ERGONOMIC HAZARDS AND ASSOCIATED HEALTH EFFECTS IN SELECTED FOOD AND BEVERAGE INDUSTRIES IN NAIROBI KENYA

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Ergonomic Hazards and Associated Health Effects in Selected Food and Beverage Industries in Nairobi Kenya

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

Signature …….. Date……

Francis Odiwuor Ayaga

This thesis has been submitted for examination with our approval as University Supervisors

Signature …….. Date……

Dr. Charles Mburu, PhD

JKUAT, Kenya

Signature …….. Date……

Dr. Benson Karanja, PhD

JKUAT, Kenya

DEDICATION

I would like to dedicate this work to my beloved mother, Sara Ayaga, who is no longer with us. Her memory and the love she showed me continue to inspire me. I would also like to dedicate this work to my children, Derbice and Francine, who have been a constant source of love and encouragement throughout this journey. May God bless all of you with strength and good health.

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I am deeply appreciative of the participants who generously dedicated their time to take part in this study. Without their involvement, this research would not have been possible. Furthermore, I would like to acknowledge the JKUAT ethical review committee and the National Commission of Science and Technology for granting me the necessary research clearance permit. Once again, thank you all for your invaluable contributions and support.

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NOMENCLATURE AND ABBREVIATIONS

ALARP	As Low as Reasonably Practicable
AVE	Average Variance Extracted
BLS	Bureau of Labour Statistic
CDC	Centre for Disease Control
CL	Confidence Limit
C127	Internal Labour Convention Number 127
DOSHI	Directorate of Occupational Safety and Health Institute
DOSHS	Directorate of Occupational Safety and health Service
HSA	Health Safety Authority
HSE	Health Safety and Environment
IEET	Institute of Energy and Environment Technology
LBP	Low Back Pain
ILC	International Labour Convention
ILO	International Labour Organization
NACOSTI	National Commission for Science, Technology, and Innovation
NIOSH	National Institute of Occupational Safety and Health.
H55	Code for Food and Beverage economic Activity According to DOSHI
KAM	Kenya Association of Manufacturers.

KES	Kenya Shillings
KG	Kilogram
MAC	Manual Handling Assessment Charts
MSD	Musculoskeletal Disorder
MSEs	Micro Small Enterprises
OH&S	Occupational Health and Safety
OSHA	Occupational Safety and Health Act
RULA	Rapid Upper Limb Assessment
UK	United Kingdom.
USA	United States of America
WMSD	Work Musculoskeletal Disorders
WRMSD	Work Related Musculoskeletal Disorders
WHO	World Health Organization
WISE	Work in Small Enterprises
%	Percentage

ABSTRACT

Ergonomic hazards in the food and beverage industries pose serious health risks to workers. These hazards are often a result of manual handling activities such as lifting, lowering, pushing, and restraining, which are common in these industries. Workers frequently perform these tasks in awkward postures, use excessive force, and engage in repetitive motions. The consequences of these hazardous activities include work related musculoskeletal disorders, reduced productivity and increased absenteeism among workers. Many workers who have been exposed to these hazards have reported experiencing pain, discomfort, and injuries, particularly in their back, fingers, shoulders, and neck. Despite such significant health risks faced by majority of the workers in the food and beverage industries being one of the largest sectors of the economy in Kenya, there has been little attention given to understanding their challenges and improving their working conditions. This research study aimed to address this gap by profiling ergonomic hazards, assessing the associated health effects among workers, and identifying existing and applied control measures in the selected food and beverage industries. The study was conducted among a population of 1821 workers in five selected facilities within Nairobi County in Kenya. To obtain a representative sample, a systematic random sampling technique was used, which resulted in 328 workers taking part in the study. The research collected primary data through the administration of semi-structured questionnaires, interviews, observations, and measurements. Collected data was analyzed using SSPS version 24.0, and findings of the study revealed that manufacturing (56%) and warehousing (46%) were the most impacted processes in terms of ergonomic hazards. These processes involved manual handling, loading, lifting, pushing, and restraining activities. The study also found that the most significant health effects experienced by workers, were largely attributed to the way they performed their tasks such as applying excessive repetitive force. Additionally, the study confirmed that a strong positive relationship existed between the encountered ergonomic hazards and the prevalence of health effects among employees in the studied workplaces. This relationship was found to be statistically significant ($r = 0.80$, p-value = 0.00). The study concluded that the most existing control measures in the workplaces implemented to mitigate the encountered ergonomic hazards by workers were significantly administrative in nature. It recommends further investigation should be carried into the health effects of other hazard categories, such as biological and chemical hazards, among workers in the food and beverage industries.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Ergonomic hazards and their associated health risks are widespread across various sectors of the economy. In recent years, there has been a growing focus on these hazards, particularly within the food and beverage industries. In 2016, Health and Safety Authority [HSA] reported nearly 8,381 non-fatal injuries, many of which were associated with manual handling tasks and resulted in musculoskeletal disorders in Ireland alone. Approximately 10,739 claims related to occupational injuries were awarded to individuals who were injured at work, with back, neck, rib, and disc injuries accounting for 25.96% of these claims were also reported by Health and Safety Authority in 2017. These statistics have outlined the significant personal suffering caused by work-related accidents and illnesses due to prevalent of ergonomic hazards the workplaces.

In Kenya, the food and beverage industries are one of the major employers, encompassing both formal and informal workers. According to Kenya National Bureau of Statistics [KNBS] (2024), manufacturing industry was one of the major industries which employed the largest workforce accounting for 362,300 (11.5%) of the workers. These statistics highlighted a significant number of workers who were exposed to safety and health risks, particularly in the food and beverage industries where manufacturing processes are largely characterized by manual material handling operations. These risks stem from their heightened exposure to work-related musculoskeletal disorders (WRMSDs) caused by ergonomic hazards prevalent in the workplaces.

The activities within the food and beverage industries primarily revolved around manufacturing operations, which encompassed processing, warehousing or storage, transportation, hospitality, and administrative services. A considerable proportion of skilled workers were typically involved in handling administrative, engineering, processing, and hospitality duties, while semi-skilled and unskilled workers were

predominantly found in departments such as warehousing, transportation, and cleaning services. Many of the tasks performed by the semi-skilled and unskilled workers are physically demanding and involved heavy manual labour. Majority of the workers observed at the end of production lines were responsible for packing finished products, which were often doing activities associated with loading, offloading, pushing, manual carrying, scooping, and exposed to relatively prolonged periods of sitting on forklifts to transport materials. In some cases, workers were required to lift heavy loads of raw materials or finished goods weighing as much as70kg or more.

The significant nature of these hazardous activities taking place within the food and beverage industries have resulted in a noticeable increase in absenteeism and a probable a rise in complaints regarding discomfort, pain, and injuries among workers as alluded by HSA (2019). Many of these complaints by workers have been largely associated with lower back issues, which were often caused by poor lifting techniques performed in awkward postures, as depicted in Plates 1.1. Technique A demonstrates the proper method, while Technique B illustrates an incorrect lifting approach while illustration C visually represents the health effects on the lower back resulting from improper lifting techniques.

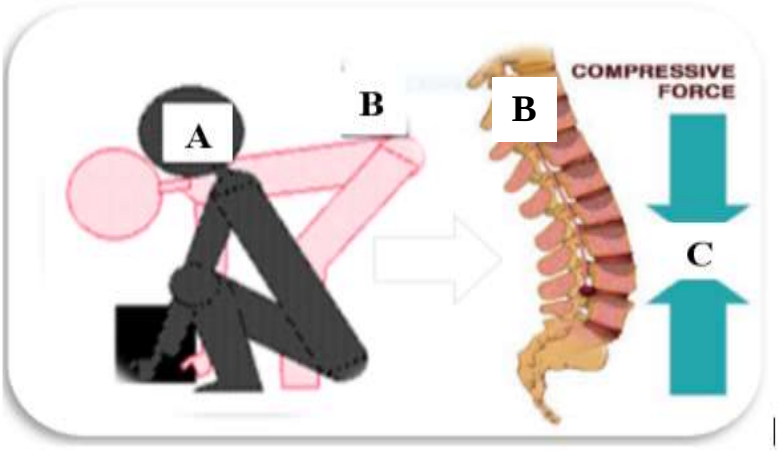
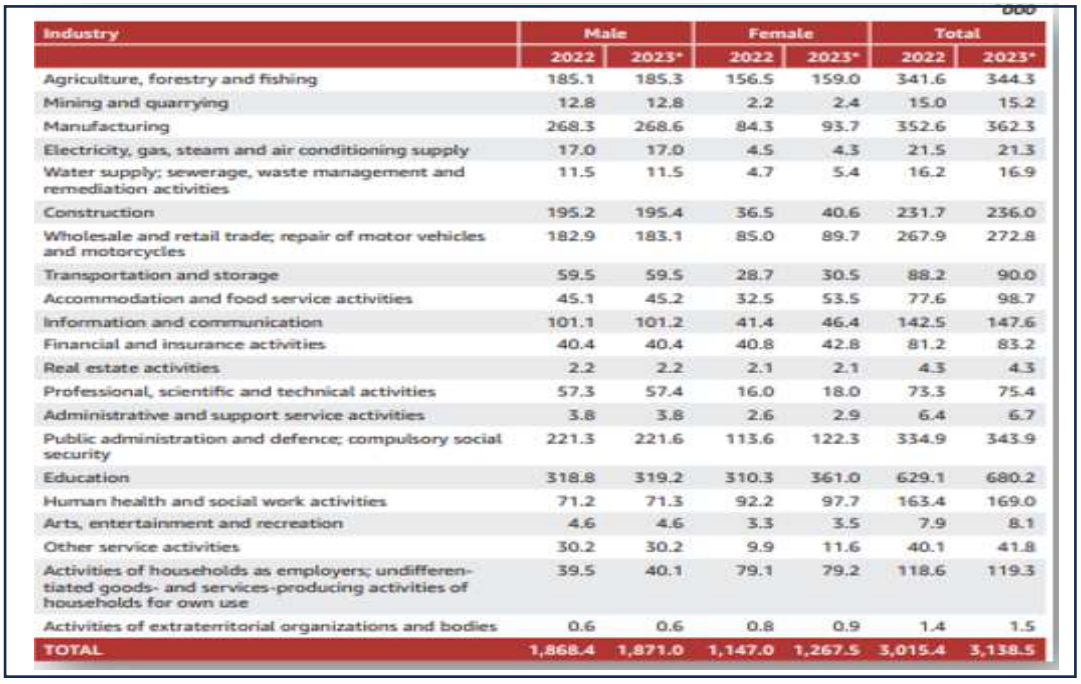


Plate 1.1: Comparison between Good and Bad Lifting Techniques (Health and Safety Authority, 2019)

Given this context, there is a growing need to identify the specific ergonomic hazards associated with operations in the food and beverage sector, evaluate the potential health effects related to these hazards, and assess the implementation of control measures to mitigate their impact on workers' health and well-being.

While previous studies have examined certain aspects of ergonomic risk factors exacerbating musculoskeletal disorders among workers in potato chip processing (Chaiklieng, 2019), there is still a relative lack of comprehensive study that has investigated ergonomic hazards, their associated health effects, and corresponding control measures in the food and beverage industries, particularly in relation to a significant proportion of the workforce exposed to physically demanding activities in the manufacturing industry. This research gap has presented an opportunity to contribute to the existing body of knowledge and address some of the limitations of previous studies.



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Industry	Male		Female		Total	
	2022	2023*	2022	2023*	2022	2023*
Agriculture, forestry and fishing	185.1	185.3	156.5	159.0	341.6	344.3
Mining and quarrying	12.8	12.8	2.2	2.4	15.0	15.2
Manufacturing	268.3	268.6	84.3	93.7	352.6	362.3
Electricity, gas, steam and air conditioning supply	17.0	17.0	4.5	4.3	21.5	21.3
Water supply; sewerage, waste management and remediation activities	11.5	11.5	4.7	5.4	16.2	16.9
Construction	195.2	195.4	36.5	40.6	231.7	236.0
Wholesale and retail trade; repair of motor vehicles and motorcycles	182.9	183.1	85.0	89.7	267.9	272.8
Transportation and storage	59.5	59.5	28.7	30.5	88.2	90.0
Accommodation and food service activities	45.1	45.2	32.5	53.5	77.6	98.7
Information and communication	101.1	101.2	41.4	46.4	142.5	147.6
Financial and insurance activities	40.4	40.4	40.8	42.8	81.2	83.2
Real estate activities	2.2	2.2	2.1	2.1	4.3	4.3
Professional, scientific and technical activities	57.3	57.4	16.0	18.0	73.3	75.4
Administrative and support service activities	3.8	3.8	2.6	2.9	6.4	6.7
Public administration and defence; compulsory social security	221.3	221.6	113.6	122.3	334.9	343.9
Education	318.8	319.2	310.3	361.0	629.1	680.2
Human health and social work activities	71.2	71.3	92.2	97.7	163.4	169.0
Arts, entertainment and recreation	4.6	4.6	3.3	3.5	7.9	8.1
Other service activities	30.2	30.2	9.9	11.6	40.1	41.8
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	39.5	40.1	79.1	79.2	118.6	119.3
Activities of extraterritorial organizations and bodies	0.6	0.6	0.8	0.9	1.4	1.5
TOTAL	1,868.4	1,871.0	1,147.0	1,267.5	3,015.4	3,138.5

Plate1.2: Population of Workers in Various Economic Sectors (Kenya National Bureau of Statistics, 2024)

Kanda and Chirengendure (2019) in their study pointed out that employees who lift or perform other material handling work would be at risk of back or other forms of injuries. A similar view is held by Brown, Shore, Dyke, Scott and Smith (2020) who concluded that ergonomic risk assessment presents an opportunity to reduce the risk of Work-related Musculoskeletal Disorders (WMSD) linked to the weights of the load handled. HSA (2019) maintains the argument that hazardous tasks involve either repetitive, sudden force, repetitive movement, awkward posture and or exposure to vibration which directly stress the body all can lead to injuries thereby resulting in Work-related Musculoskeletal Disorders (WRMD). Due to the nature of tasks performed in most manufacturing facilities, it is not uncommon for workers to manually handle material loads without properly assessing the associated risk factors that increase the likelihood of work-related injuries. This can be attributed to a lack of adherence to internal safety standards and insufficient awareness among workers. A review of findings from an assessment report conducted by Gardner, Reed and Davidson (2020) stated that material of weight as much as 363.0 kg in either metallic or plastic containers are carried by workers during transportation, loading, and unloading . According to International Labour Organization [ILO] (1967), an induvial adult male worker should not carry weight beyond the recommended permissible weight of 50.0kg as outlined in recommendation 128.

In order to effectively reduce the risk of work-related injuries and illnesses, employers should prioritize the application of the hierarchy of risk controls. This involves first considering the elimination of tasks that create hazards or finding safer alternatives to replace more hazardous processes. If these options are not feasible, engineering solutions should be implemented to modify the process or reorganize the work. Administrative controls can be combined with other control measures, while the use of personal protective equipment should be considered as a last resort to address any remaining risks. The research emphasized that the inefficiency of resources is noted as a key challenge especially regarding investigation of occupational accidents and diseases in all workplaces.

