ASSESSMENT OF RISK PERCEPTION AND ITS INFLUENCING FACTORS AMONG CONSTRUCTION WORKERS IN MALAWI

Master of Science in Environmental Health

(MSc EH)

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(BSc Environmental Health)

A thesis submitted in partial fulfillment of the requirements for a Master of Science in Environmental Health (MSc EH)

University of Malawi

The Polytechnic

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DECLARATION

I declare that this research entitled ***'Assessment of Risk Perception and Its Influencing Factors among Construction Workers in Malawi'*** is my own work. It is submitted in partial fulfillment of the requirements for the Master of Science Degree in Environmental Health at the Polytechnic, University of Malawi. It has not been submitted for any other degree to any University.

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Signature: ______________________________

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CERTIFICATE OF APPROVAL

We, the undersigned, certify that we have read and hereby recommend for acceptance by the University of Malawi a thesis entitled ***'Assessment of Risk Perception and Its Influencing Factors among Construction Workers in Malawi.'***

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Head of Department: ______________________________

Signature: ______________________________

Date: ______________________________

DEDICATION

I dedicate this thesis to my daughters: Sarah and Karen.

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ABSTRACT

This descriptive study employed a deductive research approach and a survey strategy to assess risk perception and its influencing factors among construction workers in Malawi. Three specific construction hazards and their associated risks were selected. The hazards were ‘working at height (WAH) ‘manual handling of loads (MHL)’ and ‘heavy workload or intense pressure to be more productive (HWP)’. The study engaged multistage sampling. A total of 376 eligible subjects (comprising brick layers, painters, plumbers, electricians, carpenters, unskilled labourers and their supervisors) were sampled from 30 building construction sites in the central region of Malawi. Data was collected using a questionnaire through face to face interviews and observation checklist at each project site. Univariate analysis, factor analysis and multiple linear regressions were performed in order to determine the main influencing factors among the independent variables.

The study established that workers are aware of risks posed by their work. They perceived the risk associated with WAH, MHL and HWP as very high (62.7%, $\bar{x}$ =8.80 ± 1.95); (48.5%, $\bar{x}$ =8.10 ± 2.38); (57.9%, $\bar{x}$ =8.49 ± 2.22) respectively. The workers however indicated that they would continue working in a risky environment despite being aware of risks involved. The study identified six factors as variables that showed significant effect on workers’ perception of risk ($p< 0.05$). These factors are “dreaded factor”, “avoidability and controllability”, “expert knowledge”, “personal knowledge”, education level and age. The study revealed that there was non-compliance of most of the construction sites to minimum requirements of health and safety. The safety climate was also perceived as poor by most of the workers.

It is therefore concluded that although construction workers’ perception of risk associated with construction is high, they continue to work in hazardous environment. The health and safety status of many construction sites in Malawi remain poor. This study therefore recommends that National Construction Industry Council should enhance risk perception and risk management awareness and the involvement of all key players in construction. It should also strengthen the monitoring of contractors’ compliance with safety and health obligations. Contractors should incorporate occupation health and safety management programs in the implementation of their projects. The contractors should also integrate analysis of behaviors and risk perception of the workers and other players so as to guide the identification of better health and safety interventions at their worksites.

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ABBREVIATIONS AND ACRONYMS

CRPM	Conceptual Risk Perception Model
GDP	Gross Domestic Product
H & S	Health and Safety
HSE	Health and Safety Executive
ILO	International Labour Organization
MoFEPD	Ministry of Finance, Economic Planning and Development
MoTPI	Ministry of Transport and Public Infrastructure
MoH	Ministry of Health
NCIA	National Construction Industry Act
NCIC	National Construction Industry Council
OHS	Occupation Health and Safety
OSHWA	Occupation Safety, Health and Welfare Act
PPE	Personal Protective Equipment
SMEs	Small and Medium Enterprise
WHO	World Health Organization

CHAPTER I: INTRODUCTION

1.1 Background Information

Risk perception is defined as "the ability to determine the amount of risk from a hazard" while risk is defined as "the calculation of how likely an incident is to occur, and given its occurrence, how dire the consequences would be" (Inouye, 2014, p.2). Sjöberg, Moen, and Rundmo (2004) define risk perception as "the subjective assessment of the probability of a specified type of accident happening and how concerned people are with the consequences" (p. 8). Several authors (Alexopoulos, Kavadi, Bakoyannis, & Papantonopoulos, 2009; Portell, Gil, Losilla, & Vives, 2014; Rohrman, n.d; Sjöberg et al., 2004) agree that there are multiple factors which influence risk perception both at and outside work. At an individual level, a collection of psychological, social, institutional and cultural factors influence risk perception. These factors include safety climate, peer/community pressure, risk attributes and the individual demographic and occupational characteristics (Alexopoulos, et al., 2009; Portell, et al., 2014; Rohrman, n.d; Sjöberg, et al., 2004). Risk perception is one of the factors that guide individual's response to risky situations (Rohrman, n.d). When risk is perceived lowly, workers are left exposed to harmful work conditions (Wong, Gray, & Sadiqi, 2015). In addition, lack of common perception of occupational risks among stakeholders brings confusion to health and safety management at work (Portell, et al., 2014).

Construction workers are at risk of exposure to a wide range of occupational health hazards (Weeks, 2011). The construction industry operates in a fragmented nature which, to some extent, contributes to the health and safety (H&S) hazards which construction workers are exposed to (Charles, Pillay, & Ryan, 2007). Construction work brings together a collection of tradesmen with very different practices and levels of skill, often working simultaneously at one site (Hinksman, 2011; Weeks, 2011). In addition to hazards from their own trade (primary hazards), construction workers are also exposed to hazards arising from jobs done by fellow tradesmen (bystander hazards). Although exposure to a hazard is often characteristically irregular and short lived, chances of reoccurrence are usually high (Weeks, 2011).

The cyclical demand for contracted services and self-employed individuals, alongside the involvement of large groups of unskilled labourers, exacerbates the already hazardous construction work environment and negatively affects management of health and safety in the workplace (Hinksman, 2011; Hislop, 1999; ILO, 2001). At one site, the workload of each worker is seldom consistent and difficult to predict (Hinksman, 2011). Workers are forced to perform specialized tasks, work long hours, with the responsibility of safety left in their own hands resulting in safety being compromised due to such factors as fatigue, burnout and exhaustion (Hislop, 1999).

Although the construction industry exposes workers to various types of hazards, it is widely recognized as a major contributor to the economy of many nations (Alkilani, Jup, & Sawhney, 2013). In most countries, the construction industry constitutes 5% to 15% of the gross domestic product (GDP). The construction industry constitutes for example, 4% of USA’s GDP, 6.5% of Germany’s GDP, and up to 17% of Japan’s GDP (Weeks, 2011). In Ghana, the construction industry consistently contributed an average GDP of 6.1% to the economy between 2003 and 2008 (Danso, 2010). In Malawi, the industry commands a 4% share of GDP (MoFEPD, 2014). Despite this, construction is usually among the three most risky industries in most countries (Pekka, 2011). The injury and fatality rates in the industry are considered to be high and should not be tolerable socially or from the human perspective (Dias, 2009; Wong, et al., 2015). The International Labour Organization (ILO) estimates that 17% of all the occupational accidents that occur globally are fatal (Dias, 2009). Alkilani et al. (2013) noted that the construction industry’s occupational health and safety (OHS) problems continue to increase, with 100,000 fatalities yearly, representing close to 30-40% of all occupational fatal injuries. According to annual global figures, at least 45 million non-fatal injuries (those causing at least 3 days’ absence from work) occur in construction industry, translating to at least one non-fatal injury every second (Dias, 2009).

High injury and fatality rates are reported even in countries with well-established OHS standards such as Australia and Britain. The Australian building and construction industry for instance, has injury rates twice as much as those occurring in other sectors; and the susceptibility of construction workers to fatal accident is “three times the national workplace average” (Wong, et al., 2015). In the British construction industry, construction contributes one third of all fatal accidents with a fatality likelihood which is six times higher than in other sectors (HSE, 2003). Available literature indicates that data for the Africa region on fatal work injuries occurring in specific sectors is scarce due to lack of proper recording and notification systems (Hamalainen, Takala, & Saarela, 2009; Mekkodathil, El-Menyar, & Al-Thani, 2016). Consequently, estimates for the rates of both fatal and non-fatal accidents in Malawi have not yet been established because of unavailability of data. Nonetheless, the fact remains that occupational accidents and diseases occur on daily basis in workplaces, some of which are reported while others are not (Malawi Government, 2010).

Despite the scarcity of data for the Africa region on work injuries in specific sectors including the construction industry, empirical research carried out in the region gives evidence of shortfalls in OHS regulations, management and practice which expose construction workers to risky working environments (Agumba, Pretorius, & Haupt, 2013; Chiocha, et al., 2011; Kheni, Gibb, & Dainty, 2006; Musonda & Smallwood, 2008). Several studies have reported poor OHS status in construction sector of developing countries like Jordan, Ghana and Botswana, specifically among small and medium sized enterprises (SMEs) (Alkilani, et al., 2013; Kheni, Gibb & Dainty, 2006; Musonda & Smallwood, 2008). There is dominance of SMEs which is related to more significant numbers of accidents and injuries (Alkilani, et al., 2013). The attitude of SME contractors towards health and safety is poor due to lack of awareness and desire to maximize profits. The SME do not make efforts to identify hazards, conduct risk assessment and risk control (Kheni et al., 2006). They failed to provide minimal OHS requirements like personal protective equipment (PPE), onsite safety signs and OHS training for workers (Alkilani, et al., 2013). ‘Operating machinery and equipment’ and ‘falls from height’ were the frequent causes of construction accidents (Kheni et al., 2006). According to Musonda and Smallwood (2008), poor performance of the construction industry in Botswana was proven by low levels of H&S awareness among construction workers; lack of stakeholders commitment; inadequate implementation of H&S standards and legislations. Risk taking behavior was common in construction sites and accidents were reported (Musonda & Smallwood, 2008).

Another study carried out by Gibb and Bust (2006) in five African countries (Botswana, Egypt, Malawi, Nigeria, and South Africa) revealed that occupational risks such as lifting operations are done in ways not consistent with safety practices. Workers used power/ hand tools unsatisfactorily and construction equipment and vehicles were used in unsafe manner (Chiocha, et al., 2011; Kheni et al., 2006). A comparative study by Teo, Haupt, and Feng (2008), conducted in South Africa (a developing country) and Singapore (a developed country) demonstrated that developed countries' performance in construction health and safety is more advanced as compared to developing countries. Discrepancies were reported as regards management commitment, supervisory environment, and training competence levels (Teo et al., 2008).

In Malawi the Occupation Health, Safety and Welfare Act (OSHWA, 1997) makes provision for the regulation of the conditions of employment in workplaces as regards safety, health and welfare. Nevertheless, utilization of the OSHWA is challenged by lack of sector specific OHS regulations resulting in OHS standards not being met in most Malawian workplace environments (Morse, Taulo, & Lungu, 2011). "Malawi is even far from meeting universal minimum standards of occupational health and safety, such as the ILO Convention No. 161 on Occupational Health Services and No. 155 on Occupational Safety and Health" (Morse, et al., 2011, p. 84).

In Malawi, the regulatory authority of the construction Industry is placed in the hands of the National Construction Industry Council (NCIC) which was established through the National Construction Industry Act (NCIA) No. 19 of 1996. NCIC's code of ethics for contractors requires that all contractors should give utmost consideration to safety, health and welfare of their workmen and the general public (NCIC, 2009). In spite of this, OHS standards in most sites in Malawi are poor and no one seems to take action. At sites where the contractors are doing something to promote H&S (for example, provision of PPE), cooperation and commitment of workers is lacking. Safety measures are rarely followed and PPE is worn incorrectly, disused or sold out (Chibwezo, 2015). One notable result from a study on health and safety in the Malawian construction industry, conducted among key construction stakeholders, was that poor OHS persist in the construction industry (Chiocha, Smallwood, & Emuze, 2011). Chiocha et al. (2011) concluded that consultants like architects and engineers; clients, project managers, building and civil contractors rarely provide significant contribution towards OHS resulting in poor OHS standards in the Malawian construction industry.

Implementation of an effective health and safety program is a precondition for increased employee productivity (Enshassi, n.d; Hinze, 1997). Safe Work Australia (2011) however, argues that chance or guesswork can never promote health and safety at a workplace. An effective health and safety program is underpinned by the concept of risk, through risk management (Charles et al., 2007; Safe Work Australia, 2011).

> Risk management is a four-stage process; it involves identification of hazards in the work environment, assessment of the risks posed by the hazards, the selection of appropriate risk control measures according to a risk control hierarchy and review of control measures to ensure their effectiveness (Safe Work Australia, 2011, p. 6).

Effective risk management requires commitment of business owners and managers as well as workers' participation and cooperation (Safe Work Australia, 2011).Chances of identifying all hazards and choosing effective control measures are high when risk management draws the experience, knowledge and ideas of workers. Nevertheless, accuracy of risk judged from a situation or set of action by an individual relies upon that individual's risk perception(Charles et al., 2007; Safe Work Australia, 2011).

Lay people's perception of risk from hazard(s) differs from the perception of risk by technical experts or medical personnel (Schmidt, 2004). Experts define risk in terms of annual mortalities while lay people's definition of risk considers other elements such as voluntariness, catastrophic potential, controllability familiarity and more (Renn, n.d). As a result, lay people judge risk from hazard(s) lowly as compared to judgment awarded by technical experts during risk assessment (Schmidt, 2004). Differing risk perception of people involved in risk management contributes to disagreements when selecting best practical health and safety measures (Yule, Flin, & Murdy, 2000). According to Wong et al. (2015) underestimation of risk negatively affects demand and efficiency of health and safety measures. For instance, long serving members of the work force become overconfident, rate risk as low and believe that they do not require safety training (Wong et al., 2015). Similarly, some employers/managers tend to perceive risk from their work as low, or have the belief that risk is an intrinsic part of their work. Either way; workers are left exposed to harmful work conditions (Wong et al., 2015). Risky behavior, likelihood of accidents and incidents of ill health at the workplace are influenced by the perception of risk; therefore, improvement of health and safety at workplace should seriously consider occupational risk perception of both workers and employers (Portell et al., 2014).

