ADDIS ABABA UNIVERSITY
COLLEGE OF TECHNOLOGY AND BUILT ENVIRONMENT
SCHOOL OF MECHANICAL AND INDUSTRIAL ENGINEERING

Investigating the Impact of Ergonomic Workplace Design on Employee Performance in the Healthcare Sector: A Case of Menelik II Referral Hospital

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Declaration

I hereby declare that this thesis, entitled “Investigating the Impact of Ergonomic Workplace Design on Employee Performance in the Healthcare Sector: A Case of Menelik II Referral Hospital,” is my original work and has not been submitted for any degree at another university. All sources and materials used in its preparation have been properly acknowledged.

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This is to certify that the above declaration made by the candidate is correct to the best of my knowledge.

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List of Abbreviations

AMOS	-	Analysis of Moment Structure
BOS	-	Burnout Syndrome
EHRs	-	Electronic Health Records
EMRs	-	Electronic Medical Records
ERF	-	Ergonomics Risk Factors
HFE	-	Human Factor and Ergonomic
HFMEA	-	Healthcare Failure Modes and Effects Analysis
HIT	-	Health Information Technology
HPC	-	High-Performance Cycle
ICU	-	Intensive Care Unit
JP	-	Job Performance
LBP	-	Low Back Pain
LBM	-	Lean Body Mass
NMQ	-	Nordic Musculoskeletal Questionnaire
NSEA	-	Nurse Station Ergonomics Assessment Tool
PE	-	Participatory Ergonomics
PPE	-	Personal Protective Equipment
RSIs	-	Repetitive Strain Injuries
SEIPS	-	Systems Engineering Initiative for Patient Safety
SPHM	-	Safe Patient Handling and Movement
SPSS	-	Statistical Package for Social Sciences
WMSD	-	Work related Musculoskeletal Disorder

Abstract

Poor ergonomic workplace design in healthcare settings can lead to significant challenges for employees, including health problems and decreased performance. At Menelik II Referral Hospital, healthcare employees face various work-related challenges related to the facility's ergonomic workplace design, which negatively impacts their health and job performance. This study aims to investigate the impact of ergonomic workplace design on the performance of healthcare employees and propose an improvement approach for the hospital. The study focuses on how ergonomic workplace design factors affect the physical and mental well-being of healthcare employee and, as a result, their overall performance. The study employed a mixed-methods approach, combining qualitative and quantitative data through well-structured and pre-tested surveys, interviews, and direct observations by using purposive sampling technique. This methodology allowed for a thorough assessment of the current ergonomic conditions and their effects on employees performance. SPSS version 24 was used for statistical, Pearson correlation and multiple linear regressions data analysis. The findings show a significant relationship between poor ergonomic workplace design and a higher incidence of musculoskeletal issues, increased mental load, and reduced work performance among healthcare employees. The statistical analysis found a significant positive relationship between all three ergonomic domains and employee performance. Physical ergonomics showed the strongest correlation ($r = 0.561$, $p < .001$), followed by cognitive ergonomics ($r = 0.442$, $p < .001$) and organizational ergonomics ($r = 0.436$, $p < .001$). Multiple regression analysis revealed that these factors collectively explained 56.3% of the variance in performance, with physical ergonomics being the strongest predictor ($\beta = 0.260$, $p < .001$). Based on these results, this study proposes an improvement framework with specific recommendations and strategies for enhancing ergonomic conditions at the hospital. Implementing these strategies is expected to improve employee well-being and performance, in the end, contributing to better patient outcomes. This study provides actionable recommendations for Menelik II Referral Hospital and contributes to the existing body of knowledge on ergonomics in healthcare.

Key word: - ergonomic, ergonomic workplace design, employee performance, healthcare employees

CHAPTER ONE

1. INTRODUCTION AND PROBLEM APPROCH

1.1 Introduction

Ergonomics, the science of designing things for people to use effectively and safely, is based on core principles that guide the design of workspaces, tools, and systems. The ultimate goal of these principles is to improve both human well-being and overall performance (Adiga, 2023). More specifically, it is the science of modifying and optimizing jobs, equipment, and the work environment to be consistent with human capabilities and limitations. The application of ergonomic principles involves considering the many factors that influence how people interact with their surroundings, which can range from a specific work tool to the overall physical layout of the workspace (Ali & Abdel-Hakeim, 2018).

The field of Human Factors and Ergonomics (HFE) examines the work system through several interconnected dimensions. Organizational ergonomics, for instance, analyzes how leadership, teamwork, and communication can either foster or inhibit effective work. Studies show that when leaders grant employees autonomy and involve them in decisions, it tends to improve engagement and performance (Chew et al., 2024; Abdollahpour et al., 2023). The physical and environmental aspects are also crucial. Physical ergonomics focuses on optimizing the workspace such as workstation design and equipment fit to reduce musculoskeletal strain. A well-designed physical environment, including proper lighting and moderate noise levels, not only minimizes fatigue but also conserves the mental energy essential for problem-solving and maintaining focus (Dul & Ceylan, 2011; Luximon et al., 2018; Citraresmi et al., 2025). Finally, cognitive ergonomics addresses the mental side of work. It encompasses the study of human cognitive processes such as attention, memory, perception, and decision-making as well as factors like mental workload and the usability of tools. This domain examines how these processes interact with tasks and the environment to influence performance and well-being (Kalakoski et al., 2020). The primary goal of cognitive ergonomics is to design tasks and

technology in a way that reduces unnecessary mental strain and complements how people naturally process information. When tasks are designed to match employees' mental capabilities and are supported by user-friendly technology, it prevents cognitive overload. This, in turn, frees up their mental energy to concentrate on critical activities like clinical decision-making and patient care (Carayon et al., 2021; Rech, 2024).

The application of ergonomics is particularly crucial within the healthcare sector. In this high-risk environment, proper ergonomic design is essential for protecting employees from the high rates of work-related musculoskeletal disorders (WMSDs) often caused by physically demanding tasks like patient handling (Robielos et al., 2019). Beyond physical safety, effective ergonomics directly enhances patient safety by minimizing the conditions that can lead to human error (Barboza & Carvalho, 2023). This systems-based perspective, which views performance as an outcome of the entire work system, is key to building strong and adaptable healthcare organizations (Carayon et al., 2021).

The healthcare sector, particularly in developing contexts like Ethiopia, presents a uniquely challenging work environment where professionals face demanding physical tasks, high cognitive loads, and difficult organizational structures (Chakrabortty et al., 2023; Ousman, 2022). In such a setting, the link between ergonomic design and employee performance becomes very clear. Suboptimal conditions can lead to a chain of negative outcomes, including a high prevalence of MSDs, heightened stress, and increased professional burnout, which ultimately results in a measurable decline in the efficiency and quality of care (Sönmez et al., 2025; Phoonjaroen et al., 2025; Hailu et al., 2025). These challenges are especially worse in busy public institutions, where a heavy patient load and potential resource constraints underscore the need for an optimally designed working environment to mitigate risks such as medical errors and compromised patient safety (Addis et al., 2023; Sultan et al., 2025).

While previous research in Ethiopia has highlighted specific ergonomic concerns (Fikre et al., 2024), a comprehensive investigation into the holistic impact of ergonomics on broader employee performance remained limited. A significant gap existed in understanding how physical, cognitive, and organizational factors interact to influence the productivity and well-

being of a diverse healthcare workforce within a major referral hospital. Therefore, this study aimed to address this gap by thoroughly investigating the impact of ergonomic workplace design on employee performance at Menelik II Referral Hospital. The research assessed the current workplace conditions, identified key ergonomic factors influencing performance across the physical, cognitive, and organizational domains, and developed a framework with evidence-based recommendations for improvement. The goal of this framework is to create a safer, more comfortable, and more efficient work environment that enhances both healthcare employee well-being and the quality of patient care.

1.2 Background and Justification of the study

According to Perry et al. (2021), healthcare is a fundamentally complex and adaptive system that depends on its human workforce. The natural inconsistency among these individuals in their skills, decisions, and states of well-being introduces a wide range of uncertainty that can limit the overall reliability of healthcare work.

Although Human Factors and Ergonomics (HFE) have been successfully used in other industries to reduce errors and improve reliability, its adoption within healthcare has been notably slow. There remains a significant shortage of HFE practitioners working within healthcare organizations, and consequently, the application of ergonomic principles to design better processes, tools, and work environments is still not widespread in the sector (Bitan & Sasangohar, 2022).

The work environment is a significant risk factor for developing low back pain (LBP). Nurses in the Intensive Care Unit (ICU) are especially at risk due to the physically demanding nature of their duties, such as handling and transferring patients (Tefera et al., 2021). Supporting this, a study by Mazni et al. (2025) found that frequently lifting patients is strongly linked to LBP. Furthermore, a study on nurses in Nigeria identified other major contributors, including regular bending and twisting, maintaining awkward body positions, long periods of standing, and heavy workloads (Ijabadeniyi & Fasae, 2023).

In many developing countries, nurses often lack access to patient-lifting equipment that makes moving patients difficult and challenging (Kasa et al., 2020). As a result, studies show that nurses are six times more likely to suffer back injuries than other healthcare professionals. This high rate of low back pain (LBP) leads to serious organizational problems, including increased absenteeism and a significant financial burden from workplace injuries (Dlungwane et al., 2018). According to Mazni et al. (2025), when a nurse is unable to work, the workload on their coworkers increases, which negatively impacts team performance. To address this issue, the study recommends that hospitals implement preventive strategies such as providing ergonomics training, improving workplace design, and offering physical activity programs for nurses.

In the high-risk healthcare environment, mental fatigue and information overload can have severe consequences, making cognitive ergonomics a critical area of focus. The design of the medical environment is a significant factor in human error, particularly concerning the integration of Health Information Technology (HIT) like Electronic Health Records (EHRs). While HIT is essential for quality care, its effectiveness is often compromised when human factors are not considered, as a mismatch between the user and the technology is a primary cause of medical errors (Rodríguez & Hignett, 2021). Poorly designed interfaces can increase cognitive load and lead to clinician burnout, directly impacting performance (Li et al., 2024). Furthermore, other cognitive stressors such as role overload and a lack of effective ergonomic training can also degrade employees skills, reduce productivity, and lower job satisfaction (Sun & Han, 2021; Nazir & Amin Beig, 2022, as cited in Karmacharya et al., 2025).

Therefore, an "operator centered" design approach is crucial. By designing systems and tasks that align with the actual workflows and cognitive capabilities of medical employees, organizations can reduce cognitive load, optimize decision-making, and ultimately build a safer, more effective, and higher-performing healthcare system (Rodríguez & Hignett, 2021; Karmacharya et al., 2025). This focus on cognitive well-being is essential because mental health directly impacts the quality and safety of work decisions. Poorly designed systems that increase stress and mental fatigue are a direct threat to employee health and outcomes (Silva et al., 2024).

While applying ergonomic principles can enhance healthcare employee well-being and, in turn, improve patient care and organizational outcomes, a significant gap remains between knowledge and practice, as many healthcare employees still fail to utilize these principles in their daily work (Chakrabortty et al., 2023).

In many developing countries, healthcare systems face significant challenges that negatively impact performance and safety. In a literature review on implementing ergonomics in these settings, Khan et al. (2020) identified a widespread lack of efficient healthcare service delivery, affecting the performance, safety, and quality of care. The authors found that a complex network of factors, including cultural standards, economic constraints, education levels, and health system policies determines the performance of healthcare employees. Furthermore, they noted that the safety of these workers is often compromised by a high risk of musculoskeletal disorders (MSDs). Based on their review of 39 articles, the study concluded that in the developing countries, a primary strategy for reducing these risks and improving the overall healthcare system is to focus on enhancing the workplace environment.

According to Carayon et al. (2021), who cite the International Ergonomics Association, the discipline of HFE analyzes the interplay between people and their work across three primary domains: physical (e.g., workload and workspace design), cognitive (e.g., technology usability and mental load), and organizational (e.g., teamwork and workflow). All three areas are particularly relevant in healthcare, where challenges include the physical strain of patient mobility, the cognitive demands of managing health information technologies, and organizational breakdowns in care coordination. Given this complexity, Carayon et al. (2021) argue that these factors are deeply interconnected and that a holistic systems approach is essential for HFE solutions to improve outcomes for both healthcare employees and patients. This approach emphasizes that focusing on isolated, micro-level problems is unlikely to succeed without a thorough consideration of the broader, macro-level work system.

Therefore, considering the influence of ergonomic workplace design on the performance of healthcare employees at Menelik II Referral Hospital is crucial for improving their performance

and ensuring quality patient care outcomes. Ergonomic design can reduce musculoskeletal injuries, improve job satisfaction, decrease worker absenteeism, and boost productivity.

1.3 Problem statement

A poorly designed ergonomic work environment is a significant obstacle to organizational performance, creating negative physical and psychological outcomes. Different environmental factors, such as inadequate lighting, excessive noise, and poor seating, prevent employees from concentrating and are a leading cause of musculoskeletal disorders (MSDs), which result in injury, disability, and absence, particularly in developing countries (Makhbul et al., 2022; Khan et al., 2020). These physical burdens, especially when combined with high job demands, also contribute to increased psychological strain. Work overload can exhaust an employee's capacity to manage their job's demands, which is a direct cause of emotional exhaustion and higher rates of absenteeism (Maslach & Leiter 2008, as cited in Palenzuela et al., 2019; Selamat et al., 2021). Ultimately, this combination of physical discomfort and mental stress has a clear and detrimental impact on productivity, a conclusion confirmed by Saleh (2025), who found that employees dissatisfied with their physical environment are clearly less productive.

Similarly, in Ethiopia, Menelik II Referral Hospital, which is one of the oldest and largest government hospitals in the country, faces several challenges related to the impact of ergonomic workplace design on employee performance and well-being.

During observations, it was noted that doctors are often forced into poor, unsupported postures due to non-adjustable chairs. These specific physical hazards are a direct cause of the high prevalence of work-related musculoskeletal disorders (WMSDs), leading to pain, injury, and decreased productivity.

Beyond these physical issues, healthcare professionals report experiencing a cognitive load and stress due to poorly designed software interfaces and frequent interruptions. This mental strain is a critical factor that can lead to burnout and an increased risk of medical errors. Additionally, these challenges are further complicated by an organizational environment that appears to lack a

formal ergonomics policy and consistent training, which delays the creation of a safer work culture.

Therefore, this study was designed to investigate the impact of ergonomic workplace design on healthcare employee performance and to propose an improvement approach at Menelik II Referral Hospital. By examining the interactions between employees and their work system, this research provides essential understandings for enhancing both employee well-being and the quality of patient care, which are critical for success in today's rapidly changing healthcare industry.

1.4 Research question

The study research questions are:

- What is the current ergonomic workplace design for healthcare employees at Menelik II Referral Hospital?
- What are the ergonomic workplace design factors that affect the performance of healthcare employees in the hospital, concerning the physical, cognitive, and organizational ergonomic domains?
- How to develop an improvement method for ergonomic workplace design to enhance healthcare employees' performance?

1.5 Objective

1.5.1 General objective

The general objective of this study is to investigate the impact of ergonomic workplace design on healthcare employee performance and improve ergonomic workplace design to enhance employee performance.

1.5.2 Specific objective

The specific objective of this study

- To assess the current ergonomic workplace design for healthcare employees at Menelik II Referral Hospital.
- To identify the ergonomic workplace design factors that impact the performance of healthcare employees in the hospital, considering the physical, cognitive, and organizational ergonomic domains.
- To develop a method for improving ergonomic workplace design to enhance the performance of healthcare employees in the hospital.

1.6 Scope of the study

This study focused on investigating the influence of ergonomic workplace design on the healthcare employee performance at Menelik II Referral Hospital, and on proposing a method for ergonomic design improvement aimed at enhancing employee performance. Specifically, the study assessed the existing ergonomic conditions in the workplaces used by healthcare employees at this hospital. The participants were healthcare employees who had gained at least five months of work experience at the hospital. The study identified ergonomic workplace design factors, encompassing the physical, cognitive, and organizational domains that impacted the performance of these employees.

The study was limited to the healthcare setting at Menelik II Referral Hospital. Therefore, its findings and the proposed method are context-specific. Applying them to other healthcare facilities or industries would require further review and adjustment. Additionally, the study did not include to the detailed design of specific ergonomic materials, equipment, or workplace layouts.

1.7 Limitation of the study

During the data collection process, several challenges were faced. First, the data collection process took longer than planned due to the heavy workloads of the healthcare professionals, which caused delays in the return of completed questionnaires. To overcome this challenge and ensure a sufficient response rate, consistent follow-up was required. This involved making

repeated phone calls to remind participants and scheduling in-person visits at a mutually agreeable time to facilitate the completion and collection of the surveys.

Second, during the observation period, ongoing renovations in the same areas of the hospital, including the main surgical ward and medical ward, limited what could be observed. This meant that certain tasks or workflows could not be observed. To mitigate this limitation, the researcher conducted multiple, focused observation periods in all other accessible areas, allowing for the careful documentation of specific ergonomic issues that could still be seen.

Finally, Hospital data on healthcare employee absenteeism caused by workplace discomfort was hard to find. This problem was addressed by including a specific question on this topic in questionnaires.

1.8 Significance of the study

This study is important as it provides valuable understandings of the effect of ergonomic design on the performance of healthcare employees at Menelik II R eferral Hospital. The findings and proposed improvement approach can significantly improve employee well-being, productivity, and overall performance within the hospital. Furthermore, these outcomes can contribute to advancing ergonomic design practices in healthcare settings, ultimately promoting healthier and more efficient work environments for professionals. The research also provides helpful suggestions for hospital administrators, and researchers seeking to create more supportive, and worker-friendly work environments. Additionally, it provides a research database for future studies on ergonomics in developing nations.

1.9 Organization of the study

This study is organized into six chapters. Chapter One provides an introduction, background, and problem justification for the study. Chapter Two reviews the relevant literature and previous works. Chapter Three focuses on the research design and methodology employed. In Chapter Four, data collected from Menelik II Referral Hospital are presented and subsequently analyzed. Chapter Five presents the results obtained from the data analysis and details the improvement

approach developed based on these findings. Lastly, Chapter Six provides the conclusions and recommendations of the study, based on the improvement approach presented in Chapter Five.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Introduction

This literature survey tries to explore the definitions of ergonomics, ergonomic design, and employee performance, an overview of ergonomic design in healthcare settings, previous studies on the impact of ergonomic design on employee performance, and relevant theories and concepts related to workplace ergonomics, and find out the gaps that were found in the previous studies.

2.2 Definition of ergonomics and related concept

Different scholars define ergonomics in different way.

Ergonomics is the science of designing and integrating all aspects of the work system including tools, machines, and the organizational environment to align with human capabilities and limitations to create healthy, safe, comfortable, and efficient working conditions that maximize productivity (Panjaitan et al., 2020).The basic philosophy of ergonomics is to make any design comfortable (Esmaeel et al., 2022). According to Agrawal et al. (2025) as cited in Karmacharya et al. (2025), ergonomics is the science of designing workplaces to fit the needs of employees. It involves more than just comfortable chairs, encompassing four dimensions: physical, cognitive, environmental, and organizational. Together, these dimensions create a holistic work environment that optimizes employee well-being and performance.

Ergonomic design is the process of designing things like tools, equipment, and workspaces to fit the needs and abilities of the user. The main goal is to increase comfort, lessen fatigue, and lower the risk of injuries like musculoskeletal disorders. It involves considering factors such as anthropometric measurements, physical strength, and personal characteristics to ensure the design is in harmony with the user and adaptable to their environment (Silviana et al., 2022).

Physical ergonomics factor focuses on human bodies engaged in physical activities (Smith, 2017, as cited in Arthur et al., 2024).

The cognitive ergonomics factor focuses on how the mental aspects of work influence creative potential (Dewantari & Herlina, 2022).

Organizational ergonomics depends on the internal systems of an organization, such as how employees share resources, work together, and communicate (Koirala & Nepal, 2022).

The concept of integrating human factors into job design in the workplace involves considering various elements. These include physical factors, cognitive factors related to work stress and workload, as well as interactions between humans and machines. Additionally, ergonomic considerations encompass organizational factors, which focus on teamwork, and communication (Arthur et al., 2024).

According to Latham (2023) employee performance defines as the intersection of individual attributes such as skills, knowledge, and motivation, combined with how well they fit into the organization's culture. An employee's success is not determined by their personal abilities alone; even a skilled individual will falter without motivation, and a driven employee will struggle without adequate support.

Ergonomics Risk Factors (ERF) is conditions in a workplace that do not properly fit the worker, putting their health and well-being at risk both during and after their employment (Jaffar et al., 2011).

Anthropometry is the science that measures the dimensions, weight, and proportions of the human body (Taha et al., 2009). Size, structure, and composition are the three categories used to categorize anthropometry data. Height, length, mass, volume, and surface area are all included in the size measures. The measurements for the structure include height while sitting and standing, neck circumference and length, leg length, thigh length, shoulder width, and hip width. The percentage of body fat, lean body mass (LBM), water content, and ash content are all included in the composition measurement (Man, 2013, as cited in Fitsum, 2019).

Therefore, addressing ergonomic risk factors is crucial for preventing workplace injuries and musculoskeletal disorders, thereby promoting employee well-being and reducing absenteeism.

Applying anthropometric data to design and adjust workspaces is a practice that directly enhances employee productivity.

According to Prall and Ross (2019) explain that Musculoskeletal Disorders (MSDs) are injuries or damage to the parts of the body that control movement, such as bones, muscles, joints, and nerves. These injuries can interfere with the body's ability to function properly. When these disorders are caused by job tasks especially repetitive motions like lifting, twisting, or bending they are known as Work-Related Musculoskeletal Disorders (WMSDs).

Work stress refers to the adverse mental, emotional, and physiological state employees experience when faced with difficult work situations beyond their control (Makhbu et al., 2013).

Burnout is a psychological syndrome characterized by emotional exhaustion, depersonalization (a feeling of detachment from one's job), and a feeling a lack of personal accomplishment, and it's a common problem for people in jobs that involve helping others (Montero-Marín & García-Campayo, 2010; Fajardo-Lazo et al., 2021).

Those healthy problem conditions are caused by an uncomfortable workplace design so, ergonomic design in the workplace has a crucial advantage to keep the worker healthy and to boost the overall efficiency of the organization.

According to ergonomics manual (MacLeod (2000) lists ten basic ergonomic principles. These are

Working in neutral postures; means that maintaining the muscle joints in an equally balanced manner, **Reduce Excessive Force**; Excessive force can cause worker injuries by overloading the muscles and causing tiredness. This can be reduced by using tools, machines, and mechanisms, **Keep Things in Easy Reach;** Keeping the objects close when we use them regularly and distance if not utilized constantly, **Work at Proper Heights;** Working at an improper height can cause discomfort, muscle fatigue, soft tissue damage, and the use of unnecessary force, reducing the ability to accomplish the job, **Reduce Excessive Motions;** Repetitive motions can create physical wear and tear, as well as inefficient work. Using tools instead of hands can reduce movement, **Minimize Fatigue and Static Load;** one of the most prevalent causes of fatigue is

static load, which occurs when something is held in one position without moving for a set period of time. Resting arms, hands, and feet can reduce fatigue, **Provide Clearance;** providing sufficient clearance in the workplace and simple access to the objects can decrease accidents in the body, **Move, exercise and stretch;** Workplaces should encourage movement, exercise, and aerobic activities, and **Maintain a comfortable environment;** to accomplish successful job, persons need set themselves in a comfortable environment by Providing appropriate light, eliminate or minimize vibration, work on medium temperature and avoiding extreme noise.

