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Enhancing Ergonomics in University Environments: Identifying, Addressing, and Mitigating Hazards for Optimal Health and Productivity

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Abstract– This paper contains ergonomic hazards and risks affecting both university staff and students by conducting a comprehensive case study within a university premise. The study employs a systematic approach, direct observations, and assessments of workspace design, furniture, and equipment usage. The focus is understanding posture-related discomfort and musculoskeletal issues in the university environment. The findings aim to contribute valuable insights for developing targeted interventions and recommendations to enhance the ergonomic well-being of university staff and students. Furthermore, this study suggested a standard procedure for periodic assessment of ergonomic hazards and risks and evaluating its feedback. The findings from this study aspire to contribute to the development of proactive measures that promote a safer and more ergonomic environment in a university setting, enhancing the well-being and productivity of the university community.

Index Terms— Biological Safety Cabinets, Ergonomic, Musculoskeletal Disorders, Personal Protective Equipment

1 Introduction

Ergonomics represents the practical science of designing equipment to enhance productivity by minimizing operator fatigue and discomfort. It involves tailoring the job to the individuals performing it, achieved through carefully designed equipment and procedures [1]. Ergonomics pertains to the "utilization of technology at the interface of human systems in the design or alteration of systems, aiming to improve performance, safety, health, comfort, effectiveness, and quality of life [1].

Recognizing and addressing ergonomic hazards within a university setting a university is of paramount importance. The impact of ergonomic-related hazards on the health and well-being of staff and students directly influences their overall productivity and quality of life. Environmental and cognitive factors, including elements such as temperature, humidity, noise, and lighting, with the arrangement of classrooms and the integration of technology, can notably influence the comfort, productivity, and overall well-being of students in university classrooms and laboratories [2]. In a university environment, where extensive periods are spent in various learning and working spaces, the prevalence of ergonomic hazards can significantly contribute to discomfort, fatigue, and, ultimately, a decline in academic and professional performance. By prioritizing the identification and mitigation of ergonomic hazards, a university can foster a conducive atmosphere for learning and working, ensuring their academic community's sustained health and optimal performance. Moreover, reducing ergonomic risks in a university environment is believed to reduce the risk of mental health issues, encompassing stress, fatigue, anger, depression, dissatisfaction with work, and other related challenges [4].

2 Identification of Ergonomics Hazards in University Premises

The primary goal of this paper is to improve the ergonomic conditions within a university setting. This objective is pursued by analyzing and controlling ergonomic hazards and implementing effective control methods. Moreover, this paper aims to understand the existing ergonomic challenges in the university environment and propose viable strategies to mitigate associated risks. This paper focuses on identifying hazards and formulating practical and targeted interventions to promote a safer and healthier academic atmosphere. Before identifying ergonomic hazards on university premises, locating the facilities in a particular facility is essential.

2.1 Ergonomic Hazards for University Staff

The university staff in Sri Lankan universities can be categorized as follows for convenience in identifying ergonomic hazards. Fig. 1 shows university staff categories.

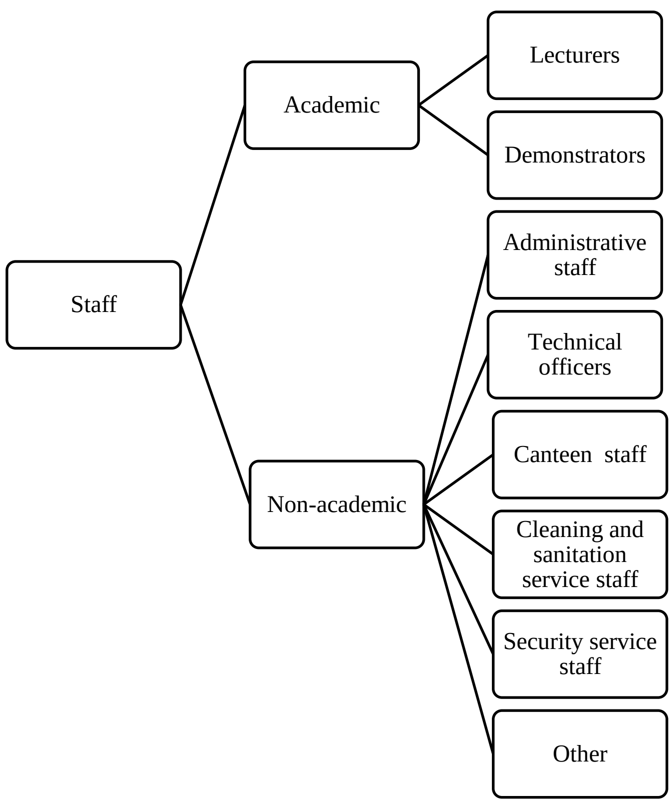

Fig 1. University staff categories

2.1.1

Office Spaces

The seating postures adopted by lecturers and academic staff in their office spaces are essential for their overall well-being, especially considering the extended seated periods. Unfortunately, some staff members may need to pay more attention to maintaining correct postures during these prolonged sitting sessions. This oversight becomes particularly evident when they engage with laptops without utilizing a stand or a separate monitor. The absence of proper ergonomic accessories can contribute to developing neck pain and discomfort over time. Addressing and rectifying these ergonomic concerns is pivotal to ensuring the health and productivity of lecturers and academic staff, underscoring the need for increased awareness and incorporating ergonomic practices in their workspaces.

