ASSOCIATION OF TEMPERATURE VARIATIONS AND HEALTH OF WORKERS IN COLD ROOMS AT JOMO KENYATTA INTERNATIONAL AIRPORT, IN NAIROBI KENYA.

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NOVEMBER, 2025

DECLARATION

This thesis represents my original research and has not been submitted for a degree at any other university.

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DEDICATION

I dedicate this thesis to my wife, Rebecca, and daughter, Ella. Their constant support, patience, and encouragement were essential in completing this study

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ABBREVIATIONS AND ACRONYMS

CWAP: Cold Work Action Program

DOSHS: Directorate of Occupational Safety and Health Services

EU: European Union

IREQ: Insulation Required

JKIA: Jomo Kenyatta International Airport.

KAA: Kenya Airports Authority

KII: Key Informant Interviews

KNBS: Kenya National Bureau of Statistics.

NIOSH: National Institute for Occupational Safety and Health

NACOSTI: National Commission for Science, Technology and Innovation.

OHC: Occupational Health Care

OSH: Occupational Safety Health.

OSHA: Occupational Safety Health Act.

PPE: Personal Protective Equipment.

SPSS: Statistical Program for Social Sciences

ILO: International Labour Organization.

DEFINITION OF OPERATIONAL TERMS

Acclimatization	This is the physiological human adaptation to exposure to a repeated set of thermal conditions in an environment.
Chilblains	This is abnormal skin sore due to exposure to extreme cold temperatures causing itchiness on the feet and hands.
Cold Chain	This refers to an uninterrupted process of continuous cooling, storage, and supply activities of perishable products aimed at maintaining a cold temperature range in a piece of equipment.
Effect	This is the outcome of a cause. Effect as a noun means result.
Ergonomics	The applied science of designing workplaces, devices, and physical working conditions to fit the workers who use them.
Hazard	Anything or situation that has the potential of causing harm or danger.
Hypothermia	This is a medical condition that occurs when the human body loses thermal heat more rapidly than it can produce, leading to extremely low body temperature.
Musculoskeletal Disorders	These are defined as musculoskeletal injuries in the human body support structure such as the neck and back that affects the bones and joints.
Occupational Health and Safety	This refers to a workplace multidisciplinary field attributed to people's wellbeing, health, and safety at work.
Risk:	This refers to the probability of negative consequences occurring leading to a loss.
Trench Foot	A prolonged medical situation of the feet attributed to damp and extremely cold conditions in an environment.

ABSTRACT

This research sought to determine the connection between fluctuations in temperature and the resulting health effects experienced by staff working in the cold storage facilities at Jomo Kenyatta International Airport (JKIA) in Nairobi, Kenya The specific aims were to determine the most commonly reported health symptoms, assess the relationship between cold exposure frequency/duration and the severity of these symptoms, evaluate the use and effectiveness of protective measures, and explore existing workplace temperature monitoring and occupational safety practices. The JKIA complex in Embakasi and Nairobi County was the setting of this descriptive cross-sectional study which included ten cold-room operating companies. A selection of 293 employees was made through stratified random sampling. The collection of data was done through structured surveys, observation checklists, interviews, and temperature monitoring records, which provided both numerical and descriptive insights. The quantitative data was analyzed using SPSS version 23 and the results were presented in tables. The analysis comprised of descriptive statistics, Chi-square tests, and logistic regression analysis which were used to find out the factors that affect health outcomes. The research showed that among the subjects, 74.2% experienced respiratory symptoms like cough, wheeze, 68.3% had musculoskeletal problems such as pain in joints, stiffness and 53.3% had circulatory symptoms such as numbness and pain induced by cold. The association between the degree and the period of cold exposure and the severity of health issues was particularly strong among the workers, who were those exposed for more than 12 hours daily or for more than three years, where the odds of getting very severe respiratory symptoms were three times higher (OR = 3.62, 95% CI: 1.88-6.96, $p < 0.001$) and, similarly, for musculoskeletal pain (OR = 2.91, 95% CI: 1.55–5.45, $p = 0.001$). PPE usage was linked to a reduction in the prevalence of symptoms but only 47% of the workers said they did it all the time, and 28% said they had training. Thematic analysis of qualitative data was considered the main conclusion of the study as it confirmed the quantitative findings and pointed out the major deficiencies in workplace policies, among which were the absence of systematic temperature monitoring and inadequate enforcement of safety regulations in the workplace. The study clearly indicated a dose-response relationship between cold exposure and health problems and therefore it called for a strong safety policy, improved PPE provision, worker training, and the regular monitoring of both the environment and health of the workers. It is a study that has already contributed to the existing knowledge about the cold exposure risks at work and at the same time highlights the necessity of interventions such as those for protecting the health of workers in temperature-controlled areas.

CHAPTER ONE

INTRODUCTION

1.1 Background

Cold-room operations are a vital part of the logistics chain at Jomo Kenyatta International Airport (JKIA), as refrigeration allows the secure handling of perishables, vaccines, and pharmaceuticals. Although the work is done under cold environments, the employees are still exposed to specific health risks, especially in tropical areas like Nairobi where people can't easily adapt to cold (Yi Iqbal et al., 2019).

Cold storage facility recent studies in South Asia have revealed a disconcerting pattern. Workers in Pakistan, for instance, reported a considerable increase in the incidence of musculoskeletal pain, skin disorders, and respiratory problems under cold storage conditions, accompanied by lower work performance when compared to their unexposed colleagues (Yi Iqbal et al., 2019).

Paying close attention to the findings on frozen food warehouses in Thailand, it was observed that in a harsh climate of −18 °C, the musculoskeletal discomfort experienced by the workers was highly likely (OR ≈ 11.9), respiratory symptoms (OR ≈ 9.7), and transient finger-related symptoms (OR ≈ 13.5) were the conditions, all in comparison to the workers in the offices (Kim, et al.,2015).

Airway symptoms in the general workplace have been associated with occupational cold exposure. A research study based on Swedish epidemiology reported that the above-mentioned exposure caused a rise in the odds of wheezing (OR 1.3), chronic cough (OR 1.2), and productive cough (OR 1.3) regardless of the intervention or changes made in the factors such as age, smoking, and asthma (Jaakkola, Set al., 2021).

Cold environments, in addition to their respiratory effects, are associated with higher occurrences of neck and lower back pain. This has been confirmed by studies from Sweden which found that workers constantly subjected to cold conditions had an increased risk of developing neck and lower back pain. Moreover, the risk was higher for those who had either frequent or heavy cold exposure. The study also revealed that men were more prone to neck pain while women were more inclined to have lower back and radiating back pain (Lewis et al., 2022). A wider scoping review has further corroborated this trend, stating that the relationships between cold exposure and musculoskeletal conditions, including carpal tunnel syndrome, are consistent, although many studies are based on self-reporting and cross-sectional designs (Farbu, E et al., 2023).

Extreme cold, as in the case of freeze-drying processes at temperatures between −43°C and −62°C, also comes with serious health risks. Workers in those places experienced very high instances of temporary finger problems (50%), breathing difficulties (21%), circulatory issues (20%), and bodily discomfort (12%) (Palmer, K. T et al., 2023).

Although there is strong international evidence to support the arguments, there is still a significant deficiency of localized research on cold-room workers in tropical countries like Kenya. The majority of the occupational health frameworks in Kenya prioritize heat stress, ergonomic risks, and chemical exposures while the cold related hazards are rarely addressed.

