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Postural Assessment of Histopathology Laboratory Technicians during Laboratory Tasks

Sumeya Ruwaie [1], Behzad Bashiri[1]
[1]Department of Biomedical Engineering, College of Engineering,
International University of Since and Technology in Kuwait
Ardiya Government Area, Al Farwaniyah Governorate, Kuwait
21010340@iuk.edu.kw; Behzad.bashiri@iuk.edu.kw

Abstract **-** Work-related musculoskeletal disorders (WMSDs) are a significant occupational health concern in healthcare and biomedical settings. Histopathology laboratory technicians face unique ergonomic challenges due to repetitive, precise, and posture-intensive tasks. This pilot study assessed the ergonomic risks associated with the work postures of histopathology laboratory technicians to inform a larger-scale investigation. Tasks analyzed included grossing, processing, embedding, and sectioning of tissues, as well as data entry, labeling, and typing grossing descriptions. A method was adapted using Rapid Upper Limb Assessment (RULA) and Nordic Musculoskeletal Questionnaire (NMQ), to assess task postures and collect data on work-related injuries in seven histopathology laboratory technicians. Individuals with previous injuries, pregnant workers, and those involved solely in administrative tasks were excluded. Descriptive results indicated that the overall prevalence of WMSDs was 38% over the past 12 months. The highest prevalence was for lower back pain (71%), while the lowest was for hip/thigh pain (14%). Additionally, the overall RULA score was 5, with most of tasks presenting scores of 5 and 6, indicating urgent need for ergonomic interventions and posture improvement. According to RULA, scores above 3 indicate the necessity for further investigation and potential ergonomic improvements. The results suggest that histopathology laboratory technicians are at a high risk for WMSDs and highlight the need for addressing risk exposures on a larger scale.

Keywords**:** Posture assessment, Work-Related Musculoskeletal Disorders, Histopathology, RULA, NMQ

1. Introduction

Histopathology is the analysis of human tissue through microscopic slides to diagnose cancer and inflammatory diseases. In the histopathology laboratory, technicians dissect samples and prepare them for analysis. There are five steps in the histopathology analysis process: i) *Grossing*: describing the specimen macroscopically and sectioning it into thin sections that can fit into cassettes, ii) *Processing* the tissue overnight to prepare it for embedding with paraffin wax, iii) *Embedding*: the step where the tissue is immersed in melted paraffin wax to create a sample block, iv) *Sectioning*: The blocks are cut into very thin sections and stocked into microscopic slides, and v) *Staining*: Microscopic slides are stained with hematoxylin and eosin stain and are viewed under the microscope. Each of these tasks exposes lab technicians to specific ergonomic challenges. For example, the specimen grossing task requires prolonged standing, which may cause lower back and foot pain. Similarly, while performing embedding and sectioning tasks, histopathology technicians maintain prolonged static postures, potentially causing discomfort in the back, wrists, and hands.

Ergonomic risks – defined as potential injuries to the musculoskeletal system due to workplace conditions – are prevalent among laboratory technicians. These risks include repetitive motions, awkward postures, and extended periods of immobility. Injuries and disorders that affect the musculoskeletal system, caused by such risk factors, are known as WMSDs [1]. Lower back pain, neck, knee, wrist, and shoulder pain are all examples of musculoskeletal disorders that laboratory technicians may suffer from. WMSDs can lead to poor performance, long-term sick leave, and increased costs for both organizations and society due to reduced productivity and higher compensation expenses [2].

Laboratory technicians' health affects their ability to perform accurately and efficiently, which in turn affects patients' outcomes. Postural assessment is a proven method for identifying ergonomic challenges by analyzing technician postures and detecting possible risk factors. A pilot study was performed to inform the design of a larger study to analyze risk factors in hospital laboratories in Kuwait. We focused on histopathology laboratory tasks, aiming to assess the posture of

histopathology laboratory technicians during their daily tasks, identify specific risk factors for MSDs, and evaluate the effectiveness of current workstation design. This pilot study included observing seven technicians, at the histopathology laboratory in Jahra Hospital in Kuwait, while performing their routine. We adapted a method combining researcher observations with a posture-based method, Rapid Upper Limb Assessment (RULA), and Nordic Musculoskeletal Questionnaire (NMQ) to investigate the research objectives from multiple angles. The outcomes of the study are intended to contribute to improved technician postures, reduced risks of injury and pain, and the design of safer and more productive work environments in hospital laboratories. We hypothesize that improving work conditions by minimizing ergonomic risk factors can lead to improving the accuracy of the procedures and results, thus creating better patient-hospital relationships and reducing healthcare costs for society.

2. Methodology

In this study we used RULA and NMQ to investigate WMSDs in the histopathology laboratory at Jahra Hospital in Kuwait. Participants involved both female and male, regardless of the nationality. The study excluded technicians with a history of injury prior to commencing work in the laboratory, pregnant technicians, and those involved only in administrative work. Seven volunteers were qualified to take part in the study based on the inclusion and exclusion criteria. The volunteer laboratory technicians were informed about the research process and objectives and filled out a consent form and a demographic questionnaire prior to participation in the study. The study adhered to ethical guidelines to ensure the safety and confidentiality of participants.

To assess musculoskeletal complaints, the NMQ was presented to the participants with anatomical diagrams that highlighted each part of the body for clarity. Participants reporting pain or discomfort were required to provide additional details regarding the duration of pain/symptoms, to specify if these pain/symptoms were present in the past seven days, to answer if the pain had affected their work activities, to note if they had seen a doctor regarding their pain/symptoms, and if they took medication due to the pain/symptoms. Following this step, observational data were collected to analyze technicians' postures during routine laboratory tasks. The researcher captured photographs of technicians performing key activities such as specimen grossing, embedding, and sectioning. These images were evaluated using the RULA, a standardized ergonomic tool designed to identify risk levels associated with upper limb postures and movements. RULA scores were used to quantify the degree of ergonomic risk and prioritize interventions.

