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Risk Perception and its Influencing Factors among Construction Workers in Malawi

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Abstract: This 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 of 376 subjects. 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 were aware of risks posed by their work. They perceived the risk associated with WAH, MHL and HWP as very high (62.7%, = 8.80 ± 1.95); (48.5%, = 8.10 ± 2.38); (57.9%, = 8.49 ± 2.22) respectively. The study identified six factors as variables that showed significant effect on workers' perception of risk ($p < 0.05$). These factors were "dreaded factor", "avoidability and controllability", "expert knowledge", "personal knowledge", education level and age. It is concluded that contractors in the Malawian construction industry should integrate analysis of behaviors and risk perception of the workers and other players to guide the identification of better health and safety interventions at their worksites.

Keywords: risk perception; safety; construction; workers; working at height; manual handling; workload; Malawi

1. Introduction

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" [1]. Sjöberg, Moen [2] 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". Several authors [3-5] 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, demographic and occupational characteristics. Risk perception is one of the factors that guide individual's response to risky situations [5]. When risk is perceived lowly, workers are left exposed to harmful work conditions [6]. In addition, lack of common perception of occupational risks among stakeholders compromises health and safety management at work [4]. "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" [7].

Construction workers are at risk of exposure to a wide range of occupational health hazards [8], including 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). 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 [9]. Construction work brings together a collection of tradesmen with very different practices and levels of skill, often working simultaneously at one site [8, 10]. 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 [8]. Nevertheless, despite the existence of various types of hazards, the construction industry is widely recognized as a major contributor to the economy of many nations [11].

There is scarcity of data for the Africa region on work-related injuries in specific sectors including the construction industry. Nevertheless, empirical research carried out in the region gives evidence of shortfalls in Occupational Health and Safety (OHS) regulations, management and practice which expose construction workers to risky working environments [12-15].

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. However, 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 [16]. Specifically, the regulatory authority of the construction Industry falls under the jurisdiction 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 [17]. In spite of this, the standard of OHS practice in most sites in Malawi is poor. At sites where the contractors are making some efforts to promote H&S (for example, provision of PPE), cooperation and commitment of workers is often lacking. Safety measures are rarely followed and PPE is worn incorrectly, disused or sold out. 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 [13]. Chiocha, Smallwood [13] 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. Malawi is reported to be 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" [16].

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 [13]. 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. The study aimed at investigating risk perception and its related factors among construction workers in Malawi. Specifically, the study aimed to assess construction workers' perception of risk posed by their work; identify factors that influence risk perception among construction workers; and determine construction workers' actions related to perceived risky situations

2. Materials and Methods

2.1. Study population

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.

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 [18]. 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. 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.

2.2. Research Design

The study was a cross-sectional survey involving analysis of data collected from the study population at a single point in time using multistage random sampling. Firstly, simple random sampling was employed to select a convenient number of 30 contractors from the 538 building contractors from the 2015 NCIC register for Central Region. 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 selected. In the event that there were more than 13 construction workers at a site, simple random sampling was employed to select 13 workers who were included in the study.

2.3. Study Variables

First of all, three specific construction hazards and their associated risks were selected and termed as risk factors. These hazards were 'WAH', 'risk of falling from a height causing serious injury', 'MHL', 'risk of chronic musculoskeletal disorders', 'HWP' as well as risk of stress causing ill health). WAH was selected due to the fact that it is rated as most risky situation causing many fatalities and minor injuries [7, 19-21]. The other two hazards were selected based on their commonality among all trades in construction [8, 19]. 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, Gil [4]. 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 1.

Table 1: An overview of the study variables.

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	
	Safety Climate	Professional Category
	Length of employment	
	Safety Training History	
	Response to risky situation	Construction Site Safety Climate
	Immediate action when exposed to risky situation	

2.4. Data collection

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, Gil [4], 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, Gil [4] 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.

2.5 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 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. Results

3.1. Construction Workers' Perception of Risk

This study has shown that the majority of workers perceive the risks associated with WAH (63%, $= 8.8 \pm 1.95$), and HWP (58%, $= 8.49 \pm 2.22$) as high while MHL was perceived as low (49%, $= 8.1 \pm 2.38$). 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, Gil [4], the evaluation of risk that workers 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 [8, 10, 19, 21-23]. This is therefore a good premise for developing a proper safety culture [3] which can facilitate health and safety risk management in the Malawian construction industry. This is in consonant with what [9] and Safe Work Australia [7] 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 [9, 14, 24] and such could also be the case in Malawi.

3.2. Factors Influencing Risk Perception

3.2.1. 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. Figure 1 shows the findings on the qualitative risk characteristics.