2.1.2 Laboratories

In a university setting, various laboratories are used depending on the specific study area. In this case study, plastic processing laboratory, dry rubber laboratory, latex laboratory, characterization laboratory, mechatronic laboratory, electronic laboratory, energy laboratory, solar laboratory, soil laboratory, survey laboratory, and concrete laboratory are considered. Moreover, multimedia labs, networking labs, software labs, and standard Information and Communication Technology (ICT) laboratories are considered ICT laboratories. In some laboratories, staff are exposed to ergonomic hazards that can impact their health and well-being. These hazards may result from prolonged periods of standing, repetitive tasks, awkward postures, and exposure to specific laboratory equipment. The staff engaged in laboratory work are demonstrators and technical officers (TO) who have faced ergonomics-related hazards in laboratory tasks. Otherwise, lecturers in laboratories, often referred to as laboratory instructors or teaching assistants, play a crucial role in facilitating hands-on learning experiences for students. Experiment demonstration, guidance and supervision, equipment setup, following safety protocols, and assessments are the work done by lecturers. In ICT laboratories, staff, especially technical officers, are exposed to various ergonomic hazards because of inadequate workstation layout, cable management, noise levels of ventilation systems, and lack of ergonomic accessories. Prolonged sitting, inadequate seating, repetitive tasks, poor computer workstation setup, noise levels, inadequate teaching tools, and limited mobility may cause ergonomics to be hazardous to lectures while teaching assistants.

2.1.3 Lecture Halls/ Rooms

Most ergonomic risks associated with lecture halls are common for staff and students. These ergonomics will be explained in the following topics. Fig. 2 illustrates the incorrect sitting posture adopted by lecturers, highlighting the need for ergonomic awareness. Meanwhile, Fig. 3 focuses explicitly on the improper sitting postures of lecturers on chairs, emphasizing the importance of addressing these issues for the well-being of educators.

Fig. 2. Incorrect sitting posture by lecturers

Fig. 3. Incorrect sitting postures by lecturers (on chair)

2.2 Ergonomic Hazards for Students

During the case study, various types of ergonomics are identified from lectures to libraries and study areas, face varied ergonomic challenges, including suboptimal seating arrangements, inadequate lighting, and technology-related issues, requiring a comprehensive approach to enhance their well-being.

2.2.1 Lecture Halls/ Rooms

During the case study, the following ergonomic hazards were identified: One notable concern is the suboptimal visibility of the projector screen from the front row (Fig. 4). The inadequate distance between the projector screen and the front row creates a challenge for students seated in this area. This results in an uncomfortable viewing experience, requiring students at the front to strain and adopt awkward postures to engage with the content.

Fig. 2. Uncomfortable screen viewing experience in lecture halls.

In addition to the visual challenges related to projector screen visibility, there is a concern about inadequate lighting in certain lecture rooms. This issue arises from malfunctioning light fittings, contributing to suboptimal illumination within the room. The broken light fittings diminish the lighting quality, potentially impacting students' and instructors' engagement and focus. Recognizing and rectifying such inadequate lighting is imperative to create an environment conducive to effective learning. Moreover, in some lecture halls, curtains or blinds are absent. The direct entry of solar radiance into these lecture halls contributes to unnecessary lighting, causing discomfort and hindering the optimal viewing of presentation screens in the daytime. Fig. 6 showcases the presence of excessive solar lighting in lecture halls.

Fig. 5. Example for incorrect sitting posture in lecture halls 1

Fig. 6. Unnecessary solar lighting at lecture halls

Fig. 5 provides an illustrative example of an incorrect sitting posture commonly observed in lecture halls, highlighting the importance of promoting proper ergonomics among students.

2.2.2 Library

Incorrect seating habits are one of the significant ergonomics identified in the library. Moreover, students who use the laptop used to use laptops without laptop stands. In the case of laptops being integrated with their keyboards, there's a common issue where the viewing angle and monitor height are generally lower than the naturally comfortable position. The eyes should align with the top of the monitor [3]. To address this concern, a laptop stand becomes essential as it elevates the laptop, eliminating the need to bend the neck downward to view the screen. Avoiding craning the neck or squinting to see the screen is crucial, as it can lead to discomfort, such as neck pain and eye strain. Utilizing a laptop stand is a preventive measure against these potential ergonomic issues [4].

2.2.3 Study area

Examining the study area desks (Fig. 7), an ergonomic concern emerges regarding the seating arrangements, which prove uncomfortable for study activities. The issue lies in the considerable distance between the bench and the table, a dimension that, unfortunately, cannot be adjusted. This fixed setup poses a potential risk of causing long-term back pain for individuals utilizing these study benches [3]. The inability to customize the distance between the bench and the table deprives users of the opportunity to optimize their sitting posture for prolonged study sessions. Consequently, the ergonomic design flaw may contribute to discomfort and, over time, lead to chronic back pains. Recognizing and addressing this concern is crucial in promoting a healthier and more conducive study environment. Fig. 8 visually captures instances of an incorrect sitting posture in the study area, emphasizing the significance of fostering proper ergonomic habits in study environments. Similarly, Fig. 9 shows an issue of improper sitting postures in study areas, underscoring the ten needs for awareness and corrective measures to ensure the well-being and comfort of individuals engaged in focused study sessions.

