Original Article

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Ergonomic Practice in Medical Laboratory Workers in a Tertiary Care Hospital in Lahore

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ABSTRACT

Objective: To evaluate the ergonomics practice pattern among medical laboratory professionals and to determine the ergonomic deficiencies to improve the workplace quality and safety at a tertiary care hospital in Lahore

Methodology: This was a cross-sectional study conducted in department of Pathology, King Edward Medical University/Mayo Hospital, Lahore from November 2019 to January 2020. All the workers engaged in all the sections of the clinical laboratory were included in the study. The results were collected using a self-administered questionnaire, which included demographic information, ergonomic practices, workplace layouts and equipment utilization pattern. Individuals were instructed to complete the questionnaires in accordance to their own specific time range and return it after filling. All the data was gathered from the surveys and then coded and securely stored in a database for further analysis and interpretation.

Results: Average age of the participants was 26.80±5.70 years. Several participants reported appropriate bench heights (70.7%) and tools within arm's reach (62.2%), deficiencies were noted in foot and knee clearance, with only 50.0% and 53.7% respectively. Limited provision of foot rails (11.0%) and floor mats (31.7%) for prolonged standing tasks was seen. Seated benches showed similar disparities, with notable deficiencies in adjustable armrests (32.9%) and footrests (29.3%). Microscope usage demonstrated challenges in maintaining neutral posture (65.1%), while pipette use and micro-manipulation tools highlighted the need for improved accessibility and ergonomic support.

Conclusion: Study revealed the varying levels of ergonomic appropriateness across the workplace and equipment among medical laboratory workers, with significant inadequacies in foot and knee clearance, the presence of foot rails, floor mats, adjustable armrests, and foot rests. Difficulties in using a microscope, as well as concerns about pipettes and micro-manipulation equipment, underscored the need for improved accessibility and ergonomics.

Keywords: Ergonomics, Medical Lab Workers, Tools, Equipment, Lab environment.

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Introduction

Ergonomics is the study to collaborate relationship among human and their profession by adjusting tools, tasks, equipment, and work environment to fit with the employee physical capability and limitations. Understanding ergonomics aids in its proper implementation and greatly enhances the overall health and safety of workers in the workplace.[1] Ergonomics substantially developed during the World War II and has since evolved to encompass fields such as design, medicine, and computer science.[2,3] It encompasses various conditions impacting workers' health

and comfort, including lighting, tool and designs of the chairs, repetitive movements motion and the heavy lifting. These factors can contribute to injuries and issues related to muscles, tendons, or nerves, potentially leading to musculoskeletal disorders.[2,4] Ergonomics is also a field that utilizes knowledge about human behavior, capabilities, constraints, and other attributes to create tools, tasks, machinery, occupations, and surroundings that facilitate productive, secure, comfortable, and efficient human utilization.[5,6] In essence, ergonomics involves tailoring work environments to suit the worker, thereby enhancing safety and productivity.[5]

In the pathology laboratories the testing of specimens demands precision and prolonged focus inherently. Healthcare laboratory technicians encompass individuals employed within the field of Pathology engage in repetitive tasks like pipetting, microscope operation, microtome management, and cell counting, necessitating them to frequently adopt uncomfortable and static positions.[7] Occupations involving extended periods of static posture exert added strain on muscles and tendons, often resulting in fatigue and discomfort.[7] The prevalence of musculoskeletal issues can be exacerbated by being female and working longer hours. Even with efforts to address ergonomic concerns and enhance equipment and workplace layout, laboratory technicians continue to experience a significant occurrence of workplace injuries.[8,9] Hence, it is imperative to recognize ergonomic hazards among healthcare laboratory technicians in order to mitigate additional physical or environmental strain stemming from their work environment.[7] While ergonomics is widely recognized and implemented in numerous countries, its awareness and application are less prominent in industrially developing countries like Pakistan. However, the purpose of this study was to investigate the current state of ergonomic practices amongst medical laboratory employees, identify frequent ergonomic challenges encountered by then and to assess the effectiveness of existing solutions.

By emphasizing the significance of ergonomics in the laboratory context, this study intends to provide evidence-based recommendations to enhance workplace conditions and enhancing the well-being of employees in laboratories.

Methodology

A cross sectional study was carried out at Pathology Department, King Edward Medical University/Mayo Hospital, Lahore from November 2019 to January 2020. Before the start of research, a pre-research planning was done in which all the aspects were considered. Ethical considerations were extensively deliberated with the Department of Pathology supervisor at King Edward Medical University, Lahore. A sample size of 82 patients was calculated using a 95% confidence level, 9% absolute precision, and a proportion of 22.2%. Non-probability convenience sampling was employed. All the workers engaged in all the sections of the clinical laboratory of either age and gender were included. New appointed workers, technicians on leave, those who were unwilling to fill the performa and individuals having previous history of musculoskeletal disorder unrelated to their current employment were excluded from the study.