So, implementing ergonomic principles into healthcare environments provides various benefits for overall efficiency in healthcare service delivery.

2.3 Ergonomic workplace design setup in healthcare

Ergonomics is essential in healthcare to protect the health and safety of both employees and patients. Applying ergonomic principles to patient handling, surgical tools, and workstation design improves care quality while preventing injuries for everyone involved. In a physically and emotionally challenging field like healthcare, using ergonomics shows an organization's commitment to the safety and comfort of its employees and patients (Adiga, 2023). Furthermore, the practice of designing systems, equipment, tools, and the environment to fit human capabilities is crucial for ensuring the safety of both patients and healthcare professionals (Larsen, 2018).

The healthcare industry, at its core, is about people, involving complex interactions between a wide range of workers, patients, and their families. Because of this human complexity, the field of Human Factors and Ergonomics (HFE) offers crucial tools to enhance the performance, quality, and safety of the entire healthcare system. This is valuable because it allows for an understanding of the work process systemically, considering the viewpoints of everyone involved, such as clinicians, patients, and caregivers, as well as the different types of challenges they face, including physical, cognitive, and organizational factors (Carayon et al., 2021).

The principles of HFE are essential for improving the well-being of clinicians. It contributes by addressing concrete problems, like making electronic health records (EHRs) easier to use, and

by solving larger organizational issues, such as managing workloads, creating better schedules, and improving teamwork. Human Factors and Ergonomics (HFE) plays a critical role in ensuring that as advanced technologies are integrated into healthcare, they are safe for patients and user-friendly for medical employees (Carayon et al., 2021).

Ergonomics and design are closely interconnected, with ergonomic principles playing a crucial role in both the design process and its practical application (Mukhopadhyay, 2022). The primary goal of ergonomic design is to balance the physical and mental effort a task requires, thereby preventing employee fatigue and stress. When a job causes physical overload, it can lead to muscle strain and exhaustion. Similarly, mentally challenging tasks can cause mental fatigue, which reduces focus and increases the likelihood of errors (Adiga, 2023).

Ergonomic design setup in healthcare is important for the safety and well-being of healthcare workers and patients. Studies have shown that ergonomics can have a positive impact on healthcare professionals and patient safety in hospital settings (Islam et al., 2023).

The field of Human Factors and Ergonomics (HFE) has the potential to significantly improve healthcare safety. By using its systems-based concepts and methods, HFE can enhance the complex work environment of healthcare professionals, which in turn improves care processes and outcomes for everyone involved, including patients and staff (Carayon et al., 2021).

According to Rodríguez and Hignett (2021), integrating Human Factors and Ergonomics (HFE) throughout the entire healthcare system is essential to enhance its robustness and resilience. Their model advocates for applying HFE principles simultaneously at all levels: the micro-level (individual clinicians and tools), the meso-level (departments and teams), and the macro-level (the entire organization). By recognizing the deep connections between HFE and other key system properties like capacity and coverage, their model provides a holistic framework for designing safer and more effective healthcare services.

Ensuring the health and safety of healthcare workers is a critical priority. Addressing burnout is not just about supporting individual well-being; it is a key strategy for improving job

satisfaction, promoting employee stability, and ensuring the continued safe and efficient functioning of the entire healthcare system (Elkefi et al., 2025).

A lack of knowledge and application of ergonomic principles in the workplace is a significant factor contributing to the high prevalence of (WMSDs). In contrast, enhancing nurses' knowledge in the ergonomic field has been shown to lead to numerous benefits, including lower medical expenses, increased efficiency, and reduced absenteeism. Furthermore, it can decrease the direct costs associated with WMSDs and provide significant economic advantages (Soroush et al., 2018).

Another significant way to reduce musculoskeletal problems among nurses is to create a regular and comprehensive training program. This program should focus on increasing their knowledge of ergonomic principles, teaching them proper working methods, and showing them how to correctly use therapeutic equipment. Furthermore, it should provide training on stress management and help create a safer, more ergonomic work environment overall (Mohammad et al., 2019).

According to Kogi et al. (2019) discussed ergonomic checkpoints have been developed specifically for healthcare work, covering areas such as materials handling, machine safety, workstations, and work organization. Table 2.1 shows these practical and basic ergonomic principles incorporated in the typical low-cost actions of the compiled checkpoints.

Table 2.1: Ten technical areas identified for ergonomic checkpoints in health care work (source from (Kogi et al., 2019)

Technical area	**Basic ergonomic principles**	**Examples of the impact**
A. Materials Handling	Organized storage, easy transport	Less physical demands
B. Machine-tool Safety	Guarding, safe equipment/wiring	Reduced accident risks
C. People transfer	Proper transfer procedures	Reassured safe procedures
D. Workstations	Natural posture, efficient operations	Efficient work with less load
E. Physical Environment	Good climate, isolating hazard Sources	Comfortable, barrier-free Space
F. Hazardous agents	Proper isolation/shielding, labels	Reduced contacts with

		Hazards
G. Infection control	Safe procedures, specific protection	Reduced risks of infection
H. Welfare facilities	Sanitary/resting facilities, Recreation	Refreshing effects and Relations
I. Preparedness	Emergency/anti-harassment Planning	Shared emergency/violence Steps
J. Work organization	Better Communication, restful schedules	Shared plans for better Teamwork

These checkpoints have been found to be useful in improving healthcare workplaces, with a focus on locally feasible improvements and action-oriented tools. Overall, the integration of ergonomic design principles in healthcare settings can contribute to the well-being of healthcare workers and the safety of patients (Aydemir & Yaşar, 2016).

Therefore, ergonomic design in healthcare aims to create a supportive and adaptive workplace that improves the health and productivity of both healthcare professionals and patients.

Ergonomics in Ethiopian healthcare

Research on ergonomics within the broader Ethiopian context reveals a significant gap between the recognized importance of ergonomic principles and their practical implementation. A study by Tafese et al. (2018), for instance, found that while over half of participants were aware of ergonomics, less than half actually applied these principles. This suggests that even when awareness is raised, a lack of deep understanding or organizational support often hinders widespread adoption (Fitsum, 2019). The consequences of this oversight, while not always immediate, can lead to severe long-term impacts, including higher rates of illness, injury, and employees struggling with their work responsibilities.

Within Ethiopian healthcare specifically, the most widely reported impact of poor ergonomics is the high prevalence of Work-Related Musculoskeletal Disorders (WMSDs). Multiple studies from different regions and professional groups consistently report notably high rates of WMSDs, ranging from 59% to over 76% (Nemera et al., 2024; Tefera et al., 2021; Ahmed, 2023; Fikre et al., 2024). These studies collectively identify a common set of risk factors characteristic of the

local context: frequent manual patient handling, a lack of assistive devices, prolonged static postures, and insufficient injury prevention training.

Beyond the physical burden, increasingly, research also points to the significant psychological strain on Ethiopian healthcare workers. Systematic reviews and large-scale studies have found high rates of occupational stress and burnout, affecting more than a third to over half of all health professionals (Mengist et al., 2021; Godifay et al., 2018; Hailu et al., 2025). These studies link burnout to a combination of high workload, organizational issues like a lack of rewards, and poor balance between professional and personal life. The literature strongly suggests that interventions must therefore address not only physical risks but also these critical psychosocial factors to improve the overall professional quality of life (Habtu et al., 2025).

Therefore, the literature shows that while a gap between ergonomic knowledge and practice exists across various sectors in Ethiopia, this problem is especially critical in healthcare. The research consistently reveals notably high rates of both physical harm (in the form of WMSDs) and psychological strain (in the form of stress and burnout) among healthcare workers. This is caused by a combination of poor physical work design, demanding tasks, and significant organizational weaknesses.

2.4 The impact of ergonomic workplace design on employee performance

Ergonomics plays a crucial role in the physical and mental well-being of employees, which has a clear effect on their productivity, the quality of their output, and their satisfaction at work. Workplaces with poor ergonomics often cause employees to suffer from fatigue, stress, and physical discomfort, which contribute to higher rates of absenteeism and turnover, as well as decreased performance. On the other hand, ergonomic changes such as providing adjustable workstations, appropriate tools, and proper lighting improve employee comfort, lower the risk of injury, and help them stay energized throughout the day. Using ergonomic solutions is essential for enabling employees to achieve the best performance without harming their health. As a result, organizations can enhance individual performance, improve overall productivity, and create a positive culture that treats employee well-being as a cornerstone of success (Ebito & Umana, 2019).

Employees are fundamental to every industry, and ergonomics significantly impacts their productivity, which in turn affects organizational productivity (Kuriakose et al., 2020; Bhatia & Arora, 2021). Furthermore, a study by Dalahmeh et al. (2018) emphasizes that how an organization manages its human resources is a critical task in strategic management. The human element whether as labor, talent, or skill, is essential for achieving strategic goals and gaining a competitive edge. Ultimately, their research confirms that employee behavior and development have a significant impact on overall organizational performance. Moreover, Employee performance has a direct and crucial impact on an organization's ability to achieve its goals (Sabir et al., 2019).

According to Latham (2023) performance is the result of both personal capability and the work environment itself. Factors like leadership, culture, and access to resources are critical. Optimal performance is achieved when the organizational environment meets the needs of the employee, creating a beneficial outcome for both the individual and the organization. A study by Yáñez-Araque et al. (2021) found that the quality of leadership, the organization's commitment to its employees, and the overall work environment directly influenced job performance.

Studies have shown that office ergonomics, such as the physical characteristics of the workplace, can minimize discomfort and improve employee performance (Bajaj et al., 2022). Ergonomic furniture, including tables and chairs, designed to provide comfort and minimize musculoskeletal disorders, can increase employee concentration and productivity (Silviana et al., 2022). Implementing effective ergonomic programs aligned with the organization's business strategy can improve overall performance by addressing factors such as workstation design, lighting conditions, and noise and vibration levels (Koirala & Nepal, 2022). Additionally, incorporating psychological and cognitive aspects of human beings through ergonomics or human factor engineering can enhance workplace performance (Roopnarain et al., 2019). Overall, considering ergonomic design factors in the workplace can lead to improved employee performance and well-being (Singh & Farooq, 2021).

A wide range of workplace factors can influence employee productivity and commitment, including organizational culture, structure, workflows, physical design of the workspace, desk

and equipment heights, sitting posture, lighting, and temperature. Addressing these elements through ergonomic practices enables employees to perform their jobs more effectively, which in turn enhances overall organizational performance and profitability (Akinbola & Popoola, 2019, as cited in Koirala & Nepal, 2022). This perspective is strongly supported by a study by Deshpande (2023), which found that a majority of respondents (88%) reported that their work was influenced by ergonomic factors like their physical environment and equipment. Furthermore, these respondents believed that ergonomic improvements designed to enhance their comfort could lead to increased productivity and job satisfaction.

Physical ergonomics, cognitive ergonomics, and organizational ergonomics significantly influence employee performance. Therefore, assessing and improving workplace ergonomics is a critical strategy that can increase employee performance and productivity while also decreasing burnout, absenteeism, and turnover rates (Koirala & Nepal, 2022).

Therefore, ergonomic workplace design enhances employee performance primarily by improving physical and mental well-being. Providing ergonomic training and an optimized work environment reduces discomfort and stress, which in turn boosts productivity, improves focus, and lowers error rates. This indicates that an organization's investment in ergonomics directly leads to a healthier, more effective workforce and better overall performance outcomes.

2.5 Ergonomic workplace design factors affecting employee performance

The discipline of ergonomics includes three main domains: physical, cognitive, and organizational (see Figure 2.1). Physical ergonomics addresses how the physical demands of a job, including posture, manual handling, repetitive movements, and workspace design, impact a worker's body. Cognitive ergonomics is concerned with mental processes, including workload, work-related stress, training, human–computer interaction, skilled performance, and decision-making. Organizational ergonomics focuses on optimizing the overall work system, which includes communication, teamwork, scheduling, participatory design, and distributed work policies, to create a more efficient and supportive system (IEA, 2000, as cited in Mackey, 2024).

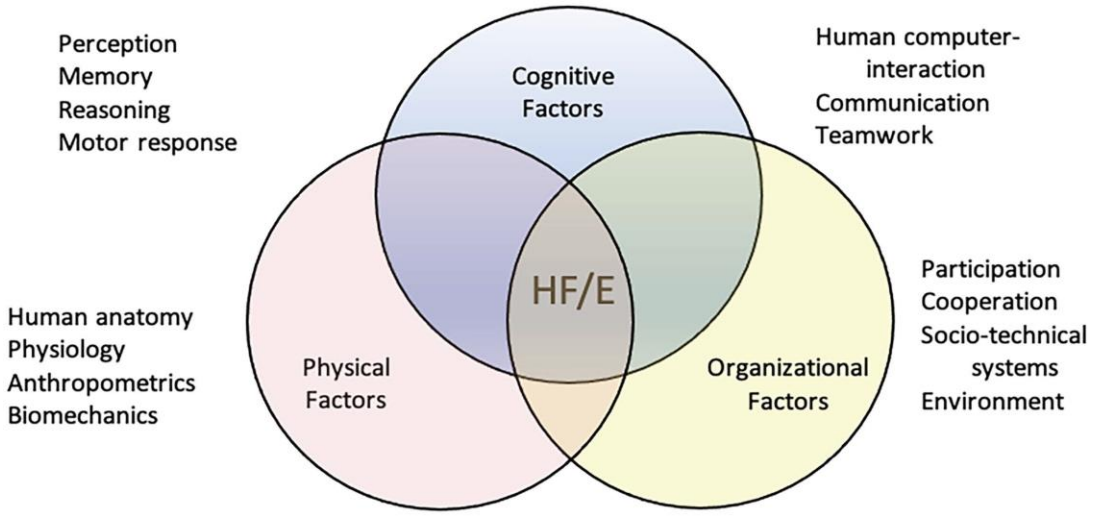

Figure 2.1: Ergonomics domains Source (Mackey, 2024)

Ergonomic design factors play a crucial role in influencing employee performance in healthcare settings. Those factors are:

2.5.1 Physical ergonomic factors

Physical ergonomic factors in healthcare settings are essential for ensuring the well-being of healthcare workers. The concept aims to align internal and external factors to match the human body's capacity for performing assigned tasks (Smith, 2017, as cited in Arthur et al., 2024). According to Keebler et al. (2022), physical ergonomics is a critical part of healthcare that focuses on designing the work to fit the physical and mental capabilities of the staff. It also considers the complex ways that people, tools, and processes interact within the healthcare organization.

Designing a workspace with ergonomic principles is key to creating a healthy and productive environment. By focusing on details such as proper posture, organized workspaces, ergonomic seating, and proper lighting, organizations can help employees work efficiently while minimizing the risk of physical discomfort and injury. A well-designed workspace shows an organization’s commitment to its employees, which helps improve job satisfaction, boost productivity, and support the organization's overall success (Adiga, 2023).

Anthropometry is the practice of measuring human body sizes and proportions. This data is essential for designing workspaces, tools, and equipment that match the physical characteristics of employees. For example, adjusting desk heights, chair sizes, and monitor positions based on this data helps prevent physical stress and improves overall comfort (Helander et al., 1997, as cited in Adiga, 2023)

Occupational risks in public hospitals arise from physical environmental factors such as noise, illumination, and temperature. These elements can significantly impact the risks experienced by healthcare workers, with noise levels and temperature showing a strong positive relationship with these risks. In contrast, poor illumination levels have a moderate to strong negative relationship with occupational risks, indicating the importance of adequate lighting in healthcare facilities (Gumasing et al., 2020). Consequently, Proper lighting level is essential for preventing visual discomfort, such as headaches and eye strain, and it also plays a considerable role in determining product quality across various industries (Idkhan & Baharuddin, 2019). Ensuring optimal temperatures and humidity levels is crucial for preventing discomfort, fatigue, and heat-related illnesses, which can negatively affect safety and productivity (Sun & Han, 2021). Moreover, noise is an important factor that affects employee productivity. Improper noise levels can impact both the comfort and performance of the employee and excessively high levels of noise can seriously affect health. Although noise is an unavoidable part of a workspace, studies have shown that reducing noise or acoustic disturbance can enhance productivity and minimize errors (Kuriakose et al., 2020).

Additionally, the implementation of human factors and ergonomics principles in healthcare practices is continuously growing, emphasizing the relevance and application of ergonomics science in improving healthcare environments (Bitan & Sasangohar, 2022). Investing in physical ergonomics enhances workplace comfort and health, boosts performance, lowers injury-related expenses and absenteeism, and ultimately improves organizational profitability, benefiting both employers and employees (Karmacharya et al., 2025).

Kuriakose et al. (2020) developed a conceptual model that includes six environmental factors: heat, noise, lighting, odor, smoke, and cleanliness. The model examines how each of these

factors impacts human responses, specifically comfort, performance, and health, and how these responses influence overall productivity. The figure below shows this relationship.

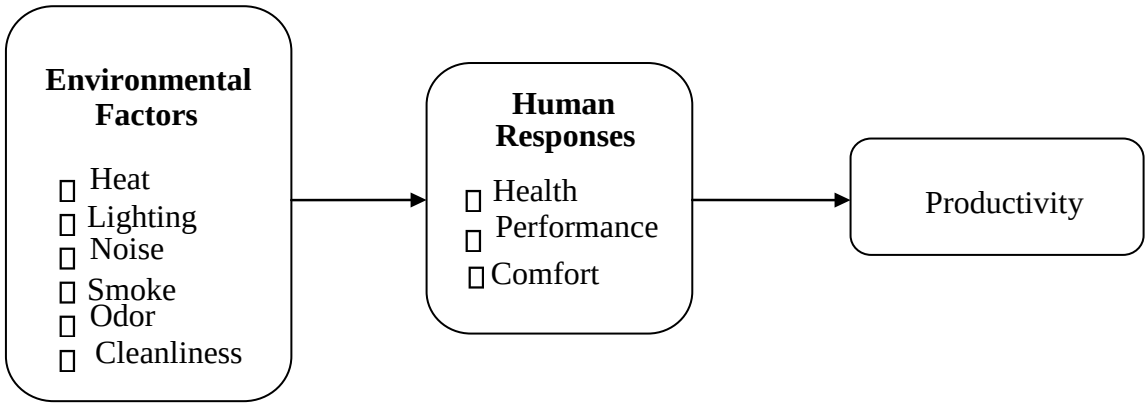

Figure 2.2: Environmental factors influence human responses and impact productivity
Source: (Kuriakose et al., 2020)

Additionally, research by Saleh (2025) suggests that the physical design of the workplace, including office layout, furniture, lighting, noise levels, temperature, and even color schemes, is a crucial factor in both employee well-being and productivity.

The design of the workspace, including elements like layout, noise control, and high-quality lighting, directly influences employee mood, as research shows a clear link between good lighting and more effective creative thinking (Peres et al., 2021, as cited in Citraresmi et al., 2025).

Thus, paying attention to physical ergonomic factors during workplace design has significant benefits for the health and well-being of employees and also boosts their overall productivity.

Patient handling and lifting in Healthcare Ergonomics

Handling and lifting patients are essential tasks in healthcare settings, but they carry significant risks of musculoskeletal injuries (MSDs) for caregivers. Additionally, patient lifts are the best method for ensuring the safety of healthcare workers and patients during mobility tasks. Proper use of lifts helps prevent injuries to healthcare workers (Teeple et al., 2017). Wiggermann et al.

(2024) suggested that implementing safe patient handling and mobility programs can reduce injuries among healthcare workers and offers guidance for enhancing compliance and effectiveness.

Fray and Davis (2024) conducted a systematic review emphasizing that safe patient handling has become a priority, as it is cost-effective and easy to implement. The main idea is to use proper body mechanics to reduce stress on the body, especially the spine. This involves keeping the patient close, bending the knees, and maintaining an upright back. Moreover, the review highlights the advantages of using lifting devices, as it is clear that manual lifting is inherently unsafe, regardless of how well one uses proper lifting techniques. Current evidence suggests that the best way to protect healthcare workers is to utilize lifting devices, with ceiling lifts being the preferred option. The research concludes that best practice guidelines highlight the need for assistive devices to reduce risks for care workers. Studies show that these devices significantly lower the physical burden on caregivers. Furthermore, Roberts (2020) suggests that a better understanding of the use of assistive devices could contribute to improved care and play a significant and essential role.

Therefore, the research on patient handling and lifting highlights that manual lifting is a major cause of caregiver injuries and should be minimized. While proper technique is important, the most effective and evidence-based solution is the use of mechanical lifting devices, such as ceiling lifts. Implementing a Safe Patient Handling program centered on this technology is a proven, cost-effective way to protect healthcare employees from physical strain, reduce injuries, and ensure safer, higher-quality patient care.

Ergonomic benefits and challenges of patient handling and lifting

Ceiling lifts are designed to minimize physical stress when transferring patients. According to a study by Holman (2010), as cited in Noble and Sweeney (2018), nurses reported spending nearly 20% of their time on tasks related to patient handling. The study found that time constraints and challenging patient-handling situations lead to less frequent use of assistive devices, particularly mechanical devices that are difficult to retrieve or not easily accessible. The most influential

factors in the decision not to use assistive devices for patient transfers were identified as these barriers and understaffing.

A Gautam et al. (2019) study of Korean hospital nurses revealed a high prevalence of Low Back Pain (LBP), with 72% of participants reporting that they had experienced it. The research further found that nurses who manually handle patients were 7.2 times more likely to report musculoskeletal symptoms.

The manual handling of patients, such as moving or repositioning them using a nurse's own body strength is consistently identified as a primary cause of Low Back Pain (LBP) among nurses. This is a widespread problem, with one study reporting that around 80% of working nurses suffer from LBP, making it difficult for them to do their jobs effectively (Ibrahim et al., 2019). Additionally, a study by Mazni et al. (2025) confirmed this, finding that over 60% of nurses had LBP and that most of them believed manual patient lifting was the main reason for their pain.

According to a study by Vinstrup et al. (2024) it's crucial for healthcare organizations to have a clear plan for managing the physical strain on their employees. The study recommends using real-life measurements to understand which tasks are most demanding. With this information, hospitals can implement targeted changes to create a safer and more manageable work environment in the long term. Knowing the physical effort required for different patient transfers is key to organizing work more effectively and safely.

Tasks that exceed the biomechanical capabilities of workers are considered ergonomic hazards, leading to musculoskeletal injuries, which can be either acute or cumulative. The primary goal of ergonomics is to modify the work environment and processes to eliminate or reduce harmful forces and other negative impacts on the musculoskeletal system resulting from task performance. Safe Patient Handling and Movement (SPHM) equipment helps relieve ergonomic strain on caregivers, ensuring their work remains within safe biomechanical limits (Matz, 2019).

Improving the work environment enhances the recruitment and retention of qualified staff, reduces lost time or restricted duties due to injuries, and helps prevent employees from unnecessarily leaving the workforce early. A supportive culture will encourage caregivers to

adopt safe practices and avoid reverting to unsafe behaviors. It is essential for every employee, including management and caregivers, to embrace an organizational culture that prioritizes safety and accountability for both patients and team members. This culture should promote the proper use of patient-handling techniques and equipment (Noble & Sweeney, 2018). Ceiling lifts have been identified as the preferred method for reducing actual injuries due to their ability to minimize manual handling and strain on healthcare workers (Fray & Davis, 2024).

