

**HEALTH AND SAFETY RISKS ASSOCIATED WITH CONSTRUCTION OF
SKYSCRAPERS IN NAIROBI CITY COUNTY, KENYA**

PETER O. OGASO (BSc. ENVH)

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DECLARATION

STUDENT

This thesis is my original work and has not been presented for a degree at any other university.

Signature _____ Date _____
Peter O. Ogaso
Q22S/CTY/PT/31414/2015
Department,of Environmental,and Occupational,Health

SUPERVISORS

This thesis has been submitted for review with our approval as university supervisors.

Signature _____ Date _____
Dr. Jackim Nyamari (Ph.D.)
Department of Population Health
The Aga Khan University

Signature _____ Date _____
Eng. Dr. Fidelis Kilonzo (Ph.D.)
Department of Biosysteml Engineering
Kenyatta University

DEDICATION

I dedicate this research project to my family for the tremendous support, even when things were so tough; they constantly encouraged me to work extra hard. My friends for moral support and encouragement throughout my studies, and lastly, my colleagues for creating an enabling environment to carry out this project.

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TABLE OF CONTENTS

DECLARATION	ii
DEDICATION	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF FIGURES	viii
LIST OF TABLES	ix
DEFINITION OF TERMS	x
ABBREVIATION & ACRONYMS	xi
ABSTRACT	xii
CHAPTER ONE: INTRODUCTION	1
1.1 Background of the Study	1
1.2 Problem Statement	3
1.3 Justification	3
1.4 Research Questions	5
1.5 Objectives	5
1.5.1 Broad Objective	5
1.5.2 Specific Objectives	5
1.6 Significance of the Study	6
1.7 Limitations of the Study	6
1.8 Conceptual Framework	7
CHAPTER TWO: LITERATURE REVIEW	10
2.1 Introduction to Literature Review	10
2.2 Construction Health and Safety	10
2.3 Theories of Risk in Construction	9
2.3.1 Psychological Approach of Risk	9
2.3.3 Risk Judgment	9
2.3.4 Socio-Cultural Risk Approaches	9
2.4 Causes and impacts of risk in the construction of Skyscrapers	13
2.5 Types and Frequency of Risks in the Construction of Skyscrapers	14

2.6 Health and Safety Risk Management and Control Strategies in Construction	16
2.7 Summary of Literature Review and Study Gaps	18
CHAPTER THREE: MATERIALS AND METHODS.....	20
3.1 Introduction	20
3.2 Study Design.....	20
3.3 Study Area	20
3.4 Study Variables	21
3.4.1 Independent variables	21
3.4.2 Dependent variable	21
3.5 Study Population.....	21
3.6 Sampling Technique	21
3.7 Sample Size Determination	22
3.8 Inclusion and Exclusion Criteria	23
3.8.1 Inclusion criteria	23
3.8.2 Exclusion Criteria	23
3.9 Data Collection Techniques and tools	23
3.10 Pre-testing of data collection tools	23
3.11 Data Management and Analysis	24
3.12 Logistical and Ethical Consideration.....	25
CHAPTER FOUR: RESULTS.....	27
4.1 Introduction.....	27
4.2 Socio-demographic Characteristics of the Respondents	27
4.3 Proportion of Workers in various skyscrapers under-construction in Nairobi County	28
4.4 Health and Safety Risk occurrence in Skyscrapers under construction in Nairobi County	29
4.4.1 Composite Health and Safety Risk likelihood risk index	30
4.4.2 Association of Health and Safety Risk with Socio-Demographic Characteristics	31
4.5 Factors influencing implementation of health and safety measures	32

4.6 Risk Management and Control Strategy Employed in the Construction of Skyscrapers	32
4.6.1 Risk Management index	34
4.7 Health and Safety Measures in Place	35
4.8 Ordinal Logistic regression	36
CHAPTER FIVE DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS	37
5.1 Introduction	37
5.2 Risk Factors Associated with the Construction of Skyscrapers	37
5.3 Factors influencing the implementation of Health and Safety Measures	39
5.4 Risk Management and Control Strategies employed in the construction of Skyscrapers	40
5.5 Conclusion	41
5.6 Recommendations	42
5.7 Further Research	43
REFERENCES	44
APPENDICES	49
Appendix 1: Informed Consent Form	49
Appendix 2: Pictorial Presentation of Observations	52
Appendix 3: Questionnaires	55
Appendix 4: Observation Checklist	57
Appendix 5: Letter of Introduction	58
Appendix 6: Kenyatta University Ethical Review Committee	59
Appendix 7: Nacosti Approval	60
Appendix 8: Graduate School Authorization	61
Appendix 9: Map of Study Area	62

LIST OF FIGURES

Figure 1.1: Conceptual Framework9

LIST OF TABLES

Table 3.2:	Sample size determination	22
Table 3.3:	Data Analysis Framework	25
Table 4.1	Socio-demographic Characteristics of the Respondents	28
Table 4.2:	Proportion of Workers in various skyscrapers under construction in Nairobi County	27
Table 4.3:	Health and safety risk likelihood of occurrence in constructing skyscrapers in Nairobi County	29
Table 4.4:	Health and Safety risk likelihood risk index.	31
Table 4.5:	Bivariate analysis between socio-demographic characteristics and Health and Safety Risk.	31
Figure 4.1:	Factors influencing implementation of health and safety measures	32
Table 4.6:	Risk Management and Control Strategy Employed in the Construction of Skyscrapers	33
Table 4.7:	Risk management index	34
Table 4.8:	Test of association between health and safety risk factors and the risk management strategies	34
Table 4.9:	Health and Safety Measures in Place	35
Table 4.10:	Ordinal logistic regression	36

DEFINATION OF TERMS

Ergonomics	The process of fitting workplace conditions, including tools and equipment, and job demands to suit the capabilities of the worker.
Highly Likely	Almost certain to happen, possibly frequently.
Likely	Will,probably happen, but,not a persistent,issue.
Occupational Injury	Fatal or non-fatal injury resulting from a work-related accident.
Occupational Safety and Health	A multidisciplinary field that deals with the prevention of injuries and work-related diseases in the workplace and the promotion and protection of workers' health and safety.
Risk Factors	Occupational,exposure of an,individual worker that,increases their likelihood of,developing an,injury.
Risk Matrix	A tool or a table that shows the relationship between impact and likelihood for different types of risks or problems.
Skyscraper	A skyscraper is a tall building that people cannot easily walk up to, which requires mechanical transportation, and is primarily used for commercial or residential purposes.
Unlikely	Uncommon.

ABBREVIATION & ACRONYMS

CBD	Central Business District
DOSHS	Directorate,of Occupational,Health and Safety,Services
G.D.P	Gross,Domestic Product
GDCF	Gross Domestic Capital Formation
GoK	Government of Kenya
I.L.O.	International,Labour,Organization.
KESH	Kenya,Shillings
KNBS	Kenya,National Bureau,of,Statistics
KUERC	Kenyatta University Ethical Review Committee
M.D.U.	Multi Dwelling Unit
N.C.A.	National Construction Authority
NACOSTI	National,Commission for,Science Technology,and,Innovation
NEMA	National Environment Management Authority
ODK	Open Data Kit
OSHA	Occupational,Safety and,Health Act
P.P.E.	Personal,Protective,Equipment

ABSTRACT

Skyscrapers are key components of development in a city or town. Since land in Nairobi's central business district and its environs is a very valuable commodity, skyscrapers respond to the need to maximize income that can be derived from a given piece of land in prime locations, leading to an increase in skyscrapers. Health and safety risks in construction of skyscrapers in Kenya is an issue of interest to the practitioners, industrialists, consumers, and the government. A literature review on health and safety in construction reveals that limited information is documented on health and safety risks associated with skyscraper construction in Nairobi. The objectives of this study were to determine health and safety risks associated with the construction of skyscrapers, determine the factors influencing the implementation of health and safety measures, and lastly to assess the health and safety risk management and control strategies employed in the construction of skyscrapers in Nairobi City County. A descriptive cross-sectional study design was utilized, in which five skyscrapers under construction at various stages in Nairobi City County were purposively selected. A total sample size of 265 respondents from a sampling frame of 790 skyscraper construction workers. Proportionate sampling was used to sample a specific number of respondents in the five skyscrapers under construction. Semi-structured questionnaires administered through the Open Data Kit platform were used for data collection. The data were analyzed using Stata version 17, and frequencies and percentages were used to describe the data. Ordinal logistic regression was used to identify the predictors. Results show that Unsafe handling of machinery and equipment, and of electricity, were the likely health and safety risk factors during the construction of skyscrapers. A significant proportion of respondents in the survey reported unlikely occurrences of multiple types of risk factors, such as falling objects, failure to use PPE, working at height, falling from a height, and unprotected edges. Health and safety risk occurrence was statistically associated with gender (Fisher's exact $p=0.008$) and age (Fisher's exact $p=0.004$). The study established that pressure from clients was the primary reason for implementing health and safety measures in the construction of skyscrapers, while reducing accidents was the least important. Reducing accident occurrence was the least likely factor workers considered when accounting for factors determining health and safety measures. The study concluded that 77.7% of risk management strategies were appropriately implemented, while 22.3% were not in the skyscrapers under construction. Finally, to ensure risk management and control strategies are fully employed, the study recommended that regular safety inspections and audits be conducted on skyscraper construction sites to reduce the health and safety burden.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Skyscrapers have become a defining feature of the city's evolving skyline. A skyscraper is a high-rise building so tall (>150m) that people cannot rely on stairs for movement and must use mechanical systems such as elevators. These buildings often host offices, hotels, residences, retail spaces, mixed-use developments, and sometimes educational facilities. A study by (Zhao et al., 2023) aver that the construction of skyscrapers contributes significantly to economic growth in major eastern cities. Evidence shows that high-rise development can stimulate urban economic performance by fostering industrial agglomeration, particularly when driven by diversified tertiary-sector expansion. Globally, according to the 2025 Council on Tall Buildings and Urban Habitat, more than half (i.e., buildings taller than 200 m) were in China(Council on Tall Buildings and Urban Habitat, 2025). Over the past decade, Kenya's gross domestic product has increased exponentially, making it a key commercial hub. Simultaneously, Nairobi is experiencing rapid population growth due to urbanization, and as a result, demand for high-rise buildings has increased exponentially.