The present occupational health regulations in Kenya regard heat stress, chemical hazards and poor ergonomics as very serious risks while neglecting cold environments. But the situation is changing at JKIA where large-scale cold storage is in place and many workers are in low temperature areas, thus, the need to monitor their health due to possible effects has arisen.

Initial findings at JKIA indicate that a few of the employees might not have enough personal protective equipment (PPE), proper shifts, or even training on the risks posed by cold and there might also be a lack of hygiene awareness among them. But at the same time, there is practically no documentation of the effects of temperature changes on the health of workers, thus making it totally necessary to do an empirical study that would evaluate the health impacts of temperature shifts on the workers specifically. The results of such an inquiry would consequently lead to the formulation of evidence-based policies that are suitable for the cold working conditions of tropical areas.

1.2 Statement of the Problem

The use of cold chain logistics at Jomo Kenyatta International Airport (JKIA) has led to an increase in the number of workers in cold storage areas. These cooling facilities are very important for keeping temperature sensitive goods like vaccines and fresh fruits and vegetables, but the health risks from long cold exposure to the workers mostly are still not explored in Kenya's occupational health. This situation is even more worrying because local workers have not been naturally acclimatized to the cold because the country has mainly warm climate (Jaakkola et al., 2021).

In different parts of the world, studies have found that people who work in cold environments suffer from a range of health problems, including respiratory illnesses (e.g., wheezing, chronic cough), circulatory disorders, and musculoskeletal problems (Farbu & Løseth, 2023; Jaakkola et al., 2021; Palmer et al., 2023). For instance, an investigation among workers in Thai cold storage plants discovered that cold-exposed workers had much higher risks of developing respiratory and musculoskeletal symptoms than the office staff (Kim et al., 2015). Similarly, the reports from the workers in the cold rooms in Pakistan revealed the presence of higher levels of joint pain, fatigue, and cold-induced skin problems (Yi Iqbal et al., 2019).

Although there are some evidences, there are still not sufficient research and reports about it in Kenya and the existing occupational safety standards do not provide enough guidelines on cold-related hazards. Regulations typically put more focus on heat stress, ergonomic, and chemical exposure risks and hardly on the other extreme side of the temperature range (Occupational Safety and Health Act, Kenya, 2007).

At JKIA, workers in the cold room area might have unreliable access to personal protective equipment (PPE) at times, no scheduled warm-up breaks, and little knowledge of the health effects of exposure to cold according to anecdotal evidence and initial observations. This shortfall in the use of preventive measures along with the absence of data-based policy leads to a scenario where the workers are suffering from health risks that could be prevented, and the employers are incapable of taking proper safety measures through interventions.

In this scenario, it is of utmost importance to determine the extent of the impact that the temperature changes in cold rooms at JKIA have on the health of the workers who are exposed to these changes. This information is crucial for the government and other stakeholders to come up with occupational health strategies that are specific to the situation in the cold logistics sector of Kenya, which is expanding.

1.3 Justification

The health hazards that workers in these facilities have to deal with still have not been accounted for properly and thus they are still not dealt with. The current guidelines for occupational health in Kenya mainly target problems related to chemical exposure, ergonomic strain, and heat stress while cold-related risks are left out completely. However, people who work in the freezing areas of JKIA undergo low temperatures regularly for a long time, with very little adjustment and also sometimes not even having the right protective gear.

Worldwide research indicates that exposure to cold can result in breathing problems, pain in joints and muscles, less efficient workers, and higher likelihood of accidents at work. These dangers may be greater in tropical areas because the staff is not used to cold at all. Nevertheless, large-scale research has not yet been done in Kenya to analyze the direct effect of these temperature changes on the health of employees in the cold storage areas of the airport.

It is therefore necessary to conduct this study in order to cover this knowledge gap and give **data-based** insights into the occupational health problems of cold room environments at JKIA. The results will be crucial in setting the scene for the creation of safety procedures, i.e., through improving the conditions and health of the workers and hence their productivity in this key sector.

1.4 Research Questions

i. What are the most common reported health symptoms/outcomes among workers in cold rooms in JKIA?
ii. Is there a relationship between the frequency and duration of exposure to cold temperatures and the severity of reported health outcomes among workers in cold rooms in JKIA?
iii. To what extent are protective measures and how effective are these measures in mitigating reported health outcomes among workers in cold rooms in JKIA?
iv. What workplace practices and policies currently exist within the organizations at JKIA to manage occupational health and safety in cold rooms in JKIA?

1.5 Objectives

1.5.1 Main Objective

This study seeks to determine the relationship between temperature changes and worker health issues among staff operating in the refrigerated areas at JKIA

1.5.2 Specific Objectives

i. To determine the most common reported health symptoms/outcomes among workers in cold rooms in JKIA?
ii. To assess the relationship between the frequency and duration of exposure to cold temperatures and the severity of reported health outcomes among workers in cold rooms in JKIA?
iii. To evaluate the use and effectiveness of protective measures among workers in cold rooms in JKIA?
iv. To explore existing workplace practices and policies related to temperature monitoring and occupational safety within the organizations at JKIA?

1.6 Significance of the Study

This study contributes to the limited research studies on occupational cold exposure in sub-Saharan Africa, with a specific focus on the aviation and logistics industries in understanding the impact of environmental temperature variations on the health and well-being of workers.

This study addresses a knowledge gap in occupational health literature in tropical airport set ups and beyond, but also offers practical insights for airport authorities to implement safety protocols that address cold related health risks, Occupational health professionals who require data for risk assessment, prevention strategies, and worker training programs, academic researchers as a reference point for future studies on

environmental hazards in similar tropical set ups and policymakers to amend occupational health standards under Kenyan labour laws,

The findings can inform the development of targeted interventions to support healthier, safer, and more productive work environments for cold room employees in Kenya's expanding cold chain logistics sector.

1.7 Delimitation and Limitation

i. The study was limited to using self-reported data, that was subjected to recall bias and underreporting. The researcher, in order to prevent this, created straightforward and well-organized surveys, and gave short tutorials just to make sure the participants realized how much their truthfully and correctly answered responses were valued.

ii. Moreover, the inability to carry out clinical evaluations restricted the opportunity to confirm the health symptoms that were reported by the subjects themselves. In order to overcome this limitation, the research employed symptom checklists which were derived from authenticated occupational health tools, and also compared respondents' answers with the documentation of workplace health records whenever permission was given.

iii. The study's target population was restricted to employees engaged in cold room operations and thereby excluding administrative personnel, which facilitated a focused analysis of those most subjected to the cold environment.

iv. The study is limited to the study of temperature variations and related health effects, which means that other occupational hazards are not

considered. This particular limitation helped to keep the research sharp and within the boundaries of available time and resources.

v. In addition, the research was of an observational type and did not intend to apply or evaluate any intervention. This restriction allowed the research to recognize connections and establish proof for future studies based on the intervention.

1.8 Conceptual Framework

The conceptual framework stemmed from the connection of temperature changes being the independent variable and the health of the cold room workers in JKIA (sick or not sick) being the dependent variable. The link between the variables is facilitated by intermediate factors such as the duration of exposure, frequency of occurrence, and the availability and proper use of personal protective equipment (PPE).