A combination of ergonomic interventions, including safe patient handling practices and policies to prevent long periods of standing and excessive work hours, is crucial for improving nurses' occupational health and well-being. Such measures have the potential to lower LBP prevalence, increase productivity, enhance job satisfaction, and improve the overall quality of care delivery (Mazni et al., 2025).

The literature confirms that manual patient handling is a primary driver of musculoskeletal injuries among healthcare workers. While assistive devices like ceiling lifts are the evidence-based solution, their effectiveness is dependent on a supportive organizational framework that addresses barriers like employees shortages. Therefore, a holistic approach combining the right equipment with a strong safety culture is essential for reducing caregiver injuries, enhancing job satisfaction, and improving the overall quality of patient care.

Patient-Centered Outcomes

Research on patient outcomes related to the use of safe patient handling techniques and technology is limited. Numerous factors within healthcare environments, such as individual patient characteristics, medical conditions, patient care environment factors, and staffing levels, complicate the ability to establish a direct causal relationship. However, clinical trials conducted in hospitals have shown a link between the use of specific types of patient handling equipment and improvements in patient outcomes. For example, a hospital study that compared the incidence of skin tears before and after the implementation of ceiling lifts and repositioning sheets/slings found a reduced risk of tissue damage and cross-infection (Matz, 2019).

Thus, the literature supports Safe Patient Handling and Mobility (SPHM) not only as a strategy to protect caregivers but also as a crucial component of delivering safer, higher-quality patient care.

Ceiling lifts are transformative tools in healthcare ergonomics, offering dual benefits for caregivers and patients. However, equitable adoption requires addressing economic, cultural, and training obstacles.

Therefore, it's important to consider physical ergonomic factors in healthcare settings to ensure the well-being of healthcare workers. Factors like noise, illumination, Patient handling and lifting and temperature can significantly impact occupational risks.

2.5.2 Cognitive ergonomic factors

Cognitive ergonomics concerns the human factors related to mental reasoning and processing, including human perception of the surrounding environment and other interactive factors within the workplace (Smith, 2017, as cited in Arthur et al., 2024). It is important in healthcare as it helps to understand the hospital environment, including the relationships, physical structures, and their interaction with activities in healthcare spaces (Bailey et al., 2023).The application of HFE in healthcare leadership and management is essential to address clinician burnout, as most stressors contributing to burnout are systemic, requiring a combination of organizational and individual interventions to reduce burnout, improve satisfaction, and enhance patient safety (Rodríguez & Hignett, 2021).

A multicenter, cross-sectional study by Hailu et al. (2025) of healthcare professionals in Southern Ethiopian Intensive Care Units (ICUs) revealed a high prevalence of burnout, affecting 38.1% of participants. The findings identified excessive workload as a primary factor, an issue driven by the imbalanced provider-to-patient ratios that are common in developing countries like Ethiopia.

Figure 2.3 shows the findings from a study by Hailu et al. (2025) on the level of burnout syndrome (BOS) among participants. The results revealed high levels of both emotional exhaustion, reported by 40.6% of participants, and depersonalization, reported by 29.2%. In

addition to these problems, half of the respondents (50.5%) scored a low level of personal accomplishment.

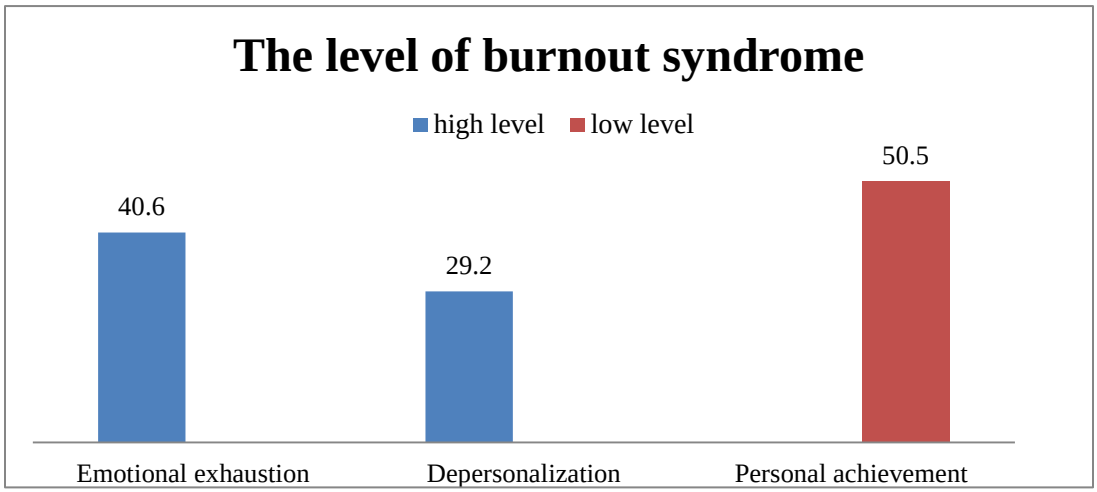

Figure 2.3: The level of burnout syndrome (BOS) among participants. (Hailu et al., 2025)

Thus, cognitive ergonomics improves the work environment to enhance mental processes, including attention, perception, memory, and decision-making. One major ergonomic issue is role overload, which can cause stress, fatigue, and decreased productivity. This negatively impacts employee well-being and overall performance (Rangrez et al., 2022). Effective training and feedback are crucial ergonomic factors, as they can enhance employee skills and knowledge, leading to better performance and job satisfaction (Sun et al., 2021). The use of cognitive ergonomics in the design process of healthcare spaces, particularly for children, aims to create more humanized environments that meet the integral needs of users, shifting focus from a disease-centered approach to user-centered design (Upadhyay et al., 2022).

Research shows that effective management of mental workload and user-friendly tool design can significantly enhance employees' creativity (Pouyakian, 2022). When tasks are structured to match an employee's mental capabilities, it prevents cognitive overload, thereby freeing up mental resources for greater exploration and experimentation with new ideas (Fang et al., 2023).

To manage mental strain, research suggests practical interventions such as taking short breaks, implementing task rotation, and using visual workflow tools (Nguyen et al., 2022, as cited in

Citraresmi et al., 2025). This approach is supported by Kim et al. (2023), who found that a manageable mental workload helps employees be more efficient and gives them the freedom to think creatively. Similarly, Abdollahpour et al. (2023) highlight that when the mental aspects of work are well-organized, it encourages people to think more deeply and become better problem-solvers.

A study by Zheng et al. (2023) shows that Transformational Leaders, who provide strong emotional support and create a psychologically safe environment, empower their teams to handle cognitively demanding tasks more creatively. This focus on psychological well-being is also crucial in task design itself. As Carayon et al. (2021) highlight, tasks that are designed to be mentally engaging and meet employees' psychological needs can spark their natural motivation and keep them curious.

By integrating HFE at all levels of the healthcare system, including micro, meso, and macro levels, a more robust and resilient healthcare system can be designed, improving safety and effectiveness from a holistic perspective (Privitera, 2020). Furthermore, Kuriakose et al. (2020) highlighted that increased levels of mental comfort can lead to more commitment to the work, thereby achieving higher productivity. Mental and physical comfort is a result of a well-designed or ergonomic workplace. Implementing concepts of cognitive ergonomics is crucial for creating a work environment that enhances employee performance, improves accuracy, increases productivity, and contributes to overall business success (Karmacharya et al., 2025).

Cognitive ergonomics is an essential component for optimizing performance in complex workplaces like healthcare. It directly addresses the mental workload that leads to employee burnout, stress, and errors. By systematically improving how information is presented, how tasks are designed, and how decisions are supported, organizations can create an environment that enhances mental comfort and focus. Therefore, investing in cognitive ergonomics is not only about employee well-being; it is a fundamental strategy for building a more accurate, productive, and safer healthcare system.

2.5.3 Organizational ergonomic factors

Organizational ergonomics involves the interaction between human factors and the organizational structure, which creates relationships within the work environment. This includes organizational policies, management structure, work design, communication models, and other relevant factors (Smith, 2017, as cited in Arthur et al., 2024).

Effective teamwork among nurses in a unit actively prevents and reduces burnout. The Korean Nurses Code of Ethics highlights collaboration, which requires nurses to maintain respectful and cooperative relationships with colleagues and healthcare professionals (Korean Nursing Association, 2023, as cited in Cho et al., 2024). This includes developing an environment of mutual understanding, clear communication, and trust. Elements of nursing teamwork contain: trust between members, a team orientation where colleagues collaborate and cover for each other, backup systems enabling help during high workload, a shared mental model for clarity on roles and quality goals, and team leadership focused on monitoring, balancing workloads, and providing support (Kalisch et al., 2010a, as cited in Cho et al., 2024). Additionally, According to Vera et al. (2017), as cited in Cho et al. (2024), nursing teamwork is a modifiable work system factor that can help manage the growing workloads within the nursing profession. Enhancing teamwork among nurses strengthens their ability to adapt flexibly to changing work environments, which can potentially reduce the physical and emotional burdens that impact their time outside of work.

Ensuring the well-being and efficiency of healthcare workers is crucial in organizational ergonomics factors in healthcare (Bailey et al., 2023). Healthcare organizations need to prioritize ergonomics, including improved medical teams, error management, and safety testing of medical devices (Bitan & Sasangohar, 2022). Santos (2021) highlighted the importance of a structured HFE framework encompassing domains such as process, product, training, and research in positively impacting the socio-technical health system. This emphasizes the necessity of reengineering healthcare with a focus on human-centered approaches. To create a sustainable learning organization that allows for continuous system improvement, it is crucial to motivate and retain professionals. A high turnover rate can undermine all efforts to improve the system.

Therefore, it's important to consider other aspects of employees' experiences within the company. For example, establishing a clear organizational communication network is essential so that collaborators can easily find the information they need. It's also important to help employees feel integrated into the organization and have a deep understanding of hospital activities, such as through guided visits to different services. Additionally, employees should integrate and transmit organizational values.

According to Elkefi et al. (2025), Participatory Ergonomics (PE) is the active involvement of healthcare workers in redesigning their work processes and physical environments. Because employees are directly involved, the solutions are better suited to the specific challenges they face every day. This approach leads to smoother workflows, less wasted effort, and better overall well-being. By working together to create a culture of safety, organizations can boost productivity while lowering the risk of job-related injuries and stress. Furthermore, the success of these initiatives depends on proactive management commitment and organizational support, which are essential for creating safer and more sustainable healthcare workplaces (Burgess-Limerick, 2018).

Wang and Shao (2024), as cited in Citraresmi et al. (2025), found that strong leadership support for ergonomic initiatives is essential for integrating Human Factors and Ergonomics (HF/E) principles into everyday organizational practices. A crucial element of Organizational ergonomics is the quality of communication between organizational leadership and employees (Koirala & Nepal, 2022).

For an ergonomics program to be successful, it needs strong organization policies and sufficient resources (Citraresmi et al., 2025). A study by Rosyadi et al. (2022), as cited in Citraresmi et al. (2025), found that organizations that prioritized ergonomics experienced fewer employee injuries and higher job satisfaction. In some cases, these organizations were motivated by government financial rewards.

Organizational ergonomics focuses on optimizing the overall work system to support the well-being and efficiency of healthcare workers. This means improving teamwork and communication, schedule, creating systems to prevent errors, and regularly testing medical

devices to ensure they are safe. A supportive organizational structure is therefore not merely beneficial but essential for improving employee retention and achieving long-term success.

2.6 Importance of ergonomic workplace design on productivity

Ergonomic Design focuses on adapting the physical and cognitive aspects of the environment to enhance user experience and well-being. Studies emphasize the significance of ergonomic considerations in office spaces to promote employee health, productivity, and satisfaction (Basakci et al., 2022). Bhandari et al. (2024) highlighted the interaction between work, workplace, and tools, coupled with personal motivation and the supporting infrastructure, as crucial factors for maximizing employee productivity. Integrating ergonomic principles not only improves individual health and safety but also boosts overall efficiency and user satisfaction in different settings (Mendonçaa, 2022). Furthermore, cognitive ergonomics in packaging design is essential to ensure user-friendly interactions and prevent frustration or accidents (Paschoarelli, 2014). The interdisciplinary nature of ergonomics addresses the interface between humans and technology, aiming to minimize issues and enhance usability in various fields such as web design, fashion, and assistive technology (Jaklin et al., 2022). Understanding the importance of ergonomics will help to customize the work environment in order to increase the productivity of workers (Chakrabortty et al., 2023).

A study by Mohammad et al. (2019) highlights that a workplace's ergonomic status is a broad system encompassing environmental conditions, equipment safety, and work procedures. Their findings show that higher ergonomic knowledge and better workplace conditions are significantly associated with a lower prevalence of Work-Related Musculoskeletal Disorders (WMSDs) among nurses. Therefore, the study concludes that a comprehensive approach combining a well-designed physical environment with continuous training on proper work techniques, fatigue management, and equipment use is essential for preventing injuries and increasing productivity.

A study by Hakanen et al. (2022), as cited in Saleh (2025) revealed that organizations with employee well-being programs experience a productivity increase of 15–20%. This can be attributed to lower absenteeism, greater employee focus, and improved decision-making.

Furthermore, the relationship between productivity and well-being is reciprocal: when employees feel supported, they contribute more effectively to the organization's success, which in turn strengthens their well-being and creates a cycle of positive growth.

Recent studies suggest that to improve work, organizations need to look at the whole picture of physical comfort, social interactions, and mental health in an employee's experience. For example, research by Van et al. (2023) highlights the importance of organizational culture in influencing employees' sense of well-being and productivity. By understanding the connections between these different factors, organizations can develop effective strategies that support individual needs while achieving collective goals, leading to long-lasting improvements in performance.

A study by Veitch et al. (2021), as cited in Saleh (2025) showed that access to natural light and plants can significantly enhance employees' mood and cognitive function, leading to higher productivity. These findings highlight the importance of including nature-inspired elements into workplace design to support the psychological well-being of employees.

Flexible work arrangements, like shared desks (hot desking), co-working spaces, and the option to work remotely, allow employees to select the environment that best suits their specific tasks and preferences (Duffy & Smith, 2022, as cited in Saleh, 2025). According to Saleh (2025), adaptable workplace designs that integrate technology offer significant benefits for employee well-being and performance. By providing a sense of autonomy, these flexible environments enhance job satisfaction, reduce stress, and support a smooth flow between collaborative and individual tasks. Furthermore, the integration of technology can promote healthier behaviors, such as encouraging movement breaks and ergonomic adjustments, thereby creating an adaptive workspace that continuously maintains optimal conditions for performance.

The benefits of a well-designed ergonomic workplace go beyond individual health to positively impact key organizational outcomes such as productivity, efficiency, and profitability. By reducing the risk of common workplace issues such as musculoskeletal disorders, repetitive strain injuries, and cognitive overload, effective ergonomics lowers injury rates and absenteeism, while increasing employee loyalty and morale (Arachie et al., 2018, as cited in Ilodilibe et al.,

2024). Adopting ergonomic principles at an organizational level is therefore a fundamental change, creating a safer and more efficient workplace that supports the physical well-being, mental comfort, and overall productivity of its employees (Pickson et al., 2017).

Good ergonomics in the workplace not just adds value to the business but also enhances employee job satisfaction. This is because many organizations believe that a healthy work environment helps create a culture of innovation and creativity, which benefits the entire organization (Sabir et al., 2019).

Educating organizations on the benefits of ergonomics is crucial for boosting productivity. When organizations invest in an improved work environment, employee health improves, which in turn leads to higher productivity and lower organizational healthcare expenses (Al-Omari & Okasheh, 2017).

Ergonomics is a scientific discipline that systematically considers an employee's physical, mental, and social factors when designing workplaces, jobs, and systems to fit their specific needs, abilities, and limitations (Akinbola & Popoola, 2019, as cited in Koirala & Nepal, 2022). It applies established theories, principles, and data to optimize the interaction between people and their work environment to enhance both human well-being and overall system performance (Ahmadi et al., 2015, as cited in Koirala & Nepal, 2022). This means organizing work so that tools are easily accessible and the environment is supportive, which ultimately leads to increased productivity (Mihartescu et al., 2021). Thus ergonomics has been recognized as a critical factor that significantly influences both employee motivation and overall job performance (Koirala & Nepal, 2022)**.**

Effective work environment design requires careful consideration of physical, human, work design, and social factors. By optimizing task conditions to reduce physical fatigue and mitigate mental stress, organizations can significantly enhance their employees' well-being and overall quality of work life (Hoff & Öberg, 2015)**.**

The positive impact of ergonomics on productivity is widely recognized, with a study of 350 companies finding that a majority (82.5%) believe it makes employees more productive

(Akinbola & Popoola, 2019, as cited in Koirala & Nepal, 2022). However, achieving these benefits requires more than just good design. It depends on a combination of effective management practices, a supportive organizational culture, and regular training that empower employees to contribute to ergonomic improvements (Koirala & Nepal, 2022; Pickson et al., 2017).

A study by Badarin et al. (2022) found that employees who moved to a less physically demanding job had a reduced risk of receiving disability benefits after leaving work. This finding highlights the critical need for better management and organization of physically demanding tasks to protect employee health and sustain their careers.

Several well-established strategies exist to distribute the physical demands of healthcare work more evenly among employees. These include effective task allocation, the implementation of rotational schedules, and the increased use of assistive devices. Adopting these measures is likely not only to help reduce the risk of musculoskeletal disorders and low-back pain but also contribute to higher job satisfaction and improved worker retention (Vinstrup et al., 2024).

Vincent and colleagues (1998), as cited in Carayon et al. (2021), proposed an organizational accident model to explain how accidents happen. The model outlines a chain of events that begins with latent failures, such as poor management decisions or flawed organizational processes. These underlying issues create negative work conditions, like excessive workloads, poor communication, inadequate supervision, or faulty equipment. In turn, these conditions can lead to active failures or unsafe acts by employees, including mistakes, omissions, cognitive failures, or violations. According to the model, these unsafe acts can result in an accident or adverse outcome if the existing safety barriers or defenses are insufficient.

The principles of HFE are essential for making this entire recovery process more effective. HFE contributes by improving person-related factors (such as training and designing systems that support human cognitive and physical abilities), technical factors (like technology design), and organizational factors (like how jobs are designed), ensuring the whole system works together as smoothly and safely as possible (Carayon et al., 2021).

Therefore, ergonomic design has numerous benefits on productivity in different aspect from individual level up to organizational level.

2.7 Relationship between ergonomic workplace design and employee performance

Ergonomic design is basic for improving performance in various settings. Research underscores the importance of considering human factors in the design of work systems (Chen et al., 2023). Ergonomics interventions, such as designing ergonomic furniture and workspaces, have been shown to improve employee productivity by providing comfort, reducing fatigue, and minimizing health issues like Musculoskeletal Disorders (MSDs) (Halis, 2022). A well-designed work environment that aligns with the capabilities and limitations of individuals can lead to increased operator performance, decreased errors, and reduced fatigue (Silviana et al., 2022). Bajaj et al. (2022) also highlighted the impact of office ergonomics on employee performance, with factors like architectonic details and color influencing productivity. Overall, integrating ergonomic principles into design can optimize working conditions, enhance user satisfaction, and boost organizational productivity.

Ergonomically improve workplace environment enhance employee performance and a key driver of overall organizational productivity (Brill et al., 1985, as cited in Kuriakose et al., 2020). Conversely, poor workplace design negatively impacts employee health, resulting in considerable financial losses estimated at $13 billion annually due to absenteeism. This highlights the strong correlation that studies have found between environmental factors and employee performance (Friedman, 2009, as cited in Kuriakose et al., 2020).

A study by Saleh (2025) highlights the important of workplace design on employee well-being and productivity. The study found that employees who were satisfied with their workspace layout, furniture, and lighting felt more motivated and satisfied with their jobs. These results indicate that organizations should regularly assess and improve their workplace design to create a better and more efficient environment for their employees.

Research shows that when organizations use "employee-centered" designs, where the focus is on the needs of the employees, it has a positive impact on job performance (JP) (Christensen et al., 2009). On the other hand, several factors at the meso-level (the management and team level) can negatively impact job performance. These include abusive bosses (Estes, 2013), insufficient resources, excessive workloads, poor co-worker relationships (Viitanen et al., 2011), and employee burnout (Palenzuela et al., 2019).

A study by Krijgsheld et al. (2022) shows that individual employee performance, which collectively shapes overall organizational performance, is influenced by factors across three interdependent levels. At the macro-level, performance is shaped by organizational factors such as organizational structure, culture, and perceived support from leadership. At the meso-level, it is affected by management styles, how work is organized, and the effectiveness of teamwork. Finally, at the micro-level, an individual's performance is influenced by their personal motivation, skills, educational background, and other personal characteristics. Moreover, Studies indicates that even small, cost-effective adjustments to the work environment, such as modifying workstation heights or implementing more flexible team structures, can produce significant gains in creative performance (Hidayat et al., 2023).

Studies clearly show a positive relationship between ergonomic design and employee performance. This means that improving the ergonomics of the workplace and systems can enhance employee health, motivation, and job satisfaction, ultimately leading to increased performance and overall organizational productivity.

2.8 Performance metrics in healthcare ergonomics

Performance is a critical factor for all organizations, both public and private. It can be defined as the work of individuals or groups carried out to legally and ethically achieve an organization's goals. Essentially, it is the achievement of job requirements as reflected in the final output produced (Naibaho et al., 2023, as cited in Pratama et al., 2023).

In healthcare, employee performance is a multidimensional construct, encompassing not only the efficiency of task completion but also the quality and safety of patient care. The field of Human

Factors and Ergonomics (HF/E) provides a critical lens for understanding how the work system directly influences these outcomes. Research consistently shows that a well-designed work environment is a key determinant of a high-performing healthcare organization (Carayon et al., 2014).

A primary focus of healthcare ergonomics is its effect on employee health, which is a direct predictor of performance. Poor physical ergonomics, particularly related to manual patient handling, is a major cause of WMSDs. These injuries are a leading reason for negative performance metrics such as **absenteeism** (missing work) and **presenteeism** (working at a reduced capacity). For example, a recent study found a direct link between the frequency of patient handling and the prevalence of musculoskeletal symptoms, which in turn affects Healthcare Workers' ability to perform their duties effectively (Oriema, 2023).

Beyond physical health, the design of the work system also significantly impacts performance metrics related to **patient safety** and **employee well-being**. Poorly designed technologies, such as confusing Electronic Health Records (EHRs), increase the cognitive load on clinicians, which is a known contributor to **medical errors** and employees **burnout** (Holden et al., 2019). Furthermore, organizational factors like teamwork and communication directly influence both employee **job satisfaction** and **employees continuity**. Job satisfaction is a critical driver of job performance among healthcare professionals, as it enhances motivation, which in turn improves the quality of patient care and overall productivity (Agwu et al., 2024; Coomber & Barriball, 2007). A study by Oriema (2023) further confirmed this by showing a clear association between poor ergonomic conditions and higher rates of presenteeism, linking the work environment directly to both health and productivity.

To better understand the mechanisms that drive performance, it is crucial to consider models of employee motivation. One influential framework is the High-Performance Cycle (HPC), a model that explains the factors that either enhance or inhibit employee motivation. Its relevance to public sector employees, including those in healthcare, was highlighted by (Selden & Brewer 2000, as cited in Latham, 2023).