Generally, construction is considered a high-risk activity. However, Skyscraper construction presents a unique risk profile due to its structural complexity and architectural design (Han et al., 2021). A study by (Ok et al., 2024) notes that the design and construction of high-rise buildings present a unique set of challenges due to their complexity, scale, and the need for advanced engineering solutions. These

challenges span structural, environmental, financial, and regulatory concerns, each of which requires specialized knowledge and careful planning to overcome.(Bakhtyar & Horvath-Kalman, 2024) argue that effective risk management is therefore integral to the skyscraper design and construction process, demanding rigorous analysis, advanced technologies, and adaptive safety strategies.

Kenya's Occupational Safety and Health Act (OSHA) 2007, the National Construction Authority (NCA) Regulations, and the Kenya National Building Code (2024) outline requirements for safe construction practices. These laws address structural integrity, site safety, worker protection, training, and risk management. However, enforcement remains uneven. Studies continue to highlight gaps in compliance, inconsistent site supervision, inadequate worker training, and limited implementation of risk management strategies across construction sites. With increasing Skyscraper construction in Nairobi County, there is limited empirical research documenting the health and safety risks associated with the construction of skyscrapers in Nairobi City County and across the country, and this informed the basis of this study. To address these gaps, this study sought to document the health and safety risks associated with skyscraper construction in Nairobi City County. It identified the key risk factors, assessed the existing health and safety control measures, and evaluated the effectiveness of risk management strategies across selected high-rise construction sites.

1.2 Problem Statement

Nairobi City has emerged as a leading commercial hub in Africa, prompting a sharp increase in infrastructure demand. Simultaneously, the city is experiencing rapid population growth, reducing land availability for development. To address the rising demand for residential and commercial space amid limited land, skyscrapers have become a preferred solution. While these high-rise developments support economic expansion and urban transformation, they also introduce occupational health and safety challenges. The construction of skyscrapers presents unique risks compared to low-rise buildings, owing to their structural complexity and architectural demands. However, there is limited empirical evidence documenting the specific occupational hazards associated with skyscraper construction in Nairobi. Additionally, the variation in construction designs may contribute to inconsistencies in the implementation of health and safety measures across sites. These inconsistencies, coupled with a lack of documentation, may hinder regulatory compliance and compromise worker safety. Furthermore, current risk management and control strategies in skyscraper construction have not been adequately assessed for their effectiveness. This study seeks to address these gaps by identifying the risk factors associated with skyscraper construction, examining the determinants influencing the implementation of health and safety measures, and assessing existing risk management strategies within Nairobi City County.

1.3 Justification

An assessment of buildings in Nairobi City County and the entire country reveals that several buildings under construction and recently completed are skyscrapers, and that, for those under construction, some of which the whole site team is at risk due to construction activities. OSHA Act 2007 stipulates that every owner shall conduct his activities in manner that will ensure, that a person, who is not, his employee thereby is, not exposed to risks to, safety or health it, further states that, every occupier shall ensure, that an employee from, other undertakings or establishments, including contractors engaged, in work at the occupier's workplace, receive appropriate instructions, regarding safety and, health risks including, emergency procedures, at the workplace during their, activities at the, workplace and action, to be taken in case of an, emergency (OSHA 2007). Despite the construction industry's importance, the rate of occupational accidents is high. In the developing world, the health and safety risks associated with construction work are much greater. It is imperative to employ preventive, corrective, engineering, and predictive practices and integrate them into construction activities, as human life is not recoverable; as a result, the risk of accidents, catastrophes, and loss of life will be significantly reduced. (ILO 2019). Proper health and safety management will ultimately lower the budget. Limited studies have examined and documented health and safety risks in the construction of skyscrapers within Nairobi County and across the entire country of Kenya; as such, this study seeks to fill this knowledge gap. The findings and recommendations from the study are intended to add new information, knowledge, and impetus for the construction of skyscrapers to inculcate a health and safety culture. The knowledge

and information shall facilitate proper health and safety risk management in the construction of skyscrapers and inculcate a safety culture not only in Nairobi but also in the entire Republic of Kenya and across the globe.

1.4 Research Questions

1. What occupational health and safety risk factors are associated with the construction of skyscrapers in Nairobi City County?
2. How does the implementation of health and safety measures influence the likelihood of occupational health and safety risks during skyscraper construction?
3. What risk management and control strategies are employed in the construction of skyscrapers in Nairobi City County?

1.5 Objectives

1.5.1 Broad Objective

To assess occupational health and safety risks and associated risk management practices during the construction of skyscrapers in Nairobi City County, Kenya.

1.5.2 Specific Objectives

- 1 To identify the occupational health and safety risk factors associated with the construction of skyscrapers in Nairobi City County.
- 2 To examine how the implementation of health and safety measures influences the likelihood of health and safety risks during skyscraper construction.

- 3 To assess the risk management and control strategies employed in the construction of skyscrapers in Nairobi City County.

1.6 Significance of the Study

The study's findings and recommendations aim to provide new information, knowledge, and impetus for the construction of skyscrapers to foster a culture of health and safety. The study will add value to anyone interested in understanding the health and safety risks associated with skyscraper construction, the management and control strategies employed in construction, and the government, policymakers, academicians, and professionals within the construction industry.

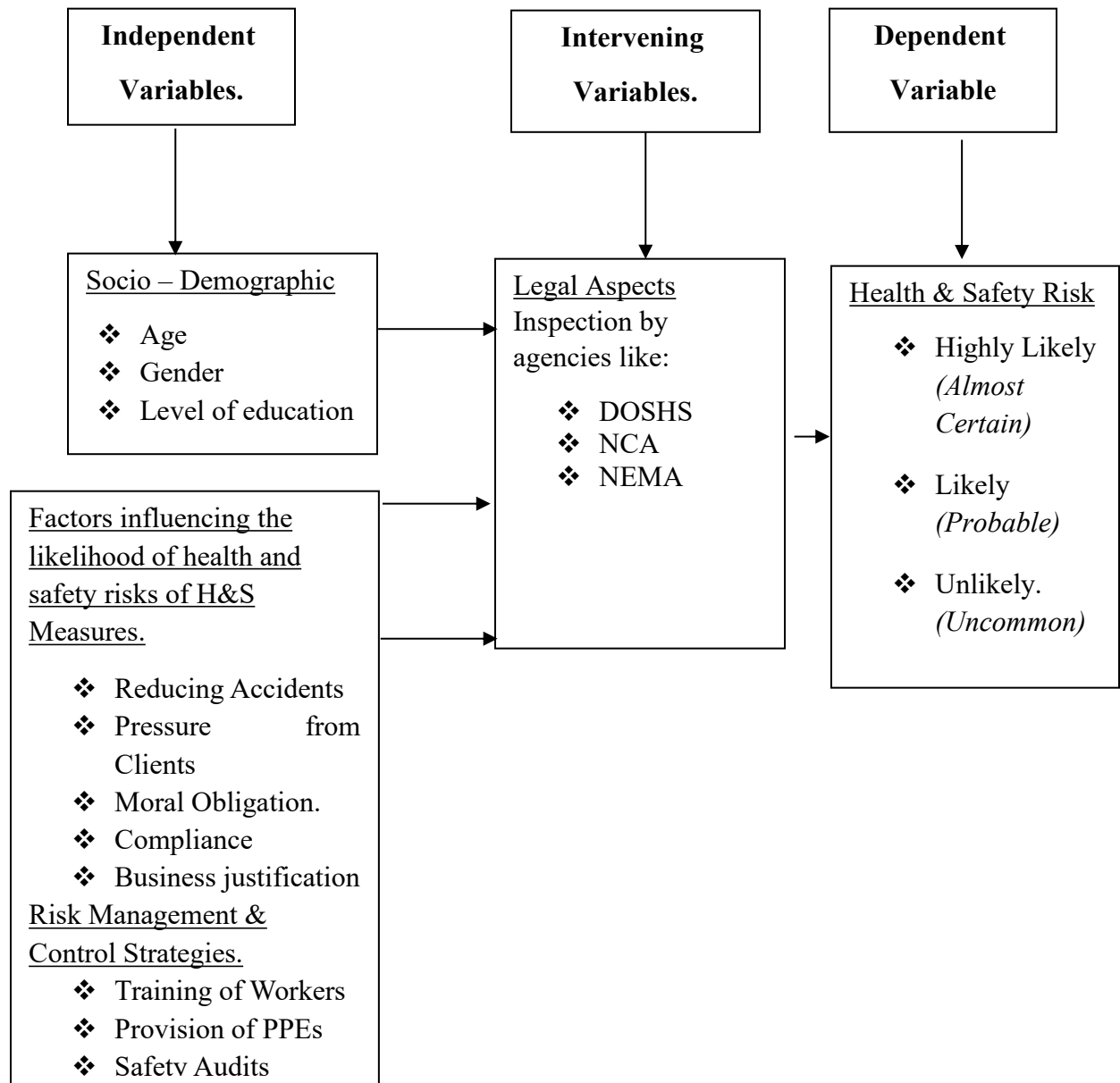
1.7 Limitations of the Study

The study aimed to find out the health and safety risks associated with the construction of skyscrapers. The study aimed to identify the health and safety risk factors associated with the construction of skyscrapers, establish factors influencing the implementation of health and safety measures in the construction of skyscrapers, and, lastly, assess the health and safety risk management and control strategies employed in the construction of skyscrapers in Nairobi City County, Kenya. The study was carried out within Nairobi City County due to rapid urbanization and population growth, which have increased demand for commercial and residential spaces. In addition, Nairobi, the capital city of Kenya, has numerous construction projects, providing a rich source of information for the study.