1.2 Statement of the Problem

In Kenya, there has been a lack of attention given to investigating and addressing the work-related health effects that are associated with ergonomic hazards in the food and beverage industries. This is despite the fact that these industries are major players in the manufacturing sector and employ a significant proportion of the waged workforce, with 304,600 workers accounting for 11.9% of the workforce, according to the Kenya National Bureau of Statistics (2024).The productivity of workers in these industries was greatly impacted, with many cases being attributed to manual handling of materials and poor lifting techniques. Unfortunately, these issues have often remained unaddressed despite the prevalence of these hazards and the associated health effects in the food and beverage industries. There has been rather very little attention paid to conduct a comprehensive study on the specific ergonomic hazards, related health effects, and the implementation of control measures in the food and beverage industries.

1.3 Justification

The purpose of this research study was aimed at contributing to the existing knowledge by providing new information and identifying gaps that could be explored in future research. The findings of this study have the potential to benefit the management of the five selected facilities by providing feedback that can help them review their processes, improve the wellbeing and productivity of their workers. Additionally, the study's findings could be influential in prompting authorities to undertake a review and update existing legislation, such as the Occupational Safety and Health Act of 2007 [OSHA, 2007), in order to better address ergonomic hazards in the food and beverage industries.

1.4 Hypothesis

1.4.1 Null hypothesis (H0)

There is no significant association between ergonomic hazards and health effects among employees in the food and beverage industries in Nairobi County

1.4.2 Alternate Hypothesis (H1)

There is a significant association between ergonomic hazards and health effects among employees in the food and beverage industries in Nairobi County

1.5 Objectives

1.5.1 Main Objective

To assess ergonomic hazards and associated health effects in selected food and beverage industries.

1.5.2 Specific Objectives

i. To profile ergonomic hazards in the selected food and beverage industries.
ii. To evaluate the association between employees' health effects and the ergonomic hazards in the selected food and beverage industries.
iii. To identify existing control measures as applied in the selected food and beverage Industries.

1.6 Research Questions

i. What are the prevalent ergonomic hazards faced by employees in the food and beverage Industries?
ii. Are there health effects that may affect workers due to prevalence of ergonomic hazards in the food and beverage industries?
iii. Are there implemented control measures to mitigate the identified ergonomic hazards in the food and beverage industries?

1.7 Scope of the Study

The study aimed to profile the ergonomic hazards present in the five sampled facilities within the food and beverage industries in Nairobi County, Kenya. It also sought to evaluate associated health effects and identify the control measures implemented in the selected facilities. The choice of the five facilities was influenced by the limited access to most facilities due to the Covid-19 pandemic restrictions,

which impacted the research process at the time of proposal development and approval since most of the facilities had adopted remote and online ways of working to minimize physical contacts.

1.8 Study Limitations

The participants were primarily chosen from workers in five facilities, as Covid-19 restrictions affected work practices and limited physical meetings in registered workplaces across Kenya. Due to the challenges posed by the pandemic and financial constraints, the study did not include a verification exercise for certain parameters like hot and cold working environments, noise levels, and material load weights.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Principles

Mechanical handling plays a significant role in various sectors, involving the handling of materials through activities like loading, moving, and unloading. This process utilizes a range of devices, such as tackles, gadgets, and equipment. To ensure the well-being of workers and minimize ergonomic health risks associated with material handling, it is crucial to design tasks that align with the capabilities of the worker, rather than forcing the worker's body to adapt to the task (HSA, 2019; Hale *at el*., 2019). Furthermore, it is essential to assess and consider all aspects of the task, including environmental factors like noise, vibration, lighting, temperature, ventilation, and humidity. By doing so, a comprehensive evaluation can be conducted to prevent a mismatch between the worker's abilities and the demands of the task, as highlighted by the International Labour Organization (ILO, 2017).

2.1.1 Material Transportation

In domestic transports, materials can be handled either manually or mechanically. Material handling operations are present in all workplace environments and are often associated with various safety hazards, including slips, trips, and falls, collisions with moving objects such as material handling equipment, and falling objects (Perttula *et al.*, 2020).

2.1.2 Material Stacking

Accidents in the organizations frequently occur during the storage of goods, particularly when engaging in activities like stacking and de-stacking materials. These accidents can range from minor incidents to severe and even fatal accidents. However, by properly stacking materials in a neat and orderly manner, the exposure to workplace hazards such as entanglement, slips/trips, and collisions with stationary objects can be minimized. Additionally, efficient stacking practices in the workplace optimize the utilization of available workspaces and ensure the smooth transfer of

raw or finished materials from storage areas to production or dispatch sections. It is important to maintain adequate space between the stacks and the walls to allow workers to easily inspect the status of the stacks and take corrective actions when necessary.

2.1.3 Corridors and Emergency Exits

To ensure the unrestricted movement of people and material handling equipment (MHE), it is crucial to keep corridors, and emergency exits free from any obstructions. This allows for easy access and evacuation in case of emergencies. Installing bollards can be an effective measure to prevent the risk of collisions between pedestrians and MHE. These bollards act as barriers, reducing the potential for MHE to accidentally collide with pedestrians moving along driveways, as illustrated below.

Plate 2.1: Prevention Risk of Collision between People and Moving Equipment

2.1.4 Material Storage and Handling

According to ILO (2017), a workplace should have a well demarcated transport ways to facilitate ease of movement of materials, people and they shall be kept free of materials. The institution recommends that main transport routes should be made wide enough to facilitate a two-way movement. It further alludes that when handling packaging materials, enough holding points should be provided to ensure adequate grip of materials or containers. ILO (2017) highlights that there should be in place a

suitable multilevel shelves and storage areas located nearer to the area where work is being performed to fasten ease of obtaining frequently used parts and tools. Materials used frequently should also be closer to the point of use. These materials should be sorted and systematically arranged to ensure heavy and lighter items are placed at lower and upper shelves respectively to make work safer and easier. Devices such as carts, hand-trucks, toolboxes fitted with rollers, or other wheeled devices can be used to transfer materials from one point to another in a bid to make easier for workers.

Plate 2.2: Folk lift Transferring Heavy Material Load

2.1.4.1 Manual Handling of Material

According to the ILO (2017), manual lifting should be considered as a last resort when transferring materials in the workplace. Workers should receive proper training on safe material handling techniques, which include maintaining a straight back and engaging the leg muscles. ILO recommendation 128 defines manual transport of loads as any task where an individual worker bears the full weight of the load, whether it involves lifting or putting down the load (ILO, 2017).

2.1.4.2 Maximum Weight

According to the ILO (2017), the maximum weight that an adult male worker can safely carry during manual load handling is 55.0kg. The ILO advises that adult women should avoid regular manual load handling altogether.

Additionally, the ILO stresses the importance of implementing appropriate measures to minimize female workers' exposure to manual duties. It is recommended that women handle lighter loads compared to men, and children should not be involved in manual load transport at all. To ensure the safety and health of workers, local authorities should establish and enforce control measures to prevent individuals under the age of 18 from engaging in load lifting activities. These measures are essential for safeguarding workers from potential injuries and fostering a secure working environment by considering use of mechanical devices to carry heavy demanding physical tasks to make work easier.

Plate 2.3: Transfer of Materials to Processing Areas Using a Lifting Device

2.1.4.3 Health Effects of Manual Handling

According to the HSA (2019), certain tasks may require workers to frequently reach overhead, leading to awkward body postures. These positions can cause deviations from neutral positions in the arms, shoulders, and back, increasing the risk of stress on joints and spinal discs. The HSA (2019) also highlights that when muscles are stressed without adequate rest and recovery time, injuries may occur.

Mufti, Ikhsan, and Putri (2019) argue that tasks involving high or significant physical strength can be considered as heavy physical work. Such tasks impose large compressive forces on the spine, potentially resulting in health risks for exposed workers. These tasks, including lifting and working in awkward postures, may trigger back disorders.

Chaiklieng (2019) concludes that both workers and employers need to be aware of the major health risks associated with specific tasks to prevent ill health. The research emphasizes the importance of conducting regular risk assessments and health surveillance to detect potential adverse health effects. It is crucial to follow a hierarchy of risk control measures when addressing health risks.

It is essential to address the risks associated with tasks involving awkward postures, heavy physical work, and potential back injuries. Regular risk assessments, health surveillance, and appropriate risk control measures should be implemented to protect the health and well-being of workers (HSA, 2019; Mufti *et al*., 2019; Chaiklieng, 2019).

2.1.5 Controls and Risk Prevention

In the workplace, hazards with high-risk ratings can be effectively managed by implementing suitable control measures to reduce the probability of resulting in an incident. The implemented control measures aim to lessen the risks associated with the hazards to as low as reasonably practicable.

2.1.5.1 Breaks and Rotation of Workers

The ILO (2017) highlights the importance of breaks and work rotation for workers who are engaged especially in performing repetitive tasks. The breaks are crucial in ensuring reduction of exhaustion and allowing for muscle relaxation. Additionally, allowing workers to take breaks between tasks can enhance their efficiency and boost morale. The institution emphasizes that proper and adequate ventilation is also essential in the workplace to ensure the free circulation of fresh air.

2.1.5.2 Labeling and Signage

According to the ILO (2017), while putting in place safety warning signs and labels in the workplace, the employer should ensure that they are easily readable, understandable, and locatable. The institution emphasizes that the safety of workers can be enhanced by using effective communication methods to provide safety information to contractors, visitors, and regular staff. This can be achieved through the implementation of appropriate labeling and signage in the workplace to prevent potential accidents. It is important to place these safety signs at strategic locations to attract workers' attention and clearly indicate the actions they need to take (ILO, 2017).

2.1.5.3 Work Environment

The workplace environment plays a crucial role in preventing potential accidents and promoting workers' health and productivity. Environmental factors such as sunlight, ventilation, and extreme weather can significantly impact workers' well-being (ILO, 2017).

2.1.5.3.1 Extreme Temperatures

To maintain body temperature, necessitating the provision of appropriate personal protective equipment (ILO, 2017; Perttula *et al*., 2020).

To ensure a healthy workplace, OSHA (2007) requires employers to provide suitable ventilation and adequate lighting in accordance with Part VI of sections 49 and 50. Additionally, maintaining a temperature range of 20.0-25.0°C for maximum productivity among seated workers, with a 5.0°C lower range for those engaged in heavy manual work is very essential (ILO, 2017). Excessively hot workplaces can lead to worker exhaustion, dehydration, and increased risk of mistakes and injuries. Conversely, extremely cold environments can cause workers to expend more energy

2.1.5.3.2 Noise

Mapping should also be conducted to identify noisy areas, and appropriate hearing conservation equipment must be provided to workers in those areas to prevent hearing loss associated with high noise levels.

2.1.5.3.3 Transport Routes

It is essential for employers to ensure that transport routes within the workplace are well-maintained to eliminate hazards such as damaged surfaces and slippery areas that can cause accidents (Perttula *et al*., 2020). When designing transport routes, consideration should be given to potential sudden changes in weather conditions. All junctions should be clearly identified and visibly marked to ensure safe passage and prevent collisions with material handling equipment.

2.1.5.4 Use of PPE in the Workplace

In the application of risk controls, the use of PPE should be considered as a last resort in the hierarchy of risk control measures (ILO, 2017). Other preventive measures, such as maintaining a safe and well-designed workplace environment, should be prioritized to minimize risks and protect workers' health and safety.

2.1.5.5 House Keeping

Perttula, Deroiste, Broek and Koskela (2020) argued that to safely transfer materials in the workplace, there should be adequate space, a tidy work environment, adequate lighting, and markings of transportation routes to work safely. The research maintained that nearly a half of the accidents happening in the construction industry are attributed to transfer of materials and partly due to poor housekeeping, inadequate planning of site layout and working spaces.

Plate 2.4: Blocked Passageways in the Warehouse

2.1.5.6 Welfare Facilities

According to (ILO, 2017) welfare facilities such as the supply of safe drinking water is vital to workers handling heavy loads or working in a hot working environment. Performing work in hot environment would require workers to need constant access to clean drinking water as outlined under section 91 of the (OSHA, 2007). Other facilities required at the workplace under sections 92, 93, 94 & 95 of OSHA (2007) includes washing facilities, accommodation for clothing e.g., PPE, resting areas, first aid items, and trained-qualified first aiders respectively.

2.1.5.7 Co-operation

Perttula *at el*. (2020) in their study argued that co-operation amongst operators is essential to improve the transfer of information about unsafe and dangerous conditions that may occur during material transfers at the workplace. The research alluded that information on accidents and work-related diseases of the employees or medical records of workers could also include workers consultation. The research also maintained that co-operation amongst the stakeholders such as employer and employees are very important in improving safety of the workers and working conditions

2.1.5. 8 Training and Instruction

To ensure the safety of workers involved in hazardous tasks like manual load transfers, it is crucial to provide adequate training, instructions, and appropriate supervision (OSHA, 2007). These trainings, instructions, and supervision should be conducted by qualified individuals (ILO, 2017; OSHA, 2007). Perttula *et al*. (2020) emphasized that providing appropriate training to personnel is essential for building their capability and competence, ultimately preventing accidents in the workplace. Training also promotes teamwork among operators by improving work methods and continuously learning better ways of performing tasks. In their study, Perttula *et al*. (2020) highlighted the importance of training workers on adopting correct positions during the lifting of material loads to prevent back injuries. They also emphasize the significance of load sharing techniques, where two people work together during manual transfers, and the use of appropriate tools and devices. These simple measures can help promote good health by preventing injuries in the workplace. By providing adequate training, instructions, and supervision, organizations can enhance the skills and knowledge of workers, promote safe work practices, and prevent accidents and injuries (OSHA, 2007; Perttula *et al*., 2020).

2.1.5.9 Medical Examination

To safeguard the health of workers, it is crucial to assess their fitness and medical condition before assigning them specific duties (ILO, 2017). Periodic medical examinations should also be conducted as mandated by regulatory authorities, such as the Kenya Medical Examination Rule (2005). This rule stipulates that medical examinations should be conducted before employing a worker to establish their baseline health condition. Additionally, annual periodic examinations should be performed, and a post-employment medical examination is required when an employee leaves their position. By conducting these medical examinations, employers can ensure that workers are physically and medically fit for their assigned tasks. This helps prevent potential health risks and ensures the overall well-being of the workforce. Compliance with regulatory requirements regarding medical examinations is essential for maintaining a safe and healthy work environment.

2.1.5.10 Technical Devices and Packaging

To minimize the exposure to health risks, it is important to provide appropriate devices for workers involved in manual load transportation (ILO, 2017). When transporting packaged loads manually, it is crucial to ensure that the load is compact and properly packed in a suitable container. According to the ILO (2017), packaged loads should be equipped with devices that securely hold them, reducing the risk of injury during material handling. Furthermore, all machines and devices used for material handling should be well-maintained and kept in good working condition. It is essential to have proper and adequate guarding of dangerous parts of machines to protect workers from potential injuries associated with machine operation. By providing suitable devices and ensuring the proper maintenance of machines, organizations can minimize the health risks associated with manual load transportation and create a safer working environment for their employees (ILO, 2017).