The HPC is particularly applicable to this ergonomics study because it treats performance not as a single event, but as a cycle influenced by the work environment. As shown in Figure 2.4, key components of this cycle such as job demands, organizational support, and employee well-being are all directly affected by ergonomic design. For example, a poorly designed workstation can increase physical strain, acting as a barrier to performance. Conversely, an ergonomic environment can act as a form of organizational support, enabling employees to meet their goals and thereby boosting their motivation and satisfaction.

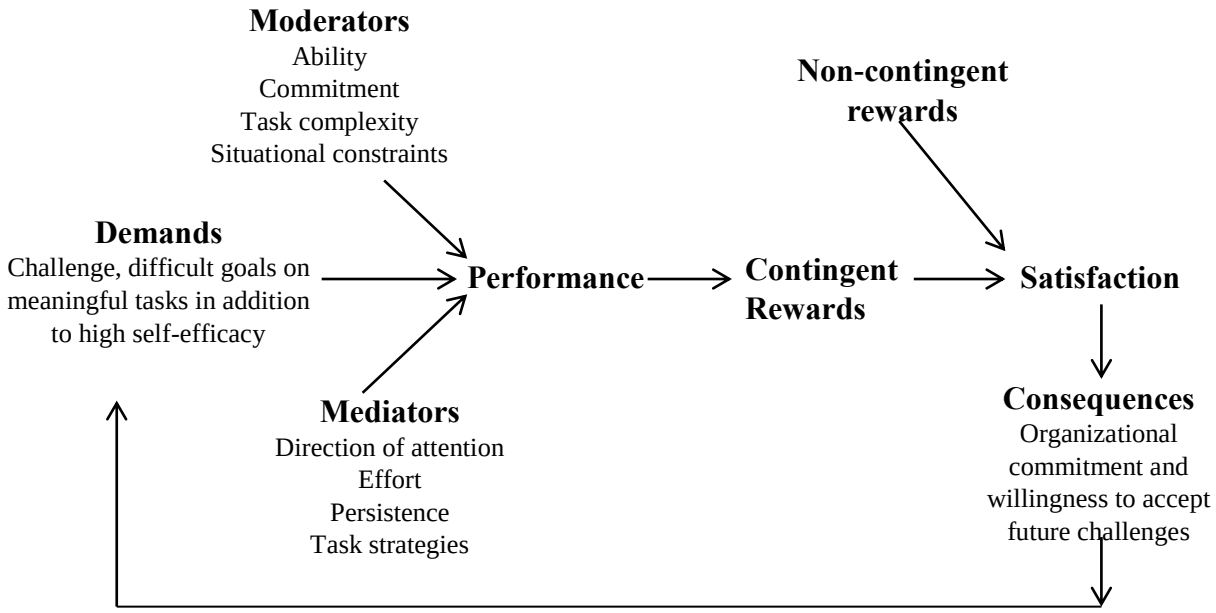

Figure 2.4: High-Performance cycle model. (Selden and G. Brewer 2000, as cited in Latham, 2023)

Therefore, an integrated ergonomic approach that addresses the physical, cognitive, and organizational dimensions of work is essential for optimizing the full range of performance metrics in healthcare. Accordingly, this study measure employee performance through employee well-being, assessed using the standardized Nordic Musculoskeletal Questionnaire (NMQ), and job satisfaction, assessed using the Job Satisfaction Survey.

2.9 Methods for improving ergonomic workplace design to enhance performance

Improving ergonomic design is not a single action but a multi-faceted process involving interventions at the physical, procedural, and organizational levels. Studies show that an integrated approach is an effective method for boosting performance and reducing strain, which can be categorized into the following interconnected areas:

1. Workspace and Equipment Design

The most direct method for improving ergonomics involves the physical modification of the work environment. This approach is grounded in the principles of anthropometry the science of human body measurement to ensure that tools and spaces fit the user (Pheasant & Haslegrave, 2018). In the healthcare sector, this translates to specific interventions such as: **Adjustable Workstations:** Providing adjustable-height desks, chairs, and monitor stands allows employees to maintain neutral postures, reducing the risk of musculoskeletal disorders (MSDs) and fatigue. Studies show that sit-stand workstations, in particular, can decrease physical discomfort and increase self-reported energy levels among hospital employees (Adiga, 2023). **Ergonomic Medical Equipment:** The design of medical tools and equipment is critical. This includes everything from lightweight, ergonomically-gripped surgical instruments to patient-lifting devices (e.g., ceiling lifts, slide sheets). The use of such equipment directly reduces the physical load on caregivers during patient handling, which is a leading cause of injury in healthcare, thereby preserving their physical capacity for other tasks (Fray & Davis, 2024). **Optimized Lighting and Environmental Factors:** Proper lighting that minimizes glare and provides sufficient illumination is essential for reducing eye strain and preventing errors, especially in detail-oriented tasks like medication administration or reading patient charts. Similarly, controlling noise levels and maintaining thermal comfort contributes to a less stressful and more focused work environment (Idkhan & Baharuddin, 2019; Sun & Han, 2021; Kuriakose et al., 2020).

2. Task Design and Process Improvement

Beyond the physical environment, ergonomic improvements must address the nature of the work itself. Task design focuses on how jobs are structured to minimize both physical and cognitive load. Key methods include: **Job Rotation and Task Variation:** To prevent the overuse of specific muscle groups, job rotation allows employees to switch between different tasks that use different parts of the body. This is particularly effective in reducing the risk of repetitive strain injuries (RSIs) and combating the monotony that leads to mental fatigue (Adiga, 2023). **Workflow Optimization:** Analyzing and redesigning clinical workflows can eliminate unnecessary steps, reduce awkward movements, and minimize physical travel distances for nurses and other staff. For example, strategically placing supply carts or decentralizing nursing stations can significantly cut down on physical exertion and save time, allowing more focus on direct patient care (Carayon, 2020). **Adequate Break and Recovery Periods:** Integrating scheduled micro-breaks and longer rest periods into the workday is a crucial ergonomic intervention. These breaks allow for physical recovery and cognitive rest, which is essential for maintaining high levels of performance and accuracy throughout a long and demanding shift (Nguyen et al., 2022, as cited in Citraresmi et al., 2025; Fang et al., 2023).

3. Participatory Ergonomics and Training

For ergonomic interventions to be successful, employee involvement and education are essential. **Participatory Ergonomics (PE) Programs:** These programs actively involve employees in identifying ergonomic risks and brainstorming solutions. Because direct-care workers have detailed knowledge of their tasks, their participation leads to more effective and sustainable interventions. Studies in healthcare settings have shown that PE programs not only reduce injury rates but also increase job satisfaction and feelings of empowerment among employees (Krishnanmoorthy et al., 2025). **Comprehensive Ergonomics Training:** Providing training on the principles of safe work practices, such as proper lifting techniques, correct posture at workstations, and the proper use of ergonomic equipment, is essential. Without training, even the best-designed tools can be used incorrectly, negating their benefits. Effective training programs

are ongoing and tailored to the specific risks of different roles within the hospital (Hamid et al., 2022; Mohammad et al., 2019).

4. Organizational and Management Commitment

The success of any ergonomic program depends on a strong organizational culture that prioritizes employee well-being. This requires visible and sustained commitment from management. **Developing an Ergonomics Strategy:** A formal Strategy signals that ergonomics is a core value of the organization. This includes establishing clear procedures for reporting ergonomic concerns, assessing risks, and implementing solutions (Carayon, 2020). **Investing in Ergonomic Solutions:** Management must be willing to allocate financial resources for ergonomic equipment, workspace renovations, and training programs. This investment is often offset by a significant return in the form of reduced absenteeism, lower workers' compensation costs, and higher productivity (Ebito & Umana, 2019). Creating a leadership-driven "culture of safety" ensures that ergonomic considerations are integrated into all aspects of planning and operations, rather than being treated as an afterthought (Carayon et al., 2021).

Therefore, enhancing performance through ergonomic workplace design requires a comprehensive, multi-level strategy. It combines well-designed physical environments with optimized work processes, effective training, and a supportive organizational culture. Investigating which of these methods are most impactful and how they are currently implemented within the specific Hospital is a crucial step toward improving both employee performance and the quality of patient care.

Topic related studies

The literature related to this study's topic is reviewed below.

The existing literature has highlighted the potential positive effects of ergonomic design on teamwork, communication, and social interactions in healthcare facilities (Gharaveis et al., 2018). Makhbul et al. (2022) discussed the significance of creating an ergonomic workstation environment for organizational competitiveness, which reveals factors such as acoustic, lighting, workstation design, working hours, and chairs are crucial for creating a comfortable and

productive workplace and emphasizes the significance of considering employees' perceptions and needs to sustain human resources and enhance organizational competitiveness. This study used the Statistical Package for the Social Sciences (SPSS) software and the Analysis of Moment Structure (AMOS) software. Prall and Ross (2019) conducted a systematic review of workplace injuries and economic burden and concluded that ergonomics is a means to prepare workers to perform tasks safely, thereby reducing costs for employers, increasing workplace productivity, and decreasing overall absenteeism. Jin et al. (2023) discussed ergonomic design elements that have been found to impact fatigue and physical strain on healthcare professionals during patient care activities. In this study, 27 empirical articles were reviewed on the connection between the mental health of healthcare professionals and healthcare facility design.

Moreover, Krijgsheld et al. (2022) conducted a systematic review of job performance in healthcare and concluded that job performance in healthcare can be conceptualized into contextual adaptive performance, task, and counterproductive work behavior. Singh and Farooq (2021) conducted a study on ergonomics workplace and its effect on employee performance and found that workplace ergonomics has a significant influence on employee performance. Carayon et al. (2021) discussed the importance of human factors and ergonomics in healthcare. The study identified new ways of providing services, including at-home health and telemedicine and the need for new models of care. Kogi et al. (2019) proposed ergonomic checkpoints for healthcare work and found that participatory steps are valid for applying the proposed ergonomic checkpoints to healthcare work by using ergonomics principles. Mokarami et al. (2021) developed and validated a Nurse Station Ergonomics Assessment Tool (NSEA) and found that nurse workstations in hospitals demand adherence to known ergonomic principles for the well-being of both staff and patients by using Content analysis method. Keebler et al. (2022) discussed the future impact of ergonomics in healthcare settings by examining three industry demands. These demands include the growing population of older adults, a focus on patient-centered care, and the increasing use of telemedicine.

Additionally, Rodríguez and Hignett (2021); Gurses et al. (2020) discussed how the integration of ergonomics in healthcare systems has been identified as a key strategy for improving safety and effectiveness, particularly in the context of the COVID-19 pandemic. Those studies used

(HFE) methods and tools and healthcare failure modes and effects analysis (HFMEA). Thomas and Suresh (2022) reviewed 40 works of literature related to ergonomics in healthcare published between 2001 and 2022 by using a systematic literature review method. Furthermore, in an exploratory literature review, Koirala and Nepal (2022) examined the role of ergonomics in enhancing employee performance. The review concluded that employee performance is significantly influenced by physical, cognitive, and organizational ergonomics. Thus, the study suggests that assessing and improving these factors is a crucial strategy for boosting employee performance and productivity. Chakrabortty et al. (2023) assesses the importance of ergonomics among healthcare workers through a systematic literature review method.

From the above literature review, the studies try to show that making workplaces more comfortable and efficient can have a lot of benefits, especially in places like healthcare facilities, by using different techniques and methods. Factors such as lighting, furniture, and overall comfort are highlighted as crucial for creating a productive workplace. Ergonomics not only enhances safety and reduces costs for employers but also helps mitigate fatigue and physical strain among healthcare professionals. Overall, integrating ergonomic principles into healthcare systems is seen as essential for improving safety, effectiveness, and worker satisfaction.

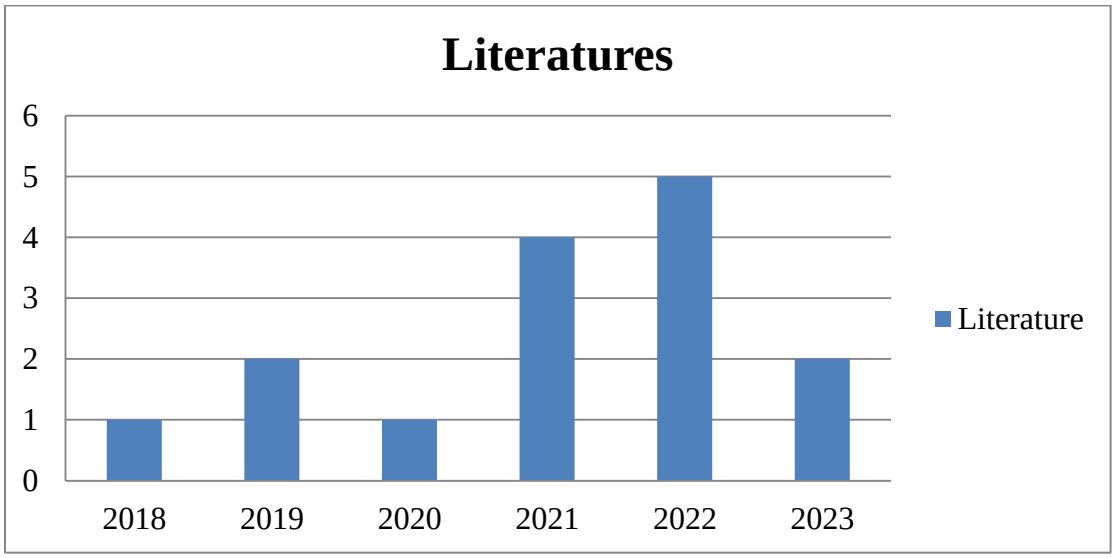

Figure 2.5: Categorization of topic related literatures by publication year

2.10 Research gap from previous studies

While a lot of research exists, there are still several critical gaps that this study addresses. Much of the existing literature examines ergonomic factors in separation. While valuable, studying these factors separately misses the complex interconnections between physical, cognitive, and organizational factors. As Carayon et al. (2021) argue in their work on socio-technical systems, these domains are deeply interconnected and influence each other. However, there remains a significant gap in empirical studies that simultaneously measure the relative impact and interaction of all three domains on healthcare system productivity.

The considerable majority of ergonomics research originates from high-income countries, proposing solutions that are often technologically advanced and expensive. As Khan et al. (2020) highlight in their review, there is a largely unexplored area of research that remains on the effectiveness of ergonomic models specifically for the unique challenges of healthcare systems in developing nations. These settings face different constraints related to funding, equipment availability, and infrastructure. Therefore, a critical gap exists in identifying low-cost, high-impact ergonomic interventions that are feasible and sustainable in these contexts.

Additionally, a study by Koirala and Nepal (2022) supports this observation of geographical bias, finding that ergonomics research primarily focuses on physical and organizational domains, with less attention given to the cognitive and behavioral aspects of work. The study also highlighted that most research is conducted in industrialized and developed nations, while the application and study of ergonomics in developing countries remain underdeveloped. Consequently, the study emphasized the critical need for more ergonomics research to be conducted in developing countries to address this gap.

Building on these major gaps, previous studies point to further limitations that this research addresses:

Keebler et al. (2022) conclude that ergonomics is still not well understood in the broader field of medicine, which shows that more research is still needed that not only identifies problems but also raises awareness.

Many studies focus only on one professional group, such as nurses (Wingler & Keys, 2019), overlooking the diverse roles and ergonomic challenges faced by other essential healthcare employees like doctors, pharmacists, and laboratory technicians.

A recent review by Karmacharya et al. (2025) recommends that future research should explore ergonomics in specific service sectors to expand the understanding of context-specific ergonomic challenges. The healthcare sector, and particularly a major referral hospital, represents one of the most complex and critical service environments. Therefore, this study answers that call for research by investigating the impact of ergonomic design on employee performance at Menelik II Referral Hospital.

Therefore, this study aims to address these multifaceted gaps by using a mixed-methods approach to investigate a wide variety of healthcare professionals, not just a single group. It adopts an integrated approach to understand the combined impact of physical, cognitive, and organizational ergonomics on performance. Most importantly, it does this within an Ethiopian hospital where resources are limited, ensuring the findings and recommendations are both practical and relevant.

CHAPTER THEREE

3. METHODOLOGY OF THE STUDY

3.1 Introduction

This methodology section offers a thorough explanation of the methods and techniques to be used in the study. It covers the overall approach, research design, data collection methods, data analysis procedures, and ethical considerations to be employed in the research process. This section provides insight into how the study was carried out and how the results were obtained.

3.2 Study area

In this study Dagmawi Minilik Referral Hospital is a case hospital located in Addis Ababa, Ethiopia. It is the oldest modern hospital in the country and provides comprehensive healthcare services. It had various departments, including internal medicine, surgery, obstetrics and gynecology, and pediatrics. The hospital also has a training school for nurses and other healthcare professionals**.**

Over the years, Menelik II Hospital has undergone renovations and expansions to meet the growing healthcare needs of the population. Today, it remains one of the largest and most important hospitals in Ethiopia, providing a wide range of medical services to the people of Addis Ababa and beyond**.** Currently, in a hospital, the number of healthcare employees that work in different departments is 767 (source from hospital's human resource).

3.3 Research design

In this study, a mixed-methods approach combining quantitative and qualitative data collection techniques was utilized. The methods include: evaluating the current ergonomic workplace design of the hospital; observing healthcare employees during task performance; and conducting a questionnaire survey.

A descriptive research type is utilized to investigate the impact of ergonomic workplace design on the performance of healthcare workers at Menelik II Referral Hospital. The research follows a structured design framework, beginning with the definition of the research problem and objectives and moving through data collection, analysis, and the integration of results, concluding with the formulation of recommendations.

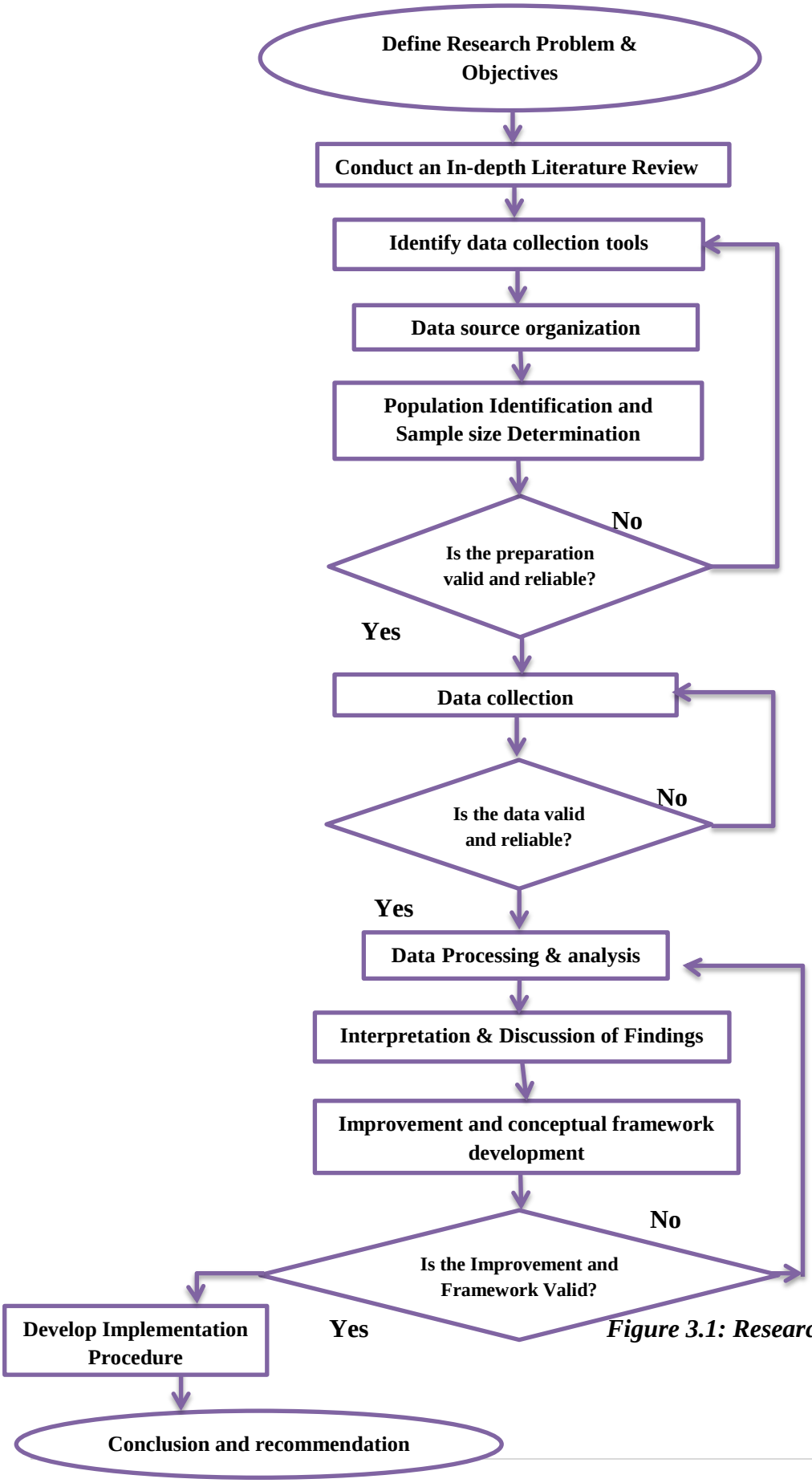

Figure 3.1: Research design frame work

3.4 Sources of data

In this study primary and secondary data source is use. The primary sources of data include observation, survey questionnaires, interviews, and photos, and the secondary sources collect from relevant books, articles, journals by using internets in different website like Google scholar, Google gate, emirate and soon.

Sources of primary Data

In this study, the following are basic Sources of primary Data:

Observation: directly observe and record behaviors, interactions, or relevant situations in the hospital.

Survey Questionnaires: by design and distribute questionnaires to gather specific answers directly from healthcare employees.

In-depth interviews: conduct direct conversations with healthcare employees and management to get in-depth information and perspectives.

Photos: take photographs to visually document specific environments, setups, or conditions relevant to the study.

Primary data is a source of information that is directly related to the issue or problem. In this study, the primary data sources were the working surroundings of the hospital and the hospital's healthcare employees and management. Data were collected through field observation, photos, semi-structured in-depth interviews, and questionnaires.

Source of secondary Data

Secondary data gives a frame for the research on which direction to go and are used to balance primary data and ensure the topic is fully explored. For this study, secondary data collected as a document review from various secondary sources. It gathered from the literature regarding the impact of ergonomic design in health care settings, and a written document and records from the hospital, research journals, books, articles, Internet resources, and other sources considered.

Both primary and secondary data Source used to address questions regarding the current ergonomic design and the ergonomic design factors that impact the performance of healthcare employees at the Minilik II referral hospital.

3.5 Population and sample size determination

3.5.1 Population

The population of the data is from Menelik II referral hospital healthcare employees. For this study, a purposive sampling technique, also known as judgment sampling, was employed. As a non-probability method, it involves the purposeful selection of participants based on their specific qualities and knowledge relevant to the research questions (Cannella et al., 2007). This technique was purposefully chosen over random sampling because the primary goal was not generalizing the findings to the entire population, but rather to gain in-depth, high-quality insights from "information-rich" individuals. To gain an overall perspective on the impact of ergonomic workplace design, participants were purposefully selected from a diverse range of roles. This strategic selection ensured the collection of detailed, diverse data that was directly relevant to the study's investigative aims.

The total population for this study consisted of all healthcare employees at Menelik II Referral Hospital, with a total of 767 individuals. This population, detailed by department in Table 3.1, was used to determine the required sample size.