1.8 Conceptual Framework

Several factors contributed to health and safety risks in the construction of skyscrapers. In our model, the conceptual framework categorized the independent variables as predictors of risks in the construction of skyscrapers in Nairobi County.

This has been categorized into socio-demographic factors including age, gender, and level of education. Risk control measures, including conducting risk assessment, site inspections, and audits, provision of P.P.E.s, use of safety nets, safety inductions, toolbox talk, and training of workers, while the intervening variables included legal aspects/framework; inspection by relevant agencies; NEMA, N.C.A., and DOSHS. The dependent variables for the study were Health and Safety Risk, measured as highly likely, likely, or unlikely at the selected skyscrapers' construction sites. The health & safety risks included falls from heights, falls through voids, being hit by falling objects, cuts, abrasions, electrocution, slips, and trips.



Source: Author 2023

Figure 1.1: Conceptual Framework

1.9: Theoretical Framework

1.9.1 Psychological Approach of Risk

Attitudes, behaviors, perceptions, perspectives, underlying beliefs, and values are incorporated into an individual's risk assessment (Perry, 2003). The reasoning behind this approach is that it largely depends on how each person involved perceives, assesses, judges, and communicates risk. As a result, when an individual estimates a probability, they base it on their experience. The manner in which a person observes the world is probably the manner in which they judge, analyze information, and make decisions. The perception of risk assessment and control is a determining factor in judgments (Holt, 2001).

1.9.2: Risk Judgment

The risk perception concept shows how people in the skyscraper perceive divergent health and safety risks. Construction workers are exposed to various site hazards, and their judgment and communication depend on their individual perceptions of risk.

1.9.3: Socio-Cultural Risk Approaches

The theory is adopted based on this perspective, and both self-direction and the notion play a critical role. An individual's experience and know-how in construction projects are critical for assessing the extent of risk. Thus, experts' opinions, with many years of experience in the construction industry, serve as the key input for risk appraisal when

past information is not available. The framework depends on social structure, organizational form, and racial elements.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction to Literature Review

This chapter outlines literature on Skyscrapers that have been seen growing significantly throughout the World and African continent over the last few decades. Construction sector in Kenya is a major employer and a driver of urban transformation, particularly in Nairobi where vertical development has increased the frequency and complexity of high-rise projects. Nairobi is home to the skyscrapers in Kenya and the largest city in the country with a rapid urbanization and population growth that has resulted to increased demand of commercial and residential spaces.

2.2 Skyscraper Construction Health and Safety

The construction sector is among the highest-risk industries worldwide. Work-related injuries and diseases remain a significant global burden; recent ILO reporting indicates that nearly 3 million workers die each year from work-related accidents. International figures show that construction is a high-fatality sector (ILO 2025). Construction employs a large proportion of the population, meaning incidents, accidents, and occupational injuries affect a significant portion of the workforce and the population as a whole (Asih & Hernadewita, 2022). A study by Ok et al. (argues that the constant shifts in project demands, unstable working conditions, frequent changes in materials, work that spans different seasons, irregular employment, and routine

exposure to harmful pollutants create a consistently high-risk environment for workers across the world.

According to the International Labour Organization, the construction industry is universally recognized as a critical global economic driver, yet its persistent ranking among sectors with the highest rates of occupational fatalities and serious injuries demands rigorous scrutiny (ILO, 2021). Standard construction sites are systematically exposed to core physical hazards, including falls from elevation, struck-by incidents, and contact with electrical sources, necessitating the implementation of comprehensive, performance-based Occupational Health and Safety (OHS) management systems to safeguard the dynamic workforce (Smith, 2023). A study in Indonesia by Wang and Cheng (2025) reports that as urbanization expands, more high-rise buildings are being constructed. This growth drives the construction industry forward but also introduces significant risks. Unlike ordinary buildings, high-rises involve complex spatial layouts, numerous construction stages, and extensive work at height. These features make the construction process more difficult and significantly increase workers' safety risks. (Chowdhury & Sacks, 2022) report further that the development of standard multi-story buildings poses intensified challenges in vertical logistics, material handling, and the prevention of catastrophic incidents. Projects involving mid-to-high-rise structures require specialized management of temporary works, including sophisticated perimeter containment and hoisting operations, where the potential severity of falls from elevation or dropped objects is significantly amplified. The elevation factor, while fundamental to vertical construction, fundamentally alters the risk profile, requiring the deployment of specialized heavy

equipment, such as tower cranes and personnel/material hoists, which introduce complex operational and maintenance risks. Additionally, the Council on Tall Buildings and Urban Habitat reports that this convergence of complexity and risk reaches an extreme threshold with the construction of high-rise buildings exceeding 100 meters, often classified as super-tall. At these elevations, OHS is critically affected by unique, severe environmental stressors, including high wind shear and drastically lower ambient temperatures, which demonstrably compromise both material stability and worker psycho-motor performance (Council on Tall Buildings, 2023). The inherent scale also mandates the development of bespoke, pre-engineered emergency protocols that extend far beyond conventional ground-level procedures, particularly concerning rapid casualty evacuation and high-altitude rescue.

According to (Mohammadfam, Soltanzadeh, Moghimbeigi, & Akbarzadeh, 2014) Studies show that construction sites face persistent risks such as falls, struck-by incidents, collisions, chemical exposure, abrasions, and injuries from manual handling. These hazards create ongoing threats to timely project completion and the delivery of high-quality work.

In Africa, Occupational health and safety in African high-rise construction is characterized by high injury rates and significant systemic challenges. A meta-analysis study by Debela *et al.* (2022) on high-rise construction industries found a pooled occupational injury prevalence of 57% across African industries, with construction sites experiencing injury rates of 57%. Key risks include falls from heights, manual tool accidents, and inadequate safety training. A review by Ansari *et al.* (2022) notes that critical challenges in high-rise developments include inadequate safety training,

insufficient personal protective equipment, temporary workers' vulnerability, limited reporting systems, and Limited enforcement of safety regulations.

2.4 Causes and impacts of risk in the construction of Skyscrapers

The construction sector has received considerable attention from researchers. Kamaruzzaman and Sing (2010) explored the causes of accidents and the prevention measures in the Malaysian industry. A questionnaire with 80 closed-ended questions was administered to relevant respondents. The results revealed that unsafe conditions and acts were the leading causes of accidents, along with other sub-causes. The results also showed that accidents could result from multiple risk factors. The main risk factors for accidents on construction sites include non-compliance with PPE requirements, the use of unsafe equipment, and inadequate site management. The human element was also noted in a study that examined construction site accidents in Singapore (Asanka & Ranasinghe, 2015).

Accident investigation reports revealed that the most common causes of accidents were workplace conditions (20%), work organization (21%), workplace design (15%), and work method (21%). In fatal accidents, cases involving workplace conditions, particularly workplace design, accounted for a third of the total accidents (Carrillo-Castrillo, Trillo-Cabello, & Rubio-Romero, 2016).

Workplace factors are also among the causes in an analysis of construction site accidents in Colombia. This study was premised on the argument that construction site activities are high-risk, leading to accidents that affect workers' mental health and social well-being, as well as the company's productivity. One hundred seventeen

accidents served as the basis for the analysis. There were 195 instances of failure of control (112 work-related, 136 personal factors), 54 unsafe conditions, and 151 unsafe acts. Worth noting is that some accidents were linked to multiple causes. Lack of control was therefore the most pronounced cause of construction site accidents. The recommendation was the need for programs that can help in risk management prioritization. This ought to have addressed the hazards in place, enabling the mitigation and control of the risk. It was also essential to develop a self-care culture among the workers (González, Bonilla, Quintero, Reyes, & Chavaro, 2016).

A study conducted in Nairobi County found that companies allocate less than 1% of their budgets to safety. In their study, Kemei and Nyerere (2016) sought to determine the common site hazards in construction sites in Nairobi, Kenya. Factors linked to construction site accidents included inadequate safety budgets, an untrained workforce, a lack of safety culture among workers, top leaders lacking safety awareness, and lax enforcement of safety regulations. Among the recommendations was the need for increased investment in O.S.H. and the prioritization of safety and health in construction. The need to empower DOSH to offer customized training was also echoed.