1.2. Statement of the Problem

The status of occupational health and safety in Malawian construction sites is sub-optimal. There is lack of sector-specific regulation coupled with little or no input to promotion of health and safety at construction sites from various stakeholders like clients, consultants, contractors, managers and workers. Occupational risks and risky behavior continue to be rampant in construction sites; a situation which may result in occurrence of accidents causing serious injuries and incidences of preventable ill health and death among workers. There appears to be lack of documented empirical evidence regarding the occupational risk perception of the various stakeholders in construction industry in Malawi. It is in this regard that this study sought to investigate risk perception of workers and its influencing factors in the construction industry especially among workers of contractors in the central region of Malawi. Understanding how risk is perceived by people involved in construction is necessary for effective risk communication and risk management. It is also a critical step towards creating effective programs and campaigns to raise awareness and make construction workplaces safer. Occupational health, well-being and the quality of life of workers are crucial prerequisites for productivity and are of utmost importance for overall socio-economic development (WHO, 1994). Health at work and healthy work environments are among the most valuable assets of individuals, communities and countries.

1.3 Broad Objective

This study aimed at investigating risk perception and its related factors among construction workers in Malawi.

1.4. Specific Objectives

Specific objectives of the study were:

1. To assess construction workers' perception of risk posed by their work.
2. To identify factors that influence risk perception among construction workers.
3. To determine construction workers' actions related to perceived risky situations.

1.5. Outline of the Dissertation

This thesis has been organized into five chapters. Chapter one is the introduction of the study and it is grouped into background information to the study, statement of the problem, research goals which contains the aim and specific objectives. Chapter two of this thesis presents a literature review which focuses on risk, risk perception and its measurement, factors influencing risk perception, and the action of workers when faced with a risky situation. Chapter three dwells on the methodologies used in this study. Chapter four presents results of the study comprising tables, figures, graphs, and texts. Finally, in chapter five the thesis gives the discussion of findings, some concluding remarks and recommendations based on the research findings.

CHAPTER II: LITERATURE REVIEW

2.1 Definition and Explanation of Risk

“Risk is always the risk of something (technical facility or natural hazard) to someone (an individual, a group of people, society or all humankind)” (Schmidt, 2004, p. 3). Risk is distinct from hazard. Hazard is something tangible (physical); it could be a thing, situation, event or material with potential to cause unwanted outcome physically, socially or financially (Rohrmann, n.d). Risk on the other hand is a multi-faceted concept that has many denotation and connotations because of the heterogeneous nature of hazards from which risks arise (Phoya, n.d; Rohrmann, n.d; Sjöberg, et al., 2004). Rohrmann (n.d) suggests that risk is an inference, interpreting what could happen if someone is exposed to a hazard. Phoya (n.d) argues that risk frequently refers to regrettable results of an event. According to Kirchsteiger (as cited in Charles et al., 2007, p. 7**),** risk is defined as “possibilities that technological activities or natural events lead to consequences that affect what human beings value.”

In most contexts, the concept ‘risk’ is described as having two dimensions; likelihood or probability that adverse event will happen and uncertainty about potential severity of the event’s outcome (Bohm & Harris, 2010; HSE, 2003; ISO, 2009; Sjoberg et al., 2004).Within the natural sciences, quantitative risk assessment often defined risk as the probability of damage. The problem with this judgment of risk was that likelihood of many hazards was low yet great damage would be caused once they occur, for instance, nuclear or chemical disaster (Rohrmann, n.d). Similarly defining risk using severity alone was inappropriate; hazards with high probability but causing less damage (such as earthquake) would be rated low. This therefore necessitates the integrative riskiness model that estimates risk by both likelihood and severity of an event (Rohrmann, n.d).

In engineering-type of calculation of risk, definition combining the probability and severity values might suffice, however it may be deceptive when applied at wide scale to intractable, public risk management (Sjoberg et al., 2004). Risk can be looked at in two ways as objective and subjective. Objective risk is operationalized by calculation of annual injury and fatality rates derived from accident data (Bohm & Harris, 2010).It can also be estimated using matrices of probability against severity of consequences in a qualitative manner or with quantitative values (Zolfagharian, Ressang, Irizarry, Nourbakhsh, & Zin, 2011). Subjective risk perception is considered to be accurate when there is high degree of congruence with objective risk measurement (Bohm & Harris, 2010). Most people would be in a position to give basic definition of risk and citing examples of risky behaviour but it is not possible for all people to give common judgment of risk posed by a hazard (Inouye, 2014).

The alarming injury and fatality rates of the construction industry are closely related to the hazards and risks faced during construction work (Hamalainen, et al., 2009). Construction work has a wide range of hazards typically classified as chemical hazards, physical hazards, biological hazards, ergonomic hazards and psycho-social hazards (Hughes & Ferrett, 2007; MoTPI, 2011; Weeks, 2011). According to Weeks (2011, paragraph.8) “Exposure differs from trade to trade, from job to job, by the day, even by the hour”. Workers may experience these hazards either as primary or bystander hazards while working close to co-workers of different trades on site (Weeks, 2011).

2.2. Definition and Explanation of Risk Perception

Risk perception stands for the subjective judgment people make about the probability that a specific incident will occur and its severity once it happens (Rohrmann, n.d; Sjöberg, et al., 2004). It is a result of complex evaluation of hazard features (Phoya,n.d; Rohrmann, n.d). Perception of risk is a construct that goes beyond the individual, it reflects the social and cultural values, beliefs, experiences, and philosophies of the individual (Phoya, n.d; Sjöberg, et al., 2004; Schmidt, 2004). In different situations, people’s risk perception will be done in different manners. The “context in which the risks are experienced” is an additional yardstick for risk perception (Alexopoulos, et al., 2009, p. 1**)**. Bohm and Harris (2010, p. 56) argue that “risk perception implies further calculation or consideration of the likelihood and severity of consequences of an incident”. Likelihood and severity of consequences are confirmed components of risk perception, however lay people’s risk perception is strongly linked to the severity of consequences component as compared to likelihood (Bohm & Harris, 2010).

It was first discovered in the 1960s that risk perception was very significant to policy; new technology opposition by the general public was said to be influenced by their risk perception. In an attempt to address this, several studies were done. For instance, Starr found out that lay people tolerated risks that were beneficial to them, termed voluntary risk; nevertheless, people also saw risks where experts saw no risk (Sjoberg, 1999). Renn (n.d), Schmist (2004) and Slovic (1987) asserted that lay people evaluate risk subjectively by considering other hazard characteristics such as catastrophic potential, voluntariness, possibility of personal control, threat to future generations and familiarity. As a result, lay people's risk perception tends to differ from their own expert's estimates of objective risk calculated from statistical data (Slovic, 1987). The evaluation of risk lay people make is less formal, accurate and based on intuition; however it is rich and reveals people' genuine concerns that may not be incorporated in experts risk assessment (Portell, et al., 2014). This discrepancy in risk assessment between experts and the general public brings dilemma when it comes to risk management (Renn, n.d; Sjöberg, et al., 2004). Improvement of risk management skills is therefore underpinned to better understanding about risk perception (Renn, n.d). Understanding workers' perception of risk will help in developing a proper safety culture (Alexopoulos, et al., 2009).

2.3. Measurement of Risk Perception

One approach to assessing risk among respondents is by qualitatively scaling risks using a Likert Scale of 1 – 5 (1= very likely to occur, 2= likely to occur, 3= moderate, 4= not very likely to occur, and 5= not likely to occur meaning no chances of occurrence). Using the Likert Scale, a study by Phoya (n.d) revealed that site managers, supervisors and workers had similar perception associated with risks like falling from height, neck pain, hearing loss and respiratory illness. Differing views were however observed for some risks like musculatory disorders and being hit by falling object (Phoya, n.d).

Paired Comparison Technique (PCT) is viewed as a better, rigorous approach which requires respondents to "compare each item with every other item until every permutation of paired comparisons has been exhausted (Bohm and Harris, 2010, p.57). The drawback with PCT is that, it is suitable for comparing small item sets; large sets comparison becomes unmanageable. Bohm and Harris (2010) used PCT to assess perception of dumber drivers and Subject Matter Experts

(SMEs) concerning seven staged and photographed dumper risk scenarios. A dumper is a four wheeled construction plant which has a load skip in front of the driver, designed to carry bulk material. SMEs comprised an H&S expert, managing directors, an instructor and engineers from dumper manufacturers. The seven scenarios included: "(i) driving forward with visibility severely obstructed by load; (ii) jumping off from the footplate; (iii) traveling unladen at top speed across uneven ground (seatbelt unsecured); (iv) driving fully laden in a high gear down a steep gradient (seatbelt secured); (v) turning fully laden dumper uphill on a steep gradient (seatbelt unsecured); (vi) sitting in the seat while being loaded by an excavator; and (vii) after tipping, driving dumper with skip still raised (seatbelt unsecured)" (Bohm & Harris, 2010, p. 58). This assessment discovered that risk perception of dumper drivers was significantly different from SMEs' risk perception and objective risk measures derived from accident data. The 'dread factor' had more influence on drivers' risk perception as compared to likelihood (Bohm & Harris, 2010).

According to Portell et al. (2014) and Slovic (1987), the psychometric paradigm is one quantitative approach in psychology used to characterize risk perception. The assumption of the theoretical framework in psychometric paradigm is that at an individual level, a collection of psychological, social and cultural factors influence risk perception. Another assumption is that quantification and modelling of these factors is possible with correct survey design and will enable clarification (understanding and interpretation) of individual responses to hazardous situations (Portell, et al., 2014; Slovic, 1987). The psychometric paradigm uses 'cognitive maps' produced through scaling and multivariate analysis to describe risk perception and attitude thereby revealing discrepancies in risk perception among different groups of people (Schmidt, 2004; Slovic, 1987).

Over the years, several studies have replicated the factor analysis of psychometric paradigm to study risk perception of different groups of lay people and experts. Factor analysis is statistical method aimed at summarizing variability among several variables and detecting a smaller number of underlying (latent) variables (Garrett-Mayer, 2006; Taylor, 2001). Portell et al. (2014) adapted the factor analysis of the psychometric paradigm to characterize occupational risk perceived by health care workers at an individual level. They analyzed the relationship between ratings of variables such as risk attributes, demographic and occupational variables (termed predictor variables) and perceived risk (termed criterion variable). The 'dread evoked factor' (comprising dread, vulnerability, severity and catastrophic potential) was found to be the main predictor of perceived risk for all the three hazards. Scores for personal knowledge were high as compared to scores of expert knowledge for all the three hazards which indicate that participants underestimated expert knowledge of the risk (Portell et al., 2014). Similarly, Alexopoulos et al. (2009) used factor analysis to study employee risk perception of specific groups of hazards in English and Greek bakery companies in order to provide insight on how cross-cultural differences affect their risk perception. Employees judged the hazards over the qualitative risk characteristics of frequency, controllability, knowledge, dread, voluntariness, familiarity, and catastrophic potential. The results highlight variations in risk perception as a result of cultural differences combined with disparity in levels of education (Alexopoulos et al., 2009).

2.4. Factors Influencing Risk Perception

Rohrman (n.d) outlines multiple factors which influence responses to all kinds of risk exposure in a model called 'the conceptual risk perception model (CRPM)'. The model presents a theory similar to the one explained by Inouye (2014), which links risk perception, risk tolerance and risk taking behavior. The CRPM elucidates that risk perception (risk magnitude appraisal) influences risk acceptance which affects risky behavior (Rohrman, n.d). Inouye (2014) postulates that inaccurate risk perception may increase risk tolerance levels which results in high-risk behavior. The trend can also take the opposite direction where by habitual engagement in high risk behavior increases risk tolerance which results in inaccurate, specifically low risk perception (Inouye, 2014). According to the CRPM factors affecting risk perception (risk magnitude appraisal) and risk acceptance are categorized as: 'hazard characteristics' (catastrophic potential, probability of dying, health impairments, harm to assets, delayed/future impacts); 'individual situation /characteristics' (affective associations, reasons of exposure, exposure or impact history, and controllability beliefs); 'societal and cultural influences' (eco-centric worldview, technology skepticism, and safety culture) (Rohrman, n.d).