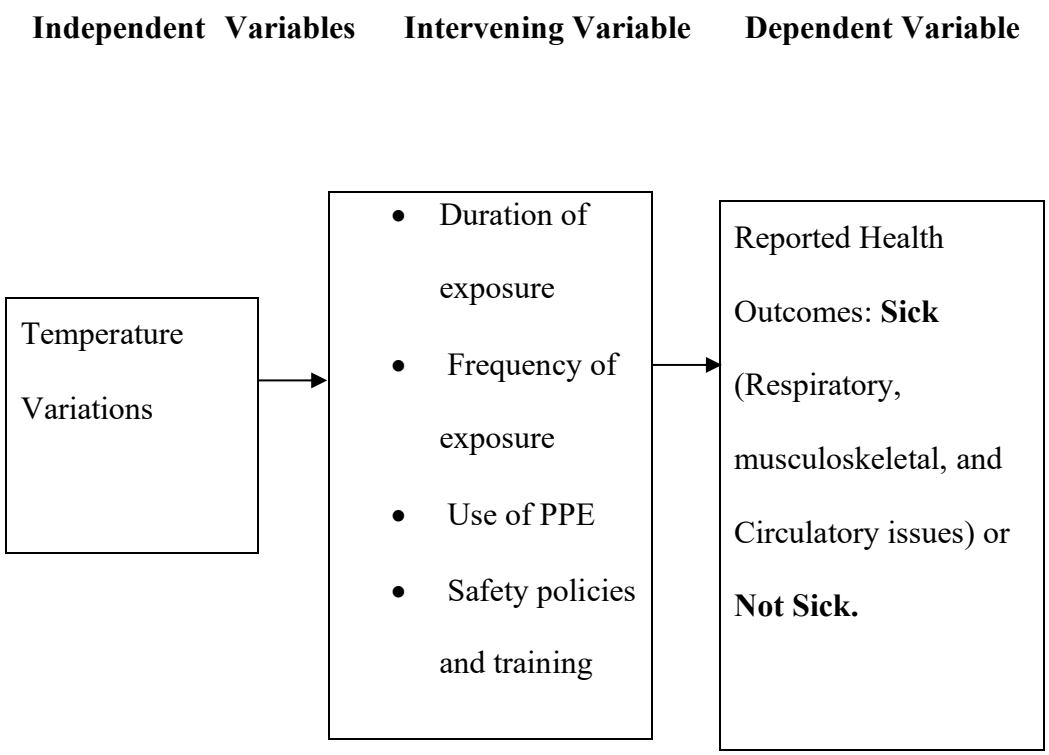

Figure 1.1: Conceptual Framework.

Source: Nanzushi, (2015)

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The purpose of this literature review is to provide an overview of the current understanding regarding the health effects of cold working conditions especially for workers exposed to extreme cold in the occupational settings. The review covers the physiological effects of cold, the measures taken to protect the workers in such conditions, and the research gap that exists in low- and middle-income tropical countries like Kenya where such studies are not common.

2.2 Occupational Cold Exposure and Health Effects

Keeping one's self for a long time in cold places has been linked to a variety of negative health effects. A research study found that cold stress could result in respiratory diseases, musculoskeletal pain, loss of mental capacity, and a higher risk of accidents at work even due to the factors of age and smoking status (Farbu et al., 2023). Workers who were constantly in cold environments were found to have much higher incidences of wheezing, chronic cough, and shortness of breath when compared to the control group, as stated by Jaakkola et al. (2021), this was even after taking into account age and smoking status as variables.

Musculoskeletal disorders are most commonly found in people who live in cold climates. A longitudinal study carried out by Palmer et al. (2023) detected that neck and shoulder pain were considerably more frequent among the workers who were repeatedly exposed to low temperatures, particularly in combination with physically demanding tasks. Besides, cold exposure has been associated with heightened muscle stiffness, diminished blood flow, and nerve compression, all of which are contributing factors to occupational discomfort and injury (Farbu et al, 2023).

Research conducted in northern Sweden proved that workers who frequently cold at workplaces had a higher chance of getting neck and lower back pain. Those with regular or severe cold exposure were at even higher risk. Interestingly, the male participants developed neck pain more often, whereas the female participants experienced back radiating and lower back pain more (Lewis et al., 2022). The risk was often underestimated in tropical climates where such exposure is not naturally occurring and not adequately mitigated in workplace regulations.

In a study conducted in Thai Poultry industry in 2020, it showed that workers who were exposed to temperatures ranging from –22 °C to +10 °C experienced on average nine cold-related symptoms per person, with movement between cold and warm areas identified as an aggravating factor. The most frequently reported symptoms were musculoskeletal pain, peripheral circulation disturbances (e.g., finger numbness, tingling, or coldness), respiratory complaints, and general fatigue. (Thetkathuek et al., 2020) Similarly, a 2023 Swedish population study linked occupational cold exposure with significantly higher odds of upper extremity pain, particularly in hands and arms (Dahlqvist et al., 2023)

A longitudinal study in Sweden found that workers with long term cold exposure were more likely to develop airway irritation and chronic cough compared to non-exposed groups (Olsson et al., 2022). The results of this study indicate that cold settings hinder the functioning of the body's heat management, blood circulation, and breathing mechanisms that are probably responsible for the symptoms mentioned.

2.3 Protective Measures and Workplace Practices

The use of personal protective equipment (PPE) is the main way to protect workers from cold hazards in cold-weather work environments. Insulating clothing, e.g. thermal gloves, and non-slip footwear are the most common recommendations to cut heat loss

and avoid injuries (Kim et al., 2015). Nevertheless, these measures are effective partly due to the employees' proper use, good supply of equipment, and awareness.

In Thailand, a research study on cold storage workers conducted by Kim et al. (2015) noted that the employees, wearing multi layered outfits and taking regular warm up breaks, experienced less discomfort. On the other hand, insufficient or used-up protective gear led to more musculoskeletal and circulatory complaints. Work shift rotation and exposure time limits are also very important; Yi Iqbal et al. (2019) highlighted that the cold workers who had over four hours of exposure during the shift had a significantly worse health status than those with shorter exposure times.

Notwithstanding these discoveries, many developing nations continue not to abide by the suggested cold safety practices because of the poor enforcement of policies, insufficient training, and scarcity of resources (ILO, 2020). These obstacles are most applicable in the case of Kenya's industrial and transport sectors, which are witnessing the growth of cold room operations but have not yet adapted the policies accordingly.

A research project in Kaunas, Lithuania focused on the influence of unstable air temperature on the performance of office work by members of the group. The results showed that people from the placebo group who performed the executive tasks for the second time had their efficiency boosted by 2.1%. Moreover, an air temperature raise led to a 0.1% performance decrease while an air temperature drop led to a 5.2% performance increase (Valančius *et al.,* 2013).

A field study in a Norwegian frozen food facilities showed that workers’ core temperatures dropped below 35 °C and hand skin temperatures reached as low as 14 °C during extended exposure to freezer environments, with longer durations corresponding to more severe discomfort and fatigue (Martinez et al., 2023). Another 2025 Norwegian

study on shift working seafood handlers found that cold exposure varied by shift, influencing physiological stress and thermoregulatory recovery, workers on longer night shifts accumulated greater thermal strain (Johansen et al., 2025).

Globally, the International Labour Organization (ILO, 2023) and OSHA (U.S.) have issued recommendations that suggest engineering controls (e.g., airlocks, heated rest areas), administrative controls (work rest scheduling), and continuous temperature logging as the most appropriate ways to deal with heat stress in employees. However, their implementation is very different around the world, especially in poor countries.