2.5 Influence of Implementation of Health and Safety Measures on the likelihood of Health and Safety risks in the Construction of Skyscrapers

Effective risk management in tall buildings is crucial for ensuring the safety and well-being of occupants, safeguarding property and assets, and maintaining the building's long-term viability. A survey by Waqar *et al.* (2023) notes that poor risk management strategies stem from overlooking key factors, including technical, integration,

operational, creativity, privacy, and standardization. They recommend that Organizations involved in the design, construction, and management of tall buildings need to address these barriers. In Indonesia, Waqar *et al.* (2023) conducted a risk analysis of skyscraper construction and identified several hazards that threaten worker health and safety. Their assessment classified 41.18 percent of the hazards as low risk, 52.94 percent as moderate risk, and 5.88 percent as high risk. In Thailand, Thrippunath *et al.* (2025) examined the prevalence of musculoskeletal disorders among workers involved in skyscraper construction. They found that low back pain was the most common issue (55 percent), followed by neck pain (50 percent) and wrist or hand pain (45 percent). Analysis further showed that tasks such as tiling, metal scavenging, and grinding posed a high risk of musculoskeletal disorders due to biomechanical strain.

In Australia, Dhakal and Giri's (2024) study findings showed that working at height was the leading physical hazard, while cement and stone dust were the main chemical hazards. Live wires posed the most significant electrical hazard, and continuous overtime was the dominant physiological hazard. Job dissatisfaction emerged as a significant psychological hazard. The study also underscored the importance of proactive hazard identification and the need for preventive measures to protect workers.

A study by Ahmad *et al.* (2016) in the Iranian construction industry identified common recurring types of accidents. Other risk factors identified included throwing objects, slipping, collisions and crashes, abrasion, electrical shock, chemicals, and manual handling. Falls and throwing-object accidents were the most frequent, each at

22.6%, followed by slipping (21.6%). The least common accident type in this study was electrical shock (9.6%).

Yilmaz (2015) investigated construction sector accidents in Turkey using an Accident Analysis Management System. According to the data, "being hit by flying and dashing objects" accounted for 23% of construction site incidents, falling objects accounted for 15%, and "being stung by something" accounted for 11%. In an examination of accident causes in the construction industry, Williams, Hamid, and Misnan (2018) identified typical types of construction site accidents as: being struck by objects, falling from a height, vehicle-related incidents, contact with tools, collapse, trip and slip, exposure to toxic chemicals, and material handling. Kemei and Nyerere (2016) also examined the types of accidents common on construction sites in Nairobi, Kenya. According to their findings, falls from height and being struck by falling objects accounted for about 64% of construction site accidents.

2.6 Health and Safety Risk Management and Control Strategies in Construction

Implementing a health and safety (HS) system or practice is a critical step toward systematically managing HS within an organization. The International Labour Organisation describes a health and safety management system (HSMS) as a set of interconnected and coordinated elements that work together to develop occupational safety and health (OSH) policies, set objectives, and guide actions to achieve them (ILO, 2024). According to Gyamfi et al. (2025), a significant obstacle to a construction company's success is inadequate supervision, especially on building sites. Supervisors play a central role in enforcing proper procedures and work practices,

which helps address systemic weaknesses. When supervision is lacking, the safety culture becomes weak and ineffective. Poor personnel management also harms work quality and reduces job satisfaction. Additionally, if supervisors do not manage employees well, new problems can emerge where none existed before. Ineffective management often results in skilled workers leaving the company. Further, Gyamfi et al (2025) report that poor supervision not only increases the likelihood of accidents but also heightens their severity and the number of workers affected.

In an extensive review, Williams, Hamid, and Misnan (2018) highlight measures that can be taken to prevent accidents on construction sites. These include eliminating risks and hazards from the design, adequately planning activities, recruiting seasoned employees, and effective health and safety management. Further, Williams, Hamid, and Misnan (2018) aver that contractors should embrace staff health and safety auditing, establish safety committees, regularly train their staff, adopt innovative technology, report accidents, and uphold proper housekeeping practices. All construction operatives must adhere strictly to safety regulations. Kemei and Nyerere (2016) highlighted the need for personal protective equipment, such as safety belts, safety ropes, retention belts, catch nets, and safety harnesses, as risk-avoidance measures, as well as for a safety and health policy.

Benny and Jaishree (2017) conducted a study in India exploring safety and accident control mechanisms. They aver that those preventive measures for accidents from scaffolding included the use of string and rigid scaffolds, ensuring that stable grounds support them, the use of safety belts and nets, movement, construction, and dismantling to be done under a qualified person's watch, keeping a safe distance from

power lines, and regular inspection. The preventive measures for slips, falls, and trips included proper disposal of waste materials, keeping the work floor clean and dry, prompt cleaning of spillages, keeping walkways clean, clearing debris, broken blocks, and concrete, wearing safety shoes, and keeping littering, binding, and cables at the allotted places. Crane accidents can be prevented by keeping loads within recommended limits, regularly inspecting wire ropes, chains, and hooks, never moving loads over workers, watching overhead electrical wires, operating only by skilled operators, checking rigging before use, and assembling under the watch of professionals. Ladder accidents can be prevented by using the correct ladder, avoiding defective/damaged ladders, never loading beyond capacity, avoiding metallic ladders in electrical work, keeping the ladder length longer than the climbing height, and training workers in ladder safety. The safety management procedure also included planning for safety, training for safety, medical services and first aid, and safety policies (Benny & Jaishree, 2017).

2.7 Summary of Literature Review and Study Gaps

This study has reviewed the literature on health and safety, and identified study gaps in the construction industry. Construction sites face persistent risks such as inadequate safety training, insufficient personal protective equipment, temporary workers' vulnerability, limited reporting systems, and Limited enforcement of safety regulations. Falling from a height, falling objects, slipping, and electrical shocks were the prevalent health and safety risks in the construction industry. These hazards create ongoing threats to timely project completion and the delivery of high-quality work.

While the construction industry offers employment to many, these safety risks make skyscraper construction a highly unsafe workplace.

CHAPTER THREE: MATERIALS AND METHODS

3.1 Introduction

This chapter outlines the study design, study area, study variables, the population under study, the sample size determination, sampling techniques, and the data collection methods. The details of data processing, statistical analysis, and the reliability and validity of the research instruments, as well as the pretesting of the data collection tools, are also discussed. Ethical considerations about the research are also presented.

3.2 Study Design

The study employed a cross-sectional analytical study design. Cross-sectional study designs are often used in public health planning, monitoring, and evaluation, and this is one of their main strengths (Setia, 2016). The study aimed to provide data on the health and safety risks associated with the construction of skyscrapers, the management and control strategies employed, and to foster a safety culture during construction.

3.3 Study Area

The study was conducted in Nairobi County, Kenya. The county is the capital city of Kenya. The location was purposive sampled due to rapid urbanization and population growth, which have increased demand for commercial and residential spaces. In addition, Nairobi, Kenya's capital, has numerous construction projects. Only Nairobi had ongoing skyscraper construction, indicating that many more complex skyscrapers

are currently under construction or have recently been completed, providing a wealth of data for this study.

3.4 Study Variables

3.4.1 Independent variables

The factors influencing health and safety risk, and risk management and control strategies were the independent variables. All the independent variables were measured as nominal data.

3.4.2 Dependent variable

The health and safety risk factors during construction were the dependent variable. This was an index measured as an ordinal variable, with categories: Highly likely, Likely, and Unlikely.

3.5 Study Population

The target population comprised 790 skilled and unskilled workers involved in skyscraper construction in Nairobi County, Kenya. The sampling frame was obtained from the site agents of the identified skyscraper construction firms.

3.6 Sampling Technique

Stratified random sampling guided the selection of construction workers from the total population of 790. Five skyscraper projects in Nairobi County, each at a different construction stage, were purposively selected because they met the study's operational definition of a skyscraper. Proportionate sampling was then applied within each stratum, followed by systematic random sampling. In each stratum, every third worker

on each active floor was selected and interviewed until the required sample size was achieved.

3.7 Sample Size Determination

The study used Yamane's formula (Singh & Masuku, 2014) to calculate the sample size, as stated.

$$n = \frac{N}{1 + N(e)^2}$$

below: **n** = Where, n is the desired sample size,

N is the total study population (790) from which the desired sample size will be drawn,

e is the confidence level at 95%.

$$n = \frac{790}{1 + 790(0.05)^2}$$

$$n=241$$

10% Attrition rate = 265 Respondents

Table 3.2 Sample size determination

Skyscraper	Number of Construction workers	Proportion per stratum
Mi-vida Homes – Garden City	50	17
N.C.C. Affordable Housing – Pangani	165	55
Aga Khan University Hospital Centre	185	62
88 Nairobi Tower	190	64
G.T.C. – Global Trade Centre	200	67
Total	790	265

A total of 265 respondents were interviewed for this study.

3.8 Inclusion and Exclusion Criteria

3.8.1 Inclusion criteria

The study included all construction workers and managers on the site who met the selection criteria and agreed to take part. Data collection took place between June and July 2022. Construction workers in buildings less than 150m were not included

3.8.2 Exclusion Criteria

Respondents not able to participate in the study and did not consent were excluded from the study. Furthermore, participants with fewer than 2 days of work experience at the construction sites were excluded from the study. This action was undertaken under the premise that individuals who have spent less than two days on construction sites are still in the process of familiarizing themselves with the safety protocols and procedures specific to the construction site.