Table 3.1: The total number of healthcare employees that work in Menelik II referral hospital (source from hospital's human resource)

No	Profession	Female	Male	Total
1	Anesthesiologist	5		5
2	Obstetrician and Gynecologist	2		2
3	Internist	3	4	7
4	Pediatrician	3		3
5	Accident /Emergency specialist		2	2

6	Psychiatrist	1		1
7	Ophthalmologist	7	2	9
8	Pathologist		4	4
9	Dental Specialist/ Dental surgeon and Dental Professional	2	8	10
10	Dermatologist and ENT Specialist	1	2	3
12	General Surgeon, Orthopedic surgeon, Neurosurgeon, URO-Surgeon, GI-surgeon and Pediatric surgeon	3	15	18
13	Nephrologist, Neonatologist, Neurologist and Endocrinologist	3	4	7
14	MD/General Practioner	28	34	62
15	Midwives	24	20	44
16	Nurse (Bsc) 299, Nurse (Diploma) 5 [ER(8), OPD (15), IPD (32), OR (21) ,ISU (6)]	264	122	386
17	Bsc anesthetists	12	14	26
18	Optometrist /refractions	4	2	6
19	Nurse Psychiatrist and Ophthalmic Nurse	6	1	7
20	BSC in radiology, Radiologist and Radiographer	10	16	26
21	Physiotherapist		1	1
22	MSc in medical Laboratory, Laboratory technologist and Laboratory technician	15	25	40
23	Pharmacist, Pharmacy technician and Pharmacy Specialist	12	46	58
24	Others: = Social worker 3, Forensic Medicine 8m Family medicine 2m Masters 22,	25	10	35
Total				**767**

3.5.2 Determination of sample size

Selecting an appropriate sample size is crucial in any study to address research questions accurately. In this study, the total population of healthcare employees in Menelik II referral hospital is known. From that the sample size determination of the study is based on the methods used by (Cochran, 1977). To calculate the total sample sizes of the study the formula is shown below.

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

Where n = the sample size,

N = the total population

(e) = error of margin of this study considered (0.05) = 95% confidence level. So, the margin of error is 0.05.

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

$$n = \frac{767}{(1 + 767(0.05^2))}$$

$$n = \frac{767}{2.918}$$

n = 262.85

n = 263

Therefore from the above calculation the total sample size of this study is 263. Based on this total simple size the questioners prepared for healthcare employees that work in the Menelik II referral hospital. Each department is allocated a sample size based on its number of healthcare employees.

3.6 Method of data collection

To gather data from both primary and secondary sources, this study uses a mixed-methods approach combining both qualitative and quantitative techniques. The data are collected through:

Semi-structured in-depth interviews

In-depth interviews, lasting 25-30 minutes each, were conducted with participants. This duration was selected to accommodate their workloads while still allowing sufficient time to explore

concepts thoroughly and provide detailed responses. Follow-up questions were used when necessary to help participants recall details that might have otherwise been unmentioned or forgotten. To enhance flexibility and clarity, interviews were conducted in both Amharic and English.

Observation of the hospital

Direct observation was carried out within Menelik II Referral Hospital. This involved carefully watching and noting how daily tasks were performed, how spaces were used, the general workflow, and interactions between staff and their environment. This firsthand look helped gather practical details about the hospital's actual working conditions and any ergonomic aspects in play. Photographs were also captured to document these observations, offering insights that might not come up in interviews or surveys.

The Structure of questioners

The questionnaire is structured to thoroughly assess various aspects of ergonomic design and its impact on employee performance. It begins with a section for demographic information to collect details about participants, such as age, gender, and job role. Following this, a series of closed-ended questions aims to capture respondents' perceptions of their work environment, focusing on specific ergonomic factors such as workstation design, furniture comfort, workload stress, and managements support. Likers-scale items, using a 1-to-5 rating scale, were used to measure employee satisfaction and perceived productivity levels, providing quantifiable insights into the impact of ergonomic design on their performance. Additionally, open-ended questions gather qualitative feedback about personal experiences and suggestions for enhancing ergonomic practices. This mixed-method approach ensures a thorough understanding of the relationship between ergonomic design and employee performance within the healthcare environment.

3.7 Per test

Before the questionnaires are distributed to the healthcare employees of Menelik Hospital, my adviser reviews and approves the content of each question. After a thorough evaluation,

adjustments are made to ensure clarity and relevance. Each question is designed to elicit detailed responses, focusing on the employees' experiences and insights regarding patient care and operational challenges. The goal is to collect meaningful data that accurately reflects the healthcare environment at Menilik hospital.

In preparation for administering the questionnaire, special attention is given to a clear introduction that explains the purpose of the study, assures confidentiality, and encourages honest responses. This approach helps create a trusting atmosphere, allowing respondents to feel comfortable sharing their perspectives.

A pilot test was conducted to ensure the feasibility and reliability of the research instruments used to evaluate the impact of ergonomic design on healthcare employee performance at Menelik II Referral Hospital. This preliminary study involved 25 healthcare employees who were asked to complete a survey designed to assess their perceptions of the current ergonomic conditions and their effects on job performance. The pilot test aimed to identify any doubts or difficulties in the survey questions, assess the time required to complete the survey, and evaluate the overall effectiveness of the data collection tools. Feedback from the pilot participants was used to refine the survey instrument, ensuring that it was clear, concise, and relevant to the research objectives. By conducting this pilot test, the researcher was able to make necessary adjustments to enhance the validity and reliability of the data collected during the main study, ultimately strengthening the conclusions drawn about the relationship between ergonomic design and employee performance.

3.8 Reliability of the data

The reliability of the data in this study was ensured through several measures. First, the survey instrument used to collect data was validated through a pilot test, which helped identify and rectify any ambiguities or inconsistencies in the questions. This ensured that the data collected was consistent and accurate. Additionally, Cronbach's alpha was used to assess the internal consistency of the survey items, confirming that they reliably measured the constructs of interest. The study also employed a systematic sampling method to select participants, ensuring that the sample was representative of the healthcare employees at Menelik II Referral Hospital.

Furthermore, data collection was conducted over a consistent period to minimize temporal biases. By controlling these variables and using validated instruments, the study aimed to provide reliable insights into the relationship between ergonomic design and employee performance.

Many studies agree that a Cronbach's Alpha coefficient of 0.7 is a good enough measure of an instrument's internal consistency, which means it shows how well different parts of a test or survey measure the same underlying concept (Taber, 2018). According to Glen (2022) an alpha coefficient below 0.5 is unacceptable; from 0.5 up to (but not including) 0.6 is poor; from 0.6 up to (but not including) 0.7 is questionable; from 0.7 up to (but not including) 0.8 is acceptable; from 0.8 up to (but not including) 0.9 is good; and an alpha of 0.9 or higher is excellent.

Cronbach's Alpha, $\alpha = \frac{k}{k-1}\left(1 - \frac{\sum S^2 y}{S^2 x}\right)$

Where, k = Number of items (The number of test questionnaires)

$\sum S^2 y$ = The sum of each item (questionnaires) Variance

$S^2 x$ = Variance of the total scores

Table 3.2: Cronbach's Alpha of the study

Variables	Value
No of item	13
summed variance of each item ()	9.12
variance of total scores()	28.04333
Cronbach's Alpha	0.73102

The above Table shows that the Cronbach's alpha value for the Likert scale questionnaire is 0.731. This indicates that the internal consistency of the study's instrument is ' acceptable'.

3.9 Data analysis techniques

For the data analysis techniques, quantitative data were organized into tables for analysis. Qualitative data obtained from interviews were carefully reviewed and summarized to extract key insights. Additionally, data from observations were summarized. Photographs and checklist data were used as supporting evidence to complement the findings from primary and secondary sources. The data analysis Tools used for this study:

Quantitative data analysis

Quantitative data were gathered through structured surveys administered to healthcare workers. The survey included Likert-scale questions designed to assess various ergonomic factors and employee performance metrics.

Descriptive Statistics: To summarize the data, the initial analysis involved descriptive statistics. Measures such as the mean, standard deviation, and frequency distributions were calculated to provide an overview of respondents' perceptions and experiences concerning ergonomic design.

Correlation Analysis: A correlation analysis was conducted to determine the strength and direction of the relationship between the identified ergonomic factors and employee performance metrics. This involved calculating Pearson or Spearman correlation coefficients.

Regression Analysis: to evaluate how well ergonomic design predicts employee performance, multiple linear regression analysis was conducted. This analysis identified which specific ergonomic elements had the most significant impact on performance, even after accounting for other potential influencing variables.

Qualitative data analysis

Qualitative data were collected through open-ended survey questions and semi-structured interviews. This allowed participants to express their experiences and perceptions regarding ergonomic design in their work environment.

3.10 Data analysis tools

The following software tools were employed for data analysis in this study:

For quantitative data analysis, for initial data organization Microsoft Excel was used, cleaning, and preparation. The cleaned dataset was then imported into SPSS (Statistical Package for the Social Sciences) for further analysis. SPSS Version 24 was used to calculate descriptive statistics (frequencies, means, and standard deviations) and to perform inferential statistical tests, specifically Pearson correlation to assess the strength and direction of the relationship between ergonomic design and employee performance, and multiple linear regressions to determine the predictive power of ergonomic factors on performance outcomes.

For qualitative data, Microsoft Word was employed to process responses from open-ended questions and interviews, creating organized, literal text documents suitable for systematic qualitative description.

3.11 Ethical considerations

After receiving approval from the Addis Ababa Health Bureau's ethical review committee to conduct this study, the research and academic department at Menelek II Hospital accepted the study and agreed to Collaborate on the next steps.

It is important to maintain ethical norms while conducting research. The main objective of research is to acquire knowledge and promote truth. This can be achieved by avoiding errors that may arise due to providing false information, fabricating or misrepresenting information. Secondly, research requires great efforts that demand coordination, communication, and cooperation amongst researchers and other people involved in the process (Akaranga & Makau, 2016). Therefore**,** the study prioritizes ethical considerations and informed consent obtained from all participants. Privacy and confidentiality of the participants maintained throughout the data collection and analysis process.

CHAPTER FOUR

4. DATA ANALYSIS AND DISCUSSION

4.1. Introduction

This chapter explains how the collected data are analyzed. The data collected from different sources hospital's records, questionnaires, observations, and interviews were analyzed to understand the relationship between the current ergonomic designs and employee performance in healthcare.

4.2 Based on the hospital records data analysis

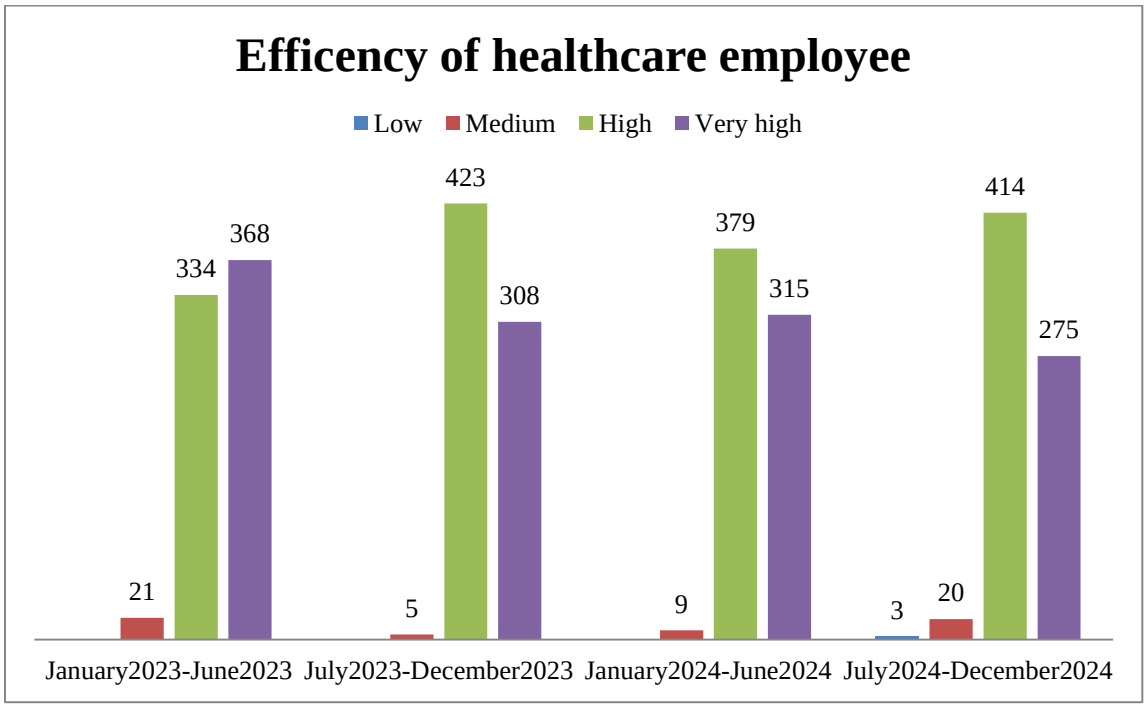

Figure 4.1: Healthcare employee efficiency (source hospital's human resource)

To establish a baseline context for employee performance, efficiency ratings were obtained from the Human Resources department at Menelik II Referral Hospital. As shown in Figure 4.1, the data from January 2023 to December 2024 reveals a significant and concerning shift: the number

of employees rated as having "Very High" efficiency decreased by 25% over the two-year period.

This observable decline in the hospital's top performance level raises a critical question about its potential underlying causes. While these Human Resources ratings are a general measure and are not directly linked to specific ergonomic factors in the hospital's records, this shift provides a powerful empirical starting point for this study.

Therefore, this study was designed to investigate whether a relationship exists between this decline in performance and the ergonomic conditions experienced by the hospital's employees. The following sections explored the specific physical, cognitive, and organizational factors that may be contributing to this shift.

4.3 Data analysis from questionnaires

4.3.1 Characteristics of the respondent's demographic

Data collection took longer than one month due to the heavy workload of healthcare employees, which caused delays in the return of completed questionnaires. A total of 263 questionnaires were distributed both manually and by email (Google forms). Out of these, 172 were returned, but only 163 were filled out completely and correctly. The incomplete responses were removed from consideration, resulting in a final response rate of 61.98% and a nonresponse rate of 38.02%.

Table 4.1: The response rate

Classification	Respondent number	Respondent percentage
Response	163	61.98%
Not Response	100	38.02%
Total	263	100%

As shown in Table 4.2, the demographic data represents a total of 163 individuals who participated in the survey. The majority of participants were female (96, or 59%), while 67 (41%) were male. This highlights a notable female predominance among the survey participants.

The academic qualifications of the majority of respondents indicated that 154 (94.48%) hold a first degree, showing that most participants were educated to at least a bachelor's level. Only a small percentage, 7 (4.29%), had a second degree, and very few, 2 (1.23%), had only a diploma.

Most of respondents have between 1 and 10 years of experience, with 82 (50.31%) having between 1 and 5 years and 65 (39.88%) having between 6 and 10 years. This suggests that the sample is mostly composed of early to mid-career professionals. Few respondents 14 (8.59%) have Less than 1 year and Very few respondents 1(0.61%) have more than 10 years of experience.

Table 4.2: Characteristics of the respondent's demographic

No	Classification		Respondent number	Respondent percentage
1.	Gender	Male	67	41%
		Female	96	59%
		Total	163	100%
2.	Academic qualification	Diploma	2	1.23%
		First degree	154	94.48%
		Second degree	7	4.29%
		Total	163	100%
3.	Years of experience	Less than 1 year	14	8.59%
		1-5 years	82	50.31%
		6-10 years	65	39.88%
		11-15 years	1	0.61%
		More than 15 years	1	0.61%
		Total	163	100%

The figure below shows the respondents' positions within the hospital. The majority were nurses (113, 69.32%). The remaining respondents included general doctors (10, 6.14%), pharmacists (8, 4.91%), midwives (8, 4.91%), anesthetists (6, 3.68%), laboratory technicians (5, 3.07%), nurse psychiatrists (4, 2.45%), laboratory technologist (4, 2.45%), doctors (2, 1.23%), dental specialists (2, 1.23%), and one psychiatrist (1, 0.61%). This representation across various hospital roles indicates that the respondents have relevant firsthand knowledge from their working environments to provide accurate responses to the questionnaire.

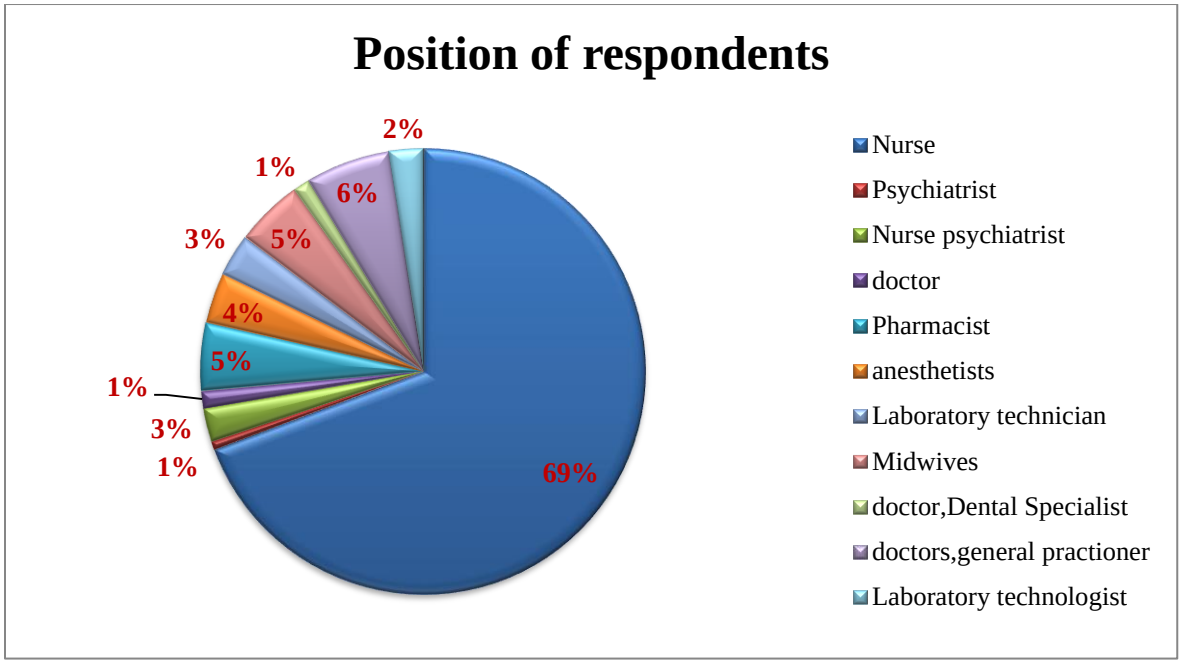

Figure 4.2: The position of respondents

Awareness of ergonomic workplace design

Table 4.3: Respondents of awareness of ergonomic workplace design

Questions	Yes	No	Mean	Standard deviation
Are you familiar with ergonomic workplace design?	32 (19.60%)	131 (80.40%)	1.804	0.398
Have you received any ergonomics training at work?	14 (8.60%)	149 (91.40%)	1.914	0.281

Rate the level of ergonomic awareness at this hospital	High level	Moderate level	Low level	Not sure		Mean	Standard deviation
	0	6 (3.70%)	52 (31.90)	105 (64.40%)		3.607	0.560
Rate the ergonomics of your personal workspace.	Excellent	Good	Fair	Poor	Very poor	Mean	Standard deviation
	0	28(17.2%)	82 (50.3%)	53(32.5%)	0	3.153	0.690

The distribution of ergonomic workplace design awareness among healthcare employees, as shown in Table 4.3, indicates that a majority of respondents are not familiar with the concept of ergonomic design. Specifically, only 32 respondents (19.6%) reported familiarity with it, while 131 (80.4%) reported being unfamiliar. Furthermore, most healthcare employees (149, 91.4%) have never received training or information about ergonomics in their workplace, compared to just 14 (8.6%) who have. When asked to rate their knowledge, most respondents chose "Not Sure" (105 respondents, 64.4%) or "Low" (52 respondents, 31.9%). Regarding the workplace itself, most staff rated its ergonomic design as "Fair" (82 respondents, 50.3%), while the rest were evenly split between "Good" (28, 17.2%) and "Poor" (53, 32.5%).

This data indicates that most healthcare employees at Menelik II Referral Hospital have a low awareness of ergonomic workplace design principles, have not received sufficient training, and work in a physical environment that is perceived as merely satisfactory rather than optimized for safety and well-being.

Factors affecting performance

To analyze the relationship between ergonomic workplace design and employee performance, the collected data were entered into SPSS software. The study's independent variables were Physical, Cognitive, and Organizational Ergonomics, and the dependent variable was employee performance. To investigate the impact of these factors on employee performance, two statistical methods were used: Pearson Correlation and multiple linear regressions.

In this study, the relationship between variables is defined as follows:

1. Independent Variable (IV). The independent variable is the factor that is considered the cause of an effect. For this study, the independent variable is Ergonomic Workplace Design, which is assessed through its three main domains: physical, cognitive, and organizational ergonomics.

2. Dependent Variable (DV). The dependent variable is the primary outcome that is measured to assess the effect of the independent variable. The dependent variable of this study is Employee Performance.

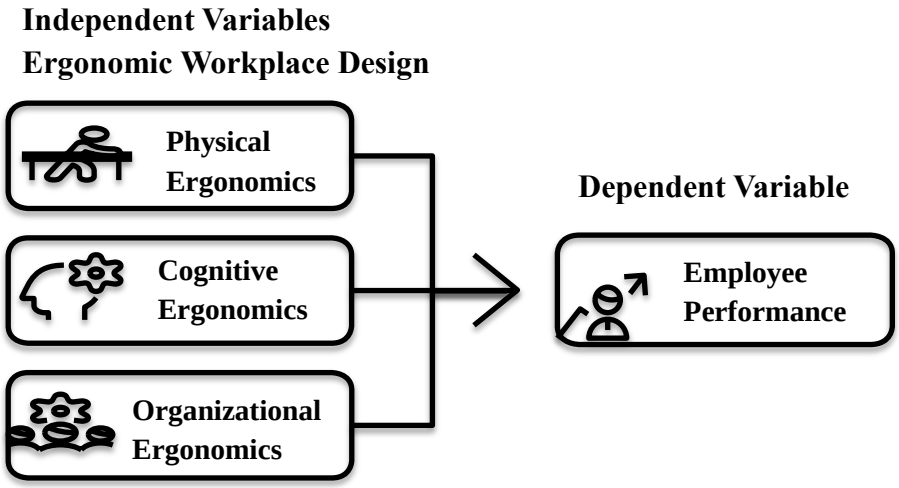

Figure 4.3: The relationship between the independent and dependent variables

Analysis of Pearson correlation

A statistical measure used to quantify the strength and direction of the linear relationship between two metric variables is Pearson correlation coefficient (r). The coefficient value ranges from -1.00 to +1.00. A value of 0 indicates no linear relationship, while values of +1.00 and -1.00 represent perfect positive and perfect negative correlations, respectively. The sign of the coefficient (+ or -) indicates the relationship direction, while its absolute value determines the strength. To interpret the strength of the association in this study, the practical guidelines proposed by (Hair et al., 2017) are used. These rules of thumb provide a basis for classifying the correlation strength, as summarized in Table 4.4.