2.4 Research Gaps in Tropical and Developing Countries

Farbu et al. (2023) state that the major part of the research regarding occupational cold exposure has been done in Europe, North America, and the Asia regions where the climate is cold and there are developed cold chain infrastructures. However, it is still the case that sub-Saharan Africa has been left out of studies on this topic, even though the region has been progressively incorporating cold storage in logistics, agriculture, and healthcare.

In a Thailand study done in 2020, workers in thermal clothing with more than 1.1 Clo insulation reported notably fewer symptoms of cold discomfort, respiratory irritation, and circulation problems than workers in lighter clothes (Thetkathuek et al., 2020). Experimental research (Mao et al., 2022, Industrial Health) showed that multi-layered thermal PPE increased thermal comfort; however, ergonomic trade-offs such as limited movement and manual dexterity that prevent regular use were also the focal point of the study.

In the case of Kenya, there is no such study that has been published and looked into specifically the relations between the exposure to cold rooms and the health of workers, mostly in the case of busy places like JKIA. The current occupational safety laws

according to the Occupational Safety and Health Act (2007) have a little mention about cold exposure, rather they are concentrated on the more common hazards like chemical handling, heat stress, and machinery safety (Government of Kenya, 2007).

Due to the scarcity of studies in this area, it is hard to create impactful and specific interventions as well as to make the necessary policy changes. The region's fast-growing cold storage industry will require health and safety standards that are based on scientific data as Kenya's position as a significant logistics and pharmaceutical hub in the region strengthens.

2.5 Gaps in Literature

Cold work environments are a significant health risk, which international research studies have confirmed, whereas respiratory, musculoskeletal, and circulatory ailments lead the list of problems. Proper PPE and exposure period such as protective measures can reduce these risks, but inconsistent practices occur in environments with limited resources.

Even though cold rooms have become more significant in the logistics infrastructure of Kenya, the research concerning the workers' health impacted by the temperature fluctuations in these environments remains very scanty. Hence, this study tries to fill that gap by taking as a reference the cold room workers at JKIA, who are regularly exposed to low temperatures without proper guidelines and policies.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

The research methodology is extensively covered in this chapter. It comprises details about the research design, the study variables, the location of the research, the population from which the subjects were selected, the participant selection process (inclusion/exclusion criteria and sampling techniques), the sample size, the data collection tools and methods, pretesting, and the assurance of data quality (validity and reliability). It concludes with details on data analysis, logistical, and ethical considerations.

3.2 Research Design

A descriptive cross-sectional design was used to collect both quantitative and qualitative data at a given population and in a given geographical area at one point in time. The study design was also preferred because it allowed measurement of the study outcome and exposures in the participants of the study simultaneously.

3.3 Variables

The independent variables included temperature variations (ambient cold room temperature (°C), duration of exposure per shift (hours) and Frequency of exposure (number of shifts per week). This variable was assessed through observational records and monitoring how much and how often temperatures change.

The dependent variable was Reported Health Outcomes/symptoms where the respondents who reported the following outcomes Respiratory symptoms, Musculoskeletal discomfort, Circulatory symptoms and Fatigue or reduced productivity were taken sick while those who did not report any of the symptoms were

regarded as not sick. This variable was assessed using a structured questionnaire with a checklist and Likert-scale questions.

The intervening variables—like the Use of Personal Protective Equipment (PPE) and Workplace Safety Practices—were factors that could either affect, alter, or even reverse the connection between cold exposure and health outcomes, Employee Awareness and Training). The variable was measured through observation checklists and items in questionnaires dealing with workplace practices, PPE availability, and training history.

3.4 Location of the Study

For the study, data was acquired at Jomo Kenyatta International Airport (JKIA) in Nairobi, the capital city of Kenya. JKIA is situated in the Embakasi region, approximately 15 km southeast of the central business district (CBD) (Longitude: $36^\circ 55.33'$ E, Latitude: $01^\circ 19.07'$ S), with the study specifically focusing on its cold room facilities for storing cargo, food, and perishable items.JKIA is Kenya's busiest airport and regional hub for both regional and international cargo airlines, including pharmaceutical and horticultural exports that require cold storage

The study was conducted in Jomo Kenyatta International Airport (JKIA) located in Kenya's Capital City, Embakasi region which is 15 km southeast of the central business district of Nairobi on 36 55.33'E Longitude: 01 19.07'S Latitude specifically within the cold room facilities used for cargo storage, food handling, and perishable goods. The map of the area is on Appendix I.

3.5 Study Population

According to human resource department records from 2020, the target population was made up of 1,240 workers across 10 companies at JKIA. There were workers in this

cohort working in cold-stored food premises or exposed otherwise to conditions of low temperature regularly.

3.6 Inclusion and Exclusion Criteria

The study's participants were intentionally chosen from the ten cold storage rooms at JKIA, and only those who had direct contact with these environments were selected. To get a sample that was representative and diverse, we took workers from different shifts and departments. After that, we performed simple stratified sampling in the ten cold rooms until we reached the target sample size.

3.7 Sampling Techniques

Utilizing a specific sampling technique, study participants were obtained from the 10 cold rooms at JKIA. The first move was to use purposive sampling to choose people who had the quality of being exposed to cold room environments. The consideration of diversity was important and therefore, the selection of participants was made in such a way that they came from different departments and worked different shifts. Following this initial selection, a simple stratified sampling approach was implemented across all 10 cold storage units to finalize the required sample size

3.8 Sample Size Determination

Sample size determination was done using Fischer's *et al*. (1998) formula

$$\text{Thus, } n = \frac{Z^2 (p\,q)}{d^2}$$

n = the preferred sample size

z = Normal SD at the appropriate level of confidence (set at 1.96)

P = Characteristics of interest were not available and for that reason, an assumption was made that 50% of study population had the characteristics of interest.

q = 1 (1-P)

d = margin of precision at 0.05

$$n = \frac{1.96 \times 1.96 (0.5 \times 0.5)}{0.05 \times 0.05} = 384$$

The study population was below 10,000, thus the desired sample size was adjusted as follows.

$$nf = \frac{n}{1+n/N}$$

n= sample size frame for >10,000 (384)

N= sampling frame (1240)

$$nf = \frac{384}{1+ [384/1240]} = 293$$

To ensure appropriate representation of each of the 10 companies, the sample size was distributed proportionately to the number of workers in cold rooms in each company using the following formula.

$$\text{Company desired sample size} = \frac{\text{company population} \times 293}{\text{Total population}}$$

Table 3.1: Sample Size Distribution

Strata	Total Population	Sample Size
Menzies Siginon Aviation Ltd	105	25
Kenya African Handling Ltd	78	18
Swiss port	95	22
Africa Flight Services	118	28
Kuehne-Nagel	239	57
Airflo Ltd	190	45
Freight Wings Ltd	175	41
Maya Freight	60	14
Freight In Time	130	31
DB Schenker	50	12
Total	**1240**	**293**

3.9 Pre-testing

Pretesting of questionnaires was done using a small sample of similar workers outside of the study area drawn from Mitchel Cotts company. The responses obtained from this pretest were used to improve the questionnaire after which the relevant amendments were made to the questionnaire.