Plate 2.5: Isolators and E-Stops Fitted on Machines

2.2 Legal Framework

2.2.1 ILO Guidelines

According to the ILO (2017), member states should prioritize the promotion of safety and health in the workplace by actively engaging in ergonomic research studies. These studies are essential for gathering valuable information that can be used to enhance safety measures and minimize workers' exposure to workplace hazards. The institution further suggested that if any work requires workers to exceed the recommended limits, there should be a process for requesting derogations. These derogations would be permitted by the relevant authority responsible for overseeing the application of recommendations in each member state. This allows for flexibility in certain circumstances while still ensuring the overall safety and well-being of workers. By conducting research and implementing appropriate measures, member states can effectively promote the safety and health of workers, creating safer working environments and reducing the risks associated with workplace hazards (ILO, 2017).

2.2.2 Council Directive 90/269/EEC

In addition to national laws, European legislation, specifically Council Directive 90/269/EEC, focuses on reducing the risk of musculoskeletal diseases associated with manual handling of loads (Perttula *et al*., 2020). This directive emphasizes that if manual handling of loads cannot be avoided, employers are required to provide suitable measures to minimize the associated risks. The directive recognizes the importance of addressing the hazards and risks involved in manual handling to protect workers from musculoskeletal diseases. It places the responsibility on employers to implement appropriate measures and provide necessary resources to reduce the risks associated with manual handling tasks. By complying with this European legislation, employers can contribute to the prevention of musculoskeletal diseases and promote the health and well-being of workers involved in manual handling activities (Perttula *et al*., 2020).

2.2.3 National Institute for Occupational Safety and Health (NIOSH)

According to the National Institute for Occupational Safety and Health, holding materials overhead or away from the body for extended periods of time, repeatedly lifting or holding objects, and placing heavy materials away from the body can increase stress on the body and the risk of injury for workers (NIOSH, 2020). These actions can lead to strain on the muscles, joints, and other body structures, potentially causing musculoskeletal disorders and other related injuries. It is important for employers and workers to be aware of these risks and take appropriate measures to minimize them. This may include implementing ergonomic principles, providing proper lifting techniques and equipment, and promoting regular breaks and rotation of tasks to reduce the strain on the body. By addressing these factors, employers can help protect the health and well-being of workers and reduce the risk of injuries associated with holding materials overhead, away from the body, or in a manner that places excessive stress on the body (NIOSH, 2020).

2.2.4 Hazardous Substance Rules, 2007, LN. 60 of 2007

The purpose of this rule is to ensure the minimization of exposure to hazardous or potentially hazardous substances in the workplace. It establishes exposure limits and guidelines to mitigate risks associated with working in hazardous conditions. The rule defines a hazardous substance as any chemical, waste, gas, medicine, drug, plant, animal, or microorganism that has the potential to cause harm to human health or the environment. It emphasizes that substances, whether in liquid, gas, or solid form, that are considered hazardous or potentially hazardous to humans or the environment, including objectionable odors, radioactivity, noise, and temperature, should be handled with caution. To minimize harm to employees, employers are expected to conduct regular workplace inspections, monitor air quality, label containers containing hazardous substances, maintain readily available material safety data sheets, and keep workers informed and aware of the dangers associated with such materials. By adhering to these guidelines, employers can ensure the safety and well-being of their employees by minimizing exposure to harmful substances in the workplace

2.2.5 Fire Risk Reduction Rules 2007, LN. 25

The legislation focuses on ensuring that workplaces are free from fire risks and outlines various requirements to achieve this goal. These requirements include implementing a fire safety policy, ensuring proper layout and design of the workplace, and adequate storage of flammable materials. The legislation emphasizes the importance of designated locations for storing flammable materials, maintaining good housekeeping practices, and proper waste disposal to minimize fire hazards. Additionally, the legislation requires workplaces to have emergency preparedness measures in place, such as fire evacuation plans and procedures. It also mandates that firefighting appliances be distributed adequately throughout the workplace and that workers receive training on how to use them effectively. Regular fire safety audits, workplace inspections, and risk assessments are also required under this legislation. These measures help identify potential fire threats and ensure that appropriate preventive measures are in place to mitigate the risks. By complying with these requirements, workplaces can enhance fire safety, protect workers and property, and minimize the potential for fire-related incidents and injuries.

2.3 Previous Related Studies

In their study, Lee *et al*. (2024) aimed to examine the disparities in workplace hazards and organizational protection resources based on enterprise size among manufacturing workers in South Korea. The findings revealed that the prevalence of hazard exposure and the availability of organizational protection resources varied depending on the size of the enterprise. Workers in smaller enterprises were found to have a higher likelihood of being exposed to physical, chemical, ergonomic, and psychological hazards, mainly due to limited access to organizational protection resources such as labor unions or safety delegates.

Furthermore, the study highlighted the existence of neglected areas concerning occupational health and safety in Micro and Small Enterprises (MSEs). To address these issues, a practical and strategic approach is necessary, which includes reducing hazard exposure, implementing legal regulations, providing resource support, and fostering personal engagement in occupational health and safety practices.

Sanmugum, Karuppiah and Sivasankar (2020) conducted a study on ergonomic risk assessment on selected hot-work workers recorded an ergonomic risk score of 17.7. The study further highlighted that the main ergonomic risk factors as: working in awkward postures, repetitive motions, working in static and sustained postures, vibration, insufficient ventilation, exposure to hazardous noise and extreme temperature. The research concluded that to effectively reduce risk level to the exposed workers, effectiveness and adequacy of the applied control measures should be evaluated further.

Johani and Pascua (2019) maintained a view that occurrence of the back disorders is attributable to manual handling of loads. In their study of impacts of manual handling training and lifting devices on risks of back pain among nurses, the research concluded that application of training programs on manual handling and the use of lifting devices are effective control measures in preventing lower back pain amongst nurses.

A study conducted on prevalence of occupational injuries and associated risk factors among workers in Bahir Dar Textile Share Company in Amhara Region, in Northwest Ethiopia by Damtie *et al*. (2020). The study findings show that the prevalence of occupational injuries over a one-year period was found to be 42.7%, while the prevalence over a two-week period was 6.7%. The most common types of injuries reported were abrasions and eye injuries. The hands and eyes were the body parts most frequently injured which were largely attributed to machinery-related incidents and falls/slips.

According to studies conducted by (ILO, 2017) procedures for material storage and handling are key essential procedures in day-to-day operations that ensure safety at the workplace. The institution emphasized that accident and material damage can be prevented by ensuring that proper arrangements and organization are maintained at the workplace. The body argued that a workplace should have adequate storage spaces, equipment should be used to handle materials while pathways should remain clear and unobstructed to reduce repetitive handling of materials. ILO (2017) maintains that repetitive handling of load can be minimized by introducing additional

control measures such as provision of firm grip for containers, establishing easy to read and understand labels and signs.

A case study in content analysis on the construction industry in India by (Goel, Ganesh & Kaur, 2019) highlighted the steps in analyzing collected data. In the study of health risk assessment on musculoskeletal disorders among potato-chip processing workers by (Chaiklieng, 2019), the study showed that results from Rapid Upper Limb Assessment (RULA) ergonomics risk indicated that all workers had a higher risk level than the acceptable MSDs risk levels. According to their findings, 77.6%, 19.6% and 2.8% of the assessed workers recorded very high level, high level, and moderate level respectively. The study established a consistency in the results with ergonomic risk assessment findings conducted in electronics workers performing repetitive behaviors. These workers too had high and very high levels of ergonomics risk. Chaiklieng (2019) argued that the results may be explained by fact that potato-chip processing requires lots of regular physical movement and involves working with automated machinery. The research noted that there were lots of twisting movements in performing the tasks and that ergonomic risk levels were high particularly in packaging tasks. Similarly, the study highlighted very high ergonomic risk level in those jobs requiring use of automated machinery because most workers who were involved in performing the task were doing so in static positions with repetitive movement of their upper limbs to hold task in front of the automated machine.

Chaiklieng (2019) further highlighted that Health risk Information from objective RULA assessment showed most workers were at a very high-risk level (77.6%) while subjective self-report assessment data showed a lower risk level of only 11.2%. The research argued that the difference may be due to workers' habits of exertions. The study indicated that there was atleast one working break during the four-hour work period excluding lunch break. Work rotation could help avoid repetitive work all day long in some jobs, workers' safety behaviors, posture adjustments, breaks, and workstation adjustment could have affected perception of the workers on musculoskeletal discomfort. The research concluded that MSDs risk can be

prevented by applying controls such as ergonomics training programs and improving the workstations among high-risk groups.

Perttula, Deroiste, Broek and Koskela (2020) in their studies concluded that in large warehouses automated systems such as automated guided vehicles and digital order picking pose specific types of risks related to cognitive ergonomics. The study further showed there was uniqueness in the challenges linked to in-house transport and materials handling faced at each workplace in the management of safety. The research concluded that several contractors and subcontractors working in the same location raised ambiguity in complying with site rules. Therefore, they proposed control measures such as ensuring information is made available on core issues such use of the routes in the site, details of devices and vehicles available onsite and when such devices can be availed on-site, etc. More so, the research further argued that good and careful planning of the logistics on safety of site and temporary workers visiting the site will help reduce injuries in the workplace.

Tuhul, El-Hamouz, Hasan and Jafar (2021) in their studies outlined that sometimes the decision to either use mechanical devices or manually handle material is complex. They argued that the complexity comes in cases where both manual transfer and equipment use cause lower back problems.

In manual transfers Tuhul *at el*. (2021) emphasized that lower back strain is caused by heavy loads and the strain of the weight placed on the human body while on the other hand, mechanical material transfer can also cause lower back problems in situations for example where work involves long-term sitting positions and vibration especially the use of Folklift driver.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Design

This study employed a descriptive - cross sectional research study design. In order to address the research questions and achieve the research objectives. The study was conducted within a specific timeframe, from October 2022 to January 2023, with the aim of gathering information on ergonomic hazards in the workplace, assessing associated health effects, and identifying the mitigative measures implemented in the selected facilities within Nairobi County. Given the limitations of time and budgetary constraints, a descriptive cross-sectional study design was deemed the most appropriate strategy, as the study was not intended to be longitudinal in nature as alluded by Goel *et al*., (2019).

3.2 Study Area and Population

Plate 3.1: Map of Nairobi Industrial Areas Showing Selected Facilities

(https://www.google.co.za/search?q=Map+of+nairobi+industrial+area&oq=Map&aqs=chrome.0.69i59j69i57j0l4.6447j1j8&sourceid=chrome&ie=UTF-8)

To collect primary data for the study, five facilities within Nairobi County were identified and coded as follows: NK, CO, UL, CD, and AC. These facilities were purposely selected to represent the characteristics of the wider population of the food and beverage industries in Nairobi County. The choice to limit the study to 5 facilities was influenced by the restrictions imposed by COVID-19 that limited physical meetings and social gatherings during the proposal development phase, made it challenging to access data and participants. By selecting these specific facilities, the study aimed to obtain a representative sample that provided insights into the overall food and beverage industry in the county.

Table 3.1: Study Area and Populations

Facility Code	Address	County	Nature of work	Population
UL	30386	Nairobi	Flour milling	400
NK	30265	Nairobi	Manufacturing of cereals & beverages	150
CO	18034	Nairobi	warehousing, engineering & distribution	1000
AC	14510	Nairobi	Restaurant	188
CD	30147	Nairobi	Processing & Packaging	83
Sub total				1821

Source: Directorate of Occupational Safety and Health Institute [DOSHI], 2019.

3.3 Sampling Method

According to Goel *et al*., (2019), sampling offers advantages such as cost savings and faster data collection in research studies. In this study, a purposive sampling technique was used to specifically target 5 facilities within Nairobi County's food and beverage industries. These facilities were selected since they represented a significant portion of the approximately 4393 food and beverage facilities in Nairobi County of which majority consisted of hotels and restaurants according to DOSHI (2019), the decision to focus on these specific industries was driven by the research

objective of examining end-to-end operations including processes with transportation, storage, warehousing, manufacturing, and dispatch operations.

The choice to limit the study to 5 facilities was also influenced by the restrictions imposed by COVID-19 which limited physical meetings and social gatherings at the time of the proposal development phase, which made it very challenging to access data and participants. Secondly, financial constraints and time limitations also played a role in determining the number of facilities included in the study.

Individuals who participated in the one-on-one interviews were selected from each facility by choosing every 10th worker encountered in the workplace. This approach aimed to provide a diverse range of perspectives from employees within the selected food and beverage facilities in Nairobi County.

3.4 Sample Size Determination

To obtain a representative sample of workers for the study from the population of 1821 workers in the 5 selected facilities, Yamane (1967:886) statistical method of sample size determination (as cited in Leon Mystica, 2020) was applied. A standard error of 5% was adopted to minimize the degree of error.

Yamane method:

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

N=Population under study ,

n= sample size for the study,

e= Marginal error (0.05)

$\mathbf{n} = 1821/(1+1821(0.05)^2 = 328$

The calculated sample size of 328 accounted for 18% of the population of workers in the selected facilities. This aligns well with a previous study conducted by

Maduekwe & Vries (2019), which recommended that a sample size ranging from 10.0% to 30.0% of the population is suitable for a reliable study.

3.4.1 Sample Distribution

To achieve the first objective of the study regarding the first objective of profiling ergonomic hazards in the selected workplaces, a survey was conducted among a sample of 328 respondents in the 5 selected facilities. The distribution of respondents was determined proportionately by considering the population of workers in each individual facility in relation to the total population of 1821 across all 5 facilities. This approach was implemented to minimize bias and ensure a representative sample of the wider population. By distributing respondents in this manner, the study aimed to capture a diverse range of perspectives and minimize the influence of any individual facility's characteristics on the overall findings. The distribution of respondents according to the workers' population ratio was as is illustrated in table below.

$$\mathbf{n_i} = (n_x/N) \times n$$

n= Calculated sample size for the study from Yamane statistical method.

$\mathbf{n_i}$= Representative sample size of respondents in each and every selected facility for the study.

$\mathbf{n_x}$= Population of workers in each and every selected food and beverage industry under study.

N= Total population of workers available in all the five selected industries under study.

Table 3.2: Sample Size Distribution of Respondents by Facilities

Facility	Population	Proportionate Distribution	Respondents
UL	400	20.0%	72
NK	150	8.2%	27
CO	1000	54.9%	180
AC	188	10.3%	34
CD	83	4.6%	15
	N=1821	100%	n=328

In order to gather information regarding second objective, every 10th worker encountered in the selected facilities was interviewed. This approach aimed to ensure representativeness of the sample and provided insights into the workers' perspectives on the health effects of ergonomic hazards.