3.9 Data Collection Techniques and Tools

The study used a structured questionnaire and an observational checklist for data collection. The questionnaire contained four sections: Section A captured socio-demographic characteristics; Section B assessed the likelihood of health and safety risks in construction; Section C examined factors influencing these risks; and Section D focused on risk management and control strategies. The tool was digitized in Open Data Kit (ODK) to enable accurate, consistent data capture. The observational checklist recorded a range of visible health and safety conditions and practices at the construction sites. Trained research enumerators, who had received instruction in basic

research ethics and in administering ODK-based tools, conducted the fieldwork with respondents who met the study's inclusion criteria.

3.10 Pre - testing of data collection tools

The pretesting of the research tools was conducted to ensure that the data collection tool did not exhibit systematic or random errors that would jeopardize its reliability and validity. The tools were pretested at a non-participating construction site in Eastleigh Business Centre, Eastleigh. Further, the use of O.D.K. technology on Android mobile devices enhanced the reliability and validity of the collected data through built-in validation logic that ensured completeness and accuracy.

3.11 Data Management and Analysis

The collected data were uploaded to the O.D.K. server in real time each day of data collection. Upon completion of data collection, field data were downloaded from the O.D.K. server platform and exported to Microsoft Excel. Stata Statistical Software (StataCorp, TX, U.S.) version 17 was used for data analysis. Descriptive statistics such as frequencies, mean \pm standard deviation, mode, and percentages were used to provide an overview of the quantitative data. The Chi-square test of independence and Fisher's exact test were used to assess differences between the independent and dependent variables. The predictors of the likelihood of health and safety risk occurrence were established using ordinal logistic regression. Adjusted odds ratios and p-values at 5% level of significance were reported to test the hypothesis. Confidence intervals for the odds ratios were also reported.

Table 3.3: Data Analysis Framework

Objectives	Type of Analysis	Statistical Tests
Socio-demographic Characteristics	Descriptive Analysis	Frequency, Percentages, Mean.
Objective One: Risk factors associated with the construction of Skyscrapers.	Inferential Analysis	Chi-square, test Fisher' exact, test, Ordinal logistic, regression,
Objective Two: Factors influencing the implementation of health and safety measures.	Descriptive Analysis	Frequency, Percentages, Mean.
Objective Three: Risk management and control strategies.	Descriptive Analysis and Narrative	Frequency, Percentages

3.12 Logistical and Ethical Considerations.

Permission to conduct this study was obtained from Kenyatta University, graduate school, and ethical review was obtained from the Kenyatta University Ethics Review Committee (KUERC) (Appendix 6). Research authorization to conduct the research was also sought from the National Commission for Science, Technology, and Innovation (NACOSTI) (Appendix 7). Further, permission was sought from the specific construction site administration upon presenting an ethical letter and NACOSTI permit. The procedures for conducting this study were scrutinized and approved by the School of Public Health, Kenyatta University, and the Graduate School of Kenyatta University (Appendix 8). Study participants were first familiarized with the nature of the study and were then provided with an informed consent form to sign as their willingness to participate in the survey. During design of data collection tools, research enumerators were only able to enter data at once instance and when submitted it, they could under construction it. Data in O.D.K. servers were password

secured and was only accessible to the principal investigator. Respondents were provided with unique numbers to conceal identity.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents the study's findings, including the analysis of the data. The results are presented in the form of tables, graphs, photographs, and narratives. The study objectives guided the analysis. The results included the socio-demographic characteristics of the respondents and observations made on construction sites to establish risk factors associated with the construction of skyscrapers, factors influencing the implementation of health and safety measures, and the risk management and control strategies employed in the construction of skyscrapers. The study sampled 265 respondents; thus, a 100% response rate was achieved (n=265). Five construction sites were sampled for observations.

4.2 Socio-demographic Characteristics of the Respondents

Table 4.1 presents data on the socio-demographic characteristics of the study participants. Results indicate that the majority of the respondents were men. Two hundred and sixteen (81.5%) of the respondents were male, and 49 (18.5%) were women. By age, 59.3% aged between 18 and 30, 75% aged between 31 and 40 years, and only 12.5% aged between 41 and above. Regarding educational status, 34.3% had achieved tertiary education, 29.8% had a secondary level of education, and 3.8% had achieved primary education, as shown in Table 4.1 below.

Table 4.1 Socio-demographic Characteristics of the Respondents

Variable	Frequency	Percentages
Gender		
Male	216	81.5
Female	49	18.5
Age		
18 – 30	157	59.3
31 – 40	75	28.3
41 and over	33	12.5
Education Level		
Primary	10	3.8
Secondary	79	29.8
Tertiary	91	34.3
University	85	32.1

4.2.1 Proportion of Workers in various skyscrapers under construction in Nairobi County

Table 4.2 presents various health and safety risks associated with skyscraper construction. A significant proportion of respondents in the survey reported an unlikely occurrence of multiple types of risk, such as falling objects (47.9%), failure to use personal protective equipment (45.3%), working at height (69.8%), falling from a height (59.3%), and unprotected edges (46.4%). Most study participants noted that unsafe handling of machinery and equipment (41.1%) and unsafe use of electricity (40.8%) were likely to occur.

Table 4.2: Proportion of Workers in various skyscrapers under construction in Nairobi County

Skyscraper	Freq.	Percent
88-Nairobi Condominium	64	24.2
Aga Khan University Centre	62	23.4
GTC-Global Trade Centre	67	25.3
Mvida Homes	17	6.4
NCC Affordable housing pangani	55	20.8
Total	265	100

4.3 Health and Safety Risk Occurrence in Skyscrapers under Construction in Nairobi County

Table 4.3 presents various health and safety risks associated with skyscraper construction. A significant proportion of respondents in the survey reported an unlikely occurrence of multiple types of risk, such as falling objects (47.9%), failure to use P.P.E.s (45.3%), working at height (69.8%), falling from a height (59.3%), and unprotected edges (46.4%). Most study participants noted that unsafe handling of machinery and equipment (41.1%) and unsafe use of electricity (40.8%) were likely to occur.

Table 4.3: Health and safety risk likelihood of occurrence in constructing skyscrapers in Nairobi County

Falling Objects	Freq.	Percent
Highly likely	59	22.3
Likely	79	29.8
Unlikely	127	47.9
Total	265	100
Failure to use P.P.E. s	Freq.	Percent
Highly likely	85	32.1
Likely	60	22.6
Unlikely	120	45.3
Total	265	100
Working at a height	Freq.	Percent
Highly likely	45	17.0
Likely	35	13.2
Unlikely	185	69.8
Total	265	100
Falling from a height	Freq.	Percent
Highly likely	47	17.7
Likely	61	23.0
Unlikely	157	59.3
Total	265	100
Falling through voids	Freq.	Percent
Highly likely	82	30.9
Likely	66	24.9
Unlikely	117	44.2

	265	100
Total		
Unprotected edges	Freq.	Percent
Highly likely	101	38.1
Likely	41	15.5
Unlikely	123	46.4
Total	265	100
Slips and trip hazards	Freq.	Percent
Highly likely	64	24.2
Likely	104	39.3
Unlikely	97	36.6
Total	265	100
Electrocution	Freq.	Percent
Highly likely	57	21.5
Likely	108	40.8
Unlikely	100	37.7
Total	265	100
Poor site management	Freq.	Percent
Highly likely	92	34.7
Likely	77	29.1
Unlikely	96	36.2
Total	265	100
Manual handling of materials	Freq.	Percent
Highly likely	61	23.0
Likely	88	33.2
Unlikely	116	43.8
Total	265	100
Unsafe machinery and equipment's	Freq.	Percent
Highly likely	54	20.4
Likely	109	41.1
Unlikely	102	38.5
Total	265	100

4.4.1 Composite Health and Safety Risk Likelihood Risk Index

Table 4.4 shows the composite risk likelihood index computed from Table 4.3. Overall, 91.3% of respondents reported that the risks identified in Table 4.3 were unlikely to occur during the construction of skyscrapers. Only 3% can account for a high probability of occurrence.

Table 4.4 Health and Safety risk likelihood risk index.

Health and Safety Risk Factors	Frequency	Percentage
Highly likely	8	3.0
Likely	15	5.7
Unlikely	242	91.3
Total	265	100

4.4.2 Association of Health and Safety Risk with Socio-Demographic Characteristics

Table 4.5 below presents the findings of the bivariate analysis conducted to identify the socio-demographic characteristics associated with health and safety risks among employees involved in the construction of skyscrapers. From the analysis, the variables that were statistically associated with the outcome included gender (Fisher's exact $p = 0.008$) and age (Fisher's exact $p = 0.004$).

Table 4.5: Bivariate analysis between socio-demographic characteristics and Health and Safety Risk.