Table 4.4: Rules of thumb for interpreting correlation coefficient strength

Coefficient Range	Strength of Association
0.00 – 0.20	Very Weak / Negligible
0.21 – 0.40	Weak
0.41 – 0.60	Moderate
0.61 – 0.80	Strong
0.81 – 1.00	Very Strong

Source: Adapted from (Hair et al., 2017)

In this study, Pearson correlation analysis was used to examine the linear relationships between the three main ergonomic factors (Physical, Cognitive, and Organizational) and the key outcome variable (Employee Performance).

Table 4.5: Pearson's correlation of independents and the dependent variables

		Physical ergonomic	Cognitive ergonomic	Organizational ergonomic	Employee performance
Physical ergonomics	Pearson Correlation	1	.541	.423	.561
	Sig. (2-tailed)		.000	.000	.000
	N	163	163	163	163
Cognitive ergonomic	Pearson Correlation	.541	1	.534	.442
	Sig. (2-tailed)	.000		.000	.000
	N	163	163	163	163
Organizational ergonomic	Pearson Correlation	.423	.534	1	.436
	Sig. (2-tailed)	.000	.000		.000
	N	163	163	163	163
Employee performance	Pearson Correlation	.561	.442	.436	1
	Sig. (2-tailed)	.000	.000	.000	
	N	163	163	163	163

Source: the output of SPSS Version 24

The results indicate from the above table are the independent variables Physical, Cognitive, and Organizational ergonomics factors are positively and significant correlation with the dependent variable employee performance.

The Pearson correlation value physical ergonomics and employee performance ($r = .561$, $p < .001$): This moderate positive correlation highlights the considerable value of investing in the physical workspace. Employees who perceive their physical environment favorably are significantly more likely to report higher performance. Cognitive ergonomics and employee performance ($r = .442$, $p < .001$): This moderate positive correlation indicates that making work mentally manageable through clear instructions, easy-to-use systems, and minimized distractions has a clear and significant benefit in terms of employee performance. Organizational ergonomics and employee performance ($r = .436$, $p < .001$): This is also a moderate positive correlation. Supportive organizational structures, including effective communication, teamwork, and manageable workloads, are directly related to better performance outcomes.

The findings also show that all three ergonomic factors are significantly and positively correlated with each other.

Physical & Cognitive Ergonomics ($r = .541$, $p < .001$): A moderate positive correlation exists between these two domains. A well-designed physical space reduces physical stress, which in turn frees up mental resources, reduces cognitive load, and makes it easier to focus.

Cognitive & Organizational Ergonomics ($r = .534$, $p < .001$): This moderate positive correlation indicates that a well-organized company with clear communication and defined roles makes work less confusing and easier to process mentally.

Physical & Organizational Ergonomics ($r = .423$, $p < .001$): This moderate positive correlation shows that workplaces with better organizational practices also tend to have better physical environments. This suggests an integrated management approach where investing in people (through communication and support) and in physical infrastructure is viewed as two sides of the same coin.

Therefore, these results indicate a highly aligned organization where various aspects of the work experience are mutually supportive. Continuing to invest in all three areas of ergonomics is the clearest path to improving employee performance, as improvements in one area will naturally support and enhance the others.

Regression analysis

Multiple linear regression analysis is a statistical technique used to evaluate how well a set of variables predicts an outcome. This analysis was used to identify which of the three ergonomic factors (Physical, Cognitive, or Organizational), the independent variables, had the most significant impact on the dependent variable, employee performance.

Table 4.6: Model Summary

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.756[a]	.563	.547	.481

Source: the Output of SPSS Version 24

From the Table 4.6 regression model summary the R Square value is 0.563. It means that 56.3% of the total variation in Employee Performance scores can be statistically explained by these three ergonomic factors combined. This confirms that ergonomics is not a minor influence but a major determinant of how well employees perform their duties at Menelik II Hospital. The model is significant ($p < .001$).

Table 4.7: Regression coefficients

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.244	.487		4.608	.000

	Physical ergonomics	.310	.107	.260	3.084	.002
	Cognitive ergonomics	.145	0.058	.152	2.500	.013
	organizational ergonomics	.232	.047	.208	4.936	.001

Source: the Output of SPSS Version 24

A multiple linear regression analysis was conducted to determine which ergonomic factors predict employee performance. The results, shown in the regression Coefficients Table 4.7, indicate that the overall model was statistically significant.

The Standardized Coefficients (Beta) are used to compare the relative importance of the three factors. Physical Ergonomics had the strongest positive impact on employee performance ($\beta = .260$, $p < .002$). Organizational Ergonomics was the second most significant factor ($\beta = .208$, $p < .001$). Cognitive Ergonomics was also a statistically significant predictor, though it had the smallest relative effect ($\beta = .152$, $p = .013$).

The Unstandardized Coefficient (β) for Physical Ergonomics ($\beta = .310$) provides a practical interpretation: for every one-point improvement on the physical ergonomics assessment scale, employee performance is predicted to increase by 0.31 points. This highlights the real-world benefit of making physical improvements.

These results provide strong evidence for what drives performance at Menelik II Referral Hospital. The most important finding of this study is that Physical Ergonomics is the main factor influencing employee performance. This means that the physical conditions where employees work like the comfort of their chairs, the height of their desks and beds, and how easy it is to reach equipment have the biggest impact on how well they can do their jobs.

While organizational factors like work schedules and teamwork ($\beta = .208$) and cognitive factors like mental stress ($\beta = .152$) are also important and should not be overlooked, the data clearly points to the physical environment as the best place to start making improvements.

Therefore, actions or changes aimed at improving the physical workspace are expected to produce the largest and most direct improvements in employee performance. Based on this finding, this study strongly recommends that the hospital's top priority should be fixing the physical work environment.

Has poor workplace design ever contributed to a stress-related absence?	Yes, significantly	Yes, somewhat	No, not at all	Not absent due to stress	Prefer not to say	Mean	Standard deviation
	16(9.82%)	35(21.47%)	24(14.72%)	68(41.2%)	20(12.27%)	3.674	0.665

The survey asked employees if the design of their workplace contributed to any stress that caused them to miss work. The results showed that 35 employees (21.5%) felt that workplace design 'somewhat' contributed to their stress-related absence, while 16 employees (9.82%) felt it contributed 'significantly'. Another 24 employees (14.72%) said it was 'not at all' a factor. The largest group, 68 employees (41.7%), reported not being absent due to stress, and 20 others (12.3%) chose 'Prefer not to say'.

This indicates that improving the physical and organizational design of the workplace could be an effective strategy to reduce stress and decrease employee absenteeism. The fact that nearly a third (approximately 31%) of the staff attribute their missed workdays to stress caused by poor workplace design highlights a significant opportunity for the hospital to boost employee well-being and attendance through focused ergonomic changes.

How satisfied are you with your work chair?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very dissatisfied	Mean	Standard deviation
	3(1.84%)	25(15.34%)	44(26.99%)	81(49.69%)	10(6.13%)	3.429	0.888

The respondents answer on satisfied with the current chair design indicate that 3(1.84%) of Very satisfied, 25(15.34%) of Satisfied, 91(55.8%) of Neutral, 81(49.69%) of Dissatisfied and,

10(6.13%) of Very dissatisfied. This shows that many respondents are dissatisfied with their current chair design.

Prevalence of work-related pain and discomfort

The survey also assessed the pain or discomfort that respondents experience in different body parts related to their work tasks or workstation setup.

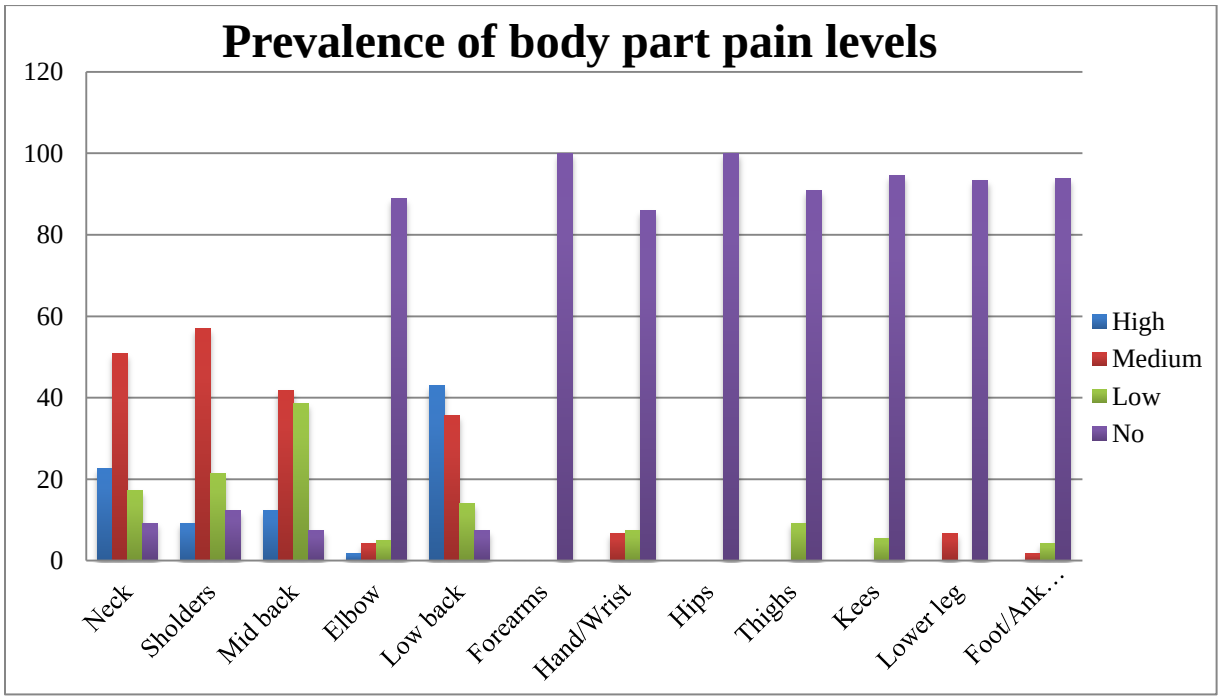

Figure 4.4: Prevalence of body part pain levels among healthcare employees

According to Figure 4.4, which details the prevalence and level of body pain among 163 respondents, the lower back was the most significantly affected area. A significant 70 respondents (42.9%) reported a "high" level of pain in this region, with another 58 (35.6%) reporting a "medium" level.

The neck and shoulders were also common sources of discomfort. For neck pain, over half of the respondents (83, or 50.9%) experienced a "medium" level, while 37 (22.7%) reported a "high" level. Shoulder pain was primarily of "medium" level, reported by 93 participants (57.1%).

Pain was notably less frequent in the arms and legs. A majority of respondents reported no pain at all in the elbows (89.0%), hands/wrists (85.9%), thighs (90.8%), and knees (94.5%). Furthermore, no participants (0%) reported any pain in their forearms or hips.

The data from the respondents show that pain is most prevalent in the back (lower, mid), neck, and shoulders, while the arms and legs were largely unaffected.

Job satisfaction and well-being

Table 4.8: Respondents of job satisfaction and well-being

Questions	Yes	No	Not sure	Mean	Standard deviation
Does ergonomic workplace design affect your job satisfaction?	94(57.7%)	16(9.8%)	53(32.5%)	1.748	0.919

Rate your overall well-being at work.	Poor	Fair	Neutral	Good	Excellent		
	7(4.3%)	60(36.8%)	69(42.3%)	27(16.6%)	0	2.712	0.791

How strongly does ergonomics affect employee commitment and satisfaction?	Significantly	Somewhat	Negligibly	Not sure		
	86(52.8%)	70(42.9%)	2(1.2%)	5(3.1%)	1.546	0.678

Table 4.8 presents employee perceptions of job satisfaction and well-being in relation to ergonomic design. A majority of respondents (94, or 57.7%) indicated that they notice a relationship between ergonomic design and their overall job satisfaction. In contrast, 16 respondents (9.8%) did not notice a connection, while significant portions (53, or 32.5%) were unsure.

Regarding overall well-being in the work environment, responses were mixed but centered on neutral to fair. The largest group rated their well-being as 'neutral' (69, or 42.3%), followed closely by 'fair' (60, or 36.8%). A smaller group felt their well-being was 'good' (27, or 16.6%), and very few rated it as 'poor' (7, or 4.3%).

The finding shows that a majority of employees see a connection between ergonomics and job satisfaction. However, when rating their current well-being, the most common response was 'neutral,' suggesting the reported importance has not yet resulted in a strong positive experience.

Organizational support

Table 4.9: Respondents of organizational support

	Very low support	Low support	Moderate support	High support	Very high support	Mean	Standard deviation
Rate the level of management support for ergonomics.	97(59.5%)	50(30.7%)	16(9.8%)	0	0	1.503	0.670

The above table 4.9 show that the respondents on Organizational Support 97(59.5%) of very low support, 50(30.7%) of low support and, 16(9.8%) of moderate support rate the level of support provided by Menelik II Referral Hospital in terms of promoting and implementing ergonomic design practices.

The findings show that the hospital provides insufficient support for implementing or promoting ergonomic design.

Patient outcomes

Table 4.10: Respondents of patient outcomes

	Not at all	Somewhat	Moderately	Significantly	Very Significantly	Mean	Standard deviation
How strongly does ergonomic workplace design affect patient outcomes?	1(0.61%)	43(26.38%)	48(29.45%)	68 (41.72%)	3(1.84)	3.055	0.801

The result of respondents on the significantly of ergonomic design practices in impact patient outcomes 1(0.61%) of not believe at all, 43(26.38%) of believe somewhat, 48(29.45%) of

believe moderately, 68 (41.72%) of believe significantly and, 3(1.84) of believe very significantly.

This shows that most of the respondents believe ergonomic design practices impact patient outcomes.

Table 4.11: Ergonomic workplace design practices on impact patient outcomes.

	Very important	Somewhat important	Neutral	Not very important	Not at all important	Mean	Standard deviation
The importance of evaluating an ergonomic workplace design by its effect on employee performance and patient outcomes.	97(59.5%)	50(30.7%)	16(9.8%)	0	0	1.503	0.670

Table 4.11 indicates that ergonomic workplace design practices impact on employee performance and patient outcomes at Menelik II Referral Hospital are reported as very important by the majority of employees. A majority of respondents rated 'very important' (97 respondents, 59.5%) and 'somewhat important' (50 respondents, 30.7%). In contrast, only 16 participants (9.8%) rated 'neutral.'

The findings show the importance of evaluating ergonomic workplace design by its impact on employee performance and patient outcomes.

Knowledge distribution and training

Table 4.12: Respondents of distribution and training

Questions	Yes	No	Not sure	Mean	Standard deviation
Would you be interested in ergonomics training?	91(55.8%)	12(7.4%)	60(36.8%)	1.810	0.946

Table 4.12 indicates that regarding knowledge distribution and training, the majority of respondents, 91 (55.8%), were interested in participating in training programs to improve their

understanding and application of ergonomic principles. In contrast, 12 (7.4%) were not interested, and 60 (36.8%) were unsure. This result highlights a clear demand among employees for further education on ergonomics.

4.3.2 Observation analysis

Nurse station

Observation of a nurse station at Menelik II Referral Hospital (Appendices A) shows that the most obvious and serious ergonomic problem is the very poor quality of the seating. Having a badly damaged chair next to other simple, non-adjustable chairs indicates a basic failure to provide employees with the necessary physical support for their demanding work. This, made worse by desks that can't be adjusted and monitor screens that are likely not placed well, directly causes staff to experience major physical discomfort, pain, and an increased risk of musculoskeletal injuries. Such conditions will definitely lead to distraction, less focus, and in the end, clearly make it harder for employees to do their jobs well, potentially affecting the quality and safety of patient care.

Patient room chair

The chair in the patient room, shown in the picture (Appendices B), is not well-suited for doctors when they are checking a patient's blood pressure or doing other tasks. This chair's design causes several problems: doctors' feet often don't touch the ground properly, their bodies can't be supported in a relaxed way, and they have to bend their backs too much. Also, the chair's height cannot be changed. Sitting like this over and over again puts strain on their bodies, which can lead to low back pain and force them into uncomfortable positions. This can affect their health and make it harder for them to do their jobs well and be productive. Because of these issues, the chair needs a better ergonomic design to help improve the doctors' health, their work performance, and their overall productivity.

4.3.3 Open ended data analysis

From the open-ended results, employees at Menelik II Referral Hospital clearly indicated that current ergonomic conditions significantly impact their work. They expressed a strong need for improved physical ergonomics, primarily through highly adjustable and supportive work chairs designed for comfort and hygiene, as current seating often causes discomfort. In addition to individual workstations, poorly designed software systems and an insufficient physical workspace layout were frequently cited as sources of considerable mental load and obstacles to effective teamwork.

Furthermore, employees feel that current methods for ergonomic training and information sharing are largely ineffective, citing lack of time and irrelevant content as major obstacles. They expressed support for more practical, role-specific, and accessible learning opportunities, alongside tangible resources. Underpinning these requests is a desire for greater management support and active employee involvement in ergonomic improvements, suggesting that addressing these aspects is crucial for meaningful change.

Addressing these multi-dimensional ergonomic issues is crucial for enhancing their well-being and ability to perform their duties effectively.

4.3.4 Interview analysis

Interviews were conducted with sixteen employees from Menelik II Hospital: eight healthcare employees and four individuals in Managerial and Supervisory roles (Department Heads), and four individuals from key support and administrative functions including Procurement, Human Resources, Facilities Management, and Senior Hospital Administration. Interview responses clearly indicate that current ergonomic conditions are a problem. Healthcare employees describe direct impacts on their comfort, leading to pain, fatigue, and stress that significantly obstruct their daily work performance and ability to focus. While management acknowledges these challenges and their relationship to healthcare employees' well-being and potential absenteeism, they emphasize significant budget constraints as the primary obstacle to implementing widespread ergonomic improvements. This creates a situation where the negative effects of poor

ergonomic design on employee performance are recognized by both groups, but practical, systemic solutions are largely delayed by resource limitations, although there is general agreement on their importance.

4.4 The discussion of the finding

The results from Menelik II Referral Hospital show a significant lack of ergonomic knowledge among healthcare employees. Only 19.6% of employees reported being familiar with ergonomic workplace design, and just 8.6% had received any related training. This widespread knowledge gap is consistent with other studies. For instance, research by Abd Rabou and Akel (2020) and Ali and Abdel-Hakeim (2018) both found that about 80% of nurses in their studies had not received ergonomics training. This lack of education is often linked to poor working conditions, a connection also found by Mohammad et al. (2019).

The statistical analysis from this study confirms a strong link between ergonomics and performance at the hospital. Correlation analysis showed that physical, cognitive, and organizational ergonomics all have moderate, positive, and significant relationships with employee performance, with physical ergonomics having the strongest effect ($r = .561$, $p < .001$). Furthermore, regression analysis revealed that these three factors together explain 56.3% of the variation in employee performance, with physical ergonomics again being the most influential predictor ($\beta = .260$, $p < .002$). These findings are supported by the broader literature. A study by Sönmez et al. (2025) also found a moderate positive correlation between ergonomic conditions and job performance ($r = 0.364$, $p < 0.001$). Similarly, research by Saleh (2025) demonstrated a strong positive link between employees' satisfaction with their workplace design and both their well-being ($r = 0.72$, $p < 0.01$) and productivity ($r = 0.68$, $p < 0.01$).

The survey also revealed specific consequences of poor ergonomics at the hospital. Nearly one-third of employees believed their stress-related absences were due to poor workplace design, and dissatisfaction with work chairs was high. Following this, a high number of respondents reported experiencing musculoskeletal pain, particularly in the neck, shoulders, and back, which is consistent with other research. For example, a study by Nemera et al. (2024) in Ethiopia found that 73.8% of nurses had work-related pain that contributed to higher absenteeism and lower job

satisfaction. This mirrors findings by Mohammad et al. (2019) that a large majority of nurses (77%) experienced such pain, most often in the neck and shoulders. The issue of Low Back Pain (LBP) is especially common, with studies by Mazni et al. (2025), Belay et al. (2016), and Aldhabi et al. (2025) all reporting high rates of LBP and other musculoskeletal disorders across different healthcare roles.

The work-related consequences of this pain, such as absenteeism and employees leaving their jobs, are also widely reported in research. Work-related pain has significant impacts on a nurse's career, a fact supported by studies in various settings. Research in Australia and Iceland identified high absenteeism among newly hired nurses (Burmeister et al., 2019), while (Zayed et al. (2019) indicated that work-related musculoskeletal disorders were the reason for over half of all nurse absences. The direct link between LBP and leaving the workforce was further confirmed by Ibrahim and Elsaay (2015), who found that 72.5% of their participants had either missed work or changed jobs due to this specific issue.

The findings from Menelik II also highlighted a critical disconnect between what employees believe and the support they receive from the organization. While over half of the respondents recognized the link between ergonomic design and their job satisfaction, a majority rated management support for ergonomics as "very low" or "low." The literature confirms that employee satisfaction is a key outcome of good ergonomics, which in turn positively impacts patient satisfaction (Momani et al., 2022). Sönmez et al. (2025) further emphasize that management has the primary responsibility for developing and implementing the ergonomic policies that foster both employee well-being and institutional efficiency.

Most employees at Menelik II believe that ergonomic design significantly impacts patient outcomes. Nearly 90% think it is very or somewhat important to evaluate ergonomic practices by their effect on both employees and patients. This belief is supported by research from Saleh (2025), which found that improving workplace design is a key factor in boosting employee satisfaction, well-being, and productivity, all of which are essential for high-quality patient care.

Ultimately, the findings at Menelik II Referral Hospital align with broader studies**;** low ergonomic awareness and training are common, but investing in physical ergonomics yields the

most improvements in employee performance, well-being, and patient outcomes. Hospitals worldwide face similar challenges, a fact that highlights the critical need for management support and focused ergonomic interventions to improve experiences for both employees and patients.