To effectively address the third objective of the study, all the workstations within the 5 workplaces selected for the study were assessed.

3.5 Research Instruments

To gather data on the first objective of profiling ergonomic hazards in the selected industries, a structured questionnaire was utilized to collect information from the respondents about their experiences. In addition to the questionnaire, observations were made during a walk-around in the selected food and beverage facilities. These observations were documented using a camera and recorded in a notebook. This multi-method approach allowed for a comprehensive understanding of the ergonomic hazards present in the workplaces, combining self-reported data from the questionnaire with direct observations of activities.

Plate 3.2: Sony DSC Digital Camera

The information regarding the second objective which aimed to evaluate associated health effects amongst workers was achieved by use of an interview guide. Moreover, a camera was used to capture the observations made during the walk abouts while a notebook was used to record data obtained from research's interaction with the workers in their workstations. To ensure consistency in responses obtained from the interviewees as alluded by (Goel *et al*., 2019).

Information pertaining to the third objective which involved identifying applied control measures in the selected food and beverage facilities was achieved by confirming existing measurements in the workstations by use a tape measure illustrated below, and the results were recorded in a checklist in appendix iii.

Plate 3.3: Decimal in Measuring Tape

The measurements in the workplace were compared against best practices and existing standards in the discipline.

3.6 Data Processing and Analysis

Information obtained from the interviews, observations, and measurements were transferred in the excel sheet to make the information more accessible and easier to analyze. Gathered data were categorized into three sections namely: demographic information, ergonomic hazards, health effects and applied existing control measures as alluded by Goel *et al*. (2019). In this study, the research applied the first 3 steps in the above concept as follows:

Analysis of data was done using SSPS version 24.0. Descriptive statistics were used to summarize demographic information, ergonomic hazards, associated health effects and applied control measures. Categorical variables were presented as frequency distribution and percentages while continuous variables were presented as mean, standard deviation (SD) and median (Chaiklieng, 2019). An interpretation was done

based on the objective of the study to explain, communicate the research findings, and make sure the research questions have been fully answered and analyzed.

3.7 Ethical Issues

Before participating in the study, all respondents were required to sign research consent forms, as shown in appendix i, indicating their voluntary agreement to participate. They were fully informed about their right to withdraw from the study at any time without facing any consequences. To protect the confidentiality of the participants, no identifying information, such as names, was included in the questionnaires.

A research license number NACOSTI/P/22/20920 (appendix vi) was obtained from the National Commission for Science, Technology, and Innovation (NACOSTI). Additionally, authorization was sought from the Nairobi County Governor (appendix vii) and County Commissioner approval was sought as stipulated in the research license. These measures were implemented to ensure that the study complied with all necessary regulations and protocols.

3.8 Pilot Test Results

3.8.1 Validity

In this study, three aspects of validity were taken into consideration. Firstly, regular consultations with two supervisors were conducted to ensure the accuracy and quality of the research. The feedback received from my supervisors, along with periodical presentations to the board at the Institute of Energy and Environmental Technology, were used to improve the content of the research and enhance its validity.

Additionally, a pilot test was conducted among 27 workers in one of the selected facilities coded as NK. The feedback obtained from this pilot test was invaluable in revising the research questionnaire to make the questions more precise and clearer for the respondents, ensuring that the data collected would be accurate and valid.

According to Creswell and Clark (2021), construct is achieved when concepts or variables have been operationalized accurately to depict the underlying theoretical constructs. In this study construct validity was achieved by subjecting the three variables namely ergonomic hazards, health effects and implemented control measures to a Confirmatory Factor Analysis (CFA) to assess how well they represented the construct. The result showed that the Average Variance Extracted (AVE) for each construct exceeded the critical value of 0.4.

Table 3.3: Average Variance Explained

Variables	Average Variance Explained
Profile of ergonomic hazards	0.801
Health risk effects	0.743
Existing control measures	0.789

The results revealed that the use of CFA and the high AVE values indicated that the variables were accurately operationalized and represented the constructs of ergonomic hazards, perceived health effects, and implemented control measures. This suggested that the findings of the study could be considered valid and reliable.

Furthermore, by assessing construct validity, the study ensured that the measurements used were appropriate and aligned with the theoretical concepts being studied. This strengthened the overall quality of this research and increased confidence in the results obtained.

Overall, the study demonstrated a strong construct validity by effectively operationalizing and measuring the variables of interest. This enhanced the credibility and trustworthiness of the findings, providing a solid foundation for drawing conclusions and making recommendations based on the research.

3.8.2 Reliability

In assessing reliability of the research instrument, a Cronbach's alpha coefficient of 0.7 was considered the critical value. Elements with coefficients values below 0.7

were considered unreliable while those with coefficients of above 0.7 were considered reliable. The study used SPSS version 24 to compute the reliability coefficients. The results were as presented in below.

Table 3.4: Reliability Results

Variables	Cronbach's Alpha
Profile of ergonomic hazards	0.7
Health risk effects	0.8
Existing control measures	0.9

Based on the findings presented above, it was observed that the profile of ergonomic hazards, health risk effects, and control measures all exhibited a Cronbach's alpha coefficient exceeding the critical value of 0.7. This indicated that the questionnaire employed to gather data from the participants in this study was considered reliable.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Response Rate

The respondents considered for this study was 328 workers amongst the 5 selected food and beverage facilities in Nairobi County.

Table 4.1: Response Rate

	Frequency	**Percent**
Responses	250	76.2
Nonresponses	78	23.8
Total	328	100.0

Out of the 328 questionnaires distributed, 250 responses were obtained while 78 of the participants did not respond indicating a response rate of 76.2%.

4.1.1 Demographics

Table 4.2: Demographic Information

Demographic Information	Frequency (n=250)	Percent
Gender		
Male	168	67.2
Female	82	32.8
Others or Unknown	0	0
Years of experience		
1-5 Years	136	54.4
6-10 Years	56	22.4
Above 10 Years	58	23.2
Department		
Housekeeping	14	5.6
Manufacturing	140	56.0
Warehousing	62	24.8
Hospitality	5	2.0
Office	15	6.0
Others	14	5.6
Total	250	100.0
Level of Education		
Primary	4	1.6
Secondary	72	29.0
College	170	68.5
Postgraduate	2	0.8
Age Bracket		
Less than 18 Years	4	1.6
18 to 29 Years	72	28.8
30 to 49 Years	174	69.6
50 and above		0
0		

4.1.2 Percentage Distribution of Respondents by Gender

Proportion of gender of workers who took part in the study were as shown below.

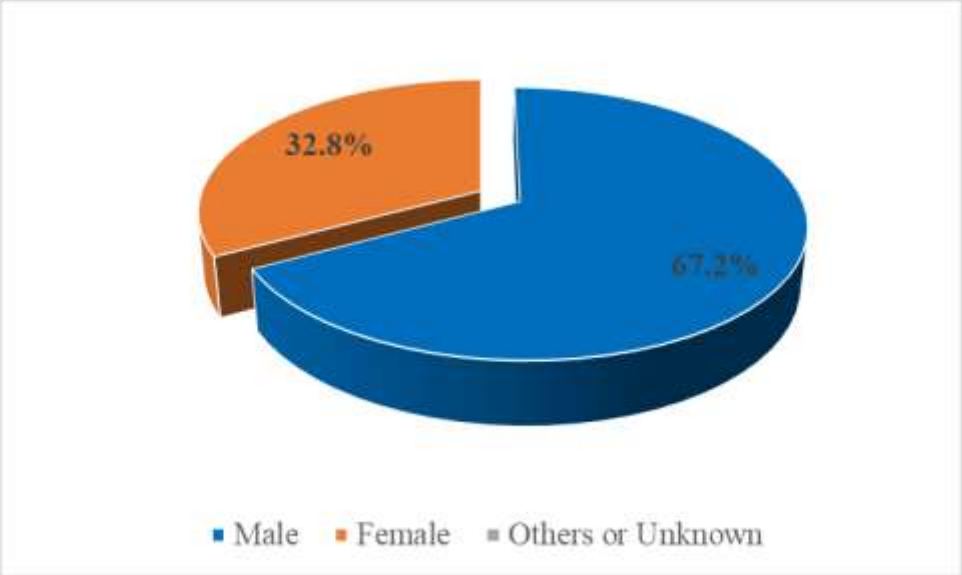


Figure 4.1: Percentage Distribution of Respondents by Gender

Based on the above results, the nature of activities in these industries may not be appealing or attractive to females or individuals of other genders, resulting in a predominantly male-dominated workforce. The findings suggest that there are fewer females or individuals of unknown gender being exposed to ergonomic hazards and their consequences compared to male workers in the same food and beverage facilities within Nairobi County.

These findings are in contrast to a study conducted by Chaiklieng (2019) and registry records by DOSHI (2019), which indicated that the majority of workers in the food and beverage industries were female, accounting for 75.7% and 72.2% respectively.

These discrepancies could further be explained based on the observations made during the tour of the facilities that revealed much of the activities performed in these workplaces were energy demanding and so involved heavy physical work.

4.1.3 Years of Service amongst Respondents

The findings revealed that a significant portion of the workforce in the food and beverage industries within Nairobi County had been employed by their current organization for less than 6 years. Conversely, a smaller proportion of employees had accumulated a relatively good amount of experience in handling the tasks associated with their roles.

These results imply that the workforce in these industries was predominantly comprised of individuals who were relatively inexperienced in their current positions. This lack of experience may potentially increase their vulnerability to ergonomic hazards and their associated risks.

The study suggest that is crucial to recognize the potential implications and appropriate measures should be taken to address the potential increased risk faced by less experienced employees these facilities. This may involve implementing comprehensive training programs, providing clear guidelines and instructions for safe work practices, and ensuring ongoing support and supervision to mitigate the potential ergonomic hazards they may encounter.

4.1.4 Age Distribution amongst Respondents

The findings highlight that a significant majority of workers who are exposed to Musculoskeletal Disorders (MSD) fall within the productive age range of 30-49 years. Results further showed that some facilities have a relatively small percentage of underage workers. These findings indicated that there is a considerable risk among male adult workers in their prime productive age, with an increased risk in the food and beverage facilities in Nairobi County due to the involvement of young people in performing hazardous tasks.

The study findings align well with a previous study conducted by Chaiklieng (2019), which reported that workers in the food and beverage Industry had an age range of 21-43 years. This consistency in findings further supports the notion that majority of

workers serving in this industry are predominantly within their prime ages, which may contribute to the observed risks and vulnerabilities.

Based on the above findings, it is crucial to have adequate supervision and monitoring in operations where underage persons are engaged. This is essential to ensure their safety and mitigate the potential risks associated with their involvement in hazardous tasks. Additionally, it is important to provide appropriate training and education to all workers, regardless of age, to promote safe work practices and prevent the occurrence of MSD.

4.1.5 Response by Department amongst Respondents

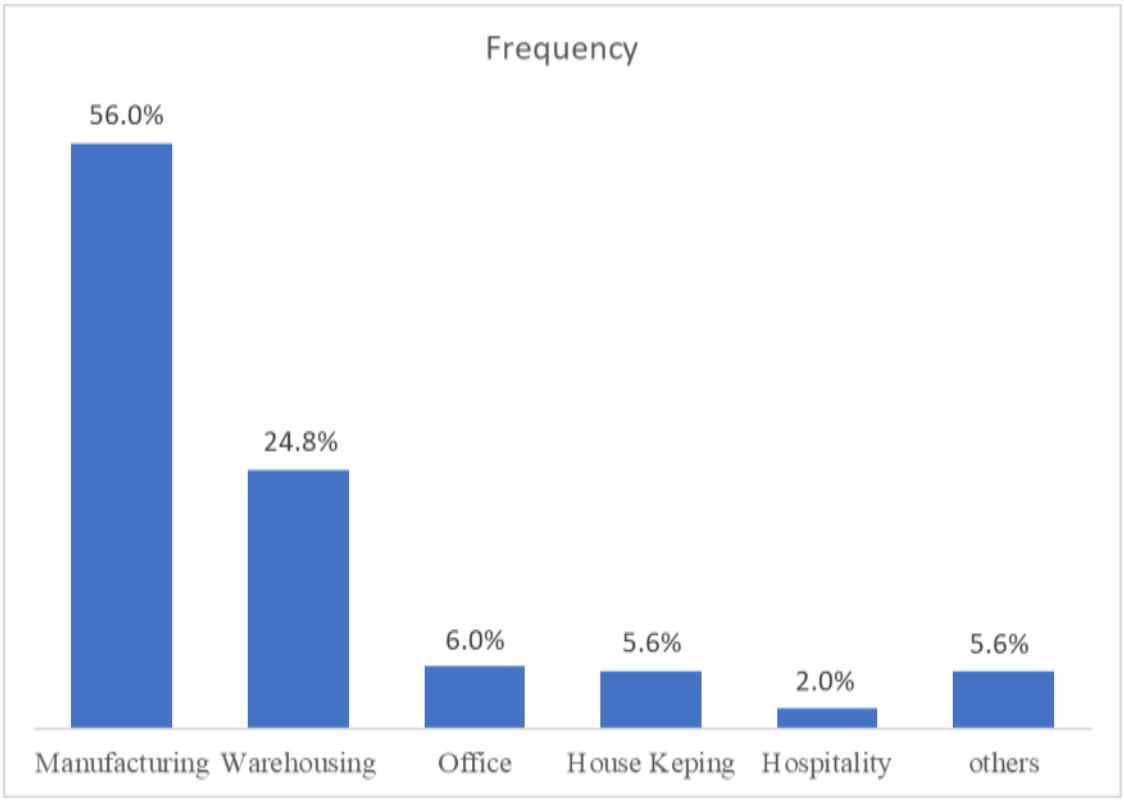


Figure 4.2: Responses by Department

In terms of workforce distribution across the departments, the results revealed that majority of workers in the food and beverage facilities in Nairobi County are stationed in the manufacturing departments, accounting for 56.0% of the respondents

followed by warehousing with 24.8%. A relatively smaller proportion of workers were spread across other departments like office, housekeeping etc. These results suggested that manufacturing and warehousing were most impacted departments with a significant percentage of workers exposed to ergonomic risk factors owing to the nature of heavy physical activities they were involved in. These findings are further supported by the observations made during the facilities tour. These findings align with a previous study by Chaiklieng (2019) which emphasized that processing and warehouse had the largest workforce exposed to MSDS at 66.4%) and warehousing (7.5%) respectively.

4.1.6 Distribution of Respondents by Level of Education

Table 4.3: Distribution of Respondents by Level of Education

Level of education	Frequency	Percent
Primary	4	1.6
Secondary	72	29.0
College	170	68.5
Postgraduate	2	0.8

Analysis of data from the above table indicates that most workers in the food and beverage facilities in Nairobi County had tertiary education, which would enable them to easily understand, interpret and implement workplace instructions and standards. The findings imply that majority of the workforce had adequate educational level which could contribute to better awareness and implementation of good ergonomic practices and written instructions, potentially reducing the risk of work-related injuries and disorders. These findings compare well with ILO (2017) adequate training and awareness for workers involved in a hazardous operation. Overall, the analysis highlights the distribution of workers across different departments and their educational backgrounds, providing insights into the potential exposure to ergonomic hazards and the level of education that may influence their understanding and management of such risks.

