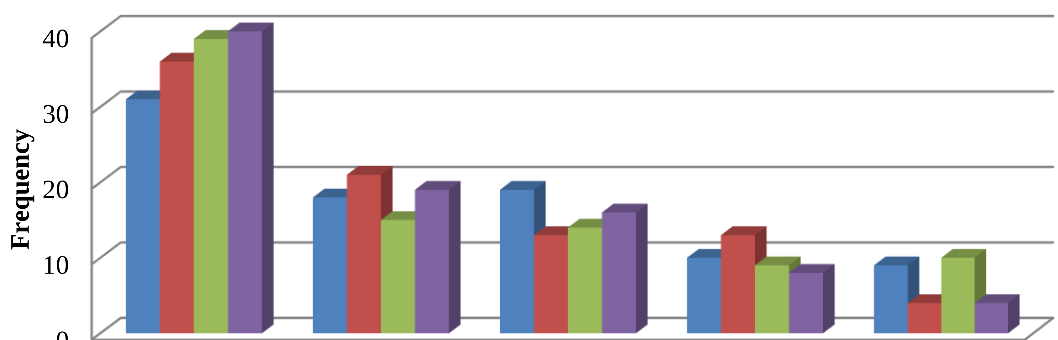
Picture 2

Pictures 1 and 2 — showing Q-Albums and completed Q-Sorting grided sheets from a P-Set.



	Pic #11	Pic # 13	Pic # 30	Pic # 32	Pic # 43	Pic # 73
Insignificant	12	5	4	9	4	8
Minor	8	9	8	4	3	10
Moderate	9	10	5	7	0	8
Major	19	7	16	14	14	16
Catastrophic	39	56	54	53	66	45

Figure 1: Number Of P-Sets Who Judged and Sorted Pictures with Perceived Major and Catastrophic



	Insignificant	Minor	Moderate	Major	Catastrophic
Pic # 17	31	18	19	10	9
Pic # 19	36	21	13	13	4
Pic # 37	39	15	14	9	10
Pic # 44	40	19	16	8	4

Figure 2: Responses for Perceived Insignificant Injury Effect Pictures

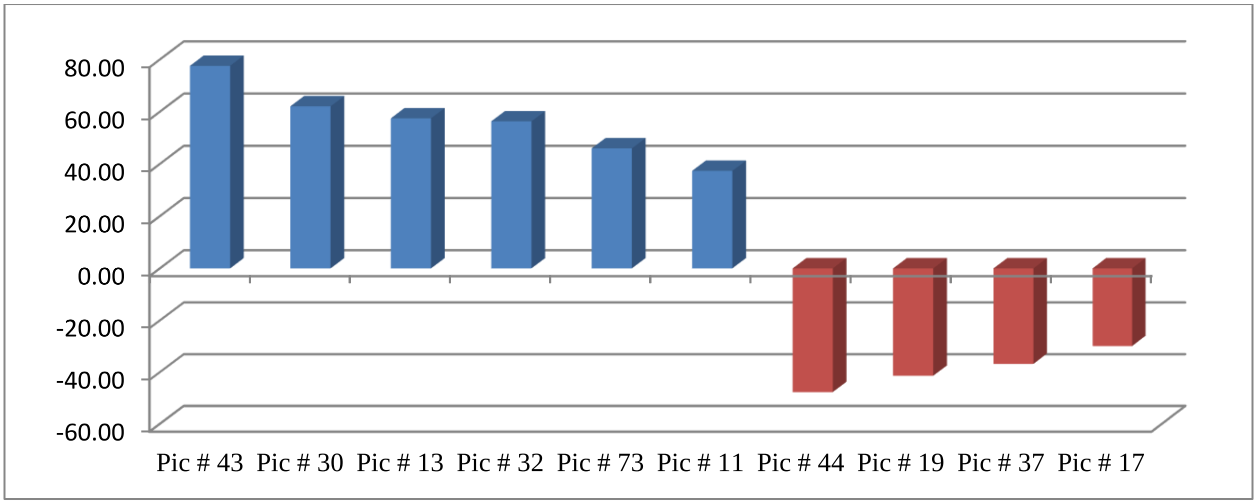


Figure 3: The Most Selected Pictures Based on Their Frequency Counts

Picture # 44: Painting without mask filter and hand gloves
Picture # 43: Erecting roof trusses without any forms of fall arrest systems

Picture # 44: Painting without mask filter and hand gloves

Picture # 43: Erecting roof trusses without fall arrest systems