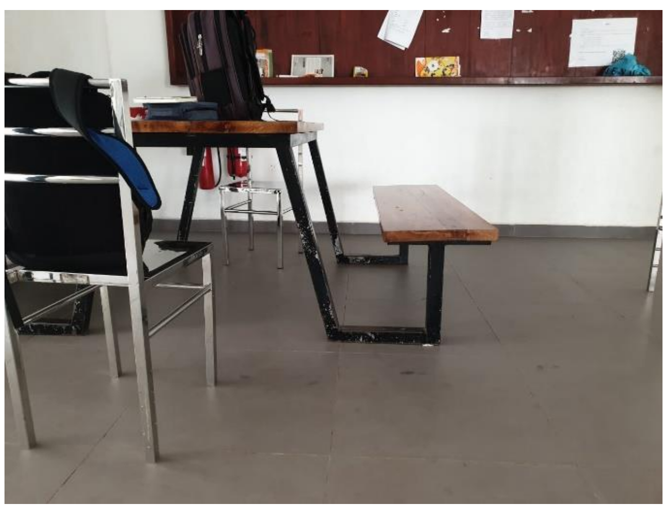

Fig. 3. Study area desks

Another concern within the study areas is lighter illuminance during nighttime study sessions. Insufficient lighting can hinder the effectiveness of study activities, potentially straining the eyes and adversely affecting concentration. Recognizing the importance of optimal lighting conditions for academic tasks, it is imperative to address this issue to ensure students have a conducive environment for nighttime study sessions.

Fig. 8. Incorrect sitting posture at study area 1

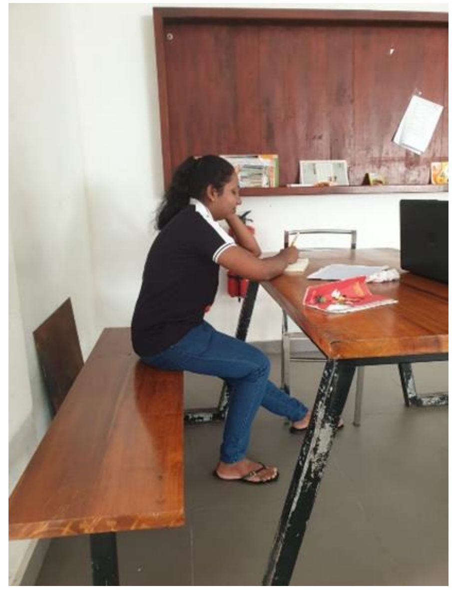

Fig. 9. Incorrect sitting posture at study area 2

Fig. 10 illustrates an example of an incorrect backpack posture, emphasizing the importance of raising awareness about potential health issues associated with improper backpack use. In contrast, Fig. 11 provides a visual suggestion for the correct backpack posture, promoting better ergonomics and mitigating the risk of discomfort or injury [4].

Fig. 5. Example for incorrect backpack posture

Fig. 114. Suggestion for correct backpack posture

2.2.4 Laboratories

Chemical-related laboratories such as microbiology, agriculture, energy, food processing, latex processing, dry rubber processing, and chemistry laboratories involve improving and developing various types of samples. Study of microorganisms, including bacteria, viruses, and fungi; developing and improving food products; experiments and analyses related to chemicals and reactions; study and development of energy and environmental-related technologies; dealing with the production and testing of rubber products; extraction and processing of latex from rubber, research, and testing related to crops, soils, and agricultural practices are the types of duties done in the above laboratories.

Laboratory researchers are at risk for developing cumulative trauma injuries because of the repetitive nature of pipetting, use of small handheld tools, opening and closing vial caps, prolonged awkward postures at a microscope, laboratory hood, or biological safety cabinet, and a variety of other laboratory tasks [5]. The cumulative concept is based on the theory that each repetition of an activity produces some trauma or wear and tear on the tissues and joints of the body. These injuries occur gradually over time.

It is essential to plan experiments in such a way as to avoid prolonged pipetting, microscope, laboratory hood, and biological safety cabinet work.

1. Pipetting - Most pipetting tasks are highly repetitive and demand hours of continuous effort. Repeating aspirating and dispensing motions 1,000 times a day is common. The ejection motion requires the most force.
2. Microscope work - Microscope work usually involves prolonged sitting, high visual demands, and repetitive adjustment of microscope controls. Common symptoms from microscope use may include eyestrain, sore hands from manipulating the controls, and sore necks and shoulders from awkward sitting postures.
3. Laboratory Hoods and Biological Safety Cabinets (BSCs) - Working in Laboratory Hoods or Biological Safety Cabinets (BSCs) promotes awkward postures due to limited knee and thigh clearance, the position of the viewing window, and the placement of work tools inside. Restricted arm movement increases stress on joints of the upper limbs, neck, and back.

Fig. 6. Incorrect sitting posture at laboratory

Some laboratory tasks may place students/staff at an increased risk for developing musculoskeletal injuries (MSIs). The most common factors that contribute to MSIs are

- Extreme Temperatures: cold air temperatures (55 °F and lower) may cause loss of dexterity proportional to exposure time.