4.2 Ergonomic Hazards

4.2.1 Workers Awareness of Prevalent Ergonomic Hazards

The indicators are rated on a scale of 1 to 5, with 1 representing strongly disagree and 5 representing strongly agree. The mean awareness scores provided an indication of the overall perception of majority of workers regarding exposure and or level of understanding of existence of different ergonomic hazards in the workplace.

Table 4.4: Percentage and Mean Awareness of Ergonomics Hazards

Indicators of Ergonomic Hazards Awareness	1	2	3	4	5	Mean
Lifting, offloading, carrying, or pushing activities happen at work	0.8	17.6	1.6	23.6	56.4	4.2
It's possible for a moving vehicle and pedestrian to collide at a junction in the workplace	11.6	31.2	20.8	16.8	19.6	3.0
Repetitive tasks involving bending, overreaching, or twisting movements can be hazardous	10.0	28.0	15.2	28.4	18.4	3.2
Nature of my task can generate dust in the working environment	16.4	31.2	11.6	18.4	22.4	3.0
Exposure to excessive heat can impact workers health	10.4	25.6	32.0	22.0	10.0	3.0
Material load carried by an individual male worker can exceed 55kg in the workplace	40.8	27.2	8.8	8.0	15.2	2.3

(Where: 1-strongly disagree, 2-disagree, 3 -neutral, 4 - agree, and 5-strongly agree)

Results in the above table reveal that a significant majority of participants (56.4%) strongly agree that manual lifting, offloading, carrying, or pushing activities occur in their workplace. The mean awareness score supports this finding, indicating a relatively high level of agreement among workers regarding the presence of these activities. Interestingly, only a negligible minority of 0.8% strongly disagree, suggesting that the majority of workers recognize the existence of hazardous manual handling operations in their respective workplaces. This observation aligns well with a previous study by Johani and Pascua (2019) who maintained that the availability of

mechanical devices for material handling operations in certain workplaces are helpful in minimizing health risks associated with manual material handling operations.

When it comes to the question of potential collisions between pedestrians and moving objects at junctions in the workplaces, participants' awareness and understanding showed a moderate level of agreement. This finding indicated a significant variation in the implementation of existing control measures across the five studied facilities, as supported by illustrations in plate 2.0.

The findings also revealed a relatively high level of awareness among respondents regarding the potential health effects of performing repetitive activities in awkward postures such as bending, overreaching, or twisting movements. This was further supported by the moderate mean awareness score among workers. These findings suggested that a significant proportion of workers, both those with and without basic knowledge of proper manual material handling techniques, were aware of the potential risks associated with such activities.

The results indicated a moderate level of awareness among workers regarding the potential generation of dust in their working environment. A notable percentage of workers (31.2%) disagree, while a significant proportion (22.4%) strongly agree with this notion. These findings suggested that different workers were engaged in various activities, some of which may lead to dust generation while others may not.

Additionally, the findings suggest that a significant percentage of workers may not be aware of the task analysis results in their respective areas of operations. It was observed in the workplace that a majority of operations in processing, warehousing, and transportation activities generate dust in the studied workplaces. This implies that either the tasks performed by workers have not been thoroughly analyzed or the workers themselves may not be fully aware of the potential dust generation associated with their tasks.

The study findings revealed that a significant majority of respondents (32.0%) acknowledged the negative health effects associated with exposure to high or low

thermal working environments. This suggested that the management of the facilities may have conducted effective sensitization efforts and shared the results of risk assessments with workers who were exposed to such extreme thermal conditions. These findings further indicated that the management of these facilities had taken proactive measures to raise awareness among workers about the potential health risks associated with working in high or low thermal environments.

Participants in the study exhibited a relatively low level of awareness regarding the weight limits for material loads. Only a small percentage (8.0%) agreed, and an even a smaller percentage (15.2%) strongly agreed with the statement that individual male workers could exceed a 55kg material load in the workplace. The mean score of 2.3 further supported this finding, indicating a lower level of awareness compared to other indicators assessed in the study. These results suggested that there may be a lack of understanding or knowledge among participants regarding the weight limits and potential risks associated with manual carrying heavy material loads in the workplace.

4.2.2 Mean Distribution of Ergonomic Hazards in Selected Facilities

Table 4.5: Ergonomics Hazards by Respondents

Indicators of Ergonomic Hazards	1	2	3	4	5
Doing repetitive task e.g. lifting, offloading, pushing etc	0.8	17.6	1.6	23.6	56.4
Working in static position or handling vibrating equipment	11.6	31.2	20.8	16.8	19.6
Adopting awkward body posture such as bending or twisting	10.0	28.0	15.2	28.4	18.4
Working with a noisy or insufficiently guarded equipment	16.4	31.2	11.6	18.4	22.4
Exposure to heat in the working environment	40.8	27.2	8.8	8.0	15.2

(Where: 1- strongly disagree, 2 -disagree, 3 - neutral, 4 - agree and 5 - strongly agree)

Based on the findings in the table above, most workers in the facilities are involved in performing repetitive and physically demanding tasks, which expose them to health effects resulting in work-related Musculoskeletal Disorders (MSDs). These findings align well with the research conducted earlier by (Mufti *et al.*, 2019).

The results indicated that a significant majority (31.2%) of the participants reported not having interacted with activities involving vibration or performing tasks in a static position over time. Additionally, 20.8% of the respondents either had no exposure to such tasks or were unsure about the nature of their task's association with vibrations.

These findings are inconsistent with the observations made during the walkabout in the facilities and also contradicts findings by Perttula *et al*. (2020), the research observed that safety hazards were prevalent in material handling operations across various workplace environments. The findings indicate that there is a lack of awareness among a significant number of workers in the selected facilities regarding the risks associated with vibrations and repetitive tasks performed in static postures. This suggests that these workers may not have been adequately informed about the potential dangers they face in their work environment when working with vibrating equipment.

The possible explanation for this lack of awareness was that the staff handling material handling equipment were not provided with the results of ergonomic risk assessments. Without access to this information, they may not be aware of the specific hazards such as vibration they are exposed to and the necessary precautions they should take to mitigate these kinds of risks.

These findings highlight the need for increased awareness and communication regarding the potential risks associated with tasks performed in static positions or with vibrating equipment. It is crucial for employers to share the results of ergonomic risk assessments with their staff, ensuring that they are well-informed about the hazards they may encounter in their work environment.

The results indicated that a significant proportion of respondents (40.8%) strongly disagreed and 27.2% disagreed with the statement regarding heat in the working environment. Additionally, only a small percentage (8.0%) confirmed that they performed work in thermal environments. These findings imply that most workplaces in the selected facilities have implemented adequate controls such regulating room temperatures, sealing off sources of heat, insulations, restricted access for accessing

hotwork rooms, provided training on risk associated with thermal conditions, availed and monitors use of PPE to minimize dehydration and exhaustion caused by exposure to thermal conditions. These findings are consistent with the recommendations by ILO (2017), which emphasizes the importance of maintaining optimal temperatures in the workplace to safeguard workers' health and productivity, considering environmental factors such as ventilation and extreme weather conditions.

The analysis of the findings highlights the prevalence of physically demanding tasks, the need for increased awareness of ergonomic hazards, and the implementation of controls to mitigate risks associated with extreme temperatures in the studies facilities.

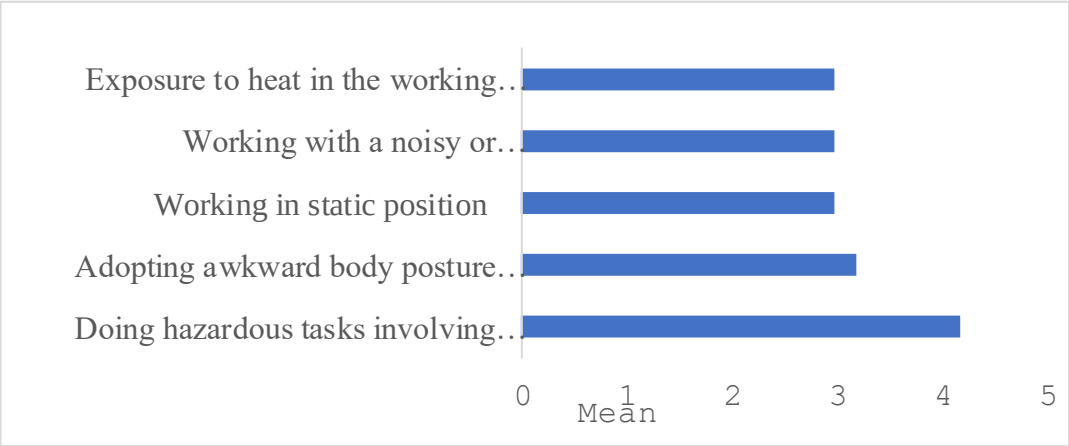


Figure 4.3: Prevalent Ergonomics Hazards in Selected Facilities

According to the study, the findings revealed the top three prevalent ergonomic hazards as perceived by workers to be of significant concern in their workplaces included: repetitive work involving lifting, offloading, restraining, carrying, or pushing, awkward body postures and working in static position while the least encountered ergonomic hazard amongst workers was associated with working in thermal environment. The findings imply that workers in the studied facilities were regularly engaged in use of force in performing repetitive manual tasks. Such hazardous activities are often done by workers in awkward body posture, a situation which significantly exposed them more to work related MSD associated attributed to

poor work designs. These findings compared very well with the previous study , which emphasized that heavy physical tasks appear to trigger other potential risk factors such as back disorder especially lifting and working in awkward postures(Mufti *et al*., 2019). The findings highlighted the importance of addressing and mitigating the risks associated with hazardous tasks in the food and beverage Industries to ensure a safer and healthier work environment for workers.

4.3 Health Effects

The study sought to evaluate health effects amongst employees in the food and beverage Industries.

4.3.1 Health Effects of Ergonomic Hazards

Table 4.6: Health Effects amongst Workers

Indicators of Health Effects	**1**	**2**	**3**	**4**	**5**
Illness or injuries reported due to unsafe work equipment	3.2	6.5	4.0	25.8	60.5
Back pain from long driving of Folklift or Hand truck	18.5	37.1	15.3	12.1	16.9
Pain or discomfort occurred in the body when working in awkward body postures e.g., static, bending, or twisted positions	8.1	25.2	7.3	52.0	7.3
Wrist pain, shoulder or back from manual lifting of materials	33.5	25.8	19.8	12.9	8.0
PPE eg earplugs are used in declared as noise hazard areas	34.4	30.3	17.2	7.4	10.7

(Where: 5 -Atleast four times, 4- Three times, 3-Two times, 2-Once and 1- Zero).

From above table, the majority of respondents in the study reported experiencing illness or injuries due to unsafe work equipment. The findings suggested that a significant percentage of workers in the selected facilities had sustained or had a high probability of suffering health effects due to encounter with unsafe or defective machinery due to nature of equipment designs not considering workers limitations. It was likely that employees in these industries frequently interact with equipment that was not ergonomically friendly, potentially leading to tasks being performed with defective devices causing workers to adjust their body to use the existing equipment. The small proportion of respondents who did not report injuries or illnesses related to

work equipment as observed in the workplaces were largely performing administrative works hence, they had less interaction with equipment in the workplace. These findings align with a previous study which had highlighted that a higher proportion of workers in the food and beverage industry present with musculoskeletal disorders (Chaiklieng, 2019). This supports the notion that ergonomic hazards and associated health issues are significantly prevalent in the selected facilities. The study also reveals that respondents who operate material handling equipment, such as forklifts or hand trucks, have encountered back pain cases. Among these respondents, 37.1% have experienced back pain once, 18.5% have not experienced any back pain, 16.9% have encountered back pain for atleast 4 times while 12.1% have encountered it three times. The study findings further suggested that material handling operators who frequently use mechanical devices like forklifts in their work processes are at risk of sustaining back pain since they mostly perform their duties in prolonged seated positions. The continuous exposure to these hazardous conditions, along with excessive vibrations, can potentially lead to the development of back pain and other related issues. It is crucial to address these concerns and implement appropriate measures to minimize the risk of MSDs among material handling operators.

These findings were supported by a previous study, which concluded that mechanical material transfer, including long-term sitting positions and vibrations associated with forklift use, could contribute to lower back problems (Tuhul *et al.*, 2021).The findings are further supported by evidence of a photo taken using a camera of an employee transferring several cases of finished goods onto the racks as illustrated in plate 2.2.

This study highlights the potential health risks faced by material handling operators and emphasizes the importance of implementing ergonomic control measures such as training on ergonomic best practices and risk assessments to mitigate the occurrence of MSDs amongst workers.

From the findings, majority of the respondents indicated they have encountered health effects associated with pain or discomfort in the workplace when performing

task in awkward body posture (mean = 4.33). Out of which 52.0% of the respondents had experienced pain in the body for at least 3 times, 25.2% had the experience once while 7.3% experienced it at least four times. These findings implied that most activities assigned to workers in the selected facilities have not taken into consideration workers' limitations and abilities therefore workers adjust their body posture to fit the task. Chaiklieng (2019), concluded that there was a high recordable injury amongst of workers working in the potato chip processing facilities.

The results of the study revealed that a significant proportion of respondents (33.5%) had not encountered back pain due to manual lifting in the workplace. Additionally, 25.8% reported experiencing back pain once, while 8.0% reported encountering back pain at least four times.

Interestingly, despite the prevalence of manual handling operations observed in most of the facilities, a considerable number of respondents (33.5%) indicated that they had not experienced any discomfort or pain associated with manual lifting activities. This suggests that either these workers have been adequately trained to perform manual handling techniques safely or they may not have attributed their back pain to work-related risk factors in the workplace. It is possible that these workers may also be involved in strenuous tasks that require excessive use of force or have adopted poor body postures during manual handling operations outside of the work environment.

Furthermore, it is worth considering that a significant number of respondents may have experienced health effects such as pain or discomfort in other parts of the body, such as the neck, shoulder, or wrist. These findings highlight the need for a comprehensive approach to address work-related musculoskeletal disorders (WRMSDs) beyond just focusing on back pain.

To mitigate the risk of WRMSDs, it is recommended to redesign tasks to minimize exposure to ergonomic hazards. This suggestion is supported by Alvee *et al*. (2024), who emphasize the importance of task redesign in minimizing the occurrence of WRMSDs. By implementing task redesign strategies and providing appropriate

training on safe manual handling techniques, employers can reduce the risk of work-related injuries and promote the overall well-being of their workers.

These findings underscored the importance of addressing ergonomic issues and promoting proper lifting techniques to prevent back pain and injuries among workers. It is crucial to create awareness and provide training to ensure that workers understand the risks associated with manual lifting and adopt safe practices in the workplace

Results further showed, 34.4% of the respondents had not used hearing protective equipment such as ear plugs in areas declared noise hazardous zone, 30.3% indicated they had only used the hearing protective equipment like ear plugs or earmuffs once, while only 7.4% had protected themselves from hazardous noise 3 times. These findings imply that majority of workers who are exposed to noisy work environment have low adherence and inconsistently use hearing protective equipment meant to protect them against harmful noise.