3.10 Validity

This accomplished through familiarization with the study tools before data collection and subjecting questionnaires to review by supervisors who facilitated the necessary corrections and moderation of research tools. To guarantee external validity of the study, sample population was representative of the study population.

3.11 Reliability

Reliability was attained through the training of research assistants in introducing the research study to the participants and the administration of the questionnaires before

data collection to familiarize themselves with the tools. Data collection was supervised throughout the entire exercise to ensure accuracy, uniformity, and completeness. Reliability was achieved by correcting the tool based on the data collected at every stage to reduce variability.

3.12 Data Collection Methods and Tools

The research assistants who were already trained gave the questionnaires during work breaks or after shifts in order to reduce the disruption. The written explanations about the study were given to all participants before they consented to participate. Observation checklists and interviews were conducted during regular operations in a way that did not disturb the flow of work.

3.13 Data Analysis

Quantitative data were gathered through self-administered questionnaires, then pre-coded for further analysis by SPSS (Version 23). included in this analysis were descriptive statistics like (e.g., means, frequencies, standard deviations, and percentages), which were presented in tables.

Thematic analysis was conducted on the qualitative data derived from interviews and observations, which allowed for a more profound understanding and further support of the numerical outcomes. The researchers used Chi-square tests and binary logistic regression to determine the relationship between temperature exposure and health effects. A p-value of 0.05 (corresponding to a 95% confidence level) was set as the benchmark for the statistical significance.

3.14 Ethical Considerations

All necessary ethical and institutional approvals were granted to the research project. In particular, the Kenyatta University Graduate School and the relevant university

ethical review committee were the ones who issued the clearance. After that, the National Commission for Science, Technology and Innovation (NACOSTI) gave out the needed research permits (which are mentioned in Appendix V), and there was also consent from the Department of Health Nairobi County Kenya Airports Authority, and the management of the cold rooms that were involved. Before the study began, written informed consent was obtained from the workers who participated. Confidentiality measures were strictly followed during the whole study period.

CHAPTER FOUR

RESULT

4.1 Introduction

The chapter concisely recounts and illustrates the data through descriptive statistics along with qualitative data gathered from the cold storage rooms personnel at JKIA via interviews. Thematic analysis was employed to classify and understand the answers.

4.2 Socio-demographic Characteristics of the Respondents

The study assessed three demographic characteristics, which were gender, age, and educational attainment (see Table 4.1).

Table 4.1: Socio-demographic Characteristics of the Respondents

		Frequency (266)	**Percentage (%)**
Gender	Male	173	65
	Female	93	35
	18-30 years	80	30
Age	31-50 years	120	45
	>51 years	66	25
Level Of Education	Secondary	120	45
	Tertiary	146	55
Duration Of	< 1-6months	24	9
Employment	6 –12 months	25	10
	1– 3 years	35	13
	>3 years	182	68
Frequency And	< 2 hours	12	5
Duration of Exposure	2 – 12 hours	254	95

Among the respondents, 266 in total, a vast majority were males, accounting for 65% (173), while females comprised the other 35% (93).

Educationally, more than half of the participants (55% or 146 individuals) reported having tertiary qualifications, while 45% (120) had achieved secondary education. The age distribution was centered on the 31–50-year group, which was the largest proportion at 45% (120). Those over 51 years old were the smallest cohort, comprising 25% (66) of the sample

Most respondents (68%) 182 of the respondents had worked for more than 3 years while 9% (24) had worked less than 6 months .95% (254) of the respondents worked between 2 and 12 hours while 5% (12) worked less than 2 hours daily.

4.2 Prevalence of Health Symptoms among Workers

Three questions were used to assess the prevalence of health symptoms reported by workers in JKIA's cold rooms, with the results serving as the reported health outcomes (Table 4.2)

Table 4.2: Distribution of Prevalence of Health Symptoms among Workers

		Frequency (266)	Percentage (%)
Respiratory	Agree	223	84
Symptoms (Coughing)	Disagree	43	16
Musculoskeletal	Agree	251	94
Issues (Backache)	Disagree	15	6
Circulatory Issues	Agree	246	93
(cold-induced	Disagree	10	7
numbness)			

Majority 84% (223) of respondents reported respiratory symptoms such as coughing and pneumonia while 16% (43) of respondents did not report any issue. Most 94% (251) of the respondents reported musculoskeletal issues such joint and back pains while 6% (15) did not report any issue. Majority 93% (246) of respondents reported circulatory issues such as persistent coughing after working in cold rooms while 7% (10) of respondents did not report any issue.

4.3 Association Between Temperature Exposure and Reported Health Outcomes

The assessment was done using the different levels of temperature exposure and the various reported health outcomes as indicators (Table 4.3).

Table 4.3: Distribution of Health Outcomes by Temperature Exposure Level

	Temperature Exposure	Frequency (266)	Percentage (%)
Respiratory Symptoms	Low	12	5
	Medium	68	25
	High	186	70
Musculoskeletal	Low	8	3
Issues	Medium	56	21
	High	202	76
Circulatory Issues	Low	13	5
	Medium	59	22
	High	194	73

Majority 70% (186) of respondents reported most respiratory symptoms under high temperature exposure while 5% (12) reported a few respiratory symptoms under low temperature exposure. Most 76% (202) of respondents reported most musculoskeletal issues under high temperature exposure while 3% (8) reported a few musculoskeletal issues under low temperature exposure. Majority 73% (194) of respondents reported

most circulatory issues under high temperature exposure while 5% (13) reported a few circulatory issues under low temperature exposure.

4.4 Influence of Intervening Factors

The assessment consisted of four questions designed to serve as indicators for presents or absences of reported health outcome under low and high exposure with and without PPE. (Table 4.4).

Table 4.4: Distribution of Influencing Intervening Factors

	Health Outcome	Frequency (266)	Percentage (%)
Low Exposure with PPE	Present	13	5
	Absent	253	95
Low Exposure with No PPE	Present	82	31
	Absent	184	69
High Exposure with PPE	Present	192	72
	Absent	74	28
High Exposure with No PPE	Present	247	93
	Absent	19	7

Majority 95% (253) of respondents presented absences of reported health outcome under low exposure with PPE while 5% (13) presented presence of reported health outcomes. Majority 69% (184) of respondents presented absents of reported health outcome under low exposure with no PPE while 31% (82) presented presence of reported health outcomes.

Majority 72% (192) of respondents presented presents of reported health outcome under high exposure with PPE while 28% (74) presented absents of reported health outcomes. Majority 93% (247) of respondents presented presents of reported health outcome under

high exposure with no PPE while 7% (28) presented absences of reported health outcomes.

4.5 Binary Logistic Regression Analysis

Bivariate analysis was conducted to examine the relationship between selected independent variables (exposure status and temperature exposure) and health outcomes (respiratory symptoms, musculoskeletal issues, circulatory problems).

Table 4.5: Bivariate Analysis

Variables	Chi Square Values	Df	P Value
Exposure Vs Health Outcome (With Ppe)	228.19	1	0.001
Exposure Vs Health Outcome (No Ppe)	145.95	1	0.001
Temperature Exposure Vs Respiratory Symptoms	105.83	2	0.0015
Temperature Exposure Vs Musculoskeletal Issues	138.14	2	0.0011
Temperature Exposure Vs Circulatory Issues	127.90	2	0.0013

Bivariate analysis using Chi-square tests revealed significant associations between exposure level and health outcomes, both among workers using PPE ($\chi^2 = 228.19$, $p < 0.001$) and those without PPE ($\chi^2 = 145.95$, $p < 0.001$). Additionally, temperature exposure was significantly associated with all key health outcomes: respiratory ($\chi^2 = 105.83$), musculoskeletal ($\chi^2 = 138.14$), and circulatory issues ($\chi^2 = 127.90$), all with $p < 0.001$.