- Awkward Body Postures: Any posture that places a body part out of a neutral position (e.g., twisting, poor posture, bending, or overreaching) may strain muscles, tendons, ligaments, and joints.
- Static Position: Occurs when one position is held for a prolonged period. The muscle is contracted, but the joint does not move, increasing the risk of fatigue, pain, and injury.
- Force: The amount of physical effort required to do a task. If the force required exceeds the body's capacity, the muscles, tendons, and ligaments experience increased stress.
- Repetition: The same joints or muscle groups are being used repeatedly without enough time for recovery. Sometimes, the task changes, but the body motion/muscle group/joint used is the same. Tissue fatigue occurs, which may result in injury.
- Contact Stress: Can cause a soft tissue injury when a sharp or hard object presses against the soft tissue of a body part (e.g., hand, wrist). It can irritate local tissues, cause bruises or blisters, obstruct blood flow, and interfere with nerve function.

The tasks commonly performed in the laboratory involve highly repetitive movements (e.g., pipetting) or prolonged static positions (e.g., microscope work). Laboratories often have limited storage space, and many frequently used items are stored on overhead shelves or cabinets, resulting in awkward lift postures and frequent reaches. Pinch grips are also used with tweezers or small pipettes. Table 1 provides a comprehensive set of ergonomic tips tailored for everyday laboratory tasks, offering valuable guidance to promote the well-being and safety of laboratory personnel [2], [4], [6].

Table 1: Ergonomics tips for common Laboratory tasks [1]

Task	Body positions	Work practices	Proper Equipment
General Work Tips	• Minimize the use of awkward body postures. • Keep arms and hands relaxed. • Avoid static positions. • Avoid twisting while carrying an object. • The load should be held directly in front of the worker and close to the body.	• For any continuous task, take frequent breaks away from the primary activity. • Alternate tasks that require different muscle groups and take breaks every 20 minutes to rest muscles. • If standing for long periods, use supportive shoes and cushioned mats. • Rotate tasks intermittently between the left and right hands to avoid overusing one side.	• When purchasing equipment, models that are adjustable in higher are preferable. • Select the right equipment for the task. • Know how to use automated processes to reduce high repetition.

Sitting and standing	• Feet should rest flat on the floor. • The chair should provide adequate low back and thigh support. • The front edge of the chair should not press up against the back of the knees. • Avoid head and neck extensions by adjusting the workstation. • Keep elbows close to the body and shoulders relaxed while working.	• Before starting work, make sure the chair is adjusted correctly. • Avoid sitting at the edge of the seat. Set against the back of the chair for proper back support. • Take frequent small breaks to reduce the likelihood of repetition, working with awkward body posture, and performing static work. Get out of the chair at least every half hour to help relieve stress on the back.	• Use a footrest if feet do not reach the floor. • Avoid using stools with a bit of back support. • If back support is not adequate or if the seat pan is too long, try a back support cushion to provide support. • Remove or adjust armrests that hinder work activities. • Use height-adjustable workstations when possible. • Use anti-fatigue mats or footrests for areas requiring prolonged standing.
Pipetting	• Maintain straight wrists. Do not twist or rotate your wrists while pipetting. • Keep elbows close to the body. • Adjust the workstation so the arm is not elevated while pipetting.	• Keep waste bins, samples, beakers, etc. As close as possible. • Take frequent breaks from pipetting to stretch the hand and arm muscles. • Alternate or use both hands to pipette. • Rotate pipetting tasks with other laboratory tasks and rotate tasks amongst employees if possible.	• Use pipettes that fit comfortably in the hand. • Use shorter pipettes and tips to reduce the elevation required by the hand to hold it. • Choose pipettes that require minimal hand and finger effort. • For highly repetitive jobs, utilize automated processes or multi-channel pipettes where possible.
Test Tube handling	• Maintain straight wrists. • Work with elbows close to the body. • Avoid reaching upward or stooping low.	• Arrange tubes to minimize the amount of reaching. • Share workload between right and left hands. • Take frequent breaks away from handling activity. • Use both hands to open tubes.	• Use upside-down containers to raise tube racks when needed. • Use cap removers to help minimize pinch gripping. • To avoid forearms resting on sharp edges, pad edges or use a

			cushion to pad the forearm.
Microscope use	• Maintain straight wrists. • Avoid titled head postures. • Avoid leaning on hard edges.	• Take frequent breaks to rest your eyes. • Every 30-60 minutes, get up to stretch and move. • Keep the microscope clean and in good condition. • Spread microscope work throughout the day or rotate microscope work among several employees, if possible.	• Move the microscope toward the edge of the work surface and set up the microscope at a slight tilt to allow a more upright head posture. • To avoid forearms resting on sharp edges, pad edges or use a cushion to pad the forearm. • Use a chair that provides good back support, adjustable height, and adjustable seat angle. • Ensure adequate room under the work surface so the operator can pull the chair up to the ocular.
Fume Hood/ Biological Safety Cabinets	• Avoid resting forearms on hard edges. Pad the edges if possible.	• Position work supplies as close as possible. • Take breaks every 20-30 minutes to stretch muscles and relieve forearm and wrist pressure.	• Remove false fronts and supplies from under the work area. • Use anti-fatigue floor mats if standing for long periods.
Hand Tool Use	• Maintain straight wrists. • If possible, avoid using a pinch grip when using tools.	• Take frequent breaks away from tool use. • Share workload between right and left hands. • Alternative how you hold objects like forceps. Switch holding with the thumb, index finger, and index and middle fingers to vary the task.	• Choose the right tool for the job. • Ensure tools are in proper working order. • Increase the diameter or span of the tweezers to reduce the grip force. • Use tools with padded or large-diameter handles to reduce the required grip force.