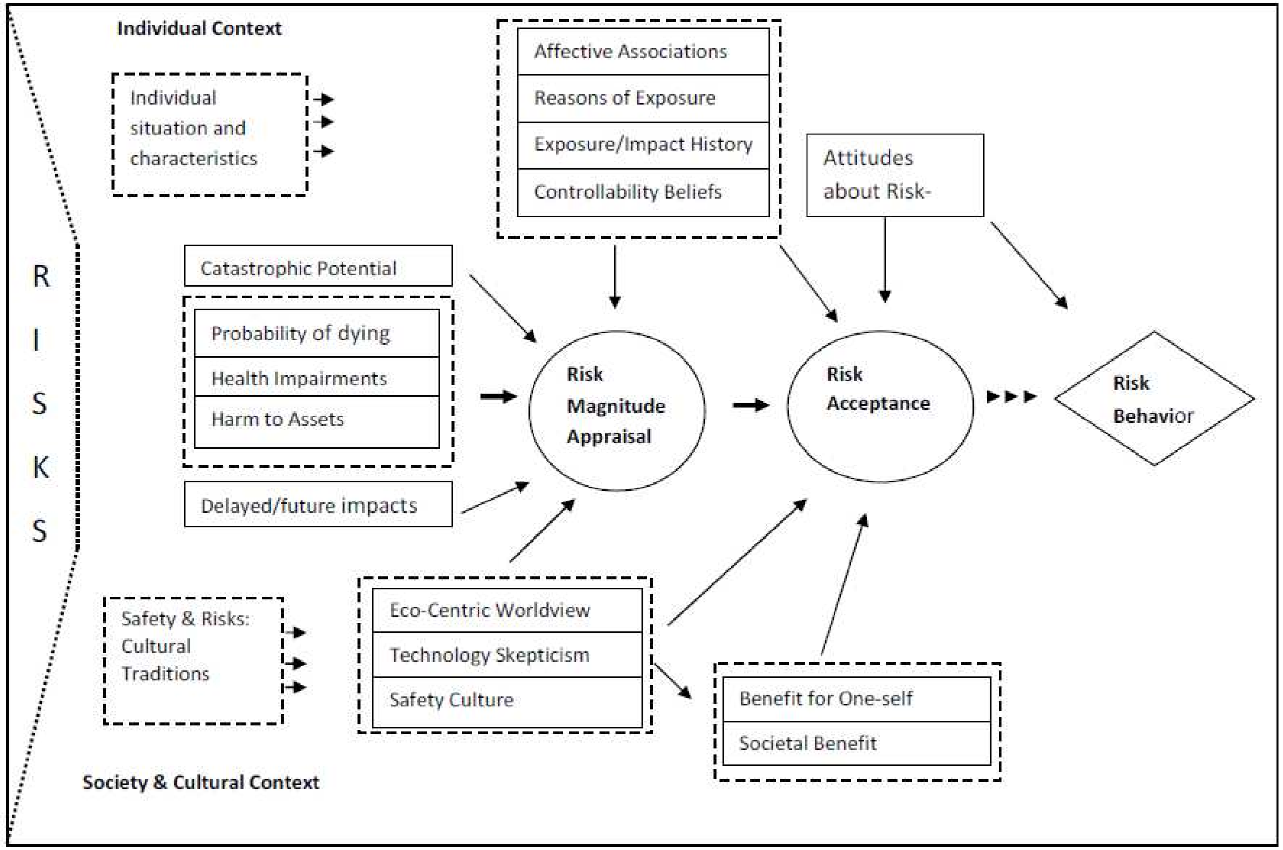

Figure 2.1: A Structural model for Subjective Evaluation of Risk (Rohrman, n.d)

Inouye (2004) suggests that factors influencing risk perception (and tolerance) both at work and outside work are at three levels: (i) structural/institutional level called macro-level factors; (ii) community/peer-to-peer level called meso-level factors; and (iii) individual psychological level called micro-level factors. Two macro-level factors are 'the culture of safety together with level of safety leadership within an organization' and 'safety enforcement and organization trust'. Risk influencing factor at the meso-level is peer/ community pressure. Factors at micro-level include 'individual level of knowledge regarding situation'; 'personal perceived control over a situation' and 'optimism bias' (Inouye, 2014).

2.4.1 Factors Influencing Risk Perception at Institutional (Societal & Cultural) Level

a. Safety Culture and Safety Leadership

Positive safety culture means behaviors, work procedures and management systems that prioritize health and safety of employees in an organization (Inouye, 2014; Che Hassan, et al., 2007). In an organization that upholds positive safety culture and has managers and supervisors that show commitment to health and safety at work, risk perception is positively influenced. Employees' risk taking behavior is also reduced thereby reducing workplace injury rates. Opposite findings are observed in organizations with a poor safety climate (Inouye, 2014). Bohm and Harris, (2010) and Che Hassan, et al., (2007) also agree that safety culture influences risk perception and is a prerequisite to successful injury control programs at the workplace.

b. Safety Enforcement and Organizational Trust

Low levels of safety compliance and high risk behavior among employees is more likely in an organization believed to have no health and safety enforcement procedures (punishment of unsafe behavior) as well as unavailability of reliable safety information and lack of credibility among safety communication officers (Inouye, 2014). The study conducted by Alexopoulos et al. (2009) among Greek and English bakery workers, showed that presence of structures for managing health and safety, such as policy had positive influence on British workers. Greek workers, on the other hand, lacked trust in their management actions which was linked to have a negative influence on their risk perception.

2.4.2. Factors Influencing Risk Perception at Peer-to-Peer Level

According to Inouye (2014), peer/community pressure influences risk taking behavior both within the environment of a workplace or outside. At the workplace, new employees, or subcontractors rarely "swim against the tide" (p.4). They usually copy high risk behavior from long serving employees even if it is against their better judgment (Inouye, 2014). For instance, situational factors like site safety rules and behavior of other personnel onsite were the factors that influenced risk taking behavior among dumper drivers (Bohm & Harris, 2010).

2.4.3. Factors Influencing Risk Perception at Individual Level

According to the psychometric paradigm, several qualitative hazard characteristics have been identified to account for risk judgment at an individual psychological level. These characteristics are catastrophic potential, perceived lack of control, inequitable distribution of risks and benefits, severity of consequences, dreaded consequences, observability, knowledge about risk by exposed people and experts, immediacy of effect or consequences, novelty (newness or the familiarity with the risk source), voluntariness of risk, preventability or avoidability, and vulnerability/personal risk (Alexopoulos, et al., 2009; Portell, et al., 2014; Slovic, 1987**)**. Studies across a wide range of these factors have revealed that there is correlation among many of them; there is similarity in the way some of these hazard characteristics are perceived (Schmidt, 2004; Slovic, 1987). These factors also referred to as items, can therefore be condensed using multivariate factor analysis into three, small set factors of higher order as follows:

a. Dreaded Risk

This presents the extent to which a hazard evokes feelings of dread. Items include catastrophic potential, perceived lack of control, inequitable distribution of risks and benefits, severity of consequences, dreaded consequences/ dreadful.

b. Unknown Risk

This represents the degree to which a risk is understood. Items include observability, knowledge about risk by exposed people and experts, immediacy of effect or consequences, novelty (newness).

c. People Affected by Risk

Represents the number of people exposed to the hazard. Items include personally affected, general public affected and future generations affected (Portell, et al., 2014; Schmidt, 2004; Slovic, 1987).

Findings of risk perception studies using the psychometric paradigm have revealed that lay people's risk perception show a positive association with hazard's position in the factor space; and it specifically correlates with the 'dread risk factor'(Portell, et al., 2014; Slovic, 1987). "The higher the risk topic is judged on this factor, the higher its perceived risk and the more people want to see its current risks reduced and regulated" (Slovic, 1987, p. 283). Risk perception studies using other approaches concur that the 'dread factor' has more influence on risk perception (Bohm & Harris, 2010). Inouye (2014) also agrees that at an individual psychological level, high levels of knowledge regarding a situation, perceived personal control over a situation and optimism bias may result in perceived low risk resulting in higher risk tolerance levels and unsafe behaviors.

Several studies (Alexopoulos et al.; Phoya, n.d; 2009; Portell, et al., 2014) reveal differing results about the influence on worker's risk perception by individual characteristics like age, education level, professional category, length of experience, and knowledge of safety (or background safety training). Phoya (n.d) revealed that risk perception correlated strongly with, education and age. However, there was no strong correlation between risk perception and workers' knowledge of safety. Alexopoulos et al. (2009) found that worker's length of experience and background safety training was responsible for disparities in risk perception noticed among Greek and English bakery workers. The study by Portell et al. (2014) revealed that professional category was a significant predictor for two risk factors while other personal characteristics (gender, age, length of experience and permanent position) were not significantly contributing to the prediction of perceived risk.

2.5 Action (Response) of Workers when Faced with Risky Situation

The decision to accept risks is steered by risk perception; similarly, behaviours shown before, during and after an incident are greatly influenced by risk perception (Rohrmann, n.d; Schmidt, 2004). Bohm and Harris (2010) explain that there is a complicated relationship between perception of risk and risk-taking behavior. Workers sometimes indulge in risky behaviour with full knowledge of amount of risk posed by work hazards. Phoya (n.d) on the other hand argues that unsuitable risky behaviours prevail when workers have wrong perception of risks. There is need for confirmation as to whether indulgence in unsuitable behavior is a result of misjudgment of risk or willingness with full knowledge of associated risks (Bohm & Harris, 2010). Slovic (1987) highlights that people willingly engage in risky behavior when they feel it is beneficial to them. For instance workers may engage in a risky activity in order to “save face in front of coworkers, impress supervisors, complete work efficiently or for financial gains like bonuses” (Inouye, 2014, p.6). Sjöberg et al. (2004) adds that when people voluntarily engage in an activity, they tolerate considerably more risk.

2. 6 Conclusion Remarks

The theories highlighted in the literature review point to the fact that risk perception is a construct that is influenced by several factors at different levels. At the workplace, risk perception may be influenced by factors that include qualitative risk characteristics (as demonstrated by psychometric paradigm studies); individual characteristics of age, gender, education level, history of safety training, professional category and length of employment; peer/ community pressure; and safety climate (safety culture, level of safety leadership, safety enforcement and organization trust). The safety behavior shown by workers will indicate their perception of risk as well as risk tolerance levels.

CHAPTER III: METHODOLOGY

3.1 Introduction

This section highlights the research design, target population and sample, data collection instruments used, analysis procedures, as well as ethical considerations for the study.

3.2 Research Design

This was a descriptive study that employed the deductive research approach aiming at assessing risk perception and its influencing factors among construction workers. Quantitative research techniques were used to collect, analyze and summarize data. A survey strategy was employed to allow rapid collection of large amount of data from the selected sample in an economic way; and also to allow generalization of findings from the sample to the population so that inferences can be made about the variables being studied (Saunders et al., 2009). The survey was cross-sectional involving analysis of data collected from the study population at a single point in time.

3.3 Study Variables

First of all, three specific construction hazards and their associated risks were selected and termed as risk factors. These hazards were 'working at height (WAH)' (risk of falling from a height causing serious injury), 'manual handling of loads (MHL)' (risk of chronic musculoskeletal disorders), and 'heavy workload or intense pressure to be more productive (HWP)' (risk of stress causing ill health). Working at height was selected due to the fact that it is rated as most risky situation causing many fatalities and minor injuries (Hughes & Ferrett, 2007; McDonald & Hrymak, 2002; Schwatka, Butler & Rosecrance, 2011; Work Safe Australia, 2015). The other two hazards were selected based on their commonality among all trades in construction (Hughes & Ferrett, 2007; Weeks, 2011). Respondents were asked to judge the 'overall perceived risk' associated with each of the three risk factors; these were the criterion variables. In order to identify factors influencing risk perception, respondents were asked to rate each of the three risk factors across nine qualitative risk characteristics, based on those used in the initial study of Portell, et al., (2014). In addition data was collected on individual characteristics of the workers, and construction site safety climate. Finally, the respondents' immediate action when they or a fellow worker is exposed to risky situation was assessed. The study variables are as presented in table 3.1 below.

Table 3.1: Variables of the Study

Criterion Variables	WAH-Overall Perceived Risk MHL -Overall Perceived Risk HWP -Overall Perceived Risk	
Independent Variables	***Categories***	***Variables***
	Qualitative Risk Characteristics	Dread Factor- dread, vulnerability, severity and catastrophic potential
		Knowledge/understanding factor- personal knowledge, expert knowledge and immediacy
		Controllable damage factor- avoidability and controllability
	Individual Characteristics	Age
		Gender
		Education Level
		Professional Category
		Length of employment
		Safety Training History
	Safety Climate	Construction Site Safety Climate
	Response to risky situation	Immediate action when exposed to risky situation

3.4 Population and Sampling

3.4.1 Target Population

In this study, the target population was all construction workers that are directly involved in actual construction work and these include brick layers, painters, plumbers, electricians, carpenters, unskilled labourers, their supervisors and managers. This excluded clients, employers (those not directly involved in work) and consultants. However, due to constraints of time and money, the study was conducted among construction workers working with building contractors in the central region of Malawi and registered with the National Construction Industry Council. In order to capture sufficient number of construction workers of all trades involved in construction, only contractors that had an active construction project were included.

3.4.2 Sample Size

According to key findings of the Malawi Labour Force Survey 2013, 2.6% of the 5.5 million (154,000) employed persons were in the construction sector (NSO, 2014).From these key findings, it was estimated that there are over 10, 000 construction workers in the central region of Malawi. Sample size was calculated using Survey System sample size calculator; an online survey software package designed to help designing and conducting surveys (Creative Research Systems, https://www.SurveySystem.com/sscalm.htm). It allows calculation of sample size for large or unknown population. At 95% confidence level and 5% confidence interval, sample size was 384 construction workers.

3.4.3 Sampling Technique

The study employed multistage random sampling. In the central region, 538 building contractors were registered with NCIC in 2015. However, the register did not indicate whether a contractor had an active project or not. Firstly, simple random sampling was employed to select a convenient number of 30 contractors from the building contractors' register. These were contacted to inquire if they had an active project or not. Those without active project were excluded and replaced by repeating the sampling process until the 30 active contractors were identified. All construction workers and subcontracted tradesmen working at project site of the selected contractors were eligible respondent. At each project site, 13 workers were to be selected. In the event that there were more than 13 construction workers at a site, simple random sampling was employed to select 13workers who were included in the study.

3.5 Data Collection Tool and Technique

Data was collected through face to face interviews that were conducted either in English or Chichewa languages depending on preference of the respondent. A questionnaire containing closed-ended questions was used to generate quantitative data. The interviews were lasting 20 to 30 minutes. In addition, an observation checklist was administered at each project site to collect additional data regarding the state of health and safety at each construction site. The state of health and safety was assessed by observing availability of safety information and warnings, as well as availability and use of PPE.

The questionnaire comprised four sections namely individual characteristics, risk perception and risk characteristics, safety climate and response to risky situation. Section one comprised questions on six individual worker's characteristics namely age, gender, education level, professional category, length of employment, and past history on safety training. Section two comprised ten questions developed by Portell, et al., (2014), with Likert Scales that allowed respondents to rate each risk factor across nine qualitative risk characteristics and judge the overall perceived risk. For 'overall perceived risk', Portell, et al, (2014) used scale starting at 0 (very small) to 100 (very high) while this questionnaire used a 0 to 10 point numeric scale. Section three adopted six safety climate evaluation questions developed by NIOSH-USA; rated on a numeric scale of 1 (strongly disagree) to 4 (strongly agree). Finally section four comprised six questions that required the respondents to answer either yes or no to indicate the possible actions he or she would take in the event that he/she or co-workers were exposed to a risky situation.