4.6 Multivariate Analysis

The results obtained from bivariate analysis were further analyzed using multivariate analysis and results are shown in table 4.6 below.

Table 4.6: Multivariate Analysis

Variables	AOR	P Value	95% CI
Exposure Level (High)	4.75	0.035	1.11 – 20.33
PPE Use (No)	3.20	0.042	1.04 – 9.83
Gender (Male)	1.85	0.271	0.62 – 5.53
Age Group (31–50 Yrs)	1.40	0.391	0.65 – 3.01
Age Group (>51 Yrs)	2.75	0.087	0.87 – 8.69

Multivariate logistic regression was conducted to determine the independent effects of temperature exposure, PPE use, gender, and age on the likelihood of experiencing cold-related health issues. The model revealed that workers with high exposure were significantly more likely to report health issues (AOR = 4.75, p = 0.035), and those not using PPE had a 3.2 times higher likelihood of reporting symptoms (p = 0.042). Although older age groups showed increased odds, these associations were not statistically significant at the 0.05 level.

4.7 Qualitative Data Analysis

4.7.1 Reported Health Symptom Reported by Cold Room Workers

Many participants mentioned experiencing pain in their lower back, neck, and shoulders. Others noted breathing discomfort or frequent colds.

> *"I've expired a long time in the cold, and my back days are very sore. And worse.."*

"After early morning shifts, I usually get colds and have shoulder congestion."

A physical exhaustion and breathing problems seemed to have affected the cold-storage workers.

4.7.2 Relationship Between Exposure and Severity of Health Outcomes

The majority of employees were in unison when saying that their symptoms got worse every time they had to spend more time in the cold room. The signs of discomfort went through a range of symptoms among which stiffness, tiredness, and more pain were the top ones to be listed.

"After four hours of it, my whole body already starts to ache.."

"Sometimes I work double shifts, and the day after, I feel my chest and back hurting."

There was a clear link between the length of exposure and the severity of health problems experienced.

4.7.3 Use and Effectiveness of Protective Measures

Although the majority of workers claimed that they were provided with protective clothing, a lot of them still considered it inefficient. They drew attention to the fact that jackets, gloves, and boots among others were sometimes of poor quality, already worn out, or not enough for the extremely cold weather..

"The coats they give you don't even quite keep you warm. It's only your inside that's still so cold.."

"The gloves don't work well when handling frozen goods. My hands still go numb.."

Evidence from these experiences indicates that even though some measures are taken for protection, they are still ineffective in avoiding health problems related to cold.

4.7.4 Workplace Practices and Safety Policies

A lot of the people involved in the study mentioned that there were hardly any formal safety policies regarding working in cold environments. The monitoring of temperatures was said to be sporadic, and the safety measures were either ambiguous or not followed at all.

"It is not clear how to respond to this question.."

"Room temperature, cold beyond reason is checked only when the system breaks down.."

Cold room operatives, hence, were at greater risk due to very few organizational safety and health measures.

In general, the interviews showed that employees commonly suffer from health problems of a physical and respiratory nature due to cold exposure. The longer the exposure, the more severe the problems. Even though workers were given protective clothing, in many cases it did not serve its purpose well enough. Furthermore, the lack of regular workplace policies and temperature monitoring meant that the risk was even greater. The results from the qualitative data seem to corroborate and clarify the trends seen in the quantitative data.

CHAPTER FIVE

DISCUSSION CONCLUSIONS AND RECOMMENDATIONS.

5.1 Introduction

The chapter's objective is to examine the research findings related to the topic 'Association of Temperature Variations and Health of Workers in Cold Rooms at Jomo Kenyatta International Airport, In Nairobi Kenya,' and afterward, to make conclusions and give recommendations.

5.1.1 Common Health Symptoms Experienced by Cold Room Workers at JKIA

According to this research study, the most common health problems among cold room workers were respiratory, musculoskeletal, and circulatory symptoms. It was also noted that there was a strong relationship between cold storage temperatures and the occurrence of respiratory symptoms, which included coughing and wheezing. Thus, those who worked in the coldest areas were more likely to suffer from respiratory issues, just like the study done by Lewis et al. (2022) who verified that cold exposure at work raises the incidence of respiratory tract symptoms. Moreover, a Swedish population-based study also pointed out that cold environmental exposure increases the risk of chronic cough and wheezing, regardless of other factors such as smoking (Johansson et al., 2021). This indicates that exposure to cold air negatively impacts respiratory health, notwithstanding the fact that Nairobi has a tropical climate.

Cold rooms workers had musculoskeletal problems, like back pain and stiff joints, and these complaints were highly common. This is in line with the view of Holmér (2018) who stated that cold exposure leads to muscle stiffness and reduced blood flow which in turn cause musculoskeletal strain to be worsened. Westerlund et al. (2022) reported that cold working conditions had significant associations with increased reports of pain

in the lower back and shoulder-neck areas. The findings indicate that the physical environment of cold storage facilities has direct impact on musculoskeletal health, thus calling for the implementation of ergonomic and thermal interventions.

Cold exposure was considerably connected with the circulatory disorders like numbness and cold-induced pain in the case of workers, being in line with the findings of Mirabelli et al. (2019), who reported a lot of circulation-related complaints in cold-exposed groups. The human body's response to cold, such as narrowing of blood vessels and less blood flow to the skin, are all well-known mechanisms that produce these symptoms (Holmér, 2018). Thus, the results of the study support the notion of cold temperature as a major factor causing the decline in circulatory health of the cold room employees.

5.1.2 Relationship between Duration and Frequency of Cold Exposure and Severity of Health Issues

The research uncovered a distinct dose-response pattern whereby the workers who were exposed for longer times and who had more frequently rotating shifts ranked the severity of their symptoms higher in all health domains. Workers who were exposed for more than 12 hours per day or for a period of three years or more showing respiratory, musculoskeletal and circulatory disorders, revealed significantly higher rates, in fact they were very much alike the studies conducted by Westerlund et al., (2022) and Johansson et al., (2021) who pointed out that the greater the intensity of exposure and the longer the duration the higher the health risks. The findings are a clear indication that there is a need to control the duration of exposure to prevent the deterioration of health due to cold.

5.1.3 Use and Effectiveness of Protective Measures on Health Outcomes in Cold Environments

The research indicated a significant connection between the application of personal protective equipment (PPE), encompassing insulated outfits and gloves, and the reporting of adverse health outcomes with a lower frequency of symptoms, thus implying that the current PPE might be either inadequately or incorrectly used. This result conforms with the recommendations given by the International Labour Organization (ILO, 2022), which point out that proper insulation through PPE quality and proper usage training can fully eliminate the risk of cold stress and its health implications. Moreover, the temperature breaks were mentioned and reported but not consistently put into practice. This discrepancy underlines the need for a tighter grip on the enforcement of all-encompassing workplace policies such as soaking time limitation and training to increase the effectiveness of the protection provided by such measures.