Ergonomics hazards in an ICT lab stem from the dynamic interplay between individuals and the technology and environment in which they operate. Prolonged computer use poses a significant risk, potentially causing eye strain, neck and shoulder pain, and repetitive strain injuries (RSIs) like carpal tunnel syndrome. To counter these issues, it is crucial to advocate for regular breaks, ensure proper screen height and angle, and provide ergonomic chairs and keyboards.

The design of seating and workstations also plays a pivotal role in mitigating ergonomic risks. Inadequate seating and poorly designed workstations can lead to discomfort, musculoskeletal problems, and back pain (Fig. 12). Implementing adjustable chairs and desks and ensuring proper monitor placement are critical elements in creating an ergonomic workstation that supports good posture.

Lighting and screen placement contribute to eye comfort and well-being [1]. Insufficient or glaring lighting can lead to eye strain, emphasizing the importance of providing adjustable lighting to reduce glare and shadows. Incorrect placement of computer monitors can result in neck strain and discomfort; hence, monitors should be at eye level or slightly below to minimize strain on the neck.

Poor cable management can create physical hazards and create a stressful environment. Implementing solutions such as cable organizers or clips helps maintain a clean and safe workspace. Inadequate keyboard and mouse setups also pose risks, potentially contributing to RSIs. Providing ergonomic keyboards and mice and proper placement is essential to reduce strain on the hands and wrists.

The choice of seating is critical in preventing back pain and discomfort during prolonged sitting. Opting for ergonomic chairs with proper lumbar support and adjustability promotes comfort and reduces the risk of back issues. Noise and distractions in the ICT lab environment can contribute to stress and decreased productivity. Implementing soundproofing measures, using noise-cancelling headphones, and organizing the workspace to minimize distractions are effective preventive strategies.

Lastly, addressing the lack of training in proper ergonomics, posture, and the importance of breaks is essential. Providing comprehensive training programs raises awareness among lab users, promoting a culture of safety. An approach involving proper equipment selection, adherence to ergonomic design principles, user education, and periodic assessments is vital to ensure a safe and comfortable ICT lab environment.

2.2.5 Workshops

Ergonomic hazards in workshops pose significant risks to the well-being of students, potentially leading to discomfort, pain, and injuries. These hazards include frequent heavy lifting, overhead work, pushing or pulling, poor prolonged posture, improperly adjusted workstations and chairs, awkward and repetitive movements, excessive force application, and exposure to vibrations.

To proactively address these ergonomic hazards, it is crucial to implement preventive measures early on. One practical approach is using adjustable equipment tailored to accommodate different body types and sizes, promoting a more inclusive and ergonomic work environment. Providing clear signage and comprehensive training to instruct students on correctly using and handling hand tools is instrumental in minimizing ergonomic risks [1].

The importance of correct personal protective equipment (PPE) must be balanced. Ensuring students use appropriate PPE adds defense against potential ergonomic hazards. Furthermore, eliminating or reducing manual lifting tasks by incorporating machinery and automation contributes to a safer work environment.

Recognizing the significance of breaks throughout the day is pivotal in mitigating ergonomic risks. Adequate rest intervals allow workers to recuperate physically and mentally and help break the monotony of repetitive tasks, reducing the likelihood of musculoskeletal issues.

In considering ergonomics hazards in a workshop, fostering a culture of awareness and responsibility is imperative. This involves continuous training, regular risk assessments, and communication between management and workers. Additionally, encouraging students to participate in identifying potential ergonomic hazards and proposing solutions actively enhances overall safety.

Fig. 7. Incorrect posture to lift heavy objects.

Fig. 8. Suggestion for correct posture to lift heavy objects.

Fig. 13 visually illustrates an incorrect posture commonly adopted when lifting heavy objects, highlighting the potential risks of strain or injury. Conversely, Fig. 14 suggests the correct posture to lift heavy objects, promoting safety and reducing the likelihood of musculoskeletal issues associated with raising activities. In conclusion, an emphasis on adjustable equipment, proper training, adherence to safety protocols, and integration of ergonomic principles can significantly reduce workshop hazards.

3 Health Impact

Chronic health effects can mostly occur due to these ergonomic hazards. One of the main problems is Musculoskeletal Disorders.

3.1 Musculoskeletal Disorders (MSDs)

Musculoskeletal disorders (MSDs) encompass cumulative and chronic injuries affecting the soft tissues, including muscles, tendons, ligaments, nerves, joints, and blood vessels. These injuries result from the body's cumulative response to prolonged misuse or abuse, often exceeding its natural limits. MSDs manifest as injuries to muscles, tendons, ligaments, joints, nerves, and discs, primarily caused or exacerbated by actions and environmental conditions that deviate from safe and healthy work practices.