3.6 Data Analysis

Data analysis was done using Statistical Package for Social Sciences version 16 (SPSS 16). First, univariate analysis was conducted to come up with descriptive statistics such as mean, standard deviation (SD), and percentage of the independent and dependent variables. Secondly, factor analysis of the risk qualitative characteristics was done. The analysis used principal component analysis (PCA) because the sample size was large enough (>300 subjects) and that communalities were high enough to opt for the PCA. To account for the problem that might arise due to inadequate sample size, the Barlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were performed. Initially, factors with Eigenvalues of over 1 were extracted. Furthermore, one method was selected to carry out the rotation: the Varimax, on assumption that the factors were not correlated with each other. In this method extraction was done, first with factor extraction via Eigenvalues > 1. Lastly, multiple regressions were done to determine significantly influencing factors for the criterion variables. Multivariate Linear Regression analysis was performed by first changing the measurement levels of the three criterion variables: "*WAH_Overall perceived risk*", "*MHL_Overall perceived risk*" and "*HWP_Overall perceived risk*"; from ordinal to continuous scale. This was followed by the multivariate linear regression on assumption that the three criterion variables were normally distributed.

3.7 Ethical Considerations

Contractors and participants were assured of voluntary participation through verbal consent. Privacy, anonymity and confidentiality were ensured. Respondents were assured that results of this study will not reflect the views of an individual person but will be shared to the public as an overall result. No gifts that could be interpreted as coercive were given.

3.8 Study Limitations

The main limitation of the study was insufficient financial resources to reach contractors in all regions of the country. The study was therefore conducted among construction workers working with building contractors in the central region of Malawi.

CHAPTER IV: RESULTS AND INTERPRETATION

4.1 Demographic Characteristics of Study Subjects

The study sampled 376 eligible subjects from 30 building construction sites. After excluding cases with data assumed to be missing completely at random, 373 subjects remained, representing a response rate of 97%. Table 4.1 presents demographic characteristics of study subjects and their descriptive statistics. Based on the results, about 98% (n = 367) were males while 2% were females. The majority of the subjects went as far as primary level of education (42%, n = 157); followed by secondary level (41%, n = 154); while only a few subjects completed tertiary level (0.54%, n = 2). In terms of professional level, most of the subjects were skilled workers (63%, n = 234), and none of them had a managerial position. Most of the study subjects were brick layers, in terms of their type of trade (47%, n = 110). The majority of the subjects (38%, n = 141) had work experience of over 10 years, followed by 1-5 years (32%, n=118). In terms of age, slightly over 70% of the subjects were aged between 20 to 40 years (20-29 years = 32%; 30-39 years= 39%); the subjects had a mean age of 35 years +/- 9.97.

Table 4.1: Number and Percentage of Respondents' Distribution by Demographic Characteristics

Characteristic	**Value**	**Count (n)**	**Percent (%)**
Respondent's Gender	Male	367	98.4
	Female	6	1.6
Highest Level of Education	No education	15	4
	Primary	157	42.1
	Secondary	154	41.3
	Vocational	45	12.1
	Tertiary	2	0.5
Professional Category	General Workers	105	28.2
	Skilled worker	234	62.7
	Supervisor	34	9.1
	Manager	0	0
Type of Trade for Skilled Workers	Brick layer	110	47
	Carpenter	46	19.7
	Electrician	18	7.7
	Painter	21	9
	Plumber	17	7.3
	Steel fixers	22	9.4
Duration of Employment	< 1 year	31	8.3
	1-5 years	118	31.6
	6-10 years	83	22.3
	>10 years	141	37.8
Respondent's Age Categories	<20	6	1.6
	20-29	121	32.4
	30-39	147	39.4
	40-49	61	16.4
	50-59	29	7.8
	≥ 60	9	2.4

4.2 Safety Training History of Workers

This section presents findings about the safety training history of subjects. As shown in table 4.2 below, about one third of the subjects (31%, n=115) had ever attended safety training. Very few subjects (5.6%, n=21) attended an on-site OHS induction course. Only 13% (n=48) attended an extensive OHS training organized by the current employer while 20% (n=74) attended extensive OHS training at school or previous job. The period during which the majority (78%, n=90) of the subjects had attended safety training was one or more years ago (earlier than October 2015).

Table 4.2: Number and Percentage of Subjects' Distribution by Safety Training History

Characteristic	Value	Count (N)	Percent (%)
Ever attended OHS training	Yes	115	30.8
	No	258	69.2
Ever attended OHS Induction training at this site	Yes	21	5.6
	No	352	94.4
Ever attended extensive OHS training lasting a day or more by contractor	Yes	48	12.9
	No	325	87.1
Ever attended extensive OHS training at school or previous job	Yes	74	19.8
	No	299	80.1
(If attended OHS training) when was the last time safety training was attended?	<3 months ago	16	13.9
	3 months to <6 months ago	2	1.7
	6 months to <1 year ago	7	6.1
	1 or more years ago	90	78.3
	TOTAL	**115**	**100**

4.3 Safety Climate at Construction Sites

In terms of safety climate of the current construction project sites, slightly over half (54.69%) of the subjects perceived their sites as poor, followed by 42.36% who perceived the sites as fair. It was also observed that all the 30 construction sites neither had safety information available for the workers nor safety signs posted on their sites. Only one of the thirty sites (3.3%) had all workers putting on a full safety kit of the required personal protective equipment (PPE). The rest of the sites had either few staff putting on a full kit of appropriate PPE or some staff putting on inadequate PPE, for instance, gumboots only.

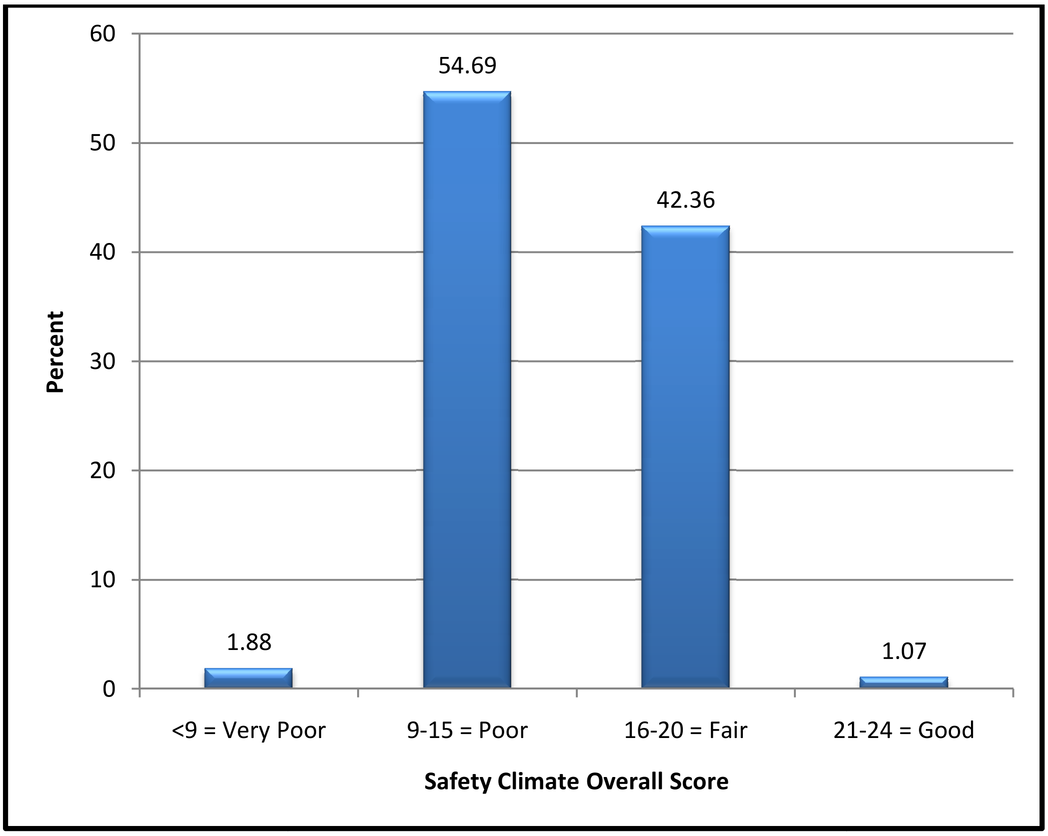

Figure 4.1: Percentage Distribution of Construction Sites by State of Safety Climate

4.4 Trends for Qualitative Risk Characteristics

Table 4.3 presents the mean scores and standard deviation of the qualitative risk characteristics and overall perceived risk for the three risk factors namely ‘working at height (WAH)’, ‘Manual handling of loads (MHL)’ and ‘Heavy workload or intense pressure to be more productive (HWP)’. Figure 4.2 presents the graphical presentation of the qualitative risk characteristics mean scores. Mean scores of personal knowledge, vulnerability and catastrophic potential for all the three factors fell between 5 (slightly high) and 6 (high). As for the dread factor (being anxious about the risk), WAH and HWP means scores were over 5 (slightly high) while the mean score for MHL was lower at 4.8. WAH mean scores for expert knowledge and severity of consequences were high, being above 6 (high) as compared to scores for MHL and HWP. One notable result was that the mean scores for severity of consequences for all three risk factors were higher (WAH=6.22; MHL=5.51; HWP=5.56) than scores of the dread factor (WAH=5.31; MHL=4.8; HWP=5.05). Paired-sample t-test was conducted to evaluate the difference of these two factors (refer to Appendix 2a). It was found that there was a statistically significant difference between the mean scores of severity of consequences and dread factor for all three risk factors; WAH severity of consequences – WAH Dread $t(372) = 9.107$, $p<0.000$; MHL severity of consequences – MHL Dread $t(372) = 6.696$, $p<0.000$; and HWP severity of consequences – MHL Dread $t(372) = 5.319$, $p<0.000$, at 95% CI. This indicates that the perception of severity of consequences had more influence on subsequent risk perception as compared to the individual’s perception of dread.

Table 4.3: ***Mean Scores for Respondent's Perception of each of the Nine Qualitative Risk Characteristics and Overall Perceived Risk***

Characteristic	**Mean ($\bar{x}$)**		
	WAH	**MHL**	**HWP**
Qualitative Risk Characteristics			
Personal Knowledge	5.67 ± 1.44	5.66 ± 1.57	5.86 ± 1.31
Expert Knowledge	6.03 ± 1.63	5.75 ± 1.75	5.72 ± 1.76
Dread	5.31 ± 1.66	4.8 ± 1.97	5.05 ± 1.89
Vulnerability	5.91 ± 1.5	5.45 ± 1.44	5.56 ± 1.49
Severity of Consequences	6.22 ± 1.23	5.51 ± 1.63	5.56 ± 1.67
Avoidability	4.45 ± 1.99	4.45 ± 1.92	4.2 ± 2.09
Controllability	3.2 ± 1.96	3.36 ± 1.98	3.53 ± 1.92
Catastrophic Potential	5.87 ± 1.54	5.09 ± 1.78	5.46 ± 1.67
Immediacy	1.43 ± 1.02	1.8 ± 1.31	2.44 ± 1.7
Overall Perceived Risk	8.8 ± 1.95	8.1 ± 2.38	8.49 ± 2.22

Note: *WAH=Working at Height; MHL= Manual Handling of Loads; HWP= Heavy Workload and Intense Pressure to be more productive.*

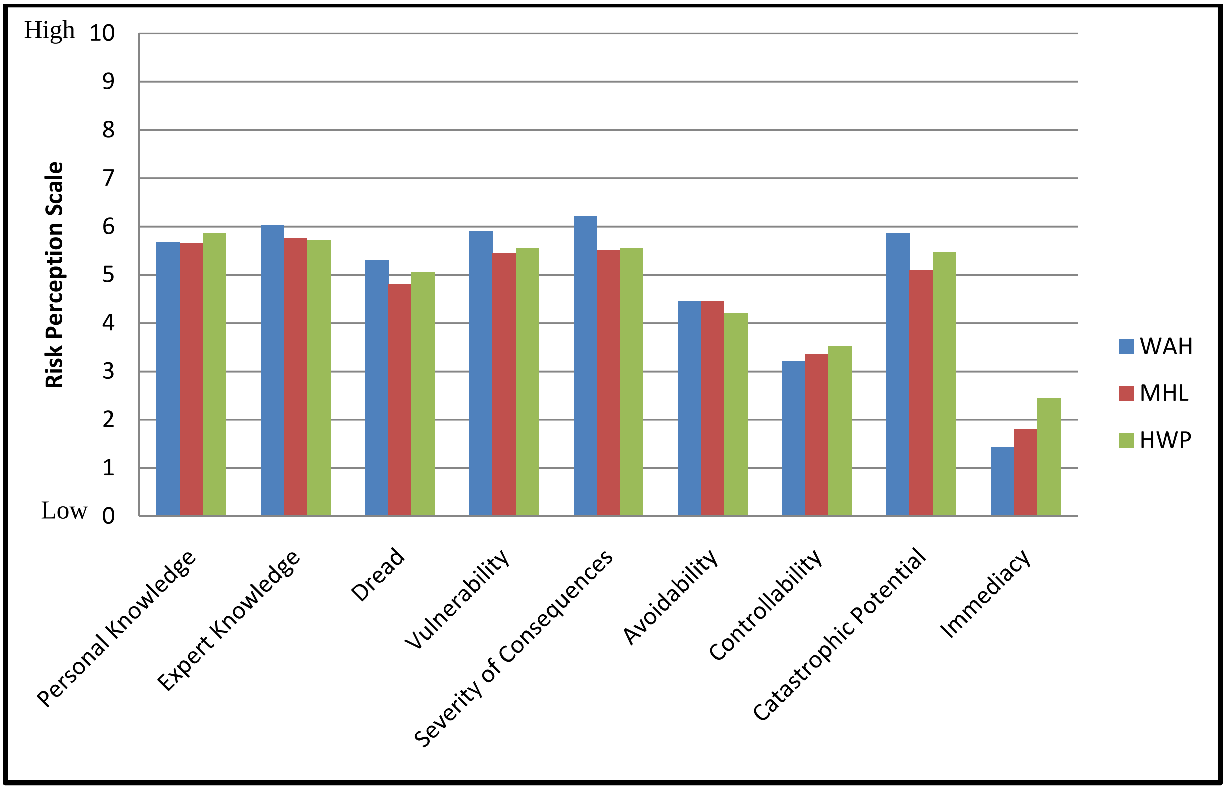

Figure 4.2: Profile of Mean Ratings for Qualitative Risk Characteristics

4.5. Construction Workers' Perception of Risk Posed by their Construction Work

This section presents results of construction workers' perception of risk posed by their construction work as measured by their rating of three criterion variables: "*overall perceived risk of working at height (WAH)*"; "*overall perceived risk of manual handling of loads (MHL)*"; and "*overall perceived risk of heavy workload or intense pressure to be more productive (HWP)*".