4.3.2 Mean Distribution of Health Effects amongst Respondents

Table 4.7: Mean Distribution of Health Effects amongst Workers

Measure of Health Risk	Mean
Illness or injuries reported due to unsafe work equipment	2.72
Pain occurred in the back from long driving of Folklift or Hand truck	1.94
Pain or discomfort when working in awkward body postures	4.33
Pain occurred in the wrist, shoulder or back from manual lifting of heavy materials	2.30
Hearing Protective Equipment like Ear Plugs are used in areas declared as noise hazard	2.30
Aggregate	2.72

Results from the table above show that, health effects associated with pain or discomfort from performing work in awkward postures (mean = 4.3) and work-related illness/injuries from use of unsafe work equipment (mean = 2.7) are the most perceived and encountered prevalent health effects while pain associated with long exposure to use mechanical devises like Folklift, or hand truck (mean = 1.9) is the least experienced health effect in the selected food and beverage facilities. During the facility visits in plate 2.2, it was observed that workers in the food and beverage industries often adopted awkward postures, disregarding proper lifting techniques. This supports the above findings and could lead to pain and discomfort associated with unneutral positions. These findings suggested that there is a high risk of workers in these industries experiencing Work-Related Musculoskeletal Disorders (WMSD) as they adjust their body positions to accommodate the tasks at hand. These findings align with the research conducted by Manikandan *et al*. (2021), who argued that the postural risk score is exacerbated by adopting working postures in unneutral positions.

On the other hand, a number of safety tags were observed on the machine indicating the assessed machines had certain unsafe conditions that would be addressed when the lines would be stopped at the end of the runs. These findings compares very well with (Mufti *et al*., 2019) who alluded that heavy physical tasks appear to trigger other potential risk factors such as back disorder especially lifting and working in awkward postures.

4.4 Control Measures

4.4.1 Applied and Existing Control Measures

Table 4.8: Applied Control Measures in Percent by Respondent

Indicators of Control measures	1	2	3	4	5
Trained and issued with instruction before given a new task	4.8	17.6	19.2	20.4	38.0
Proper arrangements and organization maintained	2.4	16.8	18.4	27.2	35.2
Material safety data sheets available when handling hazardous chemicals	12.9	12.1	9.7	26.2	39.5
Weight of material load carried wholly by worker exceeds set maximum.	31.9	20.2	11.3	11.7	25.0
Rest, break, or rotation when loading /offloading tasks/ handling chemicals	9.6	15.2	14.4	32.4	28.4
Machines maintained in good working conditions (with safety guards)	7.3	12.9	20.2	21.4	38.3

(Where: 5 -atleast four times, 4- three times, 3-two times, 2-once and 1- zero).

From the findings, 39.5% of the respondents indicated that MSDS are easily accessible to them especially when handling hazardous substances for atleast 4 times in their workplaces, 26.2% indicated they had accessed the information from MSDS 3 times while 9.7% recorded for 2 times they had access to information in the MSDS. Moreover, 35.2% of the respondents have a good experience of proper arrangements and better organization in their facilities for at least 4 times, 27.2% had three encounters while only 2.4% of the respondents indicated that there was no proper arrangement and good housekeeping practices in their workplaces at all. Results also showed that 28.4% of the respondents agreed that they have encountered for atleast 4 times rest, break, or rotation being allowed in their facilities when performing energy demanding and repetitive tasks, 38.3% have experienced working with machines maintained in safe working conditions for 4 times while 7.3% of respondents have bad experience working with unsafe machines especially occasioned by poor guarding of moving parts of the equipment.

These findings imply that most workplaces have implemented various layers of controls measures to minimize machine related injuries in the workplace. This can be interpreted that implemented controls on the machines are fairly adequate, and they include application of both Engineering such as machine guarding, raising awareness through training and instructions and implementation of safety rules. The observations recorded from the selected facilities showed good effort by the workplaces in identifying machinery safety gaps through risk assessment and fencing off the dangerous parts to avert potential risks of injury. These findings compare very well with recommendations by ILO (2017), which maintains that all machines and devises used for handling materials should be kept and maintained in good working conditions. The institution also maintains adequate controls should be implemented in the workplaces such as breaks and rotation of workers, training and instructions, use of suitable technical devices, good workplace organization amongst others. A study conducted by Ana *at el*. (2019) also affirmed the findings in this study by concluding that physical demand and musculoskeletal symptoms arising from work could be minimized by implementing other kinds of controls associated with ergonomic trainings.

4.4.2 Implemented Control Measures in the Facilities as Reported by the Respondents

Table 4.9: Distribution of Applied Control Measures

Applied Controls Measures	Mean
Setting limits for manual load carrying	2.8
Inter-task breaks and or rotation of workers	3.6
Training and task onboarding	3.7
Machines maintained in good working conditions with safety guards	3.7
Proper arrangements and workplace organization	3.8
Ease of access to MSDS	3.8
Aggregate	3.5

Above table shows a combination of different controls measures applied in the workplace.

Figure 4.5 below indicates the most implemented control measures as reported in the food and beverage facilities included access to workplace information, proper organization and workplace layout, machine guarding, and training and onboarding for tasks. Conversely, the least applied control measures were found to be adherence to safety rules regarding maximum materials load limits and the implementation of inter-task breaks or rotation of workers.

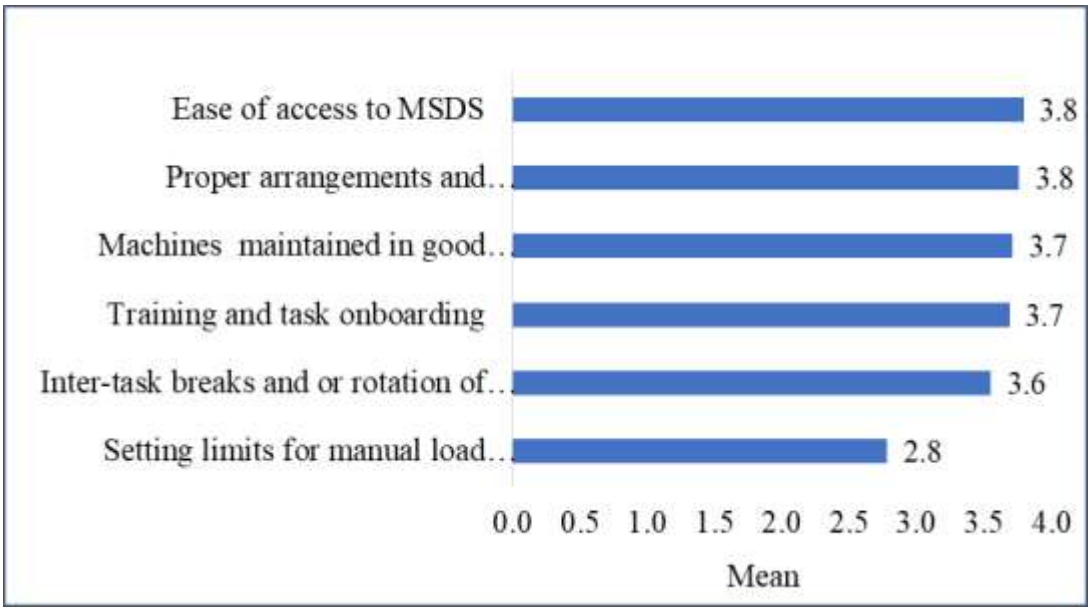


Figure 4.4: Hierarchy of Existing Control Measures

These findings are consistent with the research conducted by HSA (2019), which emphasized the use of transmission devices to minimize worker overexertion and the importance of following established ergonomics rules to reduce the risk of injury during material handling operations. The results also highlight the need for improvement in terms of adherence to safety rules and the promotion of inter-task breaks or rotation of workers in the food and beverage industries. By addressing these areas, organizations can further enhance workplace safety and reduce the risk of injuries associated with overexertion and repetitive tasks

4.4.3 Width of Internal Transport Routes as Applied Control Measure in the Facilities

The study sought to measure width (m) of the transport routes in the selected facilities in Nairobi County.

Table 4.10: Measurements of Width of Internal Transport Routes

	N	Minimum	Maximum	Mean	Std. Deviation
Width of transport routes (m)	31	0.5	5.2	2.1	1.1

The findings revealed that majority of the internal transport routes in the studied facilities were designed to facilitate the safe transfer of materials and movement of individuals, thereby reducing the risk of collisions. These results align with the recommendations of the ILO (2017), which emphasizes the importance of ensuring that main transport routes are wide enough to enable the safe movement of both materials and individuals. The findings from this analysis highlight the efforts made by the selected food and beverage industries in Nairobi County to maintain adequately sized transport routes that promote safety and efficient operations within the workplace.

4.4.4 Machinery Safety Control Measures as Implemented in the Facilities

The study examined existing control measures applied to prevent machinery related incidents in the workplace.

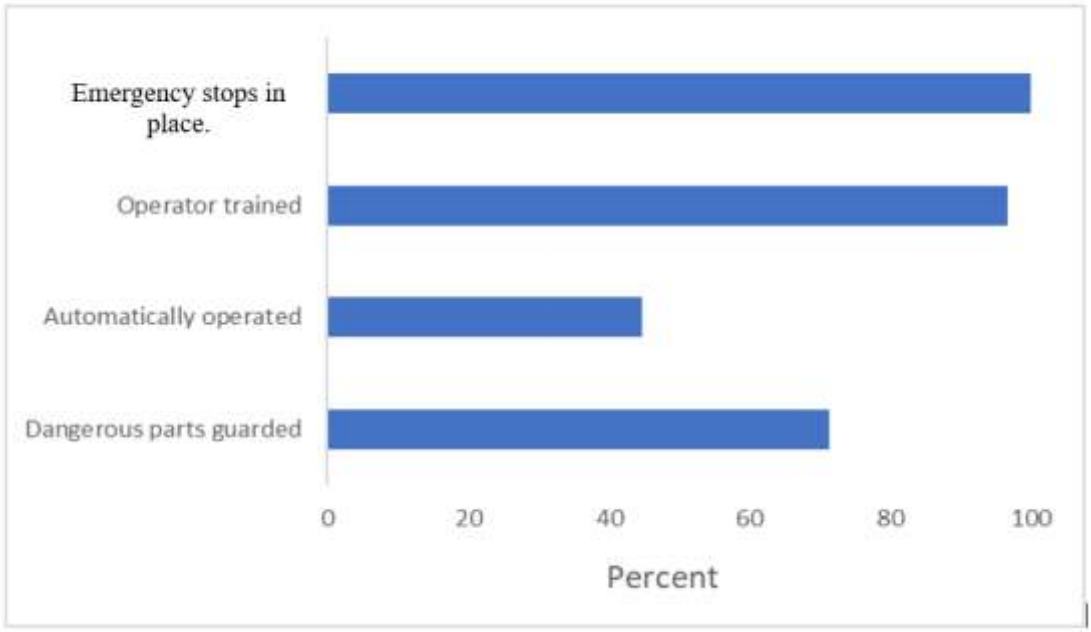


Figure 4.5: Results of Machinery Safety Assessment

Figure 4.6 shows results of machinery safety assessment, 71.4% of the examined machines have their dangerous parts properly guarded, 44.8% of the machines are operated automatically with minimal human interaction, and 96.6% of the operations are performed by trained employees. Additionally, all observed machines during the workplace walk around were equipped with emergency stop buttons. These findings suggest that management has allocated adequate resources to prioritize worker safety and prevent machinery-related accidents in the food and beverage facilities which compares well with Lee *et al*. (2024). There is also evidence of good adherence to maintenance plans and the training of operators in the sector. However, it is important to note that a significant portion of operations in these industries still involve manual and repetitive handling of tasks, which can increase the risk of work-related musculoskeletal disorders (MSDs) due to regular physical motions.

These findings also align with a study conducted by Chaiklieng (2019), who argued that working with automated machinery and performing packaging tasks in the food processing industry involves regular physical motion. Such conditions expose workers to high ergonomic risk levels, particularly when tasks are performed in repetitive postures with exertion at regular intervals.

The findings also highlight the efforts made by management to ensure worker safety through the implementation of control measures. However, there is a need to address the ergonomic risks associated with manual and repetitive tasks to further enhance worker well-being and reduce the risk of work-related MSDs.

4.5 Hypothesis Testing

The Pearson correlation analysis is a statistical method usually applied to assess the strength and direction of the linear association between two continuous variables. In this study, the Pearson correlation analysis was employed to investigate the relationship between ergonomic hazards and health effects on employees in the Food and Beverage facilities within Nairobi County.

Table 4.11: Pearson Correlation Coefficients

		Ergonomic Hazards	**Health of Employees**
Ergonomic Hazards	Pearson Correlation	1.00	
	Sig. (2-tailed)		
	N	250	
Health ofPearson Correlation		0.80**	1.00
Employees	Sig. (2-tailed)	0.00	
	N	250	250

**. Correlation is significant at the 0.05 level (2-tailed).

The results presented above indicated a strong and positive correlation between these variables (r = 0.80, p-value = 0.00). The p-value being less than the significance level of 0.05 allowed for rejection of the null hypothesis, which suggested that ergonomic hazards have no statistically significant impact on employee health in the selected industries. Therefore, the study concluded that ergonomic hazards have a positive and statistically significant effect on the health of employees in the Food and Beverage industries in Nairobi County.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

5.1.1 Specific Objective 1

The study concluded that the main group vulnerable to ergonomic hazards and musculoskeletal disorders in the food and beverage facilities of Nairobi County were male workers aged 30 to 49, who were in their prime productive years. The primary contributors to these hazards in the workplace were identified as the excessive use of force during manual handling tasks such as lifting, offloading, restraining, carrying, or pushing. Additionally, working in awkward body postures, maintaining static positions, and exposure to vibrations were also recognized as significant factors leading to these hazards.

5.1.2 Specific Objective 2

It is concluded that the health effects of ergonomic hazards on workers in the food and beverage industries are primarily intensified by improper lifting and lowering of heavy loads, along with a lack of consideration for the alignment between job requirements and employees' physical capabilities. As a result, workers are frequently compelled to engage in movements such as twisting, bending, or overreaching, which compromises their safety and well-being. This explains the high prevalence of pain or discomfort experienced by workers in this sector.

5.1.3 Specific Objective 3

The study concludes that while there is a reasonable combination of controls measures existing in the food and beverage industries, prioritization of resources during implementation of the control measures in the workplace does not consider the hierarchy of risk controls as mentioned in the literature review, majority of the applied control measures in the workplaces were mostly administrative in nature. It was also observed and concluded that there is low adherence and inconsistency in the

implementation of safety rules regarding maximum load limit an adult worker and use of personal protective equipment in noisy and cold working environments.