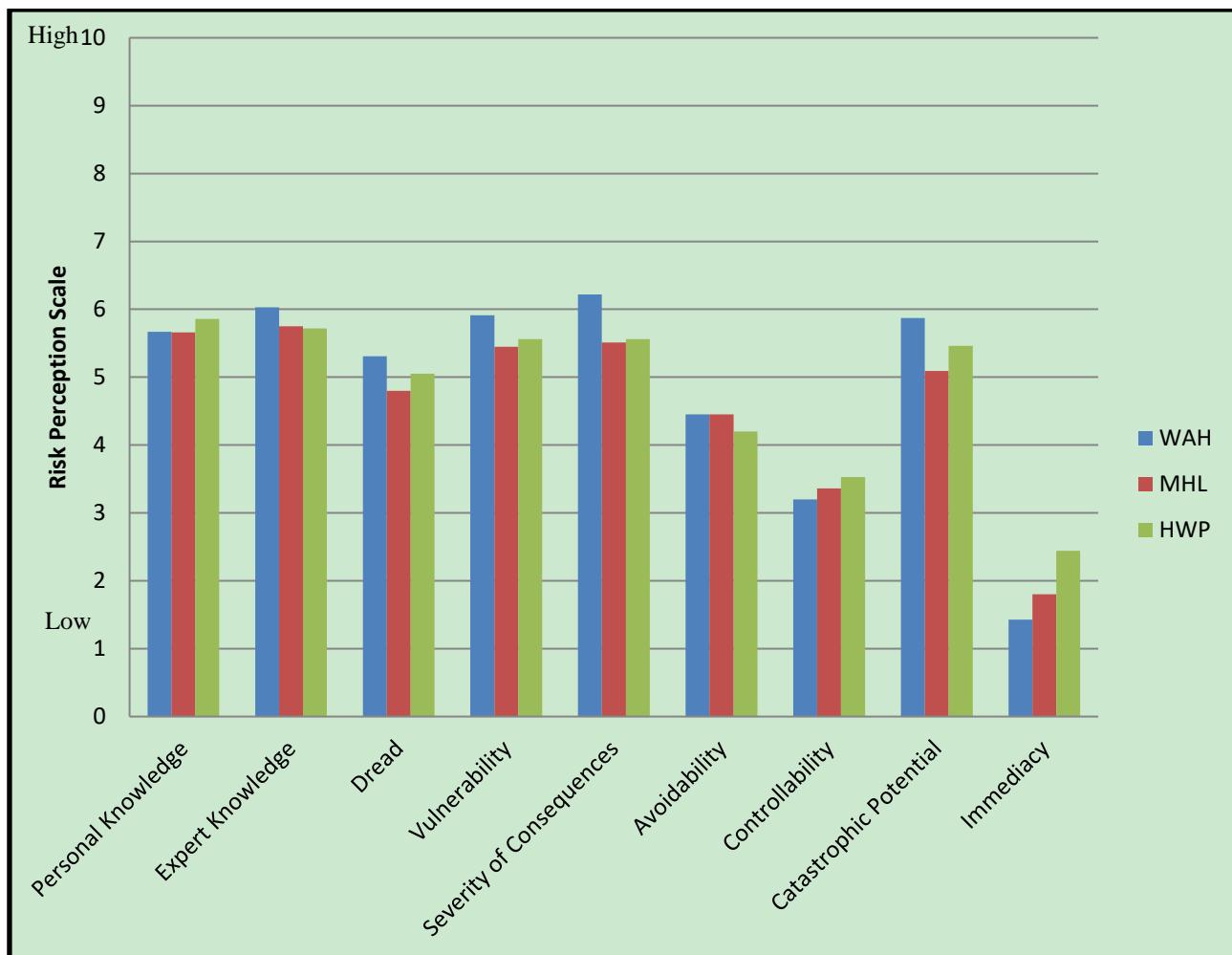


Figure 1: Profile of Mean Ratings for Qualitative Risk Characteristics

The study findings agree with several other studies that have used the psychometric paradigm [3, 4, 25] 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 (Table 2) 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.

Table 2: 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_Vulnerability	0.724	0.043	0.093	-0.134
MHL_Vulnerability	0.664	-0.085	-0.081	0.223
WAH_Vulnerability	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_Controlability	-0.103	0.580	-0.031	-0.142
MHL_Controlability	-0.063	0.744	0.042	0.025
WAH_Controlability	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 2: Risk Characteristics Factor Analysis Rotational Component Matrix (continued)

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 Kaiser Normalization

Factor loadings ≥ 0.5 are reported in bold

Findings from this study are consistent with previous psychometric studies and those that used other approaches that 'Factor 1 (dreaded factor)' has more influence on risk perception [4, 25, 26]. 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.

3.2.2. Individual characteristics

Differing findings have been reported about the influence of individual characteristics [3, 4, 27]. 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, attendance of safety induction or training course did not have any effect on construction workers' risk perception. This is contrary to what Portell, Gil [4] 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, Gil [4]. This study however concurs with Phoya, Eliufoo [27] 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 [27] 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 (i.e. 6 = 1.6% and 29 = 7.8% respectively).

According to findings by Portell, Gil [4] 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. Alexopoulos, Kavadi [3] 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.

3.2.3. 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 Chiocha, Smallwood [13] that the OHS standards in Malawi construction sites are poor and also agree with Zaid Alkilani, Jupp [11], Dias [28], Wong, Gray [6], and Pekka [29] 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 Zaid Alkilani, Jupp [11], Kheni, Gibb [14] and Musonda and Smallwood [15] 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 negatively affect the health of workers through preventable occupational accidents and diseases.

According to Bohm and Harris [26], Inouye [1] and Hassan, Basha [30], a 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 is that 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

3.3. Actions Related to Perceived Risky Situations

According to Rohrmann [5] as well as Schmidt [31], 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 findings by Rohrmann [5] and Schmidt [31] who said that behaviours are greatly influenced by risk perception. This study however is in agreement with Bohm and Harris [26] 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, Moen [2] 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 in place to improve the safety climate and safety behaviours of the workers.

5. Conclusions

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. Other factors not included in this study but need to be investigated include peer pressure and optimism bias.

The status of health and safety management in many construction sites in Malawi remains poor. 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.

Author Contribution: E.N.C. was studying for a postgraduate Degree in Environmental Health at University of Malawi, The Polytechnic and she designed the research, collected data, analysed and developed the manuscript. I.B.M.K. (PhD), S.K. (PhD) and W.U. (PhD.) from both the National Institute for Occupational Health in South Africa and the University of Malawi, The Polytechnic were involved significantly at each stage of the manuscript writing, field scoping, data analysis and reviewing the study tools.

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