Health and Safety risk likelihood	Education Level				
	Primary	Secondary	Tertiary	University	
High likely	0(0%)	1(1.3%)	3(3.3%)	4(4.7)	<i>Fisher's exact p=0.008</i>
Likely	1(10)	9(11.4%)	4(4.4%)	1(1.2%)	
Unlikely	9(90%)	69(87.3%)	84(92.3)	80(94.1%)	
Health and Safety risk likelihood	Male	Female	Total		
High likely	8(100%)	0(0%)		<i>Fisher's exact p=0.459</i>	
Likely	13(86.7%)	2(13.3%)			
Unlikely	195(80.6%)	47(19.4%)			
Health and Safety risk likelihood	18-30 years	31-40 years	31-40 years		
High likely	7(4.5%)	1(1.3%)	0(0%)	<i>Fisher's exact p=0.004</i>	
Likely	15(9.6%)	0(0.0%)	0(0%)		
Unlikely	135(86%)	74(98.7%)	33(100%)		

4.4 Health and Safety Risk Management and Control Strategies

Figure 4.1 illustrates a multiple-response analysis from study participants. Most respondents in the study (82.9%) reported that client pressure was the primary reason for implementing health and safety measures. An equal proportion (75.3%) claimed it was due to budget provision and business justification. 73.8% claimed it was a moral obligation to implement safety measures, while only 59.3% actually did so to reduce accidents.

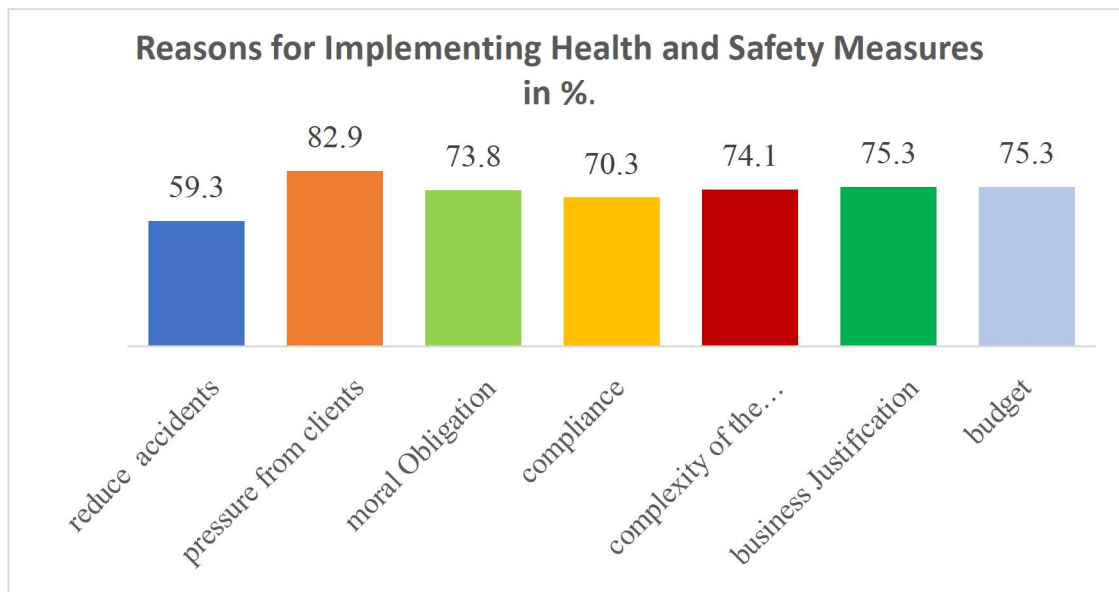


Figure 4.1: Factors influencing the implementation of health and safety measures

4.5 Risk Control Strategies Employed in the Construction of Skyscrapers

Risk management strategies and control measures employed accounted for more than 90% of the variables measured in the construction of Skyscrapers. It was least considered at 82.26% when risk hazards were addressed in design and a permit-to-work system was implemented for risky tasks, respectively, as shown in Table 4.6.

Table 4.6 Risk Management and Control Strategy Employed in the Construction of Skyscrapers

	(n)	(%)
Training and induction of all the workers		
Yes	265	100
No	0	0
Provision of Personal protective equipment		
Yes	259	97.7
No	6	2.3
Appropriate and inspected lifting equipment		
Yes	258	97.4
No	7	2.6
Routine Safety audits and inspection		
Yes	258	97.4
No	7	2.6
Risk Communication – Safety Warnings and Signages		
Yes	260	98.1
No	5	1.9
Accident Reporting and First aid facilities		
Yes	255	96.2
No	10	3.8
Safe work methods.		
Yes	246	92.8
No	19	7.2
Permit to work on risky tasks.		
Yes	218	82.3
No	47	17.7
Eradicating risk hazards from design		
Yes	218	82.3
No	47	17.7
Adequate planning for activities		
Yes	250	94.3
No	15	5.7
Coming up with health and safety committees		
Yes	247	93.2
No	18	6.8

4.5.1 Risk Management Index

A risk management strategy index was computed from Table 4.7, where risk management strategies were scored. Table 4.7 shows that 77.7% of risk management strategies were appropriately implemented in the skyscrapers under construction, while 22.3% were not.

Table 4.7: Risk management index

Risk management strategies	Freq.	Percent
Inappropriate	59	22.3
Appropriate	206	77.7
Total	265	100

4.5.2: Association between health and safety risk factors and risk management strategies

Table 4.8 presents the association test between health and safety risk factors and risk management strategies in the various skyscrapers under construction. Fisher's exact test revealed a statistically significant association between health and safety risk factors and risk management strategies.

Table 4.8: Test of association between health and safety risk factors and the risk management strategies

Health and Safety factors	Risk Management Strategies		
	Inappropriate	Appropriate	
Highly likely	1(12.5)	7(87.5)	<i>Fisher's exact (p=0.001)</i>
likely	10(66.7)	5(33.3)	
Unlikely	48(19.8)	194(80.2)	

4.6 Health and Safety Measures in Place

Table 4.9 below presents the observation checklist that documented the presence of all safety measures in place. Hazard communication was the most observed at 99.62%, and all the sites used PPEs. There was consistent use of personal protective equipment (100%), fitted guard rails, properly erected scaffolds, clear footpaths, firefighting equipment, and, but not limited to, protected edges and voids.

Table 4.9: Health and Safety Measures in Place

Safety Practices at the Site		(n)	(%)
Hazard Communication (Signages)	Present	264	99.6
	Absent	1	0.4
Use of Personal Protective Equipment:	Present	265	100.0
	Absent	0	0.0
Guard rails and safety fall arrest nets	Present	257	97.0
	Absent	8	3.0
Properly erected and inspected scaffolding	Present	262	98.9
	Absent	3	1.1
Isolated Electric cables/wires	Present	249	94.0
	Absent	16	6.0
Foot path/ Clear gangways provided	Present	250	94.3
	Absent	15	5.7
Firefighting equipment	Present	252	95.1
	Absent	13	4.9
Permit to work on risky tasks	Present	218	82.3
	Absent	47	17.7
Health and safety precautions	Present	260	98.1
	Absent	5	1.9
Protected edges and voids	Present	249	94.0
	Absent	16	6.0
Proper manual handling of materials	Present	224	84.5
	Absent	41	15.5

4.7 Factors influencing the implementation of health and safety measures in the construction of skyscrapers

Ordinal logistic regression estimates the probability of the occurrence of the identified risk. The table shows that the risk of unlikely health and safety factors in construction increases by (A.O. $R=2.682$, $p=0.039$) when appropriate risk management strategies are implemented. Education levels, skyscraper types, and other factors displayed were not.

Table 4.10: Ordinal logistic regression

Health and Safety risk likelihood factors	Odds ratio	Std err.	z	P>z	lower	upper
Risk management strategies						
Inappropriate	Ref					
Appropriate	2.682	1.281	2.065	0.039	1.051	6.842
Education Level						
Primary	Ref					
Secondary	0.470	0.576	-0.617	0.538	0.043	5.187
Tertiary	0.695	0.88	-0.287	0.774	0.058	8.318
University	0.884	1.134	-0.096	0.923	0.072	10.921
Skyscraper type						
88-Nairobi Condominium	Ref					
Aga Khan University Centre	1.402	0.874	0.542	0.588	0.413	4.759
GTC-Global Trade Centre	1.162	0.705	0.248	0.804	0.354	3.814
Mvida Homes	1.576	1.941	0.369	0.712	0.141	17.621
NCC Affordable Housing Pangani	4.345	4.917	1.298	0.194	0.473	39.93
Compliance						
Yes	Ref					
No	2.130	1.479	1.088	0.276	0.546	8.31
Business justification						
Yes	Ref					
No	2.064	1.491	1.003	0.316	0.501	8.504
Complexity						
Yes	Ref					
No	1.589	1.125	0.655	0.513	0.397	6.363
Pressure from clients						
Yes	Ref					
No	0.629	0.42	-0.695	0.487	0.17	2.328
Reduce accident						

Yes	Ref					
No	1.560	0.917	0.756	0.449	0.493	4.936

CHAPTER FIVE DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter focuses on the results discussed in Chapter 4. The results discussed in this chapter are on the risk factors associated with the construction of skyscrapers, Factors influencing the implementation of health and safety measures in the construction of skyscrapers, and the health and safety risk management and control strategies employed in the construction of skyscrapers.

5.2 Risk Factors Associated with the Construction of Skyscrapers

This study aimed to establish the health and safety risks associated with constructing skyscrapers in Nairobi County. In this study, a health and safety risk likelihood index indicates that diverse risks are unlikely to be identified during the construction of skyscrapers. The respondents' perspectives in this survey imply that construction site health and safety are highly prioritized. Aisheh *et al.* (2022) report that adopting lean construction practices reduces the likelihood of injuries in construction. They argue that there is an economic benefit and productivity if worker safety is prioritized. Kamaruzzaman and Sing (2010) examined the causes of accidents and preventive measures in the Malaysian industry. They revealed that unsafe conditions and unsafe acts were the leading causes of accidents, along with other sub-causes, and that accidents could result from numerous risk factors. (Asanka & Ranasinghe, 2015) aver that the main risk factors of accidents in construction sites include non-compliance

with personal protective equipment, use of unsafe equipment, and lack of proper site management. This study's observations at the five skyscrapers reveal diverse safety measures, including hazard communication signages, consistent use of personal protective equipment, and others.