A well-recognized example of an MSD is carpal tunnel syndrome, characterized by the compression or squeezing of the median nerve as it travels from the forearm into the palm. The carpal tunnel, a narrow and rigid passageway formed by ligaments and bones at the base of the hand, serves as the housing for the median nerve and tendons. When tendons become irritated, leading to thickening or other forms of swelling, the tunnel narrows, exerting pressure on the median nerve. This compression results in symptoms such as pain, weakness, diminished grip strength, or numbness in the hand and wrist, often radiating up the arm.

3.1.1 Symptoms of MSDs

- Pain
- Weakness
- Stiffness (OSHA)
- Sensitivity
- Swelling
- Burning sensation
- Tingling
- Drowsiness
- Difficulty moving
- Clumsiness

Ergonomics risk factors such as force, heaving, lifting, push or pull, carrying, gripping, awkward postures, repetitive activities, overhead work, contact stress, and vibration may result in MSDs [1].

4 Control Measures for Avoiding Ergonomics Hazards

There are many ways to reduce ergonomic risk factors and help fit the university's places for staff and students. The Hierarchy of the control triangle can do this (Fig. 15).

Fig. 9. Hierarchy of Controls Triangle

Implementing awareness campaigns through training programs, informative posters, and specialized lending services, such as laptop stands, contributes to proactively preventing ergonomic hazards among students in libraries, study areas, and laboratories, fostering a culture of safety and well-being.

4.1 Improve Awareness

Various types of awareness programs and sessions can be organized to improve the ergonomic hazards within a university. Awareness training sessions can be arranged for students to educate them about potential ergonomic risks within a university. This training can be integrated into the student orientation program, ensuring that all incoming students are well-informed about the importance of ergonomic practices and the measures to mitigate associated risks.

Fig. 10. Suggestion for correct sitting posture at lecture halls

It is also possible to integrate ergonomic principles into relevant academic curricula. Incorporating these principles into coursework ensures that students are educated in ergonomics from the beginning of their educational journey, promoting a culture of awareness and prevention.

Moreover, informative posters should be installed within the library and study area, emphasizing proper seating postures. These posters serve as visual reminders, educating library users on the importance of maintaining correct postures to reduce the risk of ergonomic hazards.

Fig. 11. Example poster for library [2]

Furthermore, laptop stands and mouse pad lending services within the library should be initiated to provide students with ergonomic solutions. This service offers students the convenience of borrowing laptop stands, promoting better posture and minimizing the potential risks of neck pain associated with prolonged laptop use.

It is also necessary to conduct comprehensive training sessions on properly using laboratory instruments and tools, emphasizing the prevention of ergonomic hazards. This training ensures that students are well-equipped with the knowledge and skills to operate equipment safely, minimizing the risk of ergonomic-related issues

in laboratory settings.
Conduct a training session for non-academic staff focusing on ergonomic hazards. This session is designed to equip staff members with the knowledge to identify and address potential ergonomic issues in their work environments, promoting a safer and more comfortable workplace for all.
Fig. 16 presents a visual guide offering suggestions for correct sitting posture, emphasizing the importance of maintaining proper alignment for overall well-being. In Fig. 16, specific attention is given to the recommended sitting posture in lecture halls, creating a conducive learning environment. Lastly, Fig. 17 showcases an example poster designed for libraries to educate patrons on the significance of maintaining correct postures while studying or reading.

4.2 Eliminate Hazards

The most effective way to control ergonomic hazards is to eliminate the risk factors. This is the preferred method and most effective. Some engineering controls caution. It contains the hazard at the source, like tools, equipment, design, or area to obliterate it.

4.2 Substitute the Hazard

If elimination is not possible, consider substituting or replacing the hazard with a material, process, or equipment that is less hazardous.

4.3 Engineering Controls

Some engineering controls that can apply to university environments are listed.

- Adjust the chair and desk arrangements in the study area according to ergonomic principles. This entails optimizing the positioning of chairs and desks to align with recommended ergonomic standards, fostering a comfortable and conducive environment for studying [3].
- The height of the table should encourage keeping the elbow at a 90-degree angle (Fig. 18).
- While sitting, the height of the table should be level with the belly button.
- The workbench location should be kept at a minimal distance from other necessary tools.
- Workbench height should be adjusted for the type of work being performed.

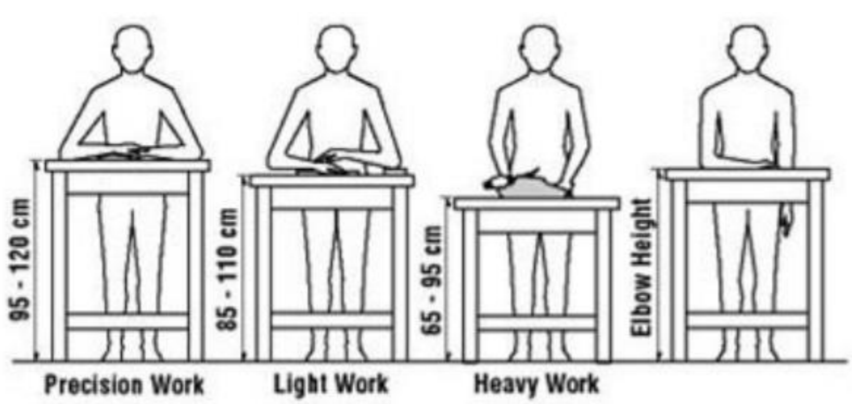

Fig. 12. Workbench Design [3]