2.1. Equations

Equation (1) was used to calculate the percentages of prevalence of WMSDs and the characteristics of histopathology technicians:

$$\% = \left(\frac{N}{7}\right) \times 100 \tag{1}$$

where N is the number of participants. In addition, Equation (2) was used to calculate Body Mass Index (BMI) of each technician

$$BMI = \frac{W}{H^2} \tag{2}$$

where W is weight and H is height.

3. Results

The participants were 4 females and 3 males with an average age of 30 ± 8.5 years. The average height was 163.4 ± 10.4 cm, and the average weight was 71.6 ± 14 kg. The BMI of participants was 26.8 ± 4.2 kg/m^2. Most participants reported that they work 6 days per week, which is a typical work duration in the country. The average working hours per week were 39 ± 3.7 hours. All technicians reported that their nature of work involves both prolonged sitting and standing. Please see Table 1 for detailed demographic and occupational characteristics of the study participants.

Quantitative data from the NMQ were analyzed to identify trends in musculoskeletal complaints. The overall prevalence of WMSDs in the past 12 months in any part of the body was 38%. According to the descriptive statistics provided in Table

2, the prevalence of pain was high in the lower back, closely followed by neck and shoulder. Medium levels of pain were reported in upper back, knee, and ankles/feet (28.57%), while the lowest pain levels were in elbow, wrist/hand, and hip/thighs. Five technicians reported that they had not visited a doctor during the past 12 months due to the reported pain levels, while the remaining two visited the doctor to treat the pain. In addition, four participants reported that they took medication to stop or treat the pain.

Table 1: Demographic and occupational characteristics of the study participants

Variable	Parameter	Count	Percentage
Gender	Female	4	57.14%
	Male	3	42.85%
Age	20 – 24	3	42.85%
	25 – 29	1	14.28%
	30 – 35	1	14.28%
	35 +	2	28.57%
BMI	Underweight	0	0%
	Normal wight	4	57.14%
	Overweight	1	14.28%
	Obesity	2	28.5%
Years of employment	Less than 1 year	1	14.28%
	Between 1 – 4 years	4	57.14%
	5 – 10 years	1	14.28%
	More than 10 years	1	14.28%
Nationality	Kuwaiti	3	42.85%
	Non-Kuwaiti	4	57.14%

RULA provided a detailed assessment of ergonomic risk levels based on the technician postures. RULA categorizes ergonomic risks of tasks into 4 categories: a) scores 1 and 2, acceptable posture with no action required, b) scores 3 and 4, low-risk posture, with changes needed in the long term, c) scores between 5 and 6, medium-risk posture, requiring prompt investigation and changes, and d) a score of 7, high-risk posture, demanding immediate ergonomic intervention. In the calculation of RULA scores, the tasks considered to be repetitive, with load levels less than 2 kg. Most of the tasks including Grossing, embedding, sectioning and processing, resulted in scores of 5 and 6, highlighting the need for work condition improvement. Only data entry and labelling with barcode task returned a score of 4, which low exposure risk.

Table 2: Prevalence of WMSDs among histopathology laboratory technicians

Site	Number of participants	Prevalence %
Neck pain	4	57.14%
Shoulder pain	4	57.14%
Elbow pain	1	14.28%
Wrist/hand pain	1	14.28%
Upper back pain	3	42.85%
Lower back pain	5	71.42%
Hip/thighs pain	1	14.28%
Knee pain	3	42.85%
Ankles/feet pain	2	28.57%
Overall	7	38%

4. Discussion

The postural assessment of histopathology laboratory technicians showed an important ergonomic risk. They were exposed to a high risk of awkward postures during embedding tasks, cutting tasks, typing of grossing description task, and data entry and the labelling with barcode. In general, most laboratory technicians suffered from awkward postures. In this study, the prevalence of WMSDs within histopathology laboratory at Jahra Hospital was found to be high, with a mean of 38 ± 21%. Most technicians have suffered from lower back pain (Table 1). Previous studies have found similar results that the major affected area of MSDs was lower back [2][3][4][5][6]. Other previous studies found different results where the area most affected by WMSDs was the neck [7][8].

Furthermore, the average RULA score was relatively high (> 5), which indicated changes to task design and posture may be needed soon. All the tasks had similar scores from RULA, but the lowest score was data entry and labelling with barcode with a score of 4. The result showed that there is a link between repetitive tasks, postures, and duration of tasks of histopathology laboratory technicians and the MSDs. The less movement the task has and different angles, such as bending the back at an angle of 10 – 60, the angle of the neck between 20+, and the hand/wrist angle for long time, there will be more risk of WMSDs or pain. Also, longer working hours and long static postures may cause chronic musculoskeletal disorders. Previous studies found the final score of RULA and REBA was in the range of 5 – 7 and 5 – 12. They explained that most of the posture should be changed soon, and the design of the workplace must improve [6].

5. Conclusion

This pilot study utilized NMQ to collect work related injury data from histopathology laboratory technicians. In addition, RULA was used to identify ergonomic risks associated with the daily laboratory tasks, revealing a high potential for WMSDs among histopathology laboratory technicians, including pain from poor posture and repetitive tasks. Given the small sample size, the generalization of these results is limited, however, the study provides a strong foundation for a large-scale investigation in Kuwait. Future research will aim to validate these initial findings and develop and explore a range of ergonomic solutions to mitigate the risks faced by technicians.

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