4.5.1. Overall Perceived Risk

Figure 4.3 presents the construction workers' overall perceived risk for WAH, MHL and HWP. Most of the workers perceived the risk of WAH as very high (62.7%, n = 234, $\bar{x}$ =8.80 ± 1.95).Workers perceived the risk of MHL as also very high (48.5%, n = 181, $\bar{x}$ =8.10 ± 2.38). Similarly, majority of the workers perceived the risk of HWP as very high (57.9%, n = 216, $\bar{x}$ =8.49 ± 2.22).

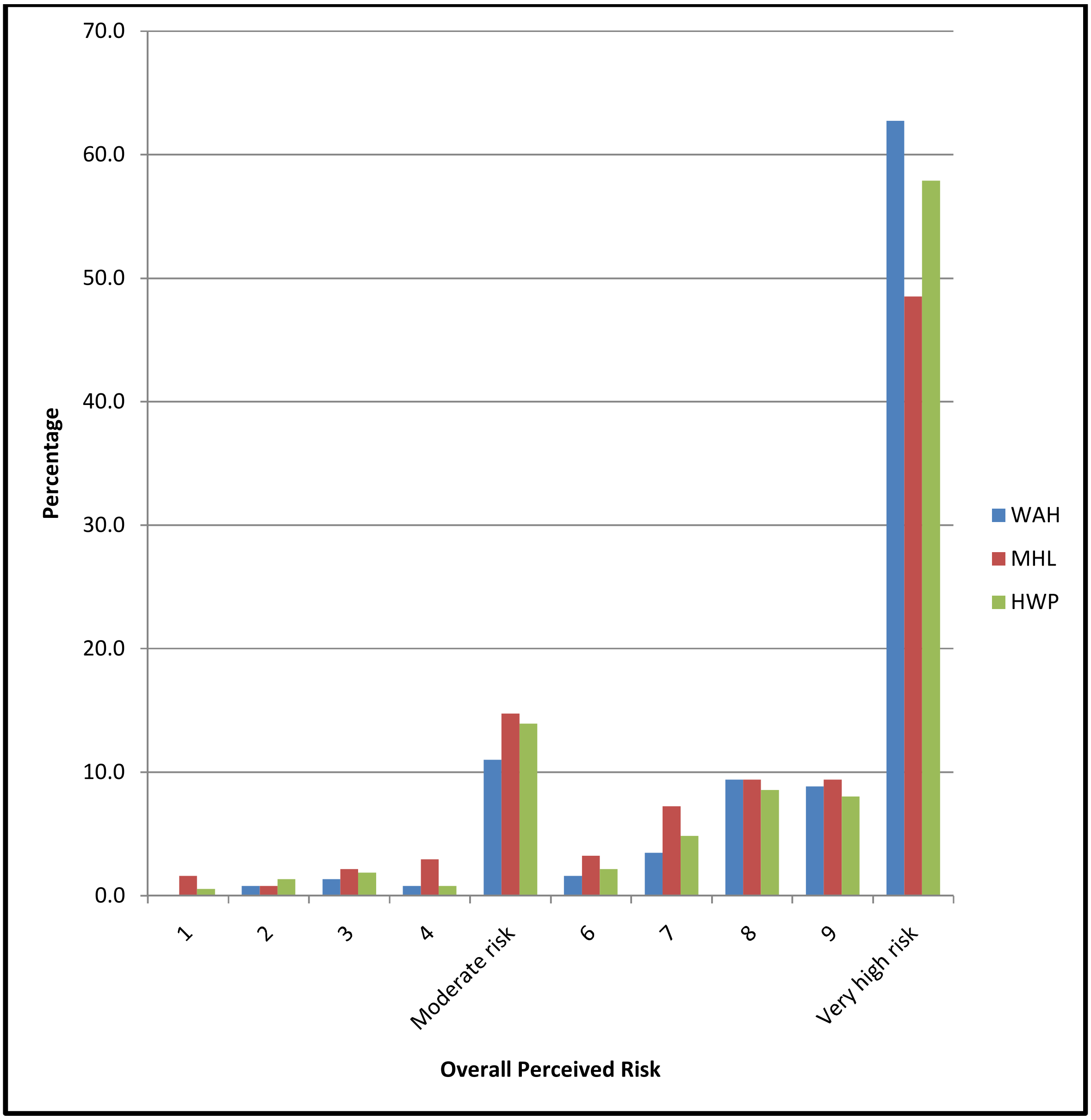

Figure 4.3: Percentage Distribution of Respondents by Overall Perceived Risk for WAH, MHL and HWP

4.5.2 Comparison of Mean Scores for Overall Perceived Risks

The mean scores for all the three risk factors were high above 8; however there was a statistically significant difference between the mean scores of these factors based on paired sample t-test results as shown in Appendix 2b. WAH_overall perceived risk score was highest ($\bar{x}$ = 8.8 ± 1.95) followed by HWP_overall perceived risk ($\bar{x}$ = 8.49 ± 2.22); while MHL_overall perceived risk had the lower score ($\bar{x}$ = 8.10 ± 2.38), ($p < 0.05$).

4.5.3. Workers' Combined Overall Perceived Risk

When the three overall risks were combined (table 4.4) into a multiple response set; it was established that the overall perceived risk was "very high" (56.4%, n = 631)[1].

Table 4.4: Number and Percentage Distribution of Respondents by Combined Overall Perceived Risk

Risk Perception Scale Values	**Count (n)**	**Percent (%)**
1	8	0.7
2	11	1.0
3	20	1.8
4	17	1.5
Moderate risk	148	13.2
6	26	2.3
7	58	5.2
8	102	9.1
9	98	8.8
Very high risk	631	56.4
Total	1119	100

[1] n = 631 gives the total number of responses out of the expected number of responses from each of the 3 criterion variables, made by each of the 373 respondents.

4.6 Factors that Influence Risk Perception among the Construction Workers

This section presents results of the analysis done to determine factors that influence risk perception among the construction workers. The first part presents results of factor analysis to determine the factors, while the other part presents results of a multivariate linear regression done to isolate the most influential factors or variables.

4.6.1 Factor Analysis

The variables that were included in this factor analysis are the 27 independent variables namely qualitative risk characteristics; and three (3) criterion variables: "*WAH_Overall perceived risk*"; "*MHL_Overall perceived risk*" and "*HWP_Overall perceived risk*".

According to Kaiser-Meyer-Olkin (KMO) results presented in Appendix 2c, the measure of sampling adequacy was greater than 0.5 (KMO=0.733), indicating that the sample was adequate enough for either factor analysis or principal component analysis (Field, 2000). The Bartlett's Test of Sphericity was significant (χ^2 = 3904.363; df = 435; P< 0.001), indicating that there was some inter-correlation among the variables in each factor and that the original correlation matrix was not an identity matrix. Factor analysis was therefore performed.

Initially, nine factors with Eigenvalues greater than one (1) were extracted (Appendix 2d). All the nine extracted factors explained about 66.93% of the total variance among the 30 selected variables (Appendix 2e). To determine the number of factors to retain, a scree-plot was then plotted to extract fewer factors. An elbow bend was observed at factor 4, so four factors were retained (Appendix 2d).

4.6.2 Factor Loadings and Factor Scores

When the four factors were extracted, it was found that eight (8) variables loaded strongly on Factor 1, herein referred to as *"Dreaded Factor"* comprising *vulnerability, severity of consequences, dread and catastrophic potential.* These were found to be inter-correlated with two criterion variables: *HWP_Overall perceived risk* and *MHL_Overall perceived risk.* In addition, six (6) variables loaded strongly on Factor 2, herein referred to as "*Avoidability and Controllability*". Furthermore, three (3) variables loaded highly on Factor 3, herein referred to as

"*Expert Knowledge*". Finally, two (2) variables loaded strongly on Factor 4, herein referred to as "*Personal Knowledge*" (Table 4.5).

In summary, the analysis identified "*Dreaded factor*"; "*Avoidability and Controllability*"; "*Expert Knowledge*"; and "*Personal Knowledge*" as risk qualitative factors that influence risk perception among the construction workers. In terms of their contribution to the total variability, "*Dreaded factor*" was found to account for 16.21% of the total variance; "*Avoidability and Controllability*" was found to account for 12.17% of the total variance; "*Expert Knowledge*" was found to account for 10.06% of the total variance; while "*Personal Knowledge*" was found to account for 5.6% of the total variance. All the four factors extracted were found to account for 44.34% of the total variance.

Table 4.5: Risk Characteristics Factor Analysis Rotational Component Matrix

Risk Characteristics	Factor 1	Factor 2	Factor 3	Factor 4
HWP_Dread	**0.737**	0.064	-0.056	0.045
MHL_Dread	**0.625**	-0.070	-0.189	0.158
WAH_Dread	0.488	-0.082	-0.022	0.015
HWP_Vunerability	**0.724**	0.043	0.093	-0.134
MHL_Vunerability	**0.664**	-0.085	-0.081	0.223
WAH_Vunerability	0.447	-0.323	0.094	-0.090
HWP _Catastrophic potential	**0.640**	0.082	0.040	-0.277
MHL_Catastrophic potential	**0.541**	-0.042	-0.023	-0.089
WAH_Catastrophic potential	0.327	-0.146	0.161	-0.427
HWP_Severity of consequences	**0.623**	0.148	0.080	-0.205
MHL_Severity of consequences	**0.600**	-0.239	-0.010	0.159
WAH_Severity of consequences	0.160	-0.121	0.334	-0.083
HWP_Controllability	-0.103	**0.580**	-0.031	-0.142
MHL_Controllability	-0.063	**0.744**	0.042	0.025
WAH_Controllability	0.039	**0.727**	0.134	-0.011
HWP_Avoidability	0.219	**0.665**	-0.117	0.039
MHL_Avoidability	0.083	**0.733**	-0.052	0.015
WAH_Avoidability	0.008	**0.725**	-0.091	-0.003

Table 4.5: Risk Characteristics Factor Analysis Rotational Component Matrix (cont.)

Risk Characteristics	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
HWP _Expert Knowledge	-0.082	-0.105	**0.755**	-0.152
MHL_Expert Knowledge	-0.142	0.009	**0.798**	-0.021
WAH_Expert Knowledge	-0.156	0.039	**0.705**	-0.150
HWP_Personal Knowledge	0.402	0.149	0.363	0.294
MHL_Personal Knowledge	0.185	0.105	0.437	**0.624**
WAH_Personal Knowledge	0.093	0.062	0.384	**0.570**
MHL_Immediacy	0.046	-0.033	-0.238	0.396
HWP_Immediacy	-0.292	-0.240	-0.240	0.347
WAH_Immediacy	0.147	0.051	-0.414	-0.030
Eigenvalue	4.376	3.287	2.715	1.592
% Variance accounted for:	16.206	12.174	10.057	5.898
Cumulative Variance	16.206	28.380	38.437	44.335

Note: Extraction method- Principal Component Analysis, with Kaizer Normalization
Factor loadings ≥ 0.5 are reported in bold

4.6.3 Factors with Significant Effect on Workers' Perception of Risk

Based on the results of the 'test of between-subjects effects' presented in Appendix 2f, all the four factors identified, "dreaded factor"; "avoidability and controllability"; "expert knowledge"; and "personal knowledge"; including education level and age showed significant effect on workers' perception of risk ($p < 0.05$). On the other hand, gender, professional category, duration of employment, ever attended safety induction or training course; and safety climate had no significant effect on the workers' perception of risk ($p \geq 0.05$).

Dreaded factor had a significant effect on workers' perception of all three risk factors, WAH, MHL and HWP ($p < 0.001$). Both avoidability and controllability had significant effect on workers' perception of WAH ($p < 0.001$) and MHL but not on HWP ($p = 0.33$). Expert knowledge had a significant effect on the perception of HWP ($p = 0.005$), and not on the other two risk factors, WAH and MHL. Personal knowledge had a significant effect on perception of WAH ($p < 0.001$) and HWP ($p < 0.001$). Age had a significant effect on the perception of MHL ($p = 0.031$) while level of education had a significant effect on WAH ($p < 0.001$) and MHL ($p = 0.024$).

4.6.4. Estimates of Parameter Effect of the Factors on Workers' Risk Perception

The results of regression analysis to estimate effects of the factors on workers' perception of risk and their corresponding 95% confidence intervals are presented in Appendix 2g. It is clear from the results that dreaded factor and personal knowledge significantly increased workers' perception of WAH while avoidability and controllability and education level significantly decreased the worker's perception of WAH ($p < 0.05$). A one-unit increase in dreaded factor and personal knowledge increased perception of WAH by a factor of 0.573 and 0.739 respectively. A one-unit increase in avoidability and controllability decreased WAH by 0.436. Not going to school did not show a significant effect on worker's perception of WAH, however attaining primary level of education significantly decreased WAH by a factor of 3.337 as compared to attaining tertiary level of education. Characteristics such as age group, gender, duration of employment, professional category, attending a safety induction course, attending a training course organized by a contractor or at school did not significantly predict workers' perception of risk as their 95% confidence intervals contained a zero ($p > 0.05$).

The results also showed that workers' perception of MHL was significantly influenced by dreaded factor, avoidability and controllability, education level and age ($p < 0.05$). Dreaded factor and education level increased workers' perception of risk associated with MHL while avoidability and controllability and age decreased the workers' risk perception. A one-unit increase in dreaded factor increased MHL risk perception by a factor of 1.321. Furthermore, not going to school significantly increased MHL risk perception by a factor of 5.305 while attaining primary level of education significantly increased MHL risk perception by a factor of 4.901compared to attaining tertiary level of education. On the other hand**,** a one-unit increase in avoidability and controllability decreased MHL risk perception by a factor of 0.486. Having age <20 and 50 to 59 did not show significant effect on perception of MHL; yet having age 20 to 29, 30 to 39 and 40 to 49 significantly reduced MHL risk perception by a factor of 1.933,2.188 and 1.727 respectively compared to having 60 years of age or more. Factors such as expert knowledge and personal knowledge, gender, professional category, attending a safety induction course, attending training course organized by a contractor or at school did not significantly predict the workers' perception of MHL ($p > 0.05$).