Ergonomics practice was applied to the medical laboratory workers as per the inclusion criteria. Each subject provided informed consent before participating in the study, and after explaining the goal of the study, they were assured that their entire information would be kept confidential. Data was collected using pre-designed performa covering various aspects of all the laboratory processes. OSHA guidelines was used for ergonomics practice. To collect thorough data, participants were given a self-administered questionnaire, with the option of completing it in print or electronically, depending on their preference. This questionnaire included several parts that addressed demographic information, ergonomic practices, workplace layouts and equipment utilization patterns. Participants were instructed to complete the questionnaire on their own within a specific time range and return it for evaluation.

The data gathered from the surveys was then coded and securely stored in a database for further analysis and interpretation. Data was entered and analyzed using SPSS-21.

Results

The study was on ergonomic practices among 82 medical laboratory workers assessed various aspects of workstations and equipment with an overall mean age of 26.80± 5.70 years. Males were 45.1% and females were 54.9%. For standing bench stations, 70.7% reported appropriate bench height, 74.4% could work with relaxed shoulders, and 62.2% had tools within arm's reach. Adequate knee and foot clearance were noted by 53.7% and 50.0%, respectively. Only 11.0% had a foot rail, and 31.7% had floor mats for prolonged standing tasks. Rounded bench edges were present for 48.8%, and 40.2% had standing benches for tasks requiring movement.

For seated benches, 47.6% had cutouts, and 48.8% had a minimum width of 20 inches. Work items were within close reach for 74.4% of participants. Regarding chairs, 64.6% could adjust them for appropriate height, and the same percentage had foot support. Only 32.9% had adjustable armrests, and 29.3% had footrests. Additionally, 75.6% knew how to adjust their chairs.

Microscope use showed that 65.1% could view the eyepiece with neutral posture, and 89.0% had microscopes within easy reach. Arm support was available for 58.5%, and 50.0% could use controls with relaxed arms. Legroom and foot support were sufficient for only 28.0%, and 36.6% had work breaks.

For pipettes, 79.3% used them for less than 4 hours per day, and 39.0% had access to advanced pipettes for longer use. Training on selecting pipettes was reported by 63.4%, and 79.3% had easy access to racks and supplies. Vials and tubes were low profile for 65.9%, and 59.8% maintained relaxed postures.

Micro-manipulation tools had locking mechanisms for 50.0% of workers. Easy-to-cap vials were noted by 61.0%, and 24.4% had cap openers. Clamps and holders were available for 61.0%.

Operating microtomes in a pistol grip position was feasible for 67.1%, with 56.1% having bench cutouts for clearance. Adjustable chairs were available for 52.4%, and 51.2% had motorized microtomes.

Cabinet ergonomics showed 35.4% had leg clearance, and 34.1% could work with relaxed shoulders. Padding was present for 29.3%, and materials were within easy reach for 52.4%. Anti-fatigue mats were used by 34.1%.

Miscellaneous factors revealed that 52.4% had bottle dispensers, 62.2% had adequate storage, 64.6% stored heavy items on low shelves, and 62.2% had clear cut-outs. Easy-to-open jars were available for 46.3%, and 42.7% had platforms for elevated tasks. Adequate bins and racks were available for 68.3%. Table I

Discussion

Practicability of ergonomics is the principal function of awareness. For a healthy, well-being and efficiency of a worker, ergonomics plays a vital role. This study aimed at assessing awareness and knowledge of ergonomic among medical laboratory workers. In past decades, there were no awareness about ergonomics so this study focused on it. However, this study was aimed to determine the ergonomics practice pattern among 82 medical laboratory professionals with the male vs. female percentage of 45.1% vs. 54.9% with an overall average age of 26.80± 5.70 years. Consistently Alwahaibi N et al[10] reported that the females accounted for 68.2% of the study population, followed by males (31.8%). The majority of these individuals were aged between 25 and 44 years. On the other hand, Mukhtad AA et al[11] included a total of 103 laboratory technicians to observe the ergonomic risk evaluation among healthcare lab workers, with an age range of 20 to 50 years and in their study population, 69% were females and 31% were males. Females make up a significant portion of those who work in healthcare, which includes medical laboratories, according to studies. This could be because the healthcare sector, particularly responsibilities such as laboratory technicians, is attracting more females due to a variety of cultural and socioeconomic factors, trends in education, and professional interests.

In terms of ergonomics practice pattern the several participants reported appropriate bench heights (70.7%) and tools within arm's reach (62.2%), deficiencies were noted in foot and knee clearance, with only 50.0% and 53.7% respectively. Microscope usage demonstrated challenges in maintaining neutral posture (65.1%), while pipette use and micro-manipulation tools highlighted the need for improved accessibility and ergonomic support. On seated bench, bench cutouts were not available. But the work items were in close reach. There was precision and close inspection for tasks. The study is about workers who spend several hours at microscopy stations. There was a lot of problems by using these microscopes without any ergonomic awareness. This ergonomic study identified these problems such as the required height that was required to use microscope was insufficient and it maintain the body in awkward position.