5.1.4 Workplace Practices and Policies on Temperature Monitoring and Occupational Safety

The research showed that there were not many established rules and practices for temperature control and cold exposure management in the cold room facilities at JKIA. Even though a few supervisors did informal checks, there were no systematic monitoring and rule enforcement for occupational safety standards at all. This lack of monitoring is a very important issue since it is very well known in health literature that environmental monitoring is the key to preventing cold stress in the workplace (Holmér, 2018; ILO, 2022). The lack of organized policies may be one of the reasons why the number of reported health symptoms is so high, and it also indicates that there is an urgent need for policy development, implementation, and regular audits.

5.2 Conclusion

The research has revealed a strong correlation between the changes in temperature of the cold storage areas at Jomo Kenyatta International Airport and the health of the workers who are exposed to these conditions. The workers were reported to suffer mostly from respiratory, musculoskeletal and circulatory problems, and the severity of these diseases was directly related to the amount of cold exposure. Even though wearing personal protective equipment (PPE) and allowing breaks were a bit effective in mitigating health risks, their irregular use curtailed their total protective impact.

The results obtained are in agreement with global literature even with the variability in climate zones, indicating that the exposure to cold at work is a major health risk that needs to be coped with through multi-faceted strategies. The study brings forward the necessity of having efficient safety procedures, good health and systematic temperature monitoring, and all-encompassing workplace policies and monitoring to protect workers' health and wellbeing in cold environments. Consequently, the research contributes to the current body of knowledge by providing location-specific insights into occupational health risks in a particular area professional setting.

5.3 Recommendations

Authorities and organizations were advised through the recommendations that were built upon the study's findings to take into consideration the relationship between temperature changes and the health of cold-room workers.

i. Cold room operation risks should be specifically addressed in the updates of workplace policies. They must be customized according to the local environment and operational conditions, and they should be based on the acknowledged international frameworks.

ii. Regular health evaluations for employees subjected to low temperatures are recommended to be put in place by organizations. This would allow for the early identification of cold-related diseases and, consequently, medical intervention being provided in time.

iii. Organizations must ensure that workers are equipped with top quality insulated clothing, gloves, and footwear which are appropriate for cold environments like cold rooms, and that such personal protective equipment (PPE) is subjected to routine replacement and inspection.

iv. Organizations have to guarantee that the cold storage rooms have dependable devices for temperature and humidity monitoring. The systems should be automatic and incorporate warnings in case of any change from the safe limits.

v. Structured shift rotations are to be implemented so as to limit cold room exposure and reduce the risk of health complications. Cold stress recovery should be done by letting workers take scheduled breaks in warm rest areas.

vi. Organizations must undertake a consistent program of training for both workers and supervisors in order to inform them about the health risks associated with cold exposure. Additionally, the training should include the proper usage and maintenance of personal protective equipment.

vii. Ensure compliance with safety regulations for cold room facilities. Enforcement mechanisms should be enhanced to ensure full adherence.

5.4 Further Research

Another study is recommended for comprehending the implications of cold environments on worker productivity and psychological well-being among miners.

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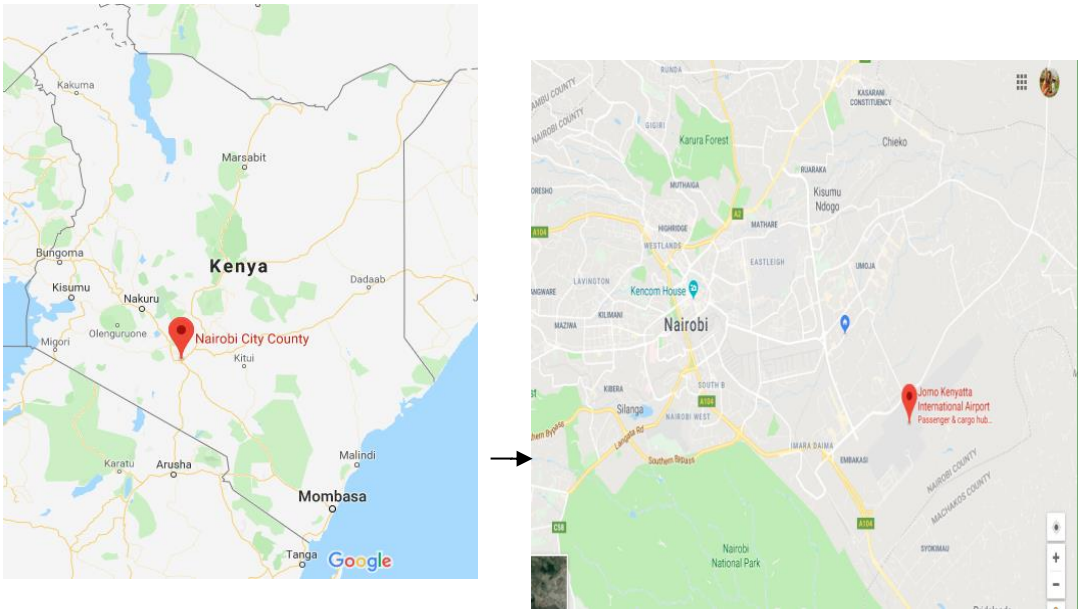
APPENDICES

Appendix I: Map Showing the Study Area

Map of Kenya **Nairobi City County**



Map of JKIA

Source : Google Map 2023

Appendix II : Questionnaire

I'm Cornelius Bett, a graduate student pursuing a Master's degree in Occupational Safety and Health at Kenyatta University. My current research project investigates the relationship between temperature fluctuations and worker health within the cold storage facilities at JKIA. I am respectfully requesting your permission for a brief interview, estimated to take approximately 20 minutes. During this time, you'll be asked to complete a questionnaire. Please be assured that all information you provide will be used exclusively for this study and will be handled with the utmost confidentiality and privacy.

Accepted ☐ **Declined ☐**

Signature……. Date……

SECTION A: PERSONAL HISTORY

Socio-demographic data

i. Name (optional)

……

ii. Gender: Male ( ) Female ( )

iii. Age: 18–30 years ( ) 31–40 years ( ) 41-50 years ( ) Above 51 years ( )

iv. Highest educational level: Secondary ( ) Tertiary ( ) University ( )

v. Employment Type: Contract ( ) Permanent ( )

vi. Period of employment

Below 2 years ( ) 3 - 5 years ( ) 6 – 10 years ( ) Over 11 years ( )

SECTION B: REPORTED HEALTH SYMPTOMS/OUTCOMES

Kindly indicate the level you agree or disagree with, with the following statements concerning any of the following reported health symptoms/outcomes experienced while or after working in the cold room? Use a scale ranging from 0= Disagree to 1 =Agree.

SYMPTOMS	**AGREE**	**DISAGREE**
Headaches		
Joint or muscle pain		
Respiratory issues (e.g., coughing)		
Cold/flu-like symptoms		
Numbness or tingling (hands/feet)		
Fatigue		
Skin irritation		

i. How often do you experience any of the above symptoms?

Rarely ( ) Occasionally ( ) Frequently ( ) Almost daily ( )

ii. Have you ever sought medical attention for these symptoms?

Yes ( ) No ( )

If yes, what was the diagnosis (if known)? ……..

SECTION C: EXPOSURE TO COLD TEMPERATURES

i. On average, how many hours per day do you spend in the cold room?