5.2 Recommendations

1. The study recommends that management in the food and beverage industries in Kenya prioritizes use of material handling devices in material handling operations, with manual handling considered as a last resort. This approach will make work safer, easier, and more attractive to all genders, including female workers.
2. It is recommended that the facilities management should focus on implementing additional engineering control measures to mitigate the risk of work-related illnesses related to manual handling of materials. It is important to ensure that work tasks are appropriately matched to the abilities of workers, and pre-task assessments should be conducted to safeguard young or underage workers from exposure to hazardous work conditions.
3. Prioritization of resource in implementing control measures should consider the hierarchy of risk controls to address the significant ergonomic risks associated with manual and repetitive tasks to enhance worker well-being and reduce the risk of work-related MSDs.
4. Further research is recommended to conduct similar studies in other counties beyond Nairobi, while also considering other potential hazards such as chemical and biological hazards in the food and beverage industries. This research would aim to provide a broader understanding of ergonomic hazards and associated health effects in different regions, considering variations in industry practices and worker demographics. Additionally, this research could explore other categories of hazards, such as biological and chemical hazards, to provide a comprehensive.
5. Further research is recommended to investigate the impact of extreme working environments and verify the noise levels in designated noisy areas within the food and beverage industries

REFERENCES

Alvee, A., Aditya, S.M., Ava, R., Eunsik, K., Jill, U. (2024). *Investigating musculoskeletal risks in manual mushroom harvesting: An ergonomic field study in Canadian farms*, Social Sciences *& Humanities Open, 10*(2024), 101049, https://doi.org/10.1016/j.ssaho.2024.101049. https://www.Scien ce direct.com/science/article/pii/S2590291124002468

Ana, L.R.F.F., & Tatiana, D.O.S. (2019). Effectiveness of ergonomic training to reduce physical demands and musculoskeletal symptoms - An overview of systematic reviews, *International Journal of Industrial Ergonomics, 74*(2019), 102845, https://www.sciencedirect.com/science/article/pii/S01 69 814119300319

Brown, C.E., Shore, E., Dyke, M.V.V., Scott, J., & Smith, R., (2020). Evaluation of an Occupational Safety and Health Training for Cannabis Cultivation Workers. *Ann Work Expo Health, 64*(7), 765-769. doi:DOI: 10.1093/ annweh/wxaa026

Chaiklieng, S. (2019). Health risk assessment on musculoskeletal disorders among potato-chip processing workers. *PLoS ONE, 14*(12), 1-8. doi:10.1371/ journal.pone.0224980

Creswell, J. W., & Clark, V. L. (2021). *Designing and conducting mixed methods research* (4th ed.). London: Sage Publications.

Destaw, D. & Abraraw, S. (2020). The Prevalence of Occupational Injuries and Associated Risk Factors among Workers in Bahir Dar Textile Share Company, Amhara Region, Northwest Ethiopia. *Journal of Environmental and Public Health, 2020,* Article ID 2875297, 9 pages https://doi.org/10.1155/2020/2875297

GOK, (2019). *Directorate of Occupational Safety Health and Social Services,* Nairobi: GOK.

GOK, (2005). *Medical Examination Rules, 2005*. (2005, April 1), Nairobi: GOK. http://ngishili.com/worksafe/Medical-Examination-Rules-2005.pdf

GOK, (2007). *Hazardous substance Rules, 2007*. (2007, April 16), Nairobi: GOK. https://www.safepro.co.ke/hazardous-substances-rules-2007 http://www.kenyalaw.org/kl/fileadmin/pdfdownloads/LegalNotices/2007/60-FactorisandOtherPlacesofWorkAct_HazardousSubstances_Rules_2007.pdf

GOK, (2007). *Fire Risk Reduction Rules, 2007*. (2007, May 4), Nairobi: GOK. http://www.kenyalaw.org/kl/fileadmin/pdfdownloads/LegalNotices/2007/59-FactoriesandOtherPlacesofWork_FireRiskReduction_Rules_2007.pdf

GOK, (2007). *Occupational Safety and Health Act, 2007*. Nairobi: GOK. www.kenyalaw.org:8181/exist/rest//db/kenyalex/Kenya...

GOK, (2019). *Directorate of Occupational Safety and Health Services.* Nairobi: GOK. Directorate of Occupational Safety Health Institute Registry.

Gardner, M., Reed, S., & Davidson, M. (2020). Assessment of Worker Exposure to Occupational Organic Dust in a Hemp Processing Facility. *Annals of Work Expoures & Health, 64*(7), 745-753. doi:10.1093/annweh/wxaa065

Goel, A., Ganesh, L. S., & Kaur, A. (2019). Deductive content analysis of research on sustainable construction in India: current progress and future directions. *Journal of Cleaner Production, 222,* 142-158.

Greene, J. C. & Dreyer, L. A. (2021). *Designing & conducting mixed methods research* (3rd ed.). London: Sage Publications.

Hale, A., & Booth, R. (2019). The safety professional in the UK: Development of a key player in occupational health and safety. *Safety science, 118,* 76-87.

Hosseini, A., Choobineh, A., Razeghi, M., Pakshir, H. R., Ghaem, H., & Vojud, M. (2019). Ergonomic Assessment of Exposure to Musculoskeletal

Disorders Risk Factors among Dentists of Shiraz, Iran. *Journal of Dentistry, 20*(1), 53–60. doi:10.30476/DENTJODS.2019.44564

Health Safety Authority. (2019). *Risk assessment for managing ergonomic risks. Retrieved from* https://www.hsa.ie/eng/publications_and_forms/publications/manual_handling_and_musculoskeletal_disorders/managing_ergonomic_risk_-_abridged.pdf

Hye-Lin, L., Ji-Hwan, K., Taesun, K., Garin, L., Hayoung, L., Hee W., Kim & Seung-Sup, K., (2024). *Disparities in workplace hazards and organizational protection resources based on enterprise size among manufacturing workers in South Korea.* https://doi.org/10.1016/j.shaw.2024.06.00

International Labour Organization. (2017). *Work Improvements in Small Enterprises International Labour Office, Geneva, 2017.* Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/instructionalmaterial/wcms_621054.pdf

Johani, W. A. A., & Pascua, G. P. (2019). Impacts of Manual Handling Training and Lifting Devices on Risks of Back Pain among Nurses: An Integrative Literature Review. *Nurse Media Journal of Nursing, 9*(2), 210-230. doi:10.14710/nmjn.v9i2.26435

Kanda, F. N. A., & Chirengendure, Y. (2019). An evaluation of ergonomic risks associated with tailoring tasks using the rapid entire body assessment method. *International Journal of Human Factors and Ergonomics, 6*(2), 102-106. doi:10.1504/IJHFE.2019.102297

Kenya National Bureau Statistics. (2024). *Economic Survey 2024*. Nairobi: KNBS. http://www.knbs.or.ke

Leon, Mystica. (2020). *Barriers to environmentally sustainable initiatives in oral health care clinical settings*. Retrieved from https://www.researchgate.

net/publication/347949539_Barriers_to_environmentally_sustainable_initiatives_in_oral_health_care_clinical_settings/citation/download

Maduekwe, E., & Vries, W. T. d. (2019). *Random Spatial and Systematic Random Sampling Approach to Development Survey Data: Evidence from Field Application in Malawi. Sustainability, 11*(6899), 1-27. doi:10.3390/su11246899

Manikandan, R., Athul, S., Rajesh, S., & T., Rajpradeesh. (2021). *Ergonomic evaluation of workers during manual material handling,* Materials Today: Proceedings, Volume 46, Part 17, 2021, Pg 7770-7776, Retrieved from https://www.sciencedirect.com/science/article/pii/S2214785321013821

Mufti, D., Ikhsan, A., & Putri, T.M. (2019). *Workplace Ergonomic Risk Assessment toward Small-Scale Household Business. Materials Science and Engineering, 528* (012013), 1-11. doi:10.1088/1757-899X/528/1/012013

National Institute of Occupational Safety and Health. (2020). *Diseases & Injuries. Cardiovascular Disease and Occupational Factors.* Retrieved from https://www.cdc.gov/niosh/index.htm

Njogu P.K. (2019). *Factors Affecting Occupational Safety and Health Performance in Public Dispensaries and Health Centers in Machakos County, Kenya,* Unpublished MSc thesis, Juja: JKUAT, Retrieved from https://www.researchgate.net/institution/Jomo_Kenyatta_University_of_Agriculture_and_Technology?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InByb2ZpbGUiLCJwYWdlIjoicHJvZmlsZSJ9fQ

Perttula, P., Deroiste, Broek, K. V. d., & Koskela, K. (2020). *In-house transport and handling*. Retrieved from http://oshwiki.eu/index.php?title=In-house_transport_and_handling&oldid=251971 " Category

Sivabalan, S., Karmegam, K., & Sivasankar. (2020). Ergonomic risk assessment on selected hot-work workers at company xxx. *Malaysian Journal of Public*

*Health Medicin*e, 20(Special1), 176-185. https://doi.org/10.37268/mjphm/vol.20/no.Special1/art.688

Tuhul, H. S., El-Hamouz, A., Hasan, A. R., & Jafar, H. A. (2021). Development of a Conceptual Framework for Occupational Safety and Health in Palestinian Manufacturing Industries. *Int J Environ Res Public Health, 18*(3), 1338. doi:10.3390/ijerph18031338

APPENDICES

Appendix I: Research Participation Consent Form

Francis Ayaga, P.O Box 30265, Nairobi, 00100, Princef254@gmail.com, +254726711821,
20th October 2022

Participant's Name……...Participant's Address……. …….

Dear,

RESEARCH CONSENT FORM

I am writing to request your participation in a research study titled **Ergonomic hazards and Associated Perceived Health Effects in Food and Beverage Industries in Nairobi County Kenya,** conducted by Francis Ayaga, a student at Jomo Kenyatta University of Agriculture and Technology. The purpose of this study is to assess ergonomic hazards, associated health effects and implemented control measures in the selected food and beverage industries in Nairobi County of Kenya.

Your participation in this study is entirely voluntary. Before you decide whether to participate, it is important that you understand the nature of the study, the procedures involved, and any potential risks or benefits. Please take the time to read this consent form carefully and feel free to ask any questions you may have before making your decision.

Study Procedures:

This study is a descriptive cross sectional which will involve sampling of participants to take part in one-on-one interviews, surveys or observations that will be conducted expected to run from October 2022 -Jan 2023.

Risks and Benefits:

There is no known risk associated with participating in this stud and your contribution to the research by answering the research questions is appreciated.

Confidentiality:

Participant confidentiality will be maintained, such as the use of coding of names, secure data storage, and limited access to the research data.

There shall be no any identifiable information used in the research findings or publications.

Voluntary Participation:

Your participation is entirely voluntary and that participants have the right to withdraw from the study at any time without penalty. Declining to participate or withdrawing from the study will not affect any current or future relationship with the research or the institution.

Contact Information:

Francis Ayaga, P.O Box 30265, Nairobi, 00100, Princef254@gmail.com, +254726711821.

By signing this consent form, you acknowledge that you have read and understood the information provided above. You also confirm that you have had the opportunity to ask questions and have received satisfactory answers. Your signature below indicates your voluntary agreement to participate in this research study.

Participant's Signature: _____ Date: _____

Research's Signature: _____ Date: _____

Please retain a copy of this consent form for your records.

Thank you for considering participation in this study. Your contribution is greatly appreciated.

Sincerely,

Francis Ayaga, Student Jomo Kenyatta University of Agriculture and Technology

Appendix II: Research Questionnaire

Instruction:
The information given will be treated with utmost confidentiality and is strictly for academic purposes only. Please note the survey is anonymous.
(Please DO NOT indicate your name anywhere on this questionnaire).
Tick the box on the right to give your consent to participate in the survey ☐

SECTION A: DEMOGRAPHICS.

About you: Please select the most appropriate answer by ticking (√) ONLY one box.

Question 1:

- Gender

a) Male □ b) Female □ C) Other (optional) □

Question 2:

- Years of experience with this organization.

a) 1-5years □ b) 6-10 years □ C) Above 11years □

Question 3:

- Your department in the organization?

a) Manufacturing □ b) Warehousing □ c) Office work □ d) Others Specify…….

Question 4:

- Highest level of education

a) Primary □

b) Secondary □

c) College level □

d) University □

e) Postgraduate □

Question 5:

- Age

a) Less than 18years □

b) 19-29years □

c) 30-49years □

d) Above 50years □

SECTION B: ERGONOMIC HAZARDS.

Question 6:

Please select the most appropriate answer by ticking (√) ONLY one box Infront of each statement. (Scale: 5-Strongly Agree; 4- Agree; 3- Neutral. 2- Disagaree: 1- Strongly Disagree).		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
#	Indicators of Ergonomics Hazards	5	4	3	2	1
A	Repetitive activities involving lifting, offloading, carrying, or pushing activities happen at work.					
B	Collision between workers and material handling equipment can happen in the workplace.					
C	Awkward posture involving bending, overreaching, or twisting movements is unsafe					
D	Working in same position or handle vibrating equipment is unsafe					
E	Performing work in very cold or hot work is unsafe.					
F	It is not safe to work with noisy or insufficiently guarded equipment					

Question 7:

Please indicate number of times you have experienced below practices occurring in the workplace. Tick (√) ONLY one box in front of each point. (Scale: 5- Atleast four times; 4- Three times; 3- Two times. 2-Once; 1- Zero)		Atleast four times	Three times	Two times	Once	Zero
#	Indicators of Ergonomics Hazards in Practice.	5	4	3	2	1
A	I have participated in repeated activities involving lifting, offloading, carrying, or pushing activities at work.					
B	Collision incident involving a vehicle and pedestrian has occurred in the workplace.					
C	I have performed tasks in awkward posture which involves bending, overreaching, or twisting movements.					
D	I work in same position or handle vibrating equipment is unsafe					

SECTON C: EVALUATION OF HEALTH EFFECTS

Question 8:

Please select the most appropriate answer by ticking (√) ONLY one box Infront each statement. (Scale: 5-Strongly Agree; 4- Agree; 3- Neutral. 2-Disagaree: 1- Strongly Disagree)		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
#	Indicators of Ergonomics Health Effects	5	4	3	2	1
A	It is necessary to report illness or injuries occurring at work.					
B	Pain on the back may result from long driving of Folklift use or carrying of load.					
C	Iam aware of my annual statutory medical examination results which have been done in the workplace.					
D	Lifting heavy materials with my hands may cause pain in the wrist, shoulder or back.					
E	Protective Equipment like Ear Plugs or Earmuffs can help reduce hazardous effects of noise like loss of hearing.					

Question 9:

Please indicate number of times you have encountered below effects in the workplace. Tick (√) ONLY one box in front of each point. (Scale: 5- Atleast four times; 4- Three times; 3- Two times; 2-Once; 1- Zero)		Atleast four times	Three times	Two times	Once	Zero
#	Indicators of Ergonomics Health Effect	5	4	3	2	1
A	I have reported illness or injuries occurring at work.					
B	Pain in the back from long driving of Folklift or truck.					
C	Pain occurred in body when working in awkward position such as twisting, bending, or overreaching.					
D	Pain has occurred in the wrist, shoulder or back from manual lifting of materials.					