There was lack of chair arm sets, supported arms and pads for prolonged work. There was sufficient legroom and foot support while using microscope and no breaks were provided. Microscopes were not easily reachable to the workers. By this study we focus on all these points so to acquire the desired ergonomic microscope station. Women had low control and high strain as compared to men. Our results shown that men and women perceive different workload in labs. With high prevenance of women working in labs more women than men took part in study. So, in this sense women have high risk of musculoskeletal disorders with high static load of upper extremity. So, the women have more harmful effect than men. Our study

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aims at that men and women should work in segregated work stations.

In the comparison of this study Alwahaibi N et al[10] reported that just 16.5% of BMSs used excellent

Table I: Ergonomic Practice in Medical Laboratory Workers. (n=82)

Stations	Questions		Yes	No
Standing Bench	Is there bench height compatible with the work performance?	The work area can be set at approximately elbow height (~36-40)	70.7%	29.3%
		Tasks can be carried out with relaxed shoulders	74.4%	25.6%
	Are the main work tools and supplies positioned within arm's reach (4-18 inches) from the table edge?		62.2%	37.8%
	Is there adequate knee and foot clearance when performing standing tasks at the bench?	4" deep clearance of knee	53.7%	46.3%
		4" high and 4" deep clearance of foot	50.0%	50.0%
		Is a foot rail or support available? (6" from floor)	11.0%	89.0%
	Are floor mats provided in areas where tasks require prolonged standing?		31.7%	68.3%
	Does the bench feature rounded or padded edges to minimize contact stress?		48.8%	51.2%
	Is a standing bench available for tasks that involve frequent movement between workstations?		40.2%	59.8%
Seated Bench	Are there bench cutouts available for seated workers?	Minimum 15" width	47.6%	52.4%
		Minimum 20" width	48.8%	51.2%
	Are work items within close reach, no more than 24 inches away?		74.4%	26.6%
Laboratory Chairs	Are the laboratory chairs adjustable to fit all workers?	Is the seat height suitable for working at bench height?	64.6%	35.4%
		Are feet supported by the floor, a ring, or a footrest?	64.6%	35.4%
	Are the armrests adjustable or removable if they obstruct work?		32.9%	67.1%
	Are suitable footrests or foot rings available?		29.3%	70.7%
	Are employees known that how to adjust the chair?		75.6%	24.4%
Microscopes	Can employees view the eyepiece while maintaining a neutral posture for the neck, shoulders, and back? (Neck flexion less than 25 degrees, shoulders relaxed, back upright and supported by chair?)		65.1%	34.1%
	Is the microscope conveniently positioned for the worker? (Typically, near the edge of the workbench)		89.0%	11.0%
	Is it possible to adjust the microscope to encourage neutral head, neck, shoulders, and arm postures during use?		72.0%	28.0%
	Are the arms supported by the work surface, chair armrests, or pads during extended periods of work?		58.5%	41.5%
	Can the worker operate the microscope controls with supported and relaxed arms?		50.0%	50.0%
	Is there ample space for legs and adequate support for the feet while using the microscope?		28.0%	72.0%
	Are breaks from microscope work offered?		36.6%	63.4%
Pipettes	Is manual pipette usage restricted to fewer than 4 hours per day?		79.3%	20.7%
	If pipette usage exceeds 4 hours per day, are multi-channel, electronic, or latch mode pipettes accessible?		39.0%	61.0%
	Have employees received training on choosing the right pipettes for pipetting tasks?		63.4%	36.6%
	Are racks, trays, beakers, and supplies accessible and positioned for convenient reach?		79.3%	20.7%
	Are vials, tubes, and receptacles designed to be as compact as possible?		65.9%	34.1%
	Do workers pipette with relaxed shoulders, and their arms and wrists in neutral positions?		59.8%	39.0%
Micro-manipulation	If forceps are utilized for extended durations, are locking mechanisms, rings, or other adapted aids employed to minimize prolonged or static pinch forces?		50.0%	50.0%
	Are the vials simple to cap and screw on?		61.0%	39.0%
	Are cap openers provided?		24.4%	75.6%
	Are clamps and holders accessible to support test tubes and other materials that need to be held for extended periods?		61.0%	39.0%
Microtome/ Cryostat	Can staff members use the microtome with both hands in a weapon's grip? (the handshake status, wrists connected towards forearm)		67.1%	32.9%
	Is equipment positioned within a bench cutout to ensure sufficient clearance for legs and knees?		56.1%	42.7%
	Is there an adjustable chair at the microtome or cryostat that offers both back and foot support?		52.4%	47.6%
	Are employees provided with access to a motorized microtome/cryostat for tasks requiring high intensity or volume?		51.2%	48.8%
Cabinets	Is there adequate leg and knee clearance to encourage neutral sitting postures when using the hood or cabinet?		35.4%	63.4%
	Can workers maintain relaxed shoulders while sitting or standing?		34.1%	65.9%
	Is there padding provided to minimize compression on soft tissues (such as edge padding or arm pads)?		29.3%	79.7%
	Are materials within the hoods and cabinets positioned as near as feasible to the worker to prevent over-reaching?		52.4%	47.6%
	Are vials, tubes, and receptacles designed to be as compact as they can be?		43.9%	56.1%
	Are anti-fatigue mats employed when employees stand for over 4 hours per day?		34.1%	65.9%
Miscellaneous	Are bottle dispensers and bottom-dispensing carboys accessible for dispensing liquids?		52.4%	46.3%
	Is there sufficient and suitable storage available for supplies?	Is sufficient space available for supplies?	62.2%	37.8%
		Are heavy bottles and boxes kept on lower shelves?	64.6%	35.4%
	Are the cut-outs free of storage items and ready for use?		62.2%	37.8%
	Are jars easy to open, or are there jar openers provided?		46.3%	53.7%
	Are there temporary platforms accessible for tasks that involve raising the arms above chest level for extended periods?		42.7%	57.3%
	Are there enough bins and racks for commonly used items?		68.3%	31.7%