- The presentation viewing experience can be enhanced by installing side LED panels that can present the same presentation as the main projector screen. Ensuring the proper functioning of these screens is crucial for optimal visual engagement and comprehension within the lecture hall back raw settings.
- Glare controls or curtains can be installed for the windows in the ICT lab to mitigate glare-related issues. This adjustment aims to create an environment with optimal lighting conditions, reducing discomfort and enhancing the overall usability of the lab for computer-based activities.

4.4 Administrative Controls

Where engineering controls cannot be implemented, it may be appropriate to consider administrative controls that establish efficient processes and procedures [4].

- Require a two-person lift when materials exceed a certain weight or are awkward in size.
- Establish a rotation system where all students are rotated away from specific tasks depending on academic activity to minimize the duration of continual exertion, repetitive motions, and awkward postures, allowing the employee to use different muscle groups.
- Properly use and maintain tools and equipment.

4.5 Personal Protective Equipment (PPE)

Though they have limited effectiveness in controlling ergonomic hazards, personal protective equipment is another control that can be utilized [4][5].

- Use padding to reduce contact stress with hard, sharp, or vibrating surfaces, such as padded gloves, elbow pads, and knee pads in places like Workshops, Latex Processing Labs, or Dry Rubber Processing Labs.
- Wear good-fitting thermal gloves to help with cold conditions while maintaining the ability to grasp items quickly in a place like all kinds of laboratories on university premises.
- Wear proper fitting, slip-resistant footwear to ensure solid footing and prevent slips, trips, and falls in places like Workshops, Chemical laboratories, Concrete labs, and Soil labs.

However, following the above controls in standard procedure will help reduce and avoid ergonomics hazards on university premises.

5 Standard Procedure for Reducing Ergonomic Risk within a university

Maintaining regular ergonomic monitoring and feedback mechanisms in the university is essential to reduce ergonomic risks. Therefore, periodic assessment can be suggested as a solution.

5.1 Periodic Ergonomic Assessment

periodic ergonomic assessments can be implemented to identify changing needs and potential new hazards. Regular assessments allow for adjustments to control measures based on evolving conditions within the university environment. One technical officer can be assigned to conduct the evaluation. A three-month time interval is suggested. The following checklist can be used to complete the ergonomic identification assessment. Table 2 shows the checklist for staff, and Table 3 shows the checklist for students.

Hazard Identification Checklist Facilities Areas Surveyor

<u>For staff</u>

Table 2: Ergonomic identification assessment checklist for university staff

Office spaces		Yes	No
a.	Is the office chair adjustable to support proper seating posture?		
b.	Can the seat height be adjusted to achieve a 90-degree angle at the knees?		
c.	Is a laptop stand available, and are lecturers encouraged to use laptops?		
d.	Does the stand elevate the laptop to eye level to reduce neck strain?		
e.	Is there a provision for an external monitor to facilitate a more ergonomic screen height?		
f.	Are lecturers encouraged to use a separate keyboard and mouse when working on laptops for extended periods?		
g.	Are additional ergonomic accessories provided, such as an external keyboard and mouse?		
h.	Is there a system for staff to report ergonomic issues or request adjustments?		

Laboratories		Yes	No
a.	Have measures been taken to control and reduce noise levels in ICT laboratories?		
b.	Are cables organized and secured to prevent tripping hazards and ensure a clean workspace?		
c.	Are there guidelines for taking breaks to avoid prolonged sitting at the computer?		
d.	Are heavy chemicals stored at waist height to minimize the need for bending or reaching?		
e.	Are laboratory hoods and BSCs designed to minimize awkward postures and promote ergonomic use?		
f.	Are microscope workstations designed to support proper seating posture?		
g.	Are pipetting stations designed to minimize repetitive and prolonged pipetting motions?		

For students

Table 3: Ergonomics identification assessment checklist for student

Lecture Halls/Rooms		Yes	No
a.	Is the projector screen visible from the front row?		
b.	Are there any obstructions or structural elements blocking the		

	view?		
c.	Are the seats in the front row at an optimal distance from the projector screen?		
d.	Is the room adequately illuminated?		
e.	Are all LED light fittings in proper working condition?		
f.	Are there any broken or malfunctioning LED light fixtures affecting lighting quality?		
g.	Is the LED panel designed to aid presentation viewing functioning correctly?		

Library		Yes	No
a.	Are library chairs designed to promote correct posture?		
b.	Do students tend to maintain the correct seating posture while using library chairs?		
c.	Do students commonly use laptops in the library?		
d.	Are there signs or guidelines promoting healthy laptop usage?		
e.	Do students use laptops without stands?		
f.	Is the library environment conducive to maintaining proper viewing angles?		