Significant predictors for workers' perception of HWP included dreaded factor, expert knowledge and personal knowledge ($p < 0.05$). A one-unit increase in dreaded factor increased HWP risk perception by a factor of 1.616; a one-unit increase in expert knowledge increased HWP risk perception by a factor of 0.242 while a one-unit increase in personal knowledge decreased HWP risk perception by a factor of 0.389. Factors such as avoidability and controllability, age group, gender, educational level, duration of employment, professional category, attending a safety induction course, attending a training course organized by a contractor or at school did not significantly predict perception of HWP ($p > 0.05$).

4.7 Construction Workers' Actions Related to Perceived Risky Situations

This section presents results of construction workers' actions related to perceived risky situations. Most of the workers (58.45%, n = 218) indicated they would not stop working to report the risk to their supervisor. When asked whether they would request for information regarding health and safety from their supervisor, most of the workers declined (80.16%, n = 299). In addition, most of the workers (67.29%, n = 234) also indicated they would not request for personal protective equipment (PPE), when it is needed. Ironically, when asked whether they would warn co-workers about health and safety risks of the situation, the majority of them indicated that they would (82.31%, n = 307). Sympathetically, majority (63.27%, n = 236) indicated they would continue working even with full knowledge of the risks associated with the situation.

CHAPTER V: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The aim of this research was to study the perception of occupational risk by Malawian construction workers and to determine factors that influence risk perception. The study had three specific objectives as follows: to assess construction workers' perception of risk posed by their construction work; to identify factors that influence risk perception among the construction workers; and to determine construction workers' actions related to perceived risky situations. This chapter therefore presents a discussion of the findings, concluding remarks and recommendations that have been drawn from the study.

5.2 Construction Workers' Perception of Risk

Workers' perception of the risk posed by construction work was assessed by rating three specific risk factors, 'working at height (WAH)' (risk of falling from a height causing serious injury); 'manual handling of loads (MHL)' (risk of chronic musculoskeletal disorders); and 'heavy workload or intense pressure to be more productive (HWP)' (risk of stress causing ill health). This study has shown that the majority of workers perceive the risks associated with WAH (63%, $\bar{x}$ =8.8±1.95), MHL (49%, $\bar{x}$ =8.1±2.38) and HWP (58%, $\bar{x}$ =8.49±2.22) as very high. Similarly, the overall risk (a combination of ratings for the three risk factors, WAH, MHL and HWP) showed that most workers (56%) perceive risk posed by their construction work as being very high. This clearly reveals that construction workers in Malawi are aware of and understand the risks posed by their work. According to Portell et al. (2014), the evaluation of risk lay people make, reveals their genuine concerns that may not be incorporated in experts risk assessment. These findings have shown that Malawian construction workers are in agreement with what other authors have said that construction work is risky (Hinksman, 2011; Hislop, 1999; Hughes & Ferrett, 2007; ILO, 2001; McDonald & Hrymak, 2002; Weeks, 2011). This is therefore a good premise for developing a proper safety culture (Alexopoulos, et al., 2009) which can facilitate health and safety risk management in the Malawian construction industry. This is in consonant with what Charles et al. (2007) and Safe Work Australia (2011) clearly stated that an effective health and safety program in the workplace is underpinned by a good risk management system. Additionally, comparison of mean ratings of these three risk factors showed that workers are more concerned about the risk posed by WAH, then HWP followed by MHL. This could be because working at height is associated with high rates of fatal injuries worldwide (Charles et al., 2007; Khen, et al., 2006; Petrovic, et al., 2007) and such could also be the case in Malawi.

5.3 Factors Influencing Risk Perception

In this study, nine qualitative risk characteristics (namely dread, vulnerability, severity of consequences, catastrophic potential, personal knowledge, expert knowledge, immediacy, avoidability and controllability); individual characteristics of age, gender, education level, professional category, duration of employment and history of safety training; and safety climate were assessed.

5.3.1. Qualitative risk characteristics

The study replicated the factor analysis of psychometric paradigm to assess the influence of nine qualitative risk characteristics, expert knowledge, personal knowledge, dread, severity of consequences, catastrophic potential, avoidability, controllability and immediacy. The study findings agree with several other studies that have used the psychometric paradigm (Alexopoulos, et al., 2009; Portell et al., 2014; Slovic 1987) that there is a correlation among many of them. There is a similarity in the way some of these qualitative risk characteristics are perceived. This study's factor analysis identified four high order factors that significantly accounted for risk perception among the workers. These are Factor 1 (dreaded factor) comprising 'vulnerability, severity of consequences, dread and catastrophic potential' which accounted for 16.21% of total variance; Factor 2 (avoidability and controllability) which account for 12.17% of total variance; Factors 3 (expert knowledge) which account for 10.06% of the total variance; and finally Factor 4 (personal knowledge) which account for 5.89% of the total variance.

Findings from this study concur with previous psychometric studies and those that used other approaches that 'Factor 1 (dreaded factor)' has more influence on risk perception (Bohm & Harris, 2010; Portell, et al., 2014; Slovic, 1987). The findings revealed that 'dreaded factor' accounted for a higher percentage (16.21%) of total variance as compared to the other factors. In fact the dreaded factor proved to have significant influence on the perception of all the three risk factors, WAH, MHL and HWP. An increase in the perception of Factor 1 (dreaded factor) was associated with an increase in overall perceived risk for WAH, MHL and HWP. Factor 2 (avoidability and controllability) accounted for 12.17%, had a significant effect on WAH and HWP; the effect was rather inverse. An increase in the perception of 'avoidability and controllability' decreased the overall perceived risk. Factors 3 (expert knowledge) accounted for 10.06% and had a positive effect on HWP. Lastly, Factor 4 (personal knowledge) accounted for 5.89% and also had a positive effect on WAH and HWP. It is apparent from these findings that risk control programmes should take into consideration the influence that these risk characteristics have on workers in order to create better measures that will make construction workplaces safer.

5.3.2 Individual Characteristics

Differing findings have been reported about the influence of individual characteristics (Alexopoulos, et al.; Phoya, n.d; Portell, et al., 2014). This study however found that some characteristics like education level and age were significant predictors of risk perception while gender, professional category, duration of employment, ever attended safety induction or training course did not have any effect on construction workers' risk perception. This is contrary to what Portell et al. (2011) observed that individual characteristics "were not significant predictors of perceived risk." A possible reason could be because the target populations of these studies were different (health care workers for Portell et al., 2011). This study however concurs with Phoya (n.d) that education level attained influence risk perception. Education was found to influence WAH and MHL, but the direction of influence differed as a function of the hazard. Perhaps workers understanding of the hazard characteristics improved thereby influencing the way the workers perceived the risk posed by the hazards. Education influenced perception of WAH positively while it influenced MHL inversely. Attaining primary education decreased the score of WAH risk perception by factor of 3.337 (at 95% CI), as compared to attaining tertiary education. On the other hand illiteracy significantly increased the score of MHL risk perception by a factor of 5.305 (at 95% CI).

This study also concurs with Phoya (n.d) that the individual characteristic age influence risk perception. A significant decrease (by a factor of 1.933) in workers' perception of risk associated with MHL was observed among young workers (aged 20 to 29) as compared to older workers. Interestingly having age <20 and 50 to 59 did not significantly predict risk perception possibly due to the insufficient number of subjects that belonged to these groups (6 =1.6% and 29 =7.8% respectively).

According to findings by Portell et al. (2014) in their study about risk characterization among Spanish health care workers, professional category was a significant predictor for two risk variables contrary to what has been revealed in this study. Professional category had no significant effect on any of the three risk variable, WAH, MHL and HWP. Alexopolous, et al., (2009) proved that risk perception was influenced by length of experience among Greek bakery workers. The "Greeks believed that risk management was a personal responsibility and was associated with length of work experience" (p. 7). Differing results were noted in this study that length of experience had no effect on perception of risk for all the variables among the construction workers possibly because the belief about who is responsible for safety is different.

5.3.2 Safety Climate

This study has revealed that majority (54.69%) of the construction workers perceived their construction site safety climate as poor followed by 42% who perceived their sites as fair. These findings echo what was reported by Chibwezo (2015) and Chiocha et al. (2011) that the OHS standards in Malawi construction sites are poor and also agree with Alkilani et al. (2013), Dias (2009), Pekka (2011), and Wong et al. (2015) that construction sites in Malawi and Africa at large continue to be neglected with little or no effort to improve the health and safety conditions of the work sites. This situation is unpleasant considering that the construction industry employs a lot of people and is one of the major contributors to the country's economy.

Findings similar to that reported by Alkilani et al. (2003), Kheni et al. (2006) and Musonda & Smallwood (2008) were also observed at the construction sites. Contractor's commitment to health and safety was pitiable as evidenced by failure to provide minimal OHS requirements like PPE, onsite safety signs and on site safety training. This may be because the contractors have poor attitude towards health and safety; they lack health and safety awareness or that they desire to maximize profits at the expense of workers lives. Without deliberate effort from the contractors and other key players, to improve the OHS state in Malawi, it is this research's thesis that construction industry will continue to silently claim lives of workers through preventable occupational accidents and diseases.

According to Bohm & Harris (2010), Inouye (2014) and Che Hassan et al. (2007), positive safety climate influences risk perception positively, reduces employees risk taking behavior thereby reducing workplace injury rates. Nevertheless, this study revealed contradicting findings that workers' perception of safety climate did not influence the workers risk perception. The regression analysis did not show a significant link between the safety climate and the worker's risk perception. The possible reason for this could be because most of the workers did not undergo safety inductions and that their sites lacked minimal safety requirements such that no idea or thought on safety (or risk) could be generated just by observing the safety climate at the sites.

5.4 Actions Related to Perceived Risky Situations

According to Rohrmann (n.d.) and Schmidt (2004), behaviours shown before, during and after an incident are greatly influenced by risk perception. Going by this statement, it would be expected that workers could stop working, report to supervisors, and request for PPE or safety information in the event that they or their colleagues are faced with risky situation. Findings of this study are not consistent with what Rohrmann (n.d.) and Schmidt (2004) said that behaviours are greatly influenced by risk perception. The study however agrees with Bohm & Harris (2010) that the relationship between risk perception and risk-taking behaviour is rather complicated. Risky behaviors are not always as a result of misjudgment of risk. In some instances, willingness to engage in risky behavior prevails. This is what was observed in this study. Despite perceiving the risk posed by their work as risky, majority (58%) of construction workers indicated that they would not stop working to report to their supervisor in times of risky situations; 80% would not ask for information regarding health and safety from their supervisor; and 67% would not request for personal protective equipment (PPE). The majority of workers (82%) indicated that they would manage to warn co-workers about health and safety risks of the situation but continue working (63.27%) even with full knowledge of risks associated. As highlighted by Sjöberg et al. (2004) construction workers in Malawi continue to work while tolerating considerably more risk at the expense of their health and safety. This could be because most of them are unskilled workers, do not have the required qualifications (even though they work as skilled workers) and they are desperate for the job. This is a sorry state because the construction sector in Malawi will continue to cause ill health and claim lives of the workers unless safety measures are deliberately put it place to improve the safety climate and safety behaviours of the workers.

5.5 Conclusion

This section presents some concluding remarks based on the findings of the study. The study provides evidence that construction workers in Malawi are aware of the risk posed by the construction work they are engaged in. They perceive the risk posed by their work as high.

Risk perception by Malawian construction workers is influenced by a number of factors. These factors include qualitative risk characteristics like dreaded factor; avoidability and controllability; expert knowledge; personal knowledge; and individual characteristics of age and education level. Gender, professional category, length of employment, safety training history and safety climate did not show a significant link with the worker's risk perception. However there is need to explore these factors further using different study designs. There were other factors that were not included in this study, like peer pressure and optimism bias, that need to be investigated.

The status of health and safety in many construction sites in Malawi remains poor. Contractors fail to comply with minimum requirements, according to the Occupation Safety, Health and Welfare Act of 1997 and NCIC's code of ethics for contractors like provision of appropriate personal protective equipment and induction training. Nonetheless, the workers continue to work in hazardous environments despite being fully aware of the risks involved; with little effort by themselves, their employers (contractors) or other responsible authorities to promote health and safety.

5.6 Recommendations

Health at work and healthy work environments are among the most valuable assets of individuals, communities and the country. The quality of life of workers is a crucial prerequisite for productivity and is of utmost importance for overall socio-economic development. Stakeholders in construction such as clients, consultants (engineers or architects) workers, and NCIC as a regulatory body need to start undertaking their moral and legal obligation in order to promote health and safety in construction sites. Chance or guesswork can never promote health and safety at a workplace (Safe Work Australia, 2011). It has been proved that although perception of risk among construction workers is high, their work environment continues to be poor. The following recommendations are therefore being proposed:

5.6.1 Recommendations for NCIC

Firstly, NCIC should enhance risk perception and risk management awareness and the involvement of all players in the construction industry in order to improve OHS management in construction worksites. NCIC as a regulatory body should develop deliberate awareness and training programs targeting key players like contractor management and supervisors as well as consultants such as engineers, architects, surveyors.

Secondly, awareness and training sessions should focus on topics such as understanding hazards and risks associated with the construction industry; risk perception, its influencing factors and risk management; and the link between risk perception and workers' response towards risky environments.

Thirdly, NCIC should strengthen the monitoring of contractors' compliance with safety and health obligations as stipulated in OSHWA and code of ethics in order to improve safety culture of the industry. This can be achieved by establishing a fully fledged OHS monitoring section and implementing strict corrective and disciplinary actions to non-complying contractors.

5.6.2 Recommendations for Contractors

Firstly contractors should incorporate OHS management programs in the implementation of their projects because it is their legal and moral obligation.