ergonomic principles. Furthermore, there was a significant link between the male gender and effective ergonomic practices. This could be because males are less stressed than females, which allows them to do their professions more ergonomically.[10] In the study by EU LL et al[12] reported that the over 60% of the participants acknowledged the importance of ergonomics in preventing injuries. Additionally, a significant majority of 68.3% strongly believed that ergonomics improves the overall quality of work.[12] This study showed that there was a lack of trays and beakers within easy reach.

According to Nigerian study by Oladeinde BH et al[13] reported that the study participants had limited awareness of ergonomics and a poor understanding of the benefits of its proper application. In the study by Nupura Rajiv Naik et al[14] demonstrated that around 67.81% of the population bends forward toward the eyepiece while performing tasks with a microscope, which is a substantial contributor to musculoskeletal pain. On the other hand, 22.98% like to retain a standing position, while 9.19% lean into the chair during working.[14] In aligns to this study, an industrial study by Rajamony B et al[15] indicated that ergonomics evaluations in industrial settings have gained raised attention because of the costs associated with repetitive motion injuries. During the working, the most common positions are either standing or sitting. According to a study on office ergonomics found that 45% of employees utilized nonadjustable chairs, 48% positioned their computers facing windows, 90% spent more than 4 hours per day using computers, and 45% established a bending and unstable back position.[16]

In the study by Haile EL et al[17] reported that there was a strong association between ergonomic workplaces and associated with work musculoskeletal diseases in the therapeutic laboratories. Poor ergonomic workstations were strongly linked to complaints, with the most common being 21.7% ankle/feet and 20.8% knees. An overall average score for workstations was 1.95, indicating subpar ergonomic conditions. Additionally, in the most of study cases stated they were unfamiliar with ergonomics.[17]

Another study also underscores the significance of healthcare execution managers in developing organizational policies and strategies grounded in ergonomics. These efforts can enhance healthcare quality performance and yield positive financial outcomes.[18]

No further relevant studies were identified in the literature, particularly highlighting a significant gap at the local level. Unfortunately, a majority of laboratory workers lacked knowledge about ergonomics, although knowledge acquisition was not the primary aim of this study. Additionally, this study has several limitations, such as not analyzing participants' affiliation, domain of specialization, subsequent qualification expertise, and qualifications for education in conjunction with awareness of ergonomics. Statistical analysis did not reveal any significant differences amongst participants of the study in the both sectors of public and private regarding their knowledge of the ergonomics advantages and the risk considerations for MSDs developments. However, it is recommended that further longitudinal and comprehensive studies be conducted to validate the findings and encourage the initiatives aimed at improving healthcare quality performance and achieving positive financial outcomes.

Conclusion

Study revealed the varying levels of ergonomic appropriateness across the workplace and equipment among medical laboratory workers, with significant inadequacies in foot and knee clearance, the presence of foot rails, floor mats, adjustable armrests, and foot rests. Challenges in maintaining a neutral posture when using a microscope, as well as concerns about pipettes and micro-manipulation equipment, underscored the need for improved accessibility and ergonomics. Addressing such deficiencies is critical for reducing musculoskeletal hazards and improving overall worker well-being in medical laboratory environments. Future initiatives should prioritize improvements in ergonomics to provide more secure and effective workplaces for laboratory professionals.

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