Study areas		Yes	No
a.	Is there a considerable distance between the study bench and the table?		
b.	Can users adjust the distance between the bench and the table for comfortable study sessions?		
c.	Is there adequate lighting in the study areas during nighttime study sessions?		
d.	Has there been any feedback or reports of discomfort or back pain from individuals using the study benches?		
e.	Are there visible signs of discomfort, such as students adopting awkward postures?		
f.	Are there alternative seating options or accessories (e.g., cushions) to optimize sitting posture?		

Laboratories		Yes	No
a.	Is there adequate space for researchers to perform tasks		

	comfortably?		
b.	Is there awareness about the potential risks associated with repetitive tasks in the laboratory?		
c.	Are experiments planned to avoid prolonged pipetting, microscope work, and hood/cabinet tasks?		
d.	Is there a system for regular maintenance and calibration of pipetting equipment?		
e.	Are microscopes set up to accommodate a range of users comfortably?		
f.	Is there an emphasis on proper seating and adjustments to reduce strain during microscope use?		
g.	Are there adequate knee and thigh clearances in laboratory hoods and BSCs?		
h.	Is placing tools and equipment within these workspaces optimized to reduce strain?		
i.	Are ergonomic principles applied to prevent awkward body postures during laboratory tasks?		
j.	Are users educated about the risks of prolonged computer use, including eye strain and RSIs?		
k.	Is there a culture that promotes regular breaks during computer work?		
l.	Can chairs, desks, and monitors be adjustable to accommodate different users?		
m.	Are computer monitors positioned at eye level or slightly below to minimize neck strain?		
n.	Is lighting adjustable to reduce glare and shadows in the ICT lab?		
o.	Is cable management implemented to reduce physical hazards and maintain a clean workspace?		

	Workshop	Yes	No
a.	Are regular risk assessments conducted to identify and address potential ergonomic hazards?		
b.	Is there open communication between management and students regarding ergonomic concerns?		
c.	Are students provided with and encouraged to use appropriate PPE (Personal Protective Equipment) for specific tasks?		
d.	Is there regular monitoring to ensure the correct usage of PPE in the workshop?		
e.	Are clear signs placed to instruct students on correctly using and handling hand tools?		
f.	Are workstations and chairs adjustable to promote proper posture during prolonged tasks?		

Moreover, a feedback system can be initiated so that students and staff members can report the ergonomics of a university environment.

5.2 Feedback Mechanisms

Communication channels can be started for individuals to provide feedback on ergonomic issues. Encouraging open communication allows staff and students to report concerns and suggestions for improvement, fostering a collaborative approach to maintaining a safe and healthy environment.

6 Conclusion

In conclusion, the multifaceted approach outlined in this paper is a robust foundation for cultivating ergonomic excellence within the University. The amalgamation of awareness-building initiatives and engineering controls is poised to mitigate existing ergonomic hazards and create a culture of proactive well-being.

The emphasis on improving awareness, evidenced by targeted training programs seamlessly integrated into student orientations and academic curricula, reflects a commitment to ensuring that every member of the academic community is well-versed in ergonomic practices from the outset. Informative posters strategically placed in libraries and study areas act as constant reminders, shaping correct postures and fostering a collective consciousness regarding the importance of ergonomic principles.

Furthermore, introducing a specialized lending service for laptop stands is a practical stride towards immediate solutions, providing students with accessible ergonomic tools. This move is pivotal in ushering a paradigm shift towards healthier practices, especially concerning prolonged laptop usage and associated risks such as neck pain.

The integration of staff members, both academic and non-academic, in tailored training sessions amplifies the scope of this initiative. It ensures that the entire educational ecosystem has the knowledge and skills to identify, address, and prevent ergonomic issues in their work environments. This holistic approach is fundamental in creating a workplace prioritizing safety and comfort for all.

On the engineering front, the proposed adjustments in chair and desk arrangements, repair of LED fixtures, and installation of glare controls exhibit a meticulous focus on the physical aspects of ergonomic well-being. These measures are not mere corrections but proactive steps to optimize study and work environments according to ergonomic standards. By doing so, the faculty endeavors to create spaces that are conducive to productivity and supportive of its occupants' long-term health and well-being.

The standard procedure for ergonomic risk reduction, particularly the periodic ergonomic assessments, stands out as a dynamic and forward-thinking strategy. The comprehensive checklist, spanning offices, laboratories, lecture halls, libraries, study areas, and workshops, ensures a systematic approach to identifying evolving hazards. The suggested three-month assessment interval aligns with the dynamic nature of academic spaces, where needs and conditions are prone to change. This systematic and regular evaluation positions the faculty at the forefront of proactive risk management, allowing for timely adjustments to control measures.

Establishing feedback mechanisms serves as the final piece in this ergonomic framework. By encouraging open channels for individuals to report concerns and suggestions, the faculty ensures an active and engaged community that collaboratively contributes to maintaining a safe and healthy environment. This feedback loop not only facilitates continuous improvement but also underscores the shared responsibility of all stakeholders in upholding ergonomic standards.

Integrating awareness, engineering controls, periodic assessments, and feedback mechanisms, this comprehensive strategy positions the Faculty of Technology toward ergonomic excellence. By prioritizing the health and well-being of its academic community, a university can set a precedent for other institutions, fostering a culture where safety and ergonomic considerations are integral to the overall educational experience.

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