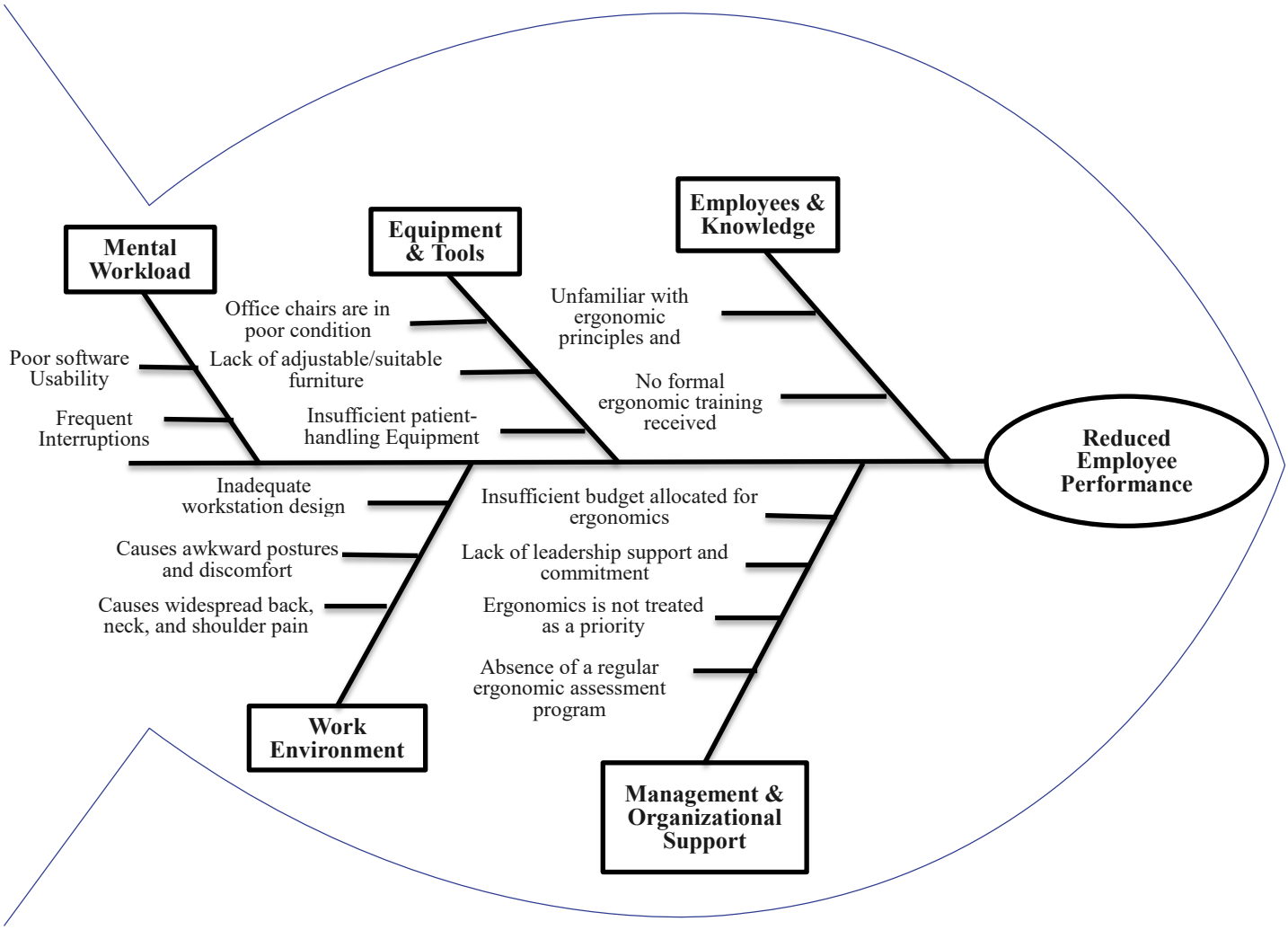

Figure 4.5: The cause of reduced employee performance

CHAPTER FIVE

5. PROPOSED CONCEPTUAL FRAMEWORK

5.1 Introduction

This chapter presents a new conceptual framework. It shows how a better-designed workspace can help hospital employees do their jobs more effectively and comfortably. The development of this framework is based on analysis findings, various literature reviews, and direct observations of the hospital environment.

5.2 Proposed Conceptual Framework

The conceptual framework for investigating the impact of ergonomic workplace design on employee performance at Menelik II Referral Hospital proposes specific relationships between workplace ergonomic factors and employee performance outcomes. This framework will guide the research by structuring the analysis and providing a basis for developing practical interventions.

Main components of the framework

1. Independent Variable: Ergonomic Workplace Design

Ergonomic workplace design, the primary independent variable, is the process of designing or arranging workplaces, products, systems, and processes to fit the people who use them, aiming to optimize human well-being and overall system performance. For Menelik II Referral Hospital, Ergonomic Design is understood as a multidimensional construct with three key domains that collectively and individually shape the work environment and experiences of healthcare employees:

A. Physical Ergonomics: This domain focuses human anatomical, physiological, anthropometric, and biomechanical characteristics as they relate to physical activity. It

directly influences the physical interaction between employees and their work environment. Well-designed physical ergonomics promotes comfort, reduces physical strain, and makes tasks safer and easier. Key aspects at Menelik II Referral Hospital include:

Workstation and Seating Design: The layout and adjustability of nurses' stations, doctors' consultation rooms, and laboratory benches. This includes a critical focus on seating design (e.g., chair height, adjustability, neck support, back support, stability).

Medical Equipment and Tool Design: The usability, handles design, weight, and force requirements of medical instruments, diagnostic equipment, and patient monitoring systems.

Patient Handling Ergonomics: Availability and usability of patient lifting aids, transfer devices, and techniques to reduce physical strain on healthcare employees during patient mobilization and care.

Environmental Factors: Adequacy of lighting for tasks, noise levels, thermal comfort (temperature and ventilation), and Structural arrangements influencing movement and workflow.

B. Cognitive Ergonomics: This ergonomics domain concerns mental processes such as perception, memory, and reasoning, as they influence interactions among humans and other system components. In a high- risk environment like a hospital, effective cognitive ergonomics supports clear thinking, efficient information processing, rational decision-making, and reduces mental fatigue and errors. Key aspects include:

Health Information Systems (HIS) and Electronic Medical Record (EMR) Usability: The design of software interfaces, ease of data entry and retrieval, clarity of information display, and support for clinical decision-making.

Clarity of Protocols and Procedures: The design and accessibility of standard operating procedures, clinical guidelines, and communication protocols to minimize uncertainty and cognitive load.

Mental Workload Management: Job design aspects that influence mental fatigue, attention demands, and decision-making complexity (e.g., task variety, interruption management).

C. Organizational (Macro) Ergonomics: This domain addresses the optimization of socio-technical systems, including their organizational policies, structures, and processes.

Supportive organizational ergonomics creates a productivity work environment, promotes safety, and empowers employees. Key aspects include:

Work Scheduling and Shift Design: Scheduling patterns, duration of shifts, rest break policies, and their impact on fatigue and wakefulness.

Teamwork and Communication Systems: Processes and tools that support effective communication and coordination among healthcare teams (e.g., multidisciplinary meetings).

Ergonomic Policies and Culture: The existence and enforcement of ergonomic policies, management commitment to ergonomics, employee involvement in ergonomic improvements, and the overall safety culture.

Ergonomic Training and Education: Availability and effectiveness of training programs for healthcare employees on ergonomic principles, safe work practices, and the use of ergonomic equipment.

2. Dependent Variable: Employee Performance

Employee Performance in the context of Menelik II Referral Hospital refers to the effectiveness and efficiency with which healthcare professionals carry out their job responsibilities, contributing to both patient outcomes and organizational goals. It is a multidimensional construct including:

- **Task Efficiency and Productivity:**

Time to Complete Tasks: Duration required for standard clinical or administrative procedures.

Patient Flow: Number of patients attended to or procedures completed in a given timeframe (where quality is maintained).

Work Output: Quantity of work accomplished (e.g., lab tests processed) relative to standards.

- **Quality of Patient Care and Service Delivery:**

Observance of Clinical Protocols: Consistency in following best practices.

Reduction in Clinical Errors: Frequency of medication, diagnostic, or procedural mistakes.

Patient Satisfaction: Feedback on perceived care quality, communication, and responsiveness from staff.

Completeness and Accuracy of Documentation: Quality of medical records.

- **Employee Safety, Health, and Well-being (as contributors to sustained performance):**

Reduction in Work-Related Musculoskeletal Disorders (WMSDs): Lower incidence of reported pain, discomfort, or injuries.

Reduced Occupational Stress and Burnout: Lower self-reported stress, emotional exhaustion, and detachment.

Job Satisfaction: Overall contentment with the job and work environment.

Reduced Absenteeism and Presenteeism: Lower rates of employees being absent or working at reduced capacity due to health problems.

3. Mediating Variables (Explaining the Ergonomics-Performance Relationship)

Mediating variables explain the process through which ergonomic design influences employee performance. The impact is often flows through these intermediate factors:

- **Physical Well-being and Comfort:** Improved physical ergonomics is expected to reduce physical strain and discomfort, leading to fewer WMSD symptoms. This enhanced well-being allows employees to perform more effectively.

Hypothesized relationship*:* Ergonomic Workplace Design → Improved Physical Well-being/Comfort → Enhanced Employee Performance.

- **Cognitive Load and Mental State:** Effective cognitive ergonomics can reduce unnecessary mental workload, minimize distractions, and improve focus. This optimized mental state contributes to better decision-making and task performance.

Hypothesized relationship: Ergonomic Workplace Design → Optimized Cognitive Load/Improved Mental State → Enhanced Employee Performance.

- **Perceived Safety and Trust:** A work environment considered safe and well-designed can increase employee confidence, reduce anxiety, and foster trust in the organization, thereby motivating better performance.

Hypothesized relationship*:* Ergonomic Workplace Design → Increased Perceived Safety/Trust → Enhanced Employee Performance.

- **Employee Engagement and Motivation:** Good ergonomic workplace design that considers employees needs can lead to higher job satisfaction, engagement, and motivation, as employees feel valued and supported.

Hypothesized relationship: Ergonomic Workplace Design → Increased Employee Engagement/Motivation → Enhanced Employee Performance.

4. Moderating Variables (Contextual Influences)

Moderating variables are factors that can change the strength or direction of the relationship between ergonomic design and employee performance (or between ergonomic workplace design and mediators):

- **Healthcare Role Type and Department-Specific Demands:** Varying tasks and demands for different roles (e.g., surgeons, nurses, lab technicians) and departments (e.g., emergency, ICU).
- **Employee Experience, Age, and Physical Condition:** These individual factors can influence how employees interact with and benefit from ergonomic workplace designs.
- **Ergonomic Training Quality and Participation:** The effectiveness of ergonomic workplace designs can be moderated by the quality of the training and its subsequent adoption by employees.
- **Workload Intensity and Shift Patterns:** High workload or demanding shifts may amplify the effects (positive or negative) of ergonomic conditions.
- **Management Support and Organizational Culture:** The degree of management commitment and a supportive safety culture can significantly moderate the success of ergonomic interventions.

The Conceptual Framework Diagram

Based on the preceding components and their hypothesized relationships, a conceptual model is proposed. A visual representation of this model is provided in Figure 5.1, shows the relationship between ergonomic workplace design, mediating factors, moderating influences, and employee performance outcomes.

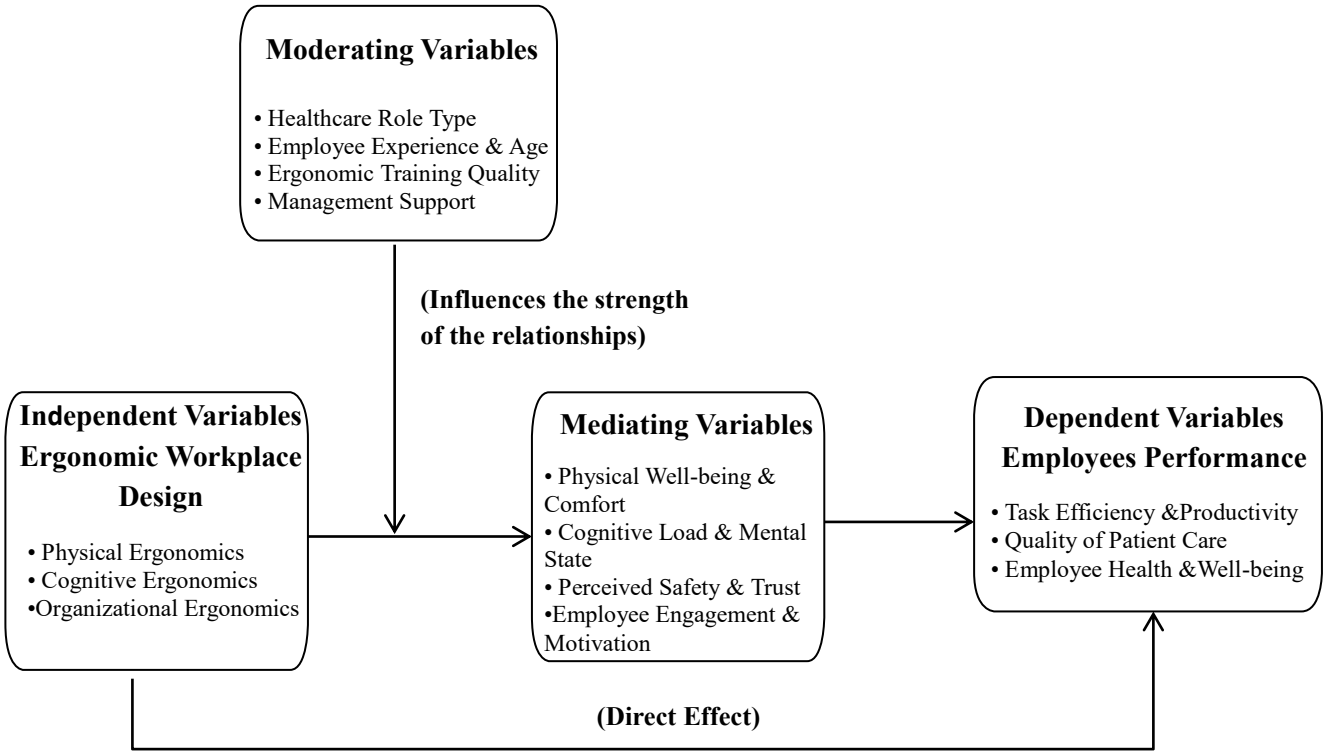

Figure 5.1: A conceptual framework for the impact of ergonomic workplace design on employee performance

This conceptual framework shows that an integrated approach to Ergonomic Workplace Design at Menelik II Referral Hospital addressing its physical, cognitive, and organizational aspects will positively influence Employee Performance. This influence is expected to be mediated by critical factors such as improved physical well-being, optimized cognitive load, enhanced perceived safety, and increased employee engagement. The strength of these relationships, in turn, is likely to be moderated by various contextual variables specific to the hospital environment and its workforce.

The model also hypothesizes that ergonomic workplace design may have a direct effect on performance that is not explained by these mediators. Understanding these complex interactions is key to designing effective ergonomic strategies that can lead to tangible improvements in both employee well-being and the quality of healthcare delivery.

5.3 Justification and Validation of the Framework

5.3.1 Justification of the Framework

A conceptual framework must be grounded in theory to be valid. The proposed relationships in this model are supported by extensive research in ergonomics, occupational health, and organizational psychology.

The Core Relationship (Ergonomics → Performance): The central concept that fitting the work to the person enhances well-being and performance is the foundational principle of ergonomics (IEA, 2000). Modern research consistently validates this, showing that ergonomic interventions reduce physical and cognitive load, which in turn leads to lower injury rates, reduced absenteeism, and higher productivity (Ebito & Umana, 2019; Koirala & Nepal, 2022).

Physical Domain: The link between physical ergonomic hazards (e.g., awkward postures, manual handling) and (WMSDs) is well-established in the healthcare literature. Studies by Karmacharya et al. (2025) underscore that interventions targeting the physical environment, such as providing patient lifting aids and adjustable workstations, are crucial not only for mitigating physical strain but also for conserving the energy and focus that employees need for high-quality patient care and performance**.**

Cognitive Domain: Beyond physical demands, the high-risk environment of healthcare, cognitive ergonomics is particularly crucial. The Systems Engineering Initiative for Patient Safety (SEIPS) model, developed by (Carayon et al., 2021), explicitly identifies tools, technology, and tasks as core elements of the work system that influence an employee's cognitive load. Poorly designed

electronic medical records (EMRs) or unclear protocols can increase mental fatigue and the risk of medical errors, directly impacting employee performance. (Holden et al., 2013)

Organizational Domain: However, improvements in the physical and cognitive domains are often insufficient without considering the organizational context. The principles of macro ergonomics emphasize that a supportive culture, strong management commitment, and employee involvement are essential. Participatory Ergonomics (PE) programs, which empower employees to co-design solutions, have been shown to be highly effective in creating sustainable improvements that promote a better work environment and boost overall productivity (Burgess-Limerick, 2018).

Mediating and Moderating Factors: Because complex relationships in social sciences are rarely direct**,** this framework incorporates mediating variables (the "how" and "why") and moderating variables (the "when" and "for whom"). This is a standard methodological approach for building robust models that reflect real-world complexity (Baron & Kenny, 1986), allowing for a more in-depth understanding of the ergonomics-performance relationship.

Therefore, by integrating these physical, cognitive, and organizational ergonomic domains within a methodologically robust framework, this study proposes a holistic model capable of explaining not just *if* ergonomic design impacts performance, but also *how*, *when*, and *for whom* these effects are most significant.

5.3.2 Validation of the Framework

The validity of the proposed framework was established through a two-part process: theoretical validation and empirical validation.

Theoretical Validation: This was achieved by grounding the framework in established theories, as detailed in the justification section above. The model's structure and proposed relationships are logically consistent with foundational models in the field, ensuring its theoretical validity.

Empirical Validation: The relationships proposed in the model were tested using the data collected for this study from Menelik II Referral Hospital. Statistical analyses, including correlation and multiple linear regression (presented in Chapter 4), were used to examine the relations between the ergonomic workplace design domains and employee performance outcomes. The results provided significant statistical support for the framework's core propositions, confirming its relevance in this specific organizational environment.

5.4 Comparison of the Proposed Framework with Existing Models

The conceptual framework developed in this study integrates and extends existing models by providing a more specific and process-oriented view of the ergonomics-performance link in a healthcare context.

Compared to ergonomic models, such as the one proposed by Kuriakose et al. (2020) which focuses on the linear impact of specific environmental factors like heat and lighting on productivity, the new framework offers a more holistic perspective. While such models are crucial for understanding the direct impact of the physical environment, they often examine a single domain in separation. In contrast, the new framework treats the physical, cognitive, and organizational domains as co-equal, interacting factors, reflecting the multifaceted nature of healthcare work.

Finally, unlike more theoretical motivational frameworks such as the High-Performance Cycle (HPC), (Selden and G. Brewer 2000, as cited in Latham, 2023) the new model operationalizes broad concepts like "organizational support" and "job demands" into tangible, measurable ergonomic variables. It thereby bridges the gap between high-level motivational theory and the practical aspects of the physical and cognitive workspace.

Therefore, the new proposed framework provides a more detailed, testable, and contextually-adapted model for understanding not just if ergonomics impacts performance, but how and why.

Table 5.1: A comparison of the proposed framework and existing models

Dimension of Comparison	Environmental Ergonomics Model (Kuriakose et al., 2020)	High-Performance Cycle (HPC) (Selden & Brewer, 2000, as cited in Latham, 2023)	The Proposed Framework (This Study)
Primary Focus	Linear impact of specific environmental factors on productivity.	General drivers of employee motivation and performance.	A specific, process-oriented model of how ergonomics impacts overall employee performance.
Key Variables	A defined set of physical environmental factors (heat, noise, etc.).	Abstract motivational concepts (e.g., job demands, support).	Co-equal, interacting physical, cognitive, and organizational ergonomic factors.
Degree of Specificity	Very concrete and specific to the physical environment.	Highly abstract and theoretical.	Bridges the gap between abstract theory and tangible, measurable ergonomic variables.
Explanation of Mechanism	Direct, linear cause-and-effect.	General link from motivators to performance.	Clearly defines and tests mediating pathways (the "how" and "why").
Primary Contribution	Establishes the link between the physical environment and productivity.	Explains the general psychological drivers of performance.	Provides a holistic, testable, and context-specific model that integrates both environmental realities and motivational mechanisms.

5.5 Proposed Model Implementation procedure

The ultimate goal of this framework is to serve as a practical tool for improving the work environment at Menelik II Referral Hospital and similar healthcare settings. The implementation of this model involves a strategic, multi-step process:

1. **Assessment:** The framework can be used as an assessment tool. Hospital management can use it to systematically assess their current workplace, identifying specific weaknesses in the physical, cognitive, and organizational ergonomic domains.

2. **Targeted Intervention Design:** Based on the assessment, the model helps in designing targeted and holistic interventions. Instead of isolated fixes (e.g., buying new chairs), the framework encourages a comprehensive strategy that might, for example, combine new patient handling equipment (physical) with updated training protocols (cognitive) and the creation of an employee-led safety committee (organizational).

3. **Prioritization and Resource Allocation:** The model helps leaders prioritize which interventions are likely to have the greatest impact on performance and well-being. By understanding the key mediating factors (like cognitive load or perceived safety), resources can be allocated to the areas that will yield the most significant improvements.

4. **Evaluation and Continuous Improvement:** After implementation, the framework provides a clear structure for evaluating the success of the interventions. By measuring changes in the mediating variables and the final performance outcomes, the organization can assess the return on its investment and identify areas for further improvement, creating a cycle of continuous improvement.

Therefore, this framework is not simply a theoretical construct but an action-oriented, cyclical guide for assessment, intervention, and continuous improvement, designed to create a healthier, safer, and more productive healthcare environment.

5.6 Importance of the Conceptual Framework

The development and application of this conceptual framework carry significant importance on multiple levels:

- **Practical Improvements at Menelik II Referral Hospital:** The primary importance lies in its potential to generate actionable insights for the hospital. By systematically investigating these links, management can:
    - Identify specific ergonomic deficiencies across departments and roles.
    - Understand critical factors impacting employee well-being and care quality.
    - Develop targeted, evidence-based ergonomic interventions.
    - Optimize resource allocation for ergonomic improvements.
    - Improve working conditions, job satisfaction, reduce turnover, and enhance patient outcomes.
- **Enhancement of Employee Well-being and Safety:** The model emphasizes employee safety, health, and well-being. Addressing ergonomic hazards can reduce WMSDs, stress, and burnout, leading to a healthier, more motivated workforce.
- **Improvement in Quality of Patient Care and Patient Safety:** Ergonomically well-designed environments reduce employee fatigue, distraction, and discomfort, which can contribute to medical errors. Improved employee performance through better ergonomics indirectly enhances patient care quality and safety.
- **Contribution to Regional Ergonomics Knowledge and Practice:** Research based on this framework can provide valuable, context-specific insights for other healthcare facilities in Ethiopia and the region, especially those in similar resource settings.
- **Academic Contribution:** The framework contributes to academic literature by applying an integrated ergonomic model to an under-researched healthcare context. Testing the proposed relationships can refine ergonomic theories.

CHAPTER SIX

6. CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This study found significant gap. The work environment at Menelik II Referral Hospital is characterized by a widespread lack of ergonomic awareness and training among healthcare employees, inadequate equipment (particularly seating), and low levels of organizational support for ergonomic principles. The physical environment is perceived by the majority of employees as only "fair" or "poor," indicating a substantial gap between the existing conditions and an optimally designed workspace.

The statistical analysis confirmed that physical, cognitive, and organizational ergonomics are all significant predictors of employee performance. Critically, physical ergonomic factors demonstrated the strongest influence. Gaps in this domain were directly related to a high prevalence of musculoskeletal pain, particularly in the back, neck, and shoulders, which in turn contributed to stress-related absenteeism and reduced job satisfaction.

This research proposes a holistic conceptual framework. This framework emphasizes that effective interventions must move beyond isolated fixes. Instead, a comprehensive strategy is required that combines investments in physical equipment (e.g., adjustable chairs and patient lifts), the implementation of continuous, job-specific training, and a demonstrated commitment from management to promote a culture of safety.

This research confirms that investing in ergonomic workplace design is not a minor operational enhancement but a strategic necessity for Menelik II Referral Hospital. By systematically addressing the identified physical, cognitive, and organizational gap, the hospital can create a safer and more supportive work environment, leading to a healthier, more motivated, and higher-performing workforce that ultimately benefits both employees and patients.