Less than 2 hours ( ) 2 – 3 hours ( ) 4 – 6 hours ( ) More than 7hours ( )

ii. How many days per week do you work in the cold room?

1–2 days ( ) 3–4 days ( ) 5–6 days ( ) Daily ( )

iii. How would you rate the severity of the health symptoms you experience related to cold exposure?

Mild ( ) Moderate ( ) Severe ( ) Very severe ( )

iv. In your opinion, is there a relationship between the amount of time you spend in the cold room and your health symptoms?

Yes ( ) No ( )

SECTION D: USE AND EFFECTIVENESS OF PROTECTIVE MEASURES

i. Do you use any protective clothing or gear while working in the cold room?

Yes ( ) No ( )

If yes, what type of protective gear do you use? (Check all that apply)

Insulated jackets/coats ( ) Gloves ( ) Headgear ( ) Thermal boots ( )

Other (please specify): _____

ii. How effective do you find protective gear in preventing cold-related health issues?

Very effective ( ) Not effective ( ) I don't use any gear ( )

iii. Is the protective clothing provided by the employer?

Yes ( ) No ( )

SECTION E: WORKPLACE PRACTICES AND POLICIES

i. Are there policies or guidelines in your workplace regarding working in cold environments?

Yes ( ) No ( )

ii. Is there any temperature monitoring system in place in the cold rooms?

Yes ( ) No ( )

Are you trained or briefed on how to work safely in cold conditions?

Yes ( ) No ( )

Thank you for your participation.

Appendix III: Research Approval Letter

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

Internal Memo

FROM: Dean, Graduate School

DATE: 9th January, 2020

TO: **Mr. Cornelius K. Bett**
Department of Environmental & Occupational Health

REF:Q22/CTY/PT/38049/2017

SUBJECT: **APPROVAL OF RESEARCH PROPOSAL**

We acknowledge receipt of your Research Proposal after fulfilling recommendations raised by the Graduate School Board of 15th November, 2019.

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation and Ethics Review Committee, Kenyatta University.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The Forms are available at the University's Website under Graduate School webpage downloads.

Thank you.

JULIA GITU
FOR: DEAN, GRADUATE SCHOOL

CC. Chairman, Department of Environmental & Occupational Health

Supervisors:

1. Dr. Isabella Kingori
   C/o Department of Environmental & Occupational Health
   Kenyatta University
2. Dr. Anthony W. Nyambura
   C/o Department of Environmental & Occupational Health
   Kenyatta University

Appendix IV: Research Authorization Letter

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: Q22/CTY/PT/38049/2017 DATE: 9th January, 2020

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

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MR. CORNELIUS K. BETT REG. NO. Q22/CTY/PT/38049/17

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

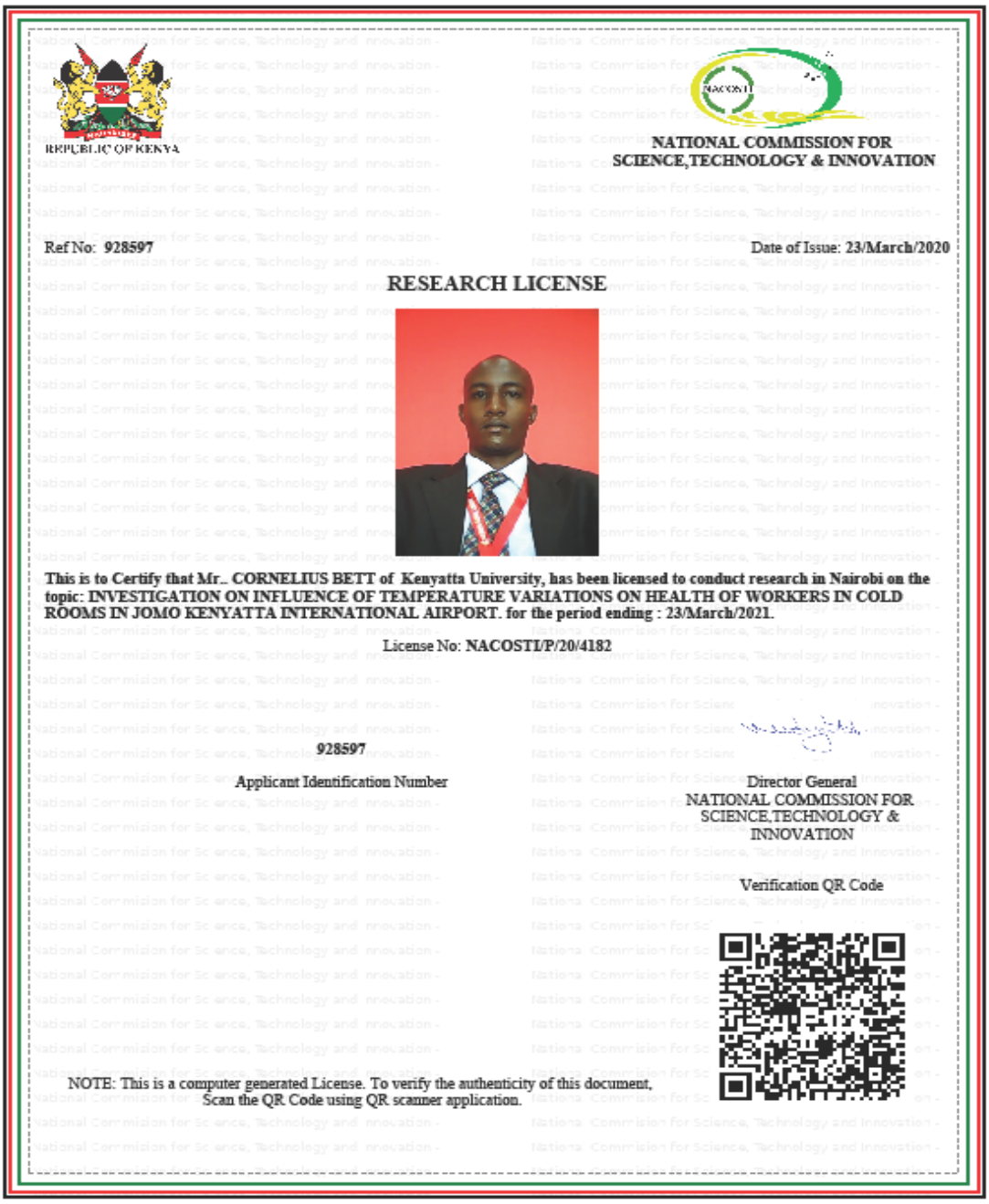
Mr. Bett intends to conduct research for a M.Sc. thesis Proposal entitled, **"Investigation on Influence of Temperature Variations on Health of Workers in Cold Rooms in Jomo Kenyatta International Airport."**

Any assistance given will be highly appreciated.

Yours faithfully,

PROF. ELISHIBA KIMANI
DEAN, GRADUATE SCHOOL

Appendix V: NACOSTI Research License



REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 928597

Date of Issue: 23/March/2020

RESEARCH LICENSE

This is to Certify that Mr.. CORNELIUS BETT of Kenyatta University, has been licensed to conduct research in Nairobi on the topic: INVESTIGATION ON INFLUENCE OF TEMPERATURE VARIATIONS ON HEALTH OF WORKERS IN COLD ROOMS IN JOMO KENYATTA INTERNATIONAL AIRPORT. for the period ending : 23/March/2021.

License No: NACOSTI/P/20/4182

928597

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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