Secondly OHS management at construction worksites should integrate the analysis of behaviors and risk perception of the workers and other players. This will guide OHS officers and managers to understand underlying factors leading to workers risk behavior and identification of better health and safety interventions.

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APPENDICES

APPENDIX 1: DATA COLLECTION TOOLS

Appendix 1a: Questionnaire

An Assessment of Risk Perception and Its Influencing Factors among Construction Workers in Malawi

Questionnaire no: ……………………………………..

Respondent (ID) no: …………………………………..

Date of interview: ……………………………………….

Date questionnaire checked: ……………………………….

Construction Project Site code no: ………………………..

Interviewer code no: ……………………………

Instructions

- Before administering the questionnaire, explain to the respondent that the purpose of the interview is to collect information on a number of issues concerning health and safety in the construction industry.
- Inform the respondent that this is not a review of his/her performance but rather an opportunity to honestly answer the questions. His/her answers will help to improve health and safety services in construction.
- Inform the respondent that this interview is anonymous and confidential. Answers to all questions are voluntary, and we will treat his/her answers with strict confidence.
- Ask the responded if he/she would you like to participate.
- Ask each and every question of the respondent.
- Check the most appropriate answer for each question and make comments where necessary.

SECTION ONE: Individual Characteristics

Q No	Question	Answers	Tick ✓ the appropriate box
1	How old are you?	…………………………	
2	Observe the Gender of respondent.		
		Male	
		Female	
3	What is the highest level of education you completed?		
		No education	
		Primary Education	
		Secondary education	
		Vocational education	
		University education	
4	Which category is best to describe your current employment on this site (i.e. professional category)?		
		Casual Labourer	
		Skilled worker (*specify the type of trade*)	
		Supervisor	
		Manager	
5	For how long have you been working in the construction industry (i.e. duration of employment)?		
		…………………………………………..	
6	Have you ever attended any of the following trainings on health and safety issues concerning this construction site?		
	Safety induction training	Yes	
		No	
	Extensive H&S training lasting a day or more by contractor.	Yes	
		No	
	Extensive H&S course at training school or previous job.	Yes	
		No	

7	(*For those that have ever attended safety induction training*) How long did the induction training last?		
		<15 minutes	
		15 minutes to <30 minutes	
		30 minutes to <1 hour	
		1 hour or more	
8	(*For those that have ever attended health and safety training*) when was the last time you attended any of these trainings?		
		<3 months ago	
		3 months to <6 months ago	
		6 months to <1 year ago	
		1 or more years ago	
9	How often are health and safety trainings conducted at this construction site?		
		Monthly	
		Quarterly	
		Twice a year	
		Once a year	
		Other, specify	

SECTION TWO: Risk Perception and Risk Characteristics

A. Working at height (risk of injury from falling from a height)

10. Personal knowledge

To what extent do you know the risk associated with this factor (to what extend do you know the harm it can cause, the possibility of suffering this harm, etc.)?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

11. Expert knowledge

To what extent would you say managers of health and safety in your company know the risk associated with this factor ‘working at height’?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

12. Dread

When you consider the personal harm this factor could cause, what is your level of fear?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

13. Vulnerability

How do you evaluate the possibility of you suffering personal harm (serious or not, now or later) as a consequence of this factor?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

14. Severity of consequences

In the event of a risk situation, the severity of the harm this factor can cause you is:

1	2	3	4	5	6	7
Very mild	Low	Slightly mild	Moderate	Slightly serious	High	Very serious

15. Avoidability

What is the possibility of you avoiding the occurrence of a risk situation produced by this factor 'working at height'?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

16. Controllability

If a risk situation arises, what is your level of control to avoid or reduce personal harm that can be caused by this factor?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

17. Catastrophic potential

What is the possibility of this factor, 'working at height' causing personal harm to a large number of people at the same time?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

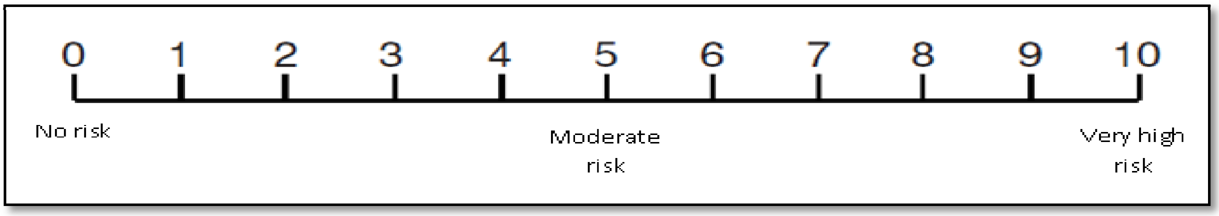
18. Immediacy

In case of exposure, when would the most severe consequences of this factor be suffered?

1	2	3	4	5	6	7
Immediately	Quiet immediate	Somewhat immediately	Intermediate	Somewhat Later	Quiet Late	Very much later

19. Overall Perceived Risk

How would you assess the risk of a very serious accident or a very serious illness associated with this factor ‘working at a height’? Consider that a very serious accident or very serious illness is one which involves an irreversible loss of health (death, loss of functional capacity, chronic diseases that severely reduces life or its quality) either immediately or medium / long term. Choose a number between zero and 10 that best represents your assessment.



B. Manual handling of loads (risk of chronic musculoskeletal injuries)

20. Personal knowledge

To what extent do you know the risk associated with this factor (to what extend do you know the harm it can cause, the possibility of suffering this harm, etc.)?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

21. Expert knowledge

To what extent would you say managers of health and safety in your company know the risk associated with this factor ‘manual handling of loads’?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

22. Dread

When you consider the personal harm this factor could cause, what is your level of fear?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

23. Vulnerability

How do you evaluate the possibility of you suffering personal harm (serious or not, now or later) as a consequence of this factor?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

Severity of consequences

In the event of a risk situation, the severity of the harm this factor can cause you is:

1	2	3	4	5	6	7
Very mild	Low	Slightly mild	Moderate	Slightly serious	High	Very serious

24. Avoidability

What is the possibility of you avoiding the occurrence of a risk situation produced by this factor 'manual handling of loads'?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

25. Controllability

If a risk situation arises, what is your level of control to avoid or reduce personal harm that can be caused by this factor?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

26. Catastrophic potential

What is the possibility of this factor, 'manual handling' causing personal harm to a large number of people at the same time?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

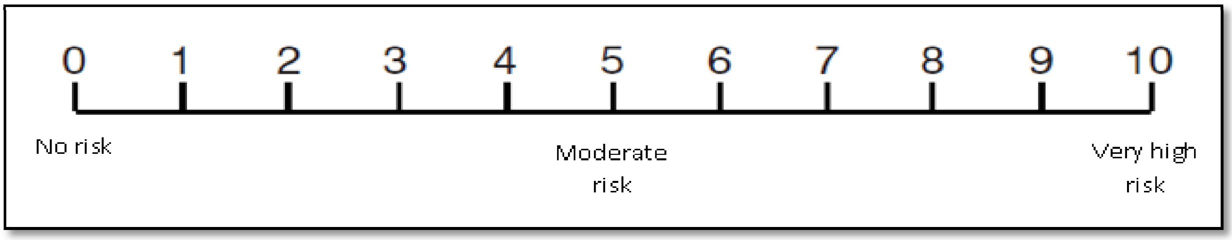
27. Immediacy

In case of exposure, when would the most severe consequences of this factor be suffered?

1	2	3	4	5	6	7
Immediately	Quiet immediate	Somewhat immediately	Intermediate	Somewhat Later	Quiet Late	Very much later

28. Overall Perceived Risk

How would you assess the risk of a very serious accident or a very serious illness associated with this factor 'manual handling of loads'? Consider that a very serious accident or very serious illness is one which involves an irreversible loss of health (death, loss of functional capacity, chronic diseases that severely reduces life or its quality) either immediately or medium / long term. Choose a number between zero and 10 that best represents your assessment.



C. Heavy workload or intense pressure to be more productive (risk of stress)

29. Personal knowledge

To what extent do you know the risk associated with this factor (to what extend do you know the harm it can cause, the possibility of suffering this harm, etc.)?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

30. Expert knowledge

To what extent would you say managers of health and safety in your company know the risk associated with this factor 'heavy workload or intense pressure to be more productive'?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

31. Dread

When you consider the personal harm this factor could cause, what is your level of fear?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

32. Vulnerability

How do you evaluate the possibility of you suffering personal harm (serious or not, now or later) as a consequence of this factor?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

33. Severity of consequences

In the event of a risk situation, the severity of the harm this factor can cause you is:

1	2	3	4	5	6	7
Very mild	Low	Slightly mild	Moderate	Slightly serious	High	Very serious

34. Avoidability

What is the possibility of you avoiding the occurrence of a risk situation produced by this factor ‘heavy workload or intense pressure to be more productive’?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

35. Controllability

If a risk situation arises, what is your level of control to avoid or reduce personal harm that can be caused by this factor?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

36. Catastrophic potential

What is the possibility of this factor, ‘heavy workload or intense pressure to be more productive’ causing personal harm to a large number of people at the same time?

1	2	3	4	5	6	7
Very Low	Low	Slightly low	Moderate	Slightly high	High	Very High

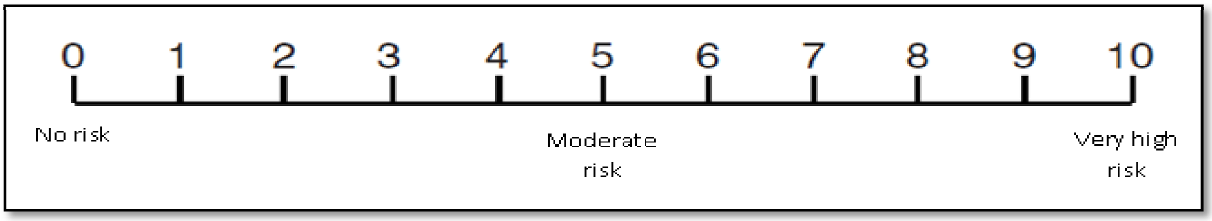
37. Immediacy

In case of exposure, when would the most severe consequences of this factor be suffered?

1	2	3	4	5	6	7
Immediately	Quiet immediate	Somewhat immediately	Intermediate	Somewhat Later	Quiet Late	Very much later

38. Overall Perceived Risk

How would you assess the risk of a very serious accident or a very serious illness associated with this factor ‘heavy workload or intense pressure to be more productive’? Consider that a very serious accident or very serious illness is one which involves an irreversible loss of health (death, loss of functional capacity, chronic diseases that severely reduces life or its quality) either immediately or medium / long term. Choose a number between zero and 10 that best represents your assessment.



SECTION THREE: Safety Climate

Indicate how much you agree or disagree with each of the following statements about safety culture at the construction site where you work. Circle the number on the scale to answer the questions:

39. New employees quickly learn that they are expected to follow good safety practices.

1	2	3	4
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

40. There are no significant compromises or shortcuts taken when worker safety is at stake.

1	2	3	4
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

41. Where I work, employees and management work together to ensure the safest possible working conditions.

1	2	3	4
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

42. Employees are told when they do not follow good safety practices.

1	2	3	4
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

43. The safety of workers is a big priority with management where I work.

1	2	3	4
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

44. I feel free to report safety violations where I work.

1	2	3	4
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

SECTION FOUR: Action related to Risky Situations

45. In general, what would be your immediate action/ response/reaction if you or co-workers were exposed to a risky situation on the site? Tick yes or no to indicate your preferred actions.

Actions		**Tick ✓ the appropriate box**
Stop working and report to my supervisor/safety officer	Yes	
	No	
Ask for information regarding health and safety from my supervisor/safety officer	Yes	
	No	
Make to my supervisor suggestions for improving health and safety	Yes	
	No	
Request for personal protective equipment (PPE), when it's needed.	Yes	
	No	
Warn co-workers about health and safety risks of the situation.	Yes	
	No	
Continue working even with full knowledge of the risks associated	Yes	
	No	
Any other, please explain		

These are the questions I had. Thank you very much for your cooperation.

46. Do you have any remarks you wish to add?

Yes: ……………………………………….. No……………………………………………

Once again thank you very much for your cooperation.

Appendix 1b: Observation Checklist

An Assessment of Risk Perception and Its Influencing Factors among Construction Workers in Malawi

Observation ChecklistNo: ☐

Interviewer: ______________________________

Date: ____/____/________

Instructions

- Before administering the checklist, explain to the respondent that the purpose of the study is to collect information on a number of issues concerning health and safety in the construction industry.
- Inform the respondent that this is not a review of the contractor's performance but rather an opportunity to help to improve health and safety services.
- Inform the respondent that this data collection is anonymous and confidential and we will treat his/her answers with strict confidence.
- Check the most appropriate answer for each question and make comments or observations in spaces provided.