SECTON D: IDENTIFICATION OF APPLIED CONTROL MEASURES

Question 10:

Please indicate your level of agreement with each statement by selecting the most appropriate answer and placing a tick (√) in the box provided. (Scale: 5-Strongly Agree; 4- Agree; 3- Neutral. 2-Disagaree: 1- Strongly Disagree)		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
#	Indicators of Applied Control Measures	5	4	3	2	1
A	Workers need to be trained and issued with instruction before given a new task.					
B	Proper arrangements and organization are always necessary to be maintained in the workplace.					
C	Material safety data sheets should be readily available to workers handling chemicals.					
D	There is need for management to set maximum weight of material load I am NOT allowed to carry.					
E	It is necessary to allow rest, breaks or rotation when performing repetitive tasks or working with hazardous chemicals.					
F	It is safe to maintain machines in good working conditions with safety guards in place.					

Question 11:

Please indicate number of times you have an experience with below practices. Tick (√) ONLY one box in front of each point. (Scale: 5-Atleast four times; 4- Three times; 3-Two times. 2-Once; 1- Zero)		At least four times	Three times	Two times	Once	Zero
#	Indicators of Applied Control Measures	5	4	3	2	1
A	I have been trained and issued with instruction before given a new task.					
B	Proper arrangements and organization are maintained in the workplace.					
C	Material safety data sheets made readily available when handling hazardous chemicals at work.					
D	Weight of material load carried wholly by worker exceeds set maximum at work.					
E	Rest, break, or rotation is allowed on doing loading, offloading tasks, or working with hazardous chemicals at work.					
F	Machines maintained in good working conditions with safety guards in the workplace.					

THANK YOU SO MUCH FOR YOUR PRECIOUS TIME

Appendix III: Facility Assessment Checklist

S/N	FALICITY CODE	ELEMENT ASSESSED	CHECKPOINT	RESULTS
		Machinery Safety features	Check if:	YES/NO
a		Machine guarding	Moving parts of machine is guarded?	
			There are any exposed parts of moving machines?	
b		Machine Operation	The task performed on the machine is automated?	
			The task performed on the machine are manually operated?	
			The task performed on the machine is partially automated?	
c		Training	The machine operator is inducted on machinery safety?	
			Machine operator is trained on how to operate the machine?	
			Trained operator running the machine is certified?	
d		Emergency stops	The machine has Emergency stop button?	
			Emergency stop buttons in place is in good working condition?	
			The emergency button is easily accessible?	
2		Internal Transport Routes	Confirm:	
a		Width	What is the measurement of narrow internal transport routes' width in metre?	
			What is the measurement of widest internal transport route in metre?	
			What is the measurement of width of the main internal transport routes?	
b		Demarcation	Are the routes marked?	
			Are the routes Labelled?	
c		Junction	Are the safe crossing points marked at intersections?	
			Are the junctions marked?	
d		Obstruction	Are materials placed on the internal transport routes?	
			Are material handling devices parked on the internal transport routes?	
e		Slip/Trip	Are there designated areas for staging materials? Is the route wet ?	
			Is the route even and smooth?	
			Is the route sloppy ?	

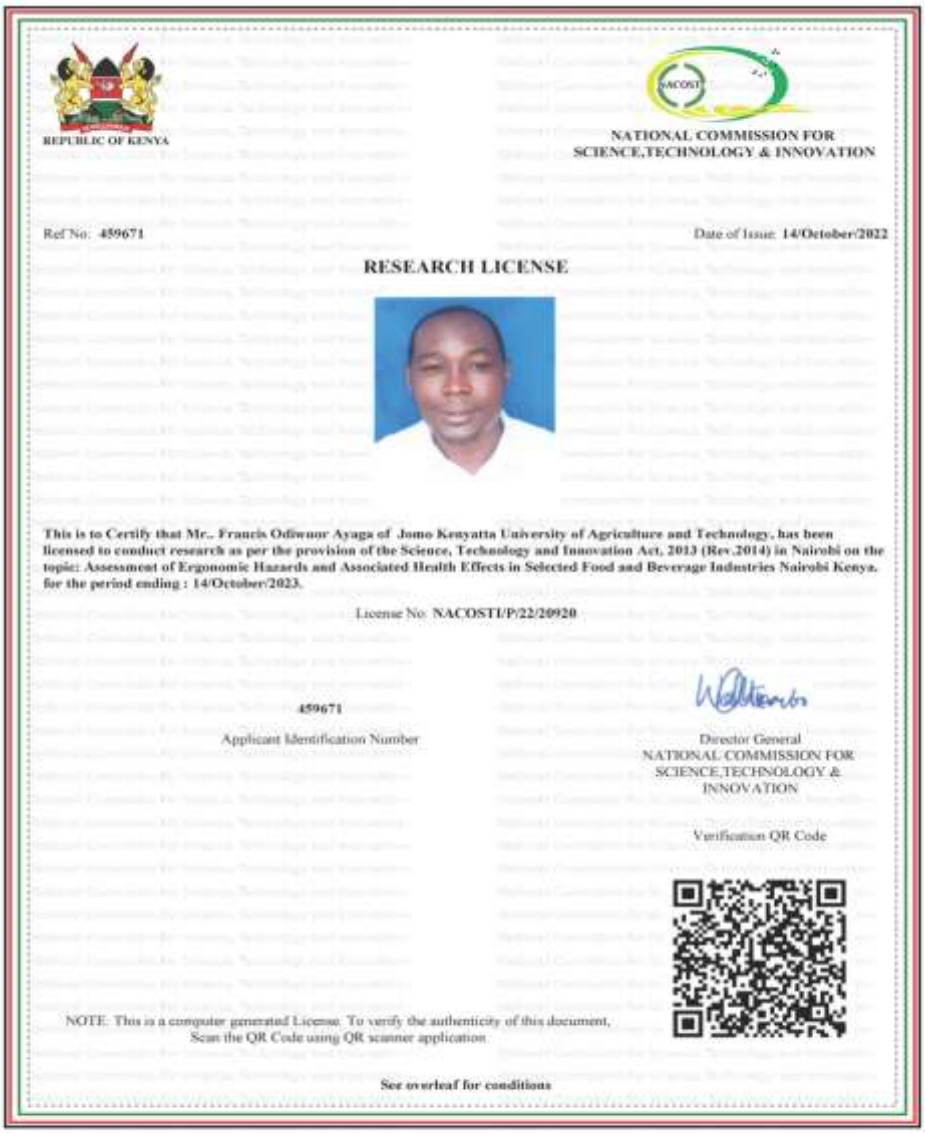
Appendix IV: Results of Internal Transport Routes

S/N	Facility Workstation Code	Width (m)	Marked and labelled (yes/no)	Junctions Marked (yes/no	Obstructed (yes/no)	Slopping or Uneven Surface (yes/no)
1	CDPH01	1.90	Yes	No	Yes	No
2	CDPH02	2.12	Yes	No	Yes	No
3	CDPH03	1.50	Yes	No	Yes	No
4	CDWH04	1.10	Yes	No	Yes	No
5	CDWH05	2.10	Yes	No	No	No
6	NKWH01	3.00	Yes	Yes	Yes	No
7	NKWH02	3.00	Yes	Yes	Yes	No
8	NKQA03	1.34	Yes	No	No	No
9	NKQA04	0.98	Yes	No	No	No
10	NKCN05	1.30	No	No	No	No
11	NKCN06	0.51	No	No	No	No
12	NKMP07		No	No	No	No
13	NKMP02		No	No	No	No
14	NKMP08	2.00	Yes	No	No	No
15	NKPH09	0.90	Yes	Yes	Yes	No
16	NKPS10	0.85	Yes	Yes	Yes	No
17	NKUP10	1.08	Yes	Yes	No	No
18	NKRD11		No	No	Yes	No
19	NKAL12		No	No	No	No
20	NKEN13	2.50	No	No	No	No
21	NKNN14	2.50	No	No	No	No
22	NKDC15	5.22	Yes	No	Yes	No
23	NKDC16	2.14	Yes	No	No	No
24	ULFG01	2.73	Yes	No	Yes	No
25	ULBP02		No	No	Yes	No
26	ULPM03		Yes	No	No	No
27	ULFW04		No	No	Yes	No
28	COMD01	2.85	Yes	No	No	No
29	COBP02	1.5	No	No	Yes	Yes
30	CORD03	3.2	Yes	No	Yes	No
31	COWH04	3	Yes	No	No	No
Aggregate		Average=2.1	Yes=20(64.5%)	Yes=5(16.1%)	Yes=15(48.4%)	Yes=1(3.2%)
			No=11(35.5%)	No=26(83.9%)	No=16(51.6%)	No=30(96.8%)

Appendix V: Results of Machinery Safety Assessment

S/N	Facility Workstation Code	Dangerous parts Guarded (yes/no)	Machine Automated (Yes/no)	Operator Trained (yes/no)	Emergency Stop in place (yes/no)
1	CDPH01	Yes	No	Yes	Yes
2	CDPH02	Yes	No	Yes	Yes
3	CDPH03	No	Yes	Yes	Yes
4	CDWH04	Yes	No	Yes	Yes
5	CDWH05	Yes	No	Yes	Yes
6	NKWH01	Yes	No	Yes	Yes
7	NKWH02	Yes	Yes	Yes	Yes
8	NKQA03	Yes	Yes	Yes	Yes
9	NKQA04	Yes	Yes	Yes	Yes
10	NKCN05	Yes	No	Yes	Yes
11	NKCN06	Yes	No	Yes	Yes
12	NKMP07	Yes	Yes	Yes	Yes
13	NKMP02	No	No	Yes	Yes
14	NKMP08		No	Yes	Yes
15	NKPH09	Yes	Yes	Yes	Yes
16	NKPS10	Yes			
17	NKUP10				
18	NKRD11	Yes	Yes	Yes	Yes
19	NKAL12	No	Yes	Yes	Yes
20	NKEN13	No	No	Yes	Yes
21	NKNN14	Yes	No	Yes	Yes
22	NKDC15	Yes	No	Yes	Yes
23	NKDC16	Yes	No	Yes	Yes
24	ULFG01	No	Yes	Yes	Yes
25	ULBP02	No	Yes	Yes	Yes
26	ULPM03	Yes	Yes	Yes	Yes
27	ULFW04	No	No	No	Yes
28	COMD01	Yes	Yes	Yes	Yes
29	COBP02	No	No	Yes	Yes
30	COWH04	Yes	No	Yes	Yes
31	CORD03	Yes	Yes	Yes	Yes
	Aggregate	Yes=20	Yes=13	Yes=28	Yes=29
		No=8	No=16	No=1	No=0
		Blank=3	Blank=2	Blank=2	Blank=2

Appendix VI: Research Permit



REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 459671

Date of Issue: 14/October/2022

RESEARCH LICENSE

This is to Certify that Mr.. Francis Odhiambo Ayaga of Jomo Kenyatta University of Agriculture and Technology, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: Assessment of Ergonomic Hazards and Associated Health Effects in Selected Food and Beverage Industries Nairobi Kenya. for the period ending : 14/October/2023.

License No: NACOSTI/P/22/20920

459671

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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See overleaf for conditions

Appendix VII: Nairobi County Approval Letter

10/14/2022

Francis Ayaga,
Jomo Kenyatta University of Agriculture & Technology,
PO Box 6200,00200,
Nairobi.
Tel: 0726711821.
Email: Princef254@mail.com.

GOVERNOR'S OFFICE
NAIROBI COUNTY
17 OCT 2022
RECEIVED

Office of County Director of Education,
PO Box 49416, 00100,
Nairobi County.

RE: **Notification of Commencement of Academic Research within Nairobi County - License No. NACOSTI/P/22/20920.**

Dear Sir/Madam,

I am a second-year student (Admission Number EET32-0315/2016) at Jomo Kenyatta University of Agriculture & Technology (JKUAT) and currently undertaking a Master of Science Degree in Occupational Health and Safety at JKUAT.

I hereby humbly write to notify your office of an academic study, titled **"Assessment of Ergonomics hazards and associated Health Effects in the selected Food and Beverages Industries within Nairobi County".** This study is scheduled to be carried out under the jurisdiction of your authority in compliance with the issued research permit as attached. It will run in the period starting **14th October 2022 to 14th October 2023.**

In this regard, please find attached a copy of the ***Approval Letter*** from JKUAT Board of Post Graduate Studies, and a copy of ***Research Permit*** granted by the National Commission of Science, Technology, and Innovation (NACOSTI).

Thank you in advance.

Yours faithfully

Francis Ayaga
ID No. 24310789

CC: Office of Nairobi County Commissioner,
CC: Office of County Governor

Appendix VIII: Safety Measures Communicated to Staff at Strategic Location

Appendix IX: Publication Abstract

Journal of Agriculture Science & Technology JAGST 23 (1) 2024, 1-11

Ergonomic Hazards in Nairobi's Food Industry

ORIGINAL RESEARCH ARTICLE

Assessment of ergonomics hazards and associated health effects in selected food and beverage industries Nairobi Kenya.

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[2]Department of Occupational Safety & Health, IEET, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya

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ABSTRACT

In the food and beverage industries, ergonomic risk factors, including awkward postures, excessive force, and repetitive tasks, have a significant impact on exacerbating work-related musculoskeletal disorders (MSDs). Repetitive tasks involving manual lifting or carrying are associated with work-related musculoskeletal disorders. This cross-sectional descriptive study aimed to profile ergonomic hazards, assess health effects among employees, and identify existing control measures implemented in the food and beverage industries in Nairobi County. The study was conducted among a population of 1821 workers in five selected facilities from October 2022 to January 2023. A systematic random sampling technique, following the Yamane (1967:886) statistical method as cited in Leon Mystica (2020), was employed to obtain a representative sample of 328 voluntary participants. Primary data was collected through self-administered structured questionnaires, observations, and taking measurements in the facilities. The study confirmed the literature's theory that most activities performed by employees in the sector are manual, repetitive, and physically demanding, primarily in the manufacturing (56.0%) and warehousing (24.0%) departments. The most prevalent factors contributing to ergonomic hazards and MSDs include excessive force exertion during manual handling, the adoption of awkward body postures, prolonged periods of static positions, and exposure to vibrations. The health effects of ergonomic hazards are further aggravated by the manual handling of heavy material loads and the mismatch between job requirements and employees' physical capabilities. The high occurrence of pain or discomfort among workers is significantly influenced by the poor posture they adopt when performing tasks. Despite a satisfactory combination of control measures implemented in the selected workplaces, their prioritization does not align with the risk control hierarchy described in existing literature. The majority of implemented control measures in the sector are administrative, and there is a lack of adherence and consistency in enforcing safety regulations regarding the maximum load limits for manual lifting.

Keywords: ergonomic hazards, hierarchy, musculoskeletal disorder, control measures, machinery safety,

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