Accident investigation reports revealed that the most common groups of causes of accidents were workplace conditions (20%), work organization (21%), workplace design (15%), and work method (21%). With fatal accidents, the proportion of workplace conditions, particularly workplace design, was behind a third of the total accidents (Carrillo-Castrillo, Trillo-Cabello, & Rubio-Romero, 2016). (Pinto, 2014) reports that assessing occupational risk factors where labour is a mixture of physical tasks and fully mechanized operations is complex and difficult to quantify risks. He concludes that the lack of reliable, precise data and the use of qualitative estimates of assessing risk in the construction industry makes tracking safety performance difficult. (Moud et al., 2019) aver that evaluating the magnitude of risk qualitatively and quantitatively is difficult to ascertain. They underscore that risk assessment has adopted linguistic expressions such as "maximum risk and minimum risk." Others have employed other terminologies such as "low risks, " " trivial risks, " or similar descriptions. Moul et al. conclude that the difficulty arises in how to define zero risk. (Berhanu et al., 2019). descriptive study in Ethiopia revealed that cuts by small objects falls from height, and being hit by a moving object were the prevalent conditions in the construction sites observed.

5.3 Factors influencing the implementation of Health and Safety Measures

The study sought to establish factors influencing the implementation of health and safety measures in constructing skyscrapers. In this study, factors affecting implementation of health and safety were measured. It was determined that pressure from clients was the most likely factor that influenced the health and safety measures taken by construction workers in skyscrapers. External pressure from the client's perspective indicates improved awareness of health and safety measures and an element of compliance in terms of the site health and safety requirements. Reducing accident occurrence was the unlikely factor workers considered in accounting for factors determining the health and safety measures. Providing a budget for health and safety was a key likely factor determining the extent of actions the construction companies took. Skyscraper construction is a capital-intensive project, so substantial financial resources are expended. (Anderson et al., 2020) Avers that budgeting for safety must be informed by retrospective data collection to inform safety-related line items. (Mei Dina & Purba, 2022) Further reports that there is a need to conduct a special analysis of the project's cost, time, and quality.

Occupational accidents not only have a negative implication on health and safety but on the economy as well. Construction offers employment to a large proportion of the population, meaning that incidents, accidents, and occupational damage affect a significant portion of society's workforce and population. The continuous change in the projects, poor working conditions, change of materials, cross-seasonal work, non-continuous employment, and exposure to pollutants make this industry a very high-risk environment for workers worldwide. The risk of accidents, including falls, being

hit by objects, crashes, chemicals, abrasion, and manual material handling is always existent in construction projects. The projects are, therefore, at a constant risk of not being finished in the set timeline and of the best quality because of these inherent risks (Mohammadfam, Soltanzadeh, Moghimbeigi, & Akbarzadeh, 2014).

5.4 Risk Management and Control Strategies employed in the construction of Skyscrapers

This study has established that the construction's risk management and control strategies were appropriate. More specifically, all respondents in skyscraper construction were trained and inducted. In contrast, this study did not establish the effect of pieces of training conducted (Cao et al., 2021). The study revealed that improved workers' concerns about their health strongly correlated with job satisfaction. Training programs can also guide workers in acquiring supplementary knowledge about potential hazards. Implementing hazard management programs and enhancing workplace safety can be facilitated by empowering workers and managers to participate actively. (Mohammadi et al., 2018) Also, the efficacy of a construction company is contingent upon the proficient administration of safety, productivity, quality, health, and environmental factors, alongside marketing and finance. They report that this implies that the safety performance of a project is equally indicative of its success as metrics such as time, quality, and cost.

The use of personal protective devices was strongly emphasized. (Wong & Siu, 2020) report that the construction industry's continuous use of personal protective equipment (P.P.E.) is influenced by several elements, such as environmental, personal and technological factors. These could include previous positive attitude, accident

experience towards utilizing personal protective equipment, acclimatization, risk aversion, safety consciousness and knowledge, outcome expectations, perceived ease of use, perceived utility, racial impact, process designed to manage safety, time pressure, and workplace environment. (Laryea et al., 2010) interviewed construct managers in the U.K. and found out that some were unaware of P.P.E. specifications and the type of clothing suitable for the jobs. Routine safety audits and inspections were conducted during the construction of the various skyscrapers. Scheduled safety audits are useful risk management strategies for improving workplace safety. With audits, preventive and corrective actions can be formulated and implemented.

5.5 Conclusion

The first objective of the study was to establish the risk factors associated with construction of Skyscrapers. This study concluded that Unsafe handling of machinery and equipment and electricity was the likely health and safety risk factor to occur during construction of skyscrapers.

The second objective was to determine the factors influencing implementation of health and safety measures in the construction of skyscrapers. In line with this objective the study established that pressure from clients was the core reason for implementing health and safety measures in the construction of Skyscrapers while to reduce accidents was the least. External pressure from the client's perspective indicates improved awareness of health and safety measures and an element of safety compliance. Reducing accident occurrence was the unlikely factor workers considered in accounting for factors determining the health and safety measures. The study also

determined that providing a budget for health and safety was a key likely factor determining the extent of actions the construction companies took.

The third objective of the study was to assess the health and safety risk management and control strategies employed. The strategies were scored and the study concluded that 77.7% of risk management strategies were appropriately put in place while 22.3% were not in the skyscrapers being constructed.

5.6 Recommendations

1. Since unsafe handling of machinery and equipment and electricity was the likely risk associated with the construction of skyscrapers, this study recommends that the contractors involved should put more emphasis on regular training and toolbox talks specifically geared towards safe handling of machinery and electrical safety onsite to mitigate against the risk.
2. The study recommends deliberate awareness creation on the importance of implementing health and safety measures and strategic action of ensuring continuous safety improvement to be prioritized by the site management and safety officers with a view of reducing the risks to acceptable levels.
3. To ensure risk management and control strategies are fully employed onsite, the study recommends the site management team should schedule and conduct regular safety inspections and audits and this should be conducted by external experts to reduce the burden of incidents and occupation accidents.

5.7 Further Research

The researcher recommends the following areas for further research:

1. Conducting a study to evaluate the effect of training on Skyscraper construction workers' knowledge, skills, and attitudes on occupational health and safety concepts.
2. Occupation accidents in Skyscraper construction sites in Nairobi County, Kenya.

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APPENDIXES

Appendix 1: Informed Consent Form

My name is **Peter Otieno Ogaso**, and I am a Master's student from Kenyatta University. I am conducting a study on titled "Health and Safety Risks Associated with Construction of Skyscrapers in Nairobi City County - Kenya." The information from the study will provide clear, honest information on the health and safety risks associated with the construction of skyscrapers. The study will also be of value to any person interested in the health and safety risks associated with the construction of skyscrapers, the management and control strategies employed in their construction, and to government policy makers, academicians, and professionals within the construction industry.

Procedures to be followed

Participation in this study will require that I ask you some questions and I will record the information from you in a questionnaire.

Voluntarism

Please remember that participation in the study is voluntary. You may ask questions related to the study at any time.

You may refuse to respond to any questions and you may stop an interview at any time. You may also stop being in the study at any time without any consequences now or in the future.

Discomforts and risks

Some of the questions you will be asked might make you feel uncomfortable. If this occurs, you can choose not to answer those questions. You are also free to stop the interview at any time. Please note that the interview might extend the wait time for your routine services by about half an hour.

Benefits

If you participate in this study, you will add new information and knowledge in the construction of skyscrapers. This knowledge and information shall facilitate proper health and safety risk management in the construction of skyscrapers not only in Nairobi but the entire Republic of Kenya and across the globe.

Reward

If you agree to participate in this study, there are no rewards or any payment to you if you participate.

Confidentiality

The interviews will take place in a private setting, and your name will not be recorded on the questionnaire. The completed questionnaires will be securely stored in a locked cabinet at Kenyatta University. All information will remain confidential.

Contact information

If you have any questions, you may contact **Dr. Jackim Nyamari Supervisor 1.** through telephone 0722589335, and **Eng. Dr. Fidelis Kilonzo Supervisor 2.** through telephone 0725396620 or the Kenyatta University Ethical Review Committee Secretariat on chairman.kuerc@ku.ac.ke ,

Participant's statement

The above information regarding my participants in the study is clear to me. I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary.

Code of participant.....

.....

Signature, or thumb print

.....
Date

Investigator's statement

I, the undersigned, I have explained to the volunteer in a language she/he understands, the procedures to be followed in the study and the risks and benefits involved.

Name of interviewer

.....

.....