SECTION ONE: GENERAL ISSUES

Indicate either: Y = Yes/Satisfactory; N = No/Unsatisfactory N/A = Not Applicable

		Check Y; N or N/A	Comment
1	Project Registration Certificate with OHSW departments available		
2	Type of works		
	Building Construction		
	Road Construction		
	Bridge construction		
	Demolition & Rehabilitation		
	Maintenance		
	Other (specify)		
3	Location		
4	Number of workers		
5	Availability of Safety Officer		
6	Worker's Safety Committee or Safety Representative available		

SECTION TWO: SAFETY TRAINING HISTORY

		Check Y; N or N/A	Comment
7	Induction training was done and records are available		
8	Extensive health & safety trainings are done and records are available.		
9	Indicate date of last Health & Safety Training		

SECTION THREE: SAFETY CLIMATE

		Check Y; N or N/A	Comment
10	Availability of safety information for workers e.g. leaflets/posters		
11	Safety warning signs posted in dangerous areas		
12	Workers provided with minimum required PPE		
13	PPE appropriately worn / used		

APPENDIX 2: DATA ANALYSIS TABLES

Appendix 2a: Paired Sample T-Test Results for Severity of Consequences versus Dread Factor

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Upper	Lower			
Pair 1: WAH Severity of consequences - WAH Dread	0.917	1.944	0.101	0.719	1.115	9.107	372	0
Pair 2: MHL Severity of consequences - MHL Dread	0.718	2.072	0.107	0.508	0.929	6.696	372	0
Pair 3: HWP Severity of consequences - HWP Dread	0.517	1.879	0.097	0.326	0.709	5.319	372	0

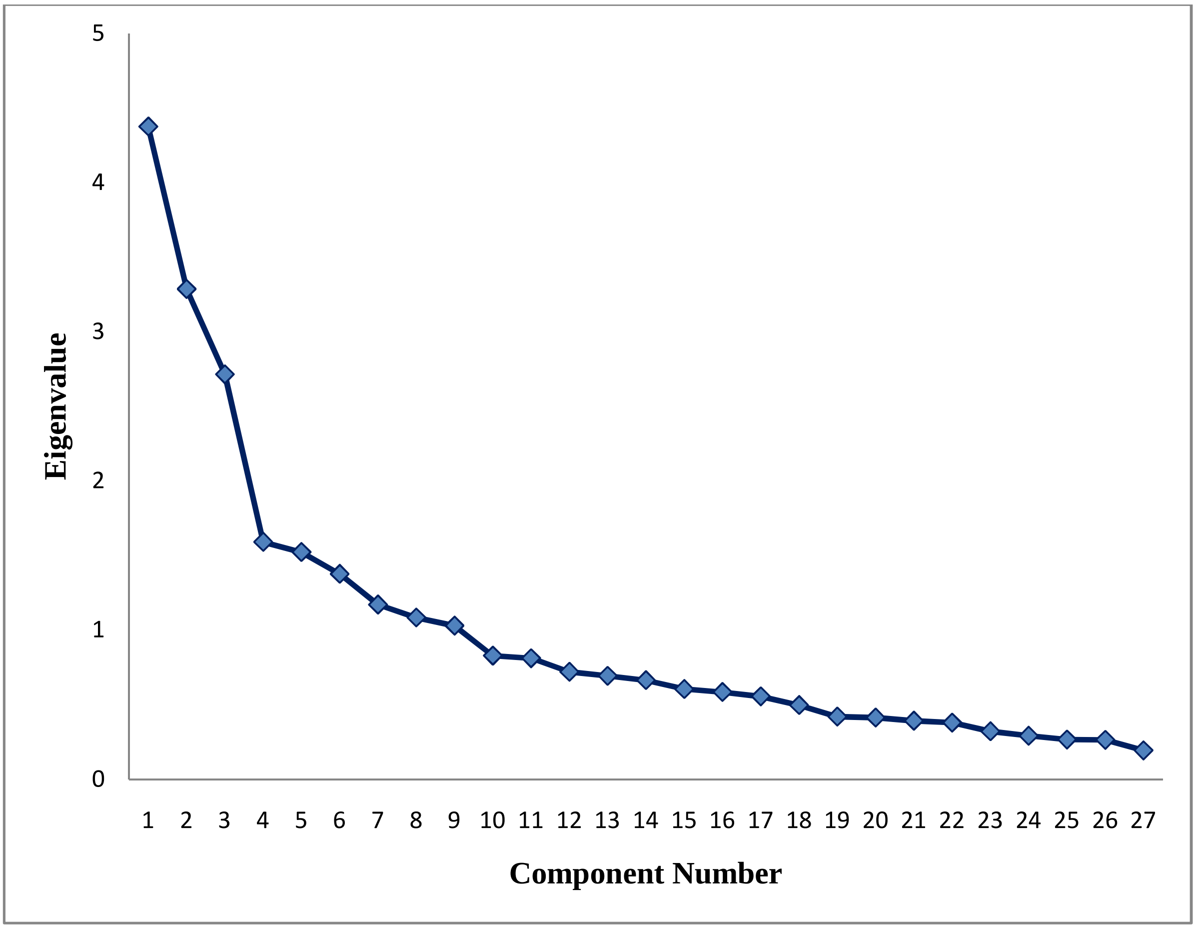
Appendix 2b: Paired Sample T-Test Results for Overall Perceived Risk

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Upper	Lower			
Pair 1: WAH_Overall perceived risk - MHL_Overall perceived risk	0.7	2.532	0.131	0.442	0.957	5.338	372	0
Pair 2: WAH _ Overall perceived risk - HWP _ Overall perceived risk	0.314	2.565	0.133	0.052	0.575	2.361	372	0.019
Pair 3: HWP _ Overall perceived risk - MHL _ Overall perceived risk	0.386	2.403	0.124	0.141	0.631	3.103	372	0.002

Appendix 2c: KMO and Bartlett's Test of Sphericity Results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.733
Bartlett's Test of Sphericity	Approx. Chi-Square	3904.363
	df	435
	Sig.	.000

Appendix2d: Scree Plot for Factor Extraction



Appendix 2e: Variance Explained by the Nine (9) Factors with Eigenvalue> 1

	Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %
1	4.376	16.206	16.206
2	3.287	12.174	28.380
3	2.715	10.057	38.437
4	1.592	5.898	44.335
5	1.524	5.645	49.979
6	1.378	6.102	55.081
7	1.172	4.341	59.423
8	1.086	4.021	63.444
9	1.031	3.489	66.932

Extraction Method: Principal Component Analysis.

Appendix 2f: Results of Test of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Working at height_Overall perceived risk	567.422[a]	25	22.697	9.26	0.000
	Manual handling of loads_Overall perceived risk	894.453[b]	25	35.778	10.27	0.000
	Heavy workload or intense pressure to be more productive_Overall perceived risk	1064.919[c]	25	42.597	19.442	0.000
Intercept	Working at height_Overall perceived risk	632.843	1	632.843	258.198	0.000
	Manual handling of loads_Overall perceived risk	559.098	1	559.098	160.485	0.000
	Heavy workload or intense pressure to be more productive_Overall perceived risk	652.436	1	652.436	297.791	0.000
Factor 1	Working at height_Overall perceived risk	95.351	1	95.351	38.903	0.000
	Manual handling of loads_Overall perceived risk	507.2	1	507.2	145.588	0.000
	Heavy workload or intense pressure to be more productive_Overall perceived risk	758.939	1	758.939	346.402	0.000

Appendix 2f: Results of Test of Between-Subjects Effects (cont.)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Factor 2	Working at height_Overall perceived risk	51.946	1	51.946	21.194	0.000
	Manual handling of loads_Overall perceived risk	64.756	1	64.756	18.588	0.000
	Heavy workload or intense pressure to be more productive_Overall perceived risk	2.087	1	2.087	0.953	0.33
Factor 3	Working at height_Overall perceived risk	4.559	1	4.559	1.86	0.174
	Manual handling of loads_Overall perceived risk	0.097	1	0.097	0.028	0.868
	Heavy workload or intense pressure to be more productive_Overall perceived risk	17.78	1	17.78	8.115	0.005
Factor 4	Working at height_Overall perceived risk	167.227	1	167.227	68.228	0.000
	Manual handling of loads_Overall perceived risk	2.069	1	2.069	0.594	0.441
	Heavy workload or intense pressure to be more productive_Overall perceived risk	46.407	1	46.407	21.181	0.000

Appendix 2f: Results of Test of Between-Subjects Effects (cont.)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Age Groups	Working at height_Overall perceived risk	29.142	5	5.828	2.378	0.39
	Manual handling of loads_Overall perceived risk	43.459	5	8.692	2.495	0.031
	Heavy workload or intense pressure to be more productive_Overall perceived risk	7.499	5	1.5	0.685	0.635
Gender	Working at height_Overall perceived risk	4.408	1	4.408	1.798	0.181
	Manual handling of loads_Overall perceived risk	9.655	1	9.655	2.771	0.097
	Heavy workload or intense pressure to be more productive_Overall perceived risk	0.023	1	0.023	0.011	0.918
Education Level	Working at height_Overall perceived risk	54.819	4	13.705	5.591	0.000
	Manual handling of loads_Overall perceived risk	39.653	4	9.913	2.846	0.024
	Heavy workload or intense pressure to be more productive_Overall perceived risk	3.658	4	0.915	0.417	0.796

Appendix 2f: Results of Test of Between-Subjects Effects (cont.)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Profession Category	Working at height_Overall perceived risk	14.248	2	7.124	2.906	0.056
	Manual handling of loads_Overall perceived risk	9.678	2	4.839	1.389	0.251
	Heavy workload or intense pressure to be more productive_Overall perceived risk	3.883	2	1.942	0.886	0.413
Duration of Employment	Working at height_Overall perceived risk	11.42	3	3.807	1.553	0.201
	Manual handling of loads_Overall perceived risk	3.044	3	1.015	0.291	0.832
	Heavy workload or intense pressure to be more productive_Overall perceived risk	11.308	3	3.769	1.72	0.162
Safety Induction	Working at height_Overall perceived risk	4.753	1	4.753	1.939	0.165
	Manual handling of loads_Overall perceived risk	0.437	1	0.437	0.125	0.723
	Heavy workload or intense pressure to be more productive_Overall perceived risk	3.138	1	3.138	1.432	0.232

Appendix 2f: Results of Test of Between-Subjects Effects (cont.)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Training by Contractor	Working at height_Overall perceived risk	6.763	1	6.763	2.759	0.098
	Manual handling of loads_Overall perceived risk	1.272	1	1.272	0.365	0.546
	Heavy workload or intense pressure to be more productive_Overall perceived risk	5.522	1	5.522	2.521	0.113
Training at school or previous job	Working at height_Overall perceived risk	2.272	1	2.272	0.927	0.336
	Manual handling of loads_Overall perceived risk	1.846	1	1.846	0.53	0.467
	Heavy workload or intense pressure to be more productive_Overall perceived risk	2.256	1	2.256	1.03	0.311
Safety Climate, Overall Score	Working at height_Overall perceived risk	4.004	3	1.335	0.545	0.652
	Manual handling of loads_Overall perceived risk	10.676	3	3.559	1.021	0.383
	Heavy workload or intense pressure to be more productive_Overall perceived risk	6.89	3	2.297	1.048	0.371

a. R Squared = .400 (Adjusted R Squared = .357)

b. R Squared = .425 (Adjusted R Squared = .384)

c. R Squared = .583 (Adjusted R Squared = .553)

Appendix 2g: Results of Regression Analysis of the Effects of Factors and Other Variables

Parameter	Working at Height			Manual Handling of Loads			Heavy Workload or Intense Pressure		
	B	95% CI		B	95% CI		B	95% CI	
		Upper	Lower		Upper	Lower		Upper	Lower
Intercept	10.090	6.799	13.381	5.116	1.193	9.040	9.859	6.748	12.971
Factor 1	0.573	0.392	0.754	1.321	1.106	1.537	1.616	1.445	1.787
Factor 2	-0.436	-0.622	-0.250	-0.486	-0.708	-0.265	0.087	-0.089	0.263
Factor 3	0.123	-0.054	0.300	-0.018	-0.229	0.193	0.242	0.075	0.409
Factor 4	0.739	0.563	0.915	0.082	-0.128	0.292	-0.389	-0.556	-0.223
Age Group									
<20	1.836	-0.030	3.701	-1.518	-3.742	0.706	0.106	-1.658	1.869
20-29	0.527	-0.808	1.862	-1.933	-3.525	-0.341	0.210	-1.052	1.472
30-39	0.216	-1.043	1.475	-2.188	-3.689	-0.687	0.191	-0.999	1.382
40-49	-0.070	-1.317	1.176	-1.727	-3.213	-0.241	-0.254	-1.433	0.924
50-59	-0.591	-1.912	0.729	-1.183	-2.758	0.391	0.281	-0.967	1.530
Gender									
Male	0.894	-0.417	2.205	-1.323	-2.886	0.240	0.065	-1.175	1.304

Appendix 2g: Results of Regression Analysis of the Effects of Factors and Other Variables (Cont.)

Parameter	Working at Height			Manual Handling of Loads			Heavy Workload or Intense Pressure		
	B	95% CI		B	95% CI		B	95% CI	
		Upper	Lower		Upper	Lower		Upper	Lower
Highest Educational Level									
No education	-2.330	-5.119	0.459	5.305	1.980	8.631	-0.710	-3.347	1.927
Primary	-3.337	-5.987	-0.687	4.901	1.742	8.060	-0.853	-3.359	1.652
Secondary	-3.422	-6.079	-0.764	5.161	1.993	8.329	-0.804	-3.316	1.709
Vocational	-4.222	-6.844	-1.600	5.025	1.900	8.151	-1.100	-3.579	1.379
Profession									
Casual Labourer	0.359	-0.497	1.214	0.189	-0.831	1.209	0.480	-0.329	1.289
Skilled Worker	0.685	-0.005	1.375	-0.255	-1.078	0.567	0.201	-0.451	0.853
Duration of Employment									
<1 year	-0.756	-1.669	0.157	0.371	-0.717	1.460	0.309	-0.555	1.172
1-5 years	-0.612	-1.216	-0.008	0.332	-0.388	1.052	-0.145	-0.716	0.426
6-10 years	-0.481	-1.018	0.056	0.226	-0.414	0.866	-0.415	-0.923	0.093

Appendix 2g: Results of Regression Analysis of the Effects of Factors and Other Variables (cont.)

Parameter	Working at Height			Manual Handling of Loads			Heavy Workload or Intense Pressure		
	B	95% CI		B	95% CI		B	95% CI	
		Upper	Lower		Upper	Lower		Upper	Lower
Ever Attended Safety Course									
Yes	0.518	-0.213	1.249	0.157	-0.715	1.029	0.421	-0.271	1.112
Safety Training by Contractor									
Yes	-0.459	-1.002	0.084	-0.199	-0.847	0.449	-0.415	-0.928	0.099
Training at School or previous Job									
Yes	0.239	-0.250	0.728	0.216	-0.367	0.799	0.239	-0.224	0.701
Safety Climate, Overall Score									
Very poor	1.302	-0.781	3.385	2.015	-0.468	4.498	-0.027	-1.996	1.942
Poor	0.814	-0.905	2.533	0.995	-1.054	3.044	-0.880	-2.506	0.745
Fair	0.868	-0.842	2.578	1.112	-0.927	3.151	-0.935	-2.552	0.682