6.2 Recommendation

Based on the findings of this research, several recommendations can be made for Menelik II Referral Hospital and similar healthcare institutions:

- Implement Ergonomic Assessments: Conduct regular ergonomic assessments of workspaces to identify potential hazards and areas for improvement. This proactive approach will help mitigate risks associated with poor ergonomic practices.
- Invest in Ergonomic Equipment: Allocate resources towards acquiring ergonomic furniture and equipment, such as adjustable desks, supportive seating, and assistive devices for patient handling. This investment will enhance comfort and reduce the physical stress on healthcare employees.
- Provide Training Programs: Develop comprehensive training programs focused on proper body mechanics and ergonomic practices. Educating healthcare employee on safe lifting techniques and the use of ergonomic tools will empower them to minimize injury risks.
- Foster a Culture of Safety: Encourage open communication regarding ergonomic concerns among healthcare employee members. Creating an environment where employees feel comfortable reporting issues can lead to timely interventions and improvements in workplace safety.
- Monitor and Evaluate Ergonomic Interventions: Establish a system for monitoring the effectiveness of implemented ergonomic changes over time. Regular evaluations will help assess whether these interventions lead to sustained improvements in employee performance and satisfaction.

By adopting these recommendations, Menelik II Referral Hospital can enhance its commitment to employee health and safety while simultaneously improving the quality of care provided to patients.

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APPENDICES

Appendices A

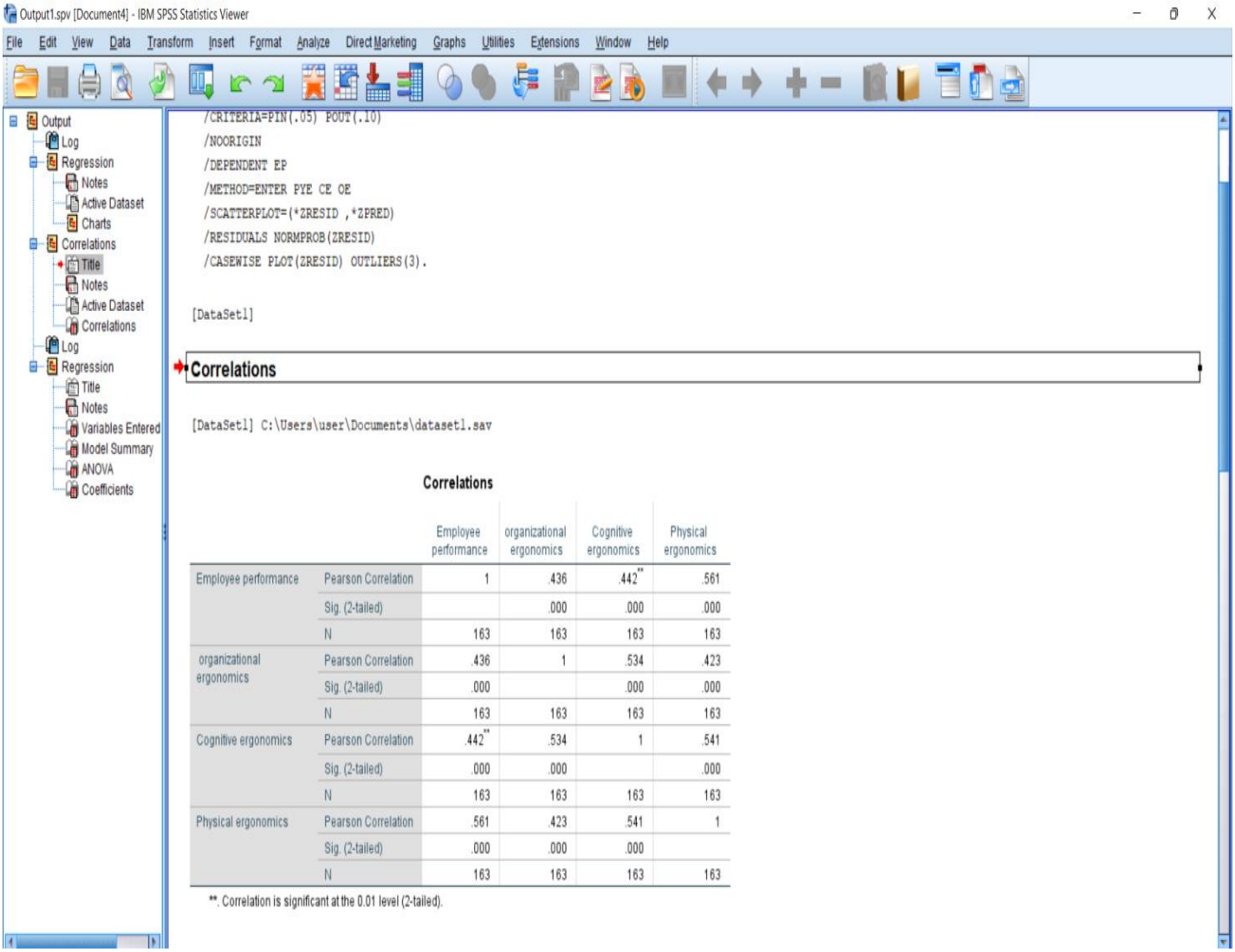
Observed ergonomic conditions at a nurse station in Menelik II Referral Hospital

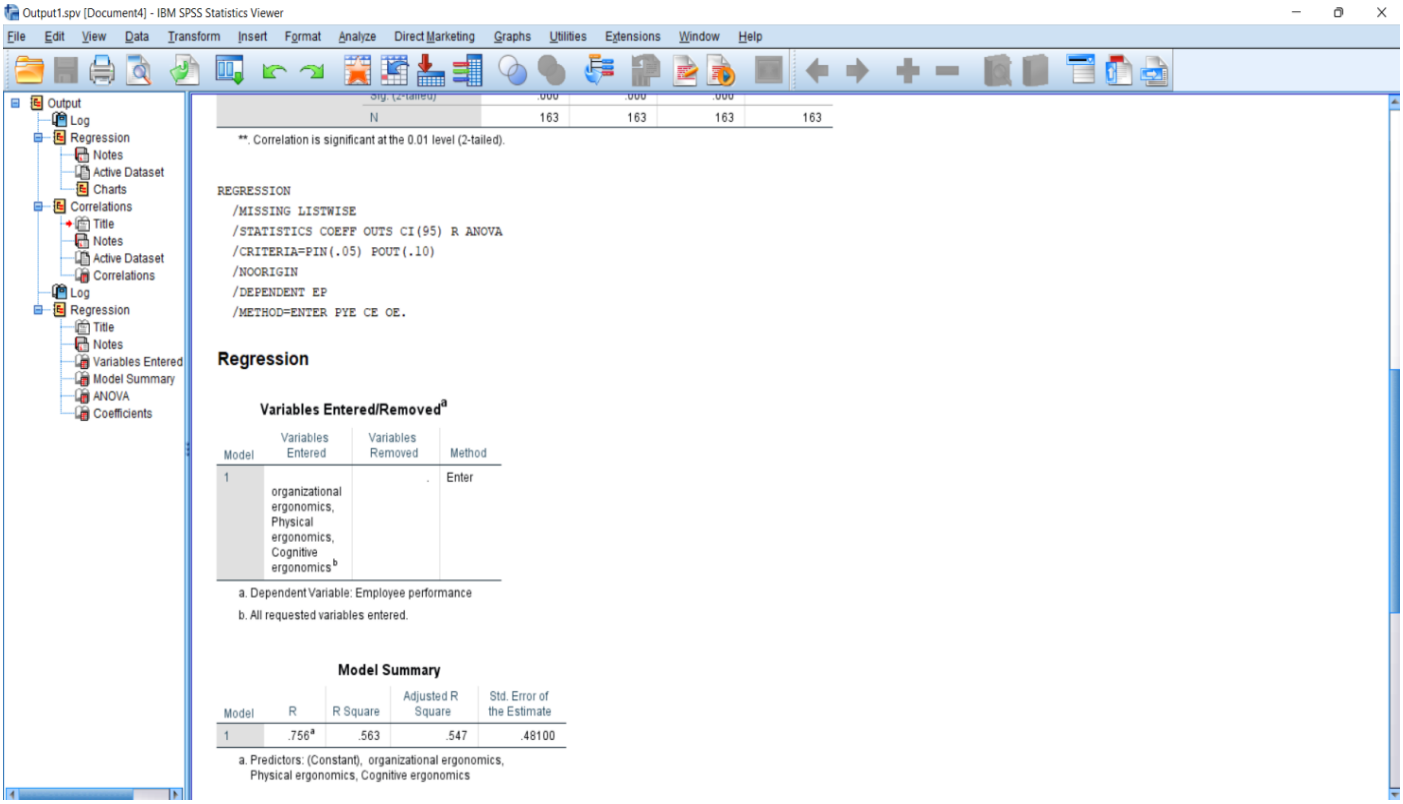
Appendices B

Doctor using the patient room chair to check blood pressure

Appendices C

The correlation and multiple linear regressions result from SPSS




Output1.spv [Document4] - IBM SPSS Statistics Viewer
File Edit View Data Transform Insert Format Analyze Direct Marketing Graphs Utilities Extensions Window Help
Output
Log
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Variables Entered
Model Summary
ANOVA
Coefficients
N 163 163 163 163
**. Correlation is significant at the 0.01 level (2-tailed).
REGRESSION
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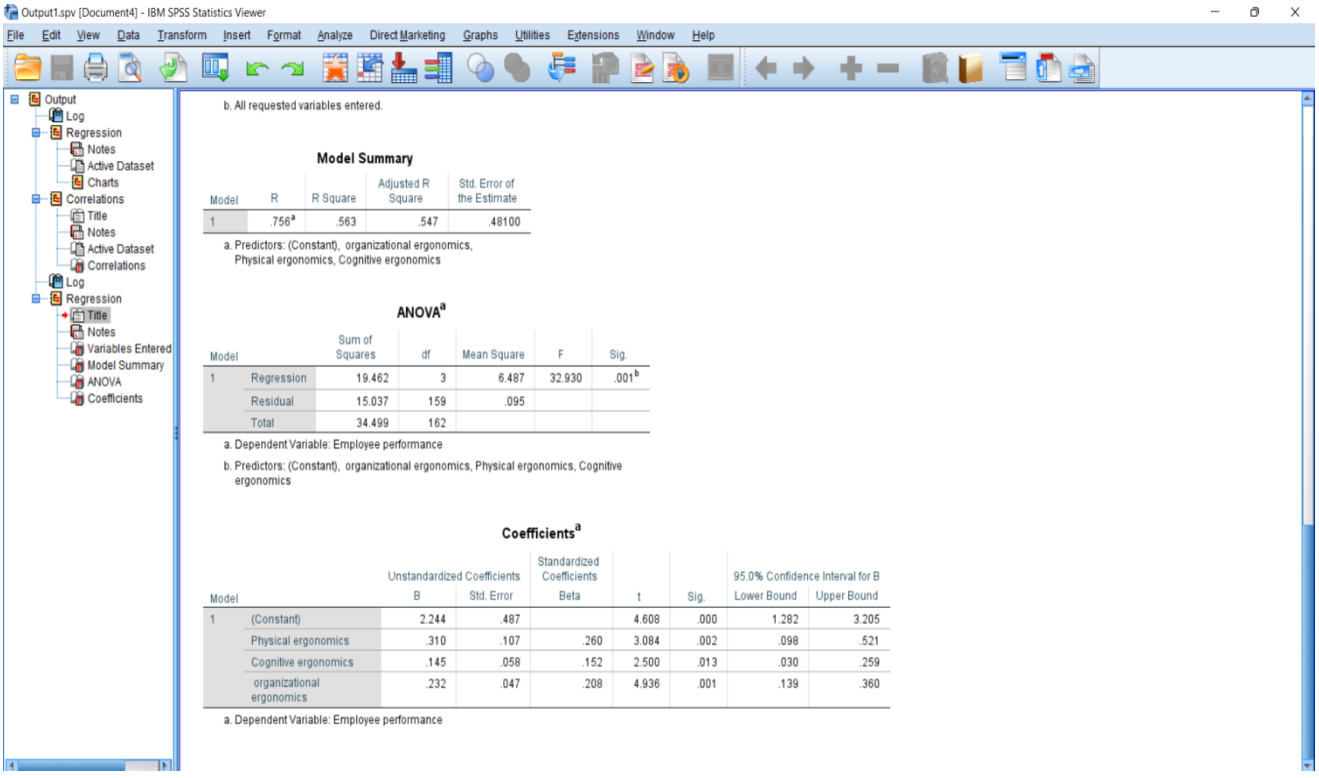
1 | organizational ergonomics, Physical ergonomics, Cognitive ergonomics[b] | . | Enter
a. Dependent Variable: Employee performance
b. All requested variables entered.
Model Summary
Model | R | R Square | Adjusted R Square | Std. Error of the Estimate
1 | .756[a] | .563 | .547 | .48100
a. Predictors: (Constant), organizational ergonomics, Physical ergonomics, Cognitive ergonomics


Output1.spv [Document4] - IBM SPSS Statistics Viewer
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Output
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a. Predictors: (Constant), organizational ergonomics, Physical ergonomics, Cognitive ergonomics
ANOVA[a]
Model | | Sum of Squares | df | Mean Square | F | Sig.
1 | Regression | 19.462 | 3 | 6.487 | 32.930 | .001[b]
Residual | 15.037 | 159 | .095
Total | 34.499 | 162
a. Dependent Variable: Employee performance
b. Predictors: (Constant), organizational ergonomics, Physical ergonomics, Cognitive ergonomics
Coefficients[a]
Model | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. | 95.0% Confidence Interval for B Lower Bound | 95.0% Confidence Interval for B Upper Bound
1 | (Constant) | 2.244 | .487 | | 4.608 | .000 | 1.282 | 3.205
Physical ergonomics | .310 | .107 | .260 | 3.084 | .002 | .098 | .521
Cognitive ergonomics | .145 | .058 | .152 | 2.500 | .013 | .030 | .259
organizational ergonomics | .232 | .047 | .208 | 4.936 | .001 | .139 | .360
a. Dependent Variable: Employee performance

Appendices D

ADDIS ABABA UNIVERSITY

COLLEGE OF TECHNOLOGY AND BUILT ENVIRONMENT

School of Mechanical and Industrial Engineering

Graduate Program in Industrial Engineering

Survey Questionnaire

Dear Respondent,

I am writing to invite you to participate in an important research study being conducted by Ms. Kidist Fitsum, a Master of Science (M.Sc.) student at the Addis Ababa College of Technology and Built Environment, Addis Ababa University.

Ms. Fitsum is currently pursuing her M.Sc. degree in Industrial Engineering at the School of Mechanical and Industrial Engineering. As part of her graduate research, she is conducting a study titled "Investigating the Impact of Ergonomic Workplace Design on Employee Performance in the Healthcare Sector: A Case of Menelik II Referral Hospital."

The primary objective of this research is to gather valuable insights into the current ergonomic workplace design challenges faced by employees at the Menelik II Referral Hospital. Your participation in this questionnaire will be instrumental in helping Ms. Fitsum obtain significant and reliable data to support her academic work. Your responses to the questions will provide valuable information about the ergonomic workplace design problems in your workplace. This data will be used solely for academic purposes, contributing to Ms. Fitsum's M.Sc. research project and the broader understanding of ergonomic considerations in the healthcare sector.

I kindly request your support in this study by taking the time to complete the questionnaire. Your participation will not only assist Ms. Fitsum in her academic pursuits but also have the potential to inform future improvements in ergonomic workplace design at the Menelik II Referral Hospital.

Thank you in advance for your time and valuable contribution to this important research study. If you have any questions or concerns, please do not feel free to reach out.

Sincerely,

[Ms. Kidist Fitsum]

For additional information +251933654253

Part one: Personal Details

1. Gender Male ☐ Female ☐
2. Age Less than 25 ☐ 25-35 ☐ 36-45 ☐
   46-55 ☐ Above 55 ☐
3. Academic Qualification Certificate ☐ Diploma ☐ First degree ☐
   Second degree ☐ Third degree ☐
4. Years of experience in this hospital Less than 1 Year ☐ 1-5 Years ☐ 6-10 Years ☐
   11-15 Years ☐ More than15 Year ☐
5. Your position in the hospital _____.

Part two: Awareness of Ergonomic Workplace Design

Dear respondents, when answering the questionnaire, please do not include your name. Instead, put a tick mark "√" where it corresponds with your response in the provided space. For written answers, please be brief. Your honest responses are valued.

1. Are you familiar with the concept of ergonomic workplace design?

   Yes ☐ No ☐

2. Have you received any training or information about ergonomic workplace design in your workplace?

   Yes ☐ No ☐

3. Rate the overall level of knowledge and awareness among healthcare employees regarding ergonomic workplace design practices at Menelik II referral hospital?

   High level ☐ Moderate level ☐

   Low level ☐ Not sure ☐

4. Rate your workplace's overall ergonomic design.

   Excellent ☐ Good ☐

   Fair ☐ Poor ☐

   Very poor ☐

Part three: Factors Affecting healthcare employees Performance

Please rate the following statements based on your experience. Use a scale of 1 to 5, Where:

1. Strongly disagree, 2. Disagree, 3. Neutral, 4. Agree and 5. Indicates strongly agree.

No		Scale				
		1	2	3	4	5
Physical Ergonomic Factors						
5.	The hospital has implemented ergonomic workplace design principles in the layout and organization of workstations.					
6.	The hospital provides ergonomic equipment (e.g., adjustable chairs, standing desks) to support healthcare employee comfort and productivity.					
7.	There is suitable physical work environment (e.g., lighting, noise level, temperature) where I work.					
8.	The design of my workspace allows for comfortable postures and minimizes awkward movements during my everyday tasks.					
Cognitive Ergonomic Factors						
9.	The information I need for my work is easy to find and understand.					
10.	My work environment is designed to minimize unnecessary distractions and interruptions, allowing for better focus and concentration.					
11.	The systems and tools I use for my work are straightforward and do not add to my mental stress					
Organizational Ergonomic Factors						
12.	The hospital offers training programs to educate employees about ergonomics and its benefits.					
13.	My work schedule and how tasks are divided allow me to manage my workload and get enough rest.					
14.	Our workplace setup and processes make it easy for us to communicate and work together effectively.					
Employee Performance						
15.	I effectively complete my work tasks.					
16.	I feel physically comfortable while doing my job.					
17.	I am productive and efficient in my work.					

18. If work stress caused you to be absent from work (in the last 5 months), did workplace design (e.g., physical setup, tools, task organization) contribute to that stress?

Yes, significantly ☐ Yes, somewhat ☐

No, not at all ☐ Not absent due to stress ☐

Prefer not to say ☐

19. How satisfied are you with the current work chair at Menelik II referral hospital?

Very satisfied	☐	Satisfied	☐
Neutral	☐	Dissatisfied	☐
Very dissatisfied	☐		

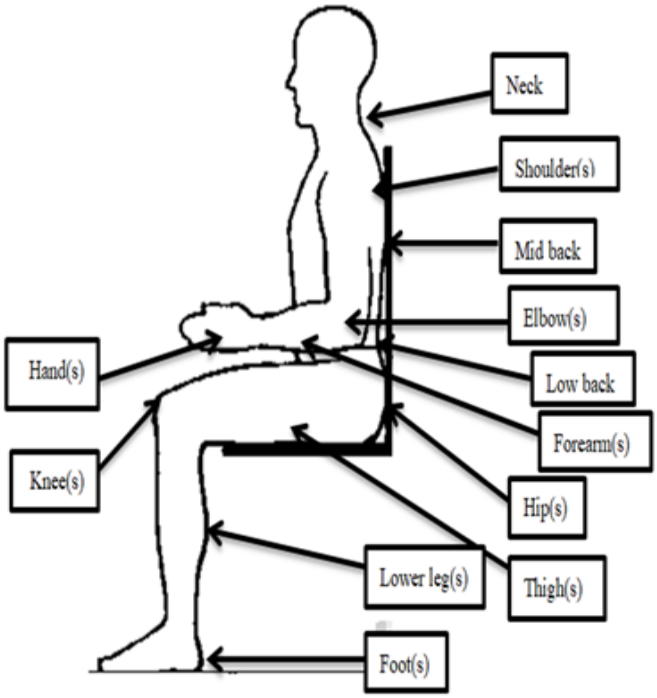
What chair features or characteristics do you believe are important for supporting your work and well-being?

20. _____.

Prevalence of Work-Related Pain and Discomfort in different body parts

21. Do you experience any physical pain or discomfort that you believe is related to your work tasks or workstation setup? If yes, please indicate the body part(s) and usual level of pain/discomfort below (Refer to the provided image if needed).

No	Body part	Level of the pain			
		High	Medium	Low	No
1.	Neck				
2.	Shoulders				
3.	Mid back				
4.	Elbows				
5.	Low back				
6.	Forearms				
7.	Hands/Wrist				
8.	Hips				
9.	Thighs				
10.	Knees				
11.	Lower leg				
12.	Foots/Ankles				



22. Are there any challenges in mental load, teamwork and communication that you believe could be addressed through further improvements in ergonomic design?

_____.

Part four: Job Satisfaction and Well-being

23. Do you notice a relationship between ergonomic workplace design and your overall job satisfaction?

Yes ☐ No ☐ Not sure ☐

24. How would you rate your overall well-being in relation to your work environment?

Poor ☐ Fair ☐

Neutral ☐ Good ☐

Excellent ☐

25. In your opinion, how does ergonomic workplace design contribute to employee commitment and job satisfaction?

Significantly ☐ Somewhat ☐

Negligibly ☐ Not sure ☐

Organizational Support

26. Rate the level of support provided by Menelik II Referral Hospital in terms of promoting and implementing ergonomic workplace design practices.

Very low support ☐ Low support ☐

Moderate support ☐ High support ☐

Very high support ☐

27. Are there any specific ways in which the hospital could further support employees in using ergonomic workplace design principles and practices? Please provide suggestions.

_____.

Patient Outcomes

28. How significantly do you believe ergonomic workplace design practices impact patient outcomes?

Not at all ☐ Somewhat ☐

Moderately ☐ Significantly ☐

Very Significantly ☐

29. How important do you believe it is for healthcare employee performance and patient outcomes to be considered together when evaluating the effectiveness of ergonomic workplace design practices?

Very important ☐ Somewhat important ☐

Neutral ☐ Not very important ☐

Not at all important ☐

Knowledge Distribution and Training

30. Would you be interested in participating in training programs focused on improving your understanding and application of ergonomic workplace design principles?

Yes ☐ No ☐ Not sure ☐

31. Are there any specific challenges in distributing knowledge about ergonomic design practices among healthcare employees? If yes, please describe them.

_____.

32. In your opinion, what methods or strategies could be employed to enhance knowledge distribution and training related to ergonomic workplace design in the healthcare sector?

_____.

Thank you for your participation! Your response is greatly appreciated.

Interview questions

For Healthcare Employees at Menelik II Referral Hospital

1. How do things like your chair or how you help patients affect your comfort and your work?
2. How do things like lighting, noise, temperature, or how your work is organized affect your focus, stress, and overall well-being at work?
3. Have you had pain, tiredness, or stress because of your workspace? How did it affect work?
4. What simple changes to your workspace or tasks would make your job more comfortable and efficient?
5. What makes it hard to improve ergonomics in Menelik II Referral Hospital, and what are your suggestions to make it better?

For Management at Menelik II Referral Hospital

1. What are the biggest ergonomic problems healthcare employees faces here, and how do they affect staff work, absences, and patient care?
2. What stops the hospital from making big ergonomic improvements? What help or resources are needed?
3. How important is fixing ergonomics for reducing injuries, keeping staff, and boosting productivity at Menelik II?
4. Are there any plans now or for the future to improve ergonomics for healthcare employees? What are the goals and how will you measure success?
5. How does the hospital currently handle healthcare employee feedback or concerns about ergonomics? Is there a formal system?