Interviewer signature

Date

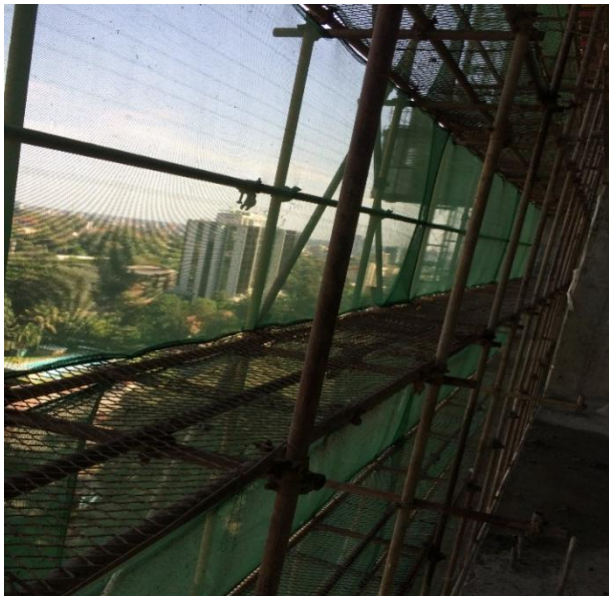
Appendix 2: Pictorial Presentation of Observations



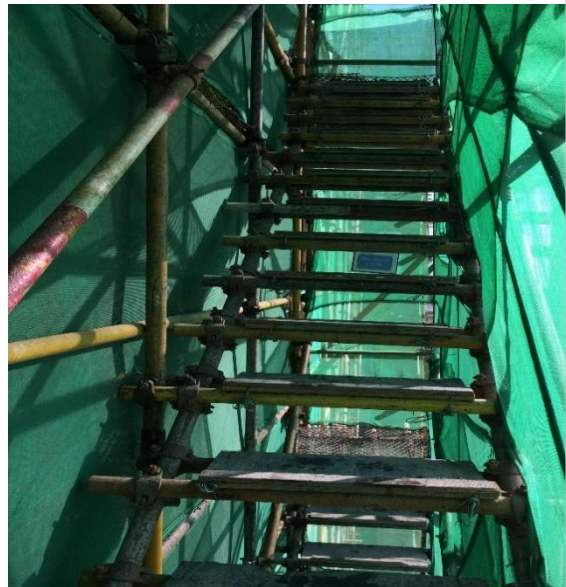
P.P.E.s compliant workers doing concrete works at the top most floor.



Well secured edges at the top most floor.



Fall arrest protection netting in place



Temporary access ladders with handrails



Lift shaft well barricaded



Material delivery area at the upper floor



Hazard Communication Signage



Building well screened/covered with green netting



Permits, Licenses and Approvals Prominently displayed.



Walk ways well covered to protect against the falling object

Appendix 3: Questionnaires

Kenyatta University

Department of Occupational & Environmental Health

Declaration: This information is confidential and is meant for academic purposes only.

A. Socio-demographic factors.

1. Gender of Respondents:

Male:

Female:

2. Ages in years (Please tick)

i. 18 to 30

ii. 31 to 40

iii. 41 and above

3. What is your highest attained education level? (Indicate appropriately, use tick)

i. University

ii. Tertiary

iii. Secondary

iv. Primary

B. What are some of the health and safety risk factors associated with the construction of skyscrapers?

(On a scale of 1 – 3, indicate the likelihood of the risk factor. Use a tick, (Highly likely, Likely & Unlikely)

	Health and Safety Risk Factors	1	2	3
1.	Falling Objects			
2.	Failure to use P.P.E.s			
3.	Working at a height			
4.	Falling from a height			
5.	Falling through voids			
6.	Unprotected edges			
7.	Slips and trip hazards			
8.	Electrocution			
9.	Poor site management			
10	Manual handling of materials			
11	Unsafe machinery and equipment's			

- C. What are the factors influencing implementation of health and safety measures in the construction of skyscrapers?

(On the scale of 1 – 3, indicate the likely factors in the construction of skyscraper)

	Factors influencing implementation of safety measures	1	2	3
1.	Moral Obligation – right thing to do			
2.	Compliance – requirement by law			
3.	Business justification - reduces cost and keeps the workplace safe			
4.	Complexity of the project			
5.	Pressure from the client			
6.	Provision of Budget for health and safety			
7.	Reduce accident occurrence			

- D. What are the health and safety risk management and control strategies employed in the construction of skyscrapers?

	Risk management and control strategy employed	Yes	No
1.	Training and inductions of all the workers		
2.	Provision of Personal protective equipment's.		
3.	Appropriate and inspected lifting equipment's.		
4.	Routine safety audits and inspection		
5.	Risk communication - Safety warning and signages		
6.	Accident reporting and First aid facilities.		
7.	Safe work methods for scaffolds, ladders, harnesses etc.		
8.	Permit to work for risky tasks		
9.	Eradicating risk hazards from design		
10.	Adequate planning for activities		
11.	Coming up with health and safety committees		

Thank you for participation!

Appendix 4: Observation Checklist

	Health and Safety Measures in Place	Present	Absent
1	Hazard Communication (Signages)		
2	Use of personal protective equipment: helmet, hand gloves, overall, reflective vests and safety shoes.		
3	Guard rails and safety fall arrest nets		
4	Properly erected and inspected scaffolding		
5	Isolated electric cables/wire		
6	Foot path/clear gangways provided		
7	Firefighting Equipment		
8	Health and Safety Precautions		
9	Protected edges and voids		
10	Proper manual handling of material		

Thank you for your participation!

Appendix 5: Letter of Introduction

PETER O. OGASO

P. O BOX 7490 -00200

NAIROBI

Cell Phone No: 0723862986

Email: peterogaso@gmail.com

RECIPIENT:

.....

Dear Sir/Madam,

I am pursuing master's degree in Occupation Safety and Health at Kenyatta University. Currently in my final year doing a thesis to investigate health and safety risks associated with the construction of skyscrapers in Nairobi City County.

Your participation will be highly appreciated.

Thank you.

Yours Most Sincerely.

PETER OGASO.

Appendix 6: Kenyatta University Ethical Review Committee



**KENYATTA UNIVERSITY
CENTRE FOR RESEARCH ETHICS AND SAFETY**

Fax: 8711242/8711575
Email: chairman.kuerc@ku.ac.ke
Nairobi, 00100

P. O. Box 43844,

Tel: 8710901/12

Website: www.ku.ac.ke
Our Ref: **KU/ERC/APPROVAL/VOL.1**

Date: 22nd /03/2022

Peter Ogaso
P.O BOX 43844-00100
Nairobi.

Dear Mr. Ogaso,

**APPLICATION NUMBER: PKU/2441/I1573- HEALTH AND SAFETY RISKS
ASSOCIATED WITH THE CONSTRUCTION OF SKYSCRAPERS IN NAIROBI CITY
COUNTY, KENYA**

This is to inform you that **KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE** has reviewed and approved your above research proposal. Your application approval number is **PKU/2441/I1573**. The approval period is **22nd /03/2022 to 22nd /03/2023**

This approval is subject to compliance with the following requirements:

- i. Only approved documents including (informed consents, study instruments, MTA) will be used
- ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by **KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE**
- iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE** within 72 hours of notification
- iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to **KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE** within 72 hours
- v. Clearance for export of biological specimens must be obtained from relevant institutions.

- vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- vii. Submission of an executive summary report within 90 days upon completion of the study to **KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE**

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) <https://research-portal.nacosti.go.ke> and also obtain other clearances needed.

To serve you better, researchers are kindly requested to access and complete a customer feedback form and sent it back online as you continue with research and upon completion of data collection found on the following website link; https://docs.google.com/forms/d/1ytWefDwvyz5h1oz_VIn0xbxg3uGdlDzMXFWNDsMrRPO/edit?usp=sharing

Yours sincerely



Prof. Judith Kimiywe
Director: Centre for Research Ethics and Safety

Appendix 7: Nacosti Approval


NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
 Date of Issue: **25/February/2022**

RESEARCH LICENSE

This is to Certify that Mr. Peter Otieno Ogaso of Kenyatta University, has been licensed to conduct research in Nairobi on the topic: HEALTH AND SAFETY RISKS ASSOCIATED WITH CONSTRUCTION OF SKYSCRAPERS IN NAIROBI CITY COUNTY for the period ending : 25/February/2023.
 License No: **NACOSTI/P/22/15896**
377755
 Applicant Identification Number

 Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
 Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is Guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014

CONDITIONS

1. The License is valid for the proposed research, location and specified period
2. The License any rights thereunder are non-transferable
3. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research
4. Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government
5. The License does not give authority to transfer research materials
6. NACOSTI may monitor and evaluate the licensed research project
7. The Licensee shall submit one hard copy and upload a soft copy of their final report (thesis) within one year of completion of research
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice



Appendix 8: Graduate School Authorization.

**KENYATTA UNIVERSITY
GRADUATE SCHOOL**

E-mail: dean-graduate@ku.ac.ke

Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Our Ref: Q21S/CTY/PT/31414/2015

DATE: 24th September, 2021

Director General,
National Commission for Science, Technology
and Innovation
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MR. PETER O. OGASO REG. NO. Q21S/CTY/PT/31414/15

I write to introduce Mr. Peter O. Ogaso who is a Postgraduate Student of this University. He is registered for M.Sc. degree programme in the **Department of Environmental & Occupational Health**.

Mr. Ogaso intends to conduct research for a M.Sc. thesis Proposal entitled, **"Health and Safety Risks Associated with the Construction of Skyscrapers."**

Any assistance given will be highly appreciated.

Yours faithfully,

**PROF. ELISHIBA KIMANI
DEAN, GRADUATE SCHOOL**



Appendix 9: Map of Study Area

