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Rehabilitation Communications
DOI: doi.org/10.55627/rehab.003.002.0921
Research Article

Ergonomic Risk Assessment and Upper Limb Musculoskeletal Disorders Among Physiotherapists

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Abstract

Ergonomic risk in a workplace environment can result in musculoskeletal disorders in physiotherapists because of their demanding work. It is a major contributor to musculoskeletal upper limb disorders (WRULDs) and work-related upper limb disorders. This study examines the ergonomics hazards and their connection with WRULDs among physiotherapists. Cross-sectional research was done to investigate ergonomic risk and work-related upper limb problems. 204 physiotherapists, ages 24 to 40, from clinical settings in Islamabad and Rawalpindi, who had at least a year's experience and most of them worked five hours a day, made up the sample. A standardized Nordic musculoskeletal questionnaire was used to assess WRULDs, together with demographic information. Using a Rapid Upper Limb Assessment (RULA) sheet and the pen and paper observational method, the posture was evaluated. The mean age of the research participants was 28.21±3.04, with a mean BMI of 22.94±3.75. In the study, 62% of physiotherapists had reported upper limb disorders. The order of pain was shoulder > wrist > elbow. Postural assessment on the RULA scale showed a mean of 4.26 ±1.18. The result showed that 112 (65.8%) participants were at a low level of risk, 49 (28.8%) of participants were at medium risk, and 9 (5.2%) were at a high level of risk. WRULDs were substantially correlated with ergonomic risk (9.488) (p-value<0.05), according to the chi-square test analysis. The elbow was not shown to be substantially related to ergonomic hazards (p-value>0.05), however, the shoulder and wrist were (p-value<0.05). The study concluded that ergonomic risk is common among physiotherapists, and there is a need to change working posture by adjusting workstation heights, encouraging regular breaks for stretching exercises, and promoting the use of ergonomic tools. It is further concluded that there is an association between ergonomic risk and musculoskeletal problems of the upper limb. The findings emphasize the need for workplace interventions to improve postures and mitigate upper limb musculoskeletal risks among physiotherapists.

Keywords: Ergonomic Risk, Posture, RULA, Upper limb musculoskeletal disorder.

1. Introduction

Ergonomic risk pertains to potential hazards or factors present in a workplace environment that can result in discomfort, musculoskeletal disorders, and other health issues for individuals. These risks arise from inadequately matched interactions between employees and their work tasks, equipment, and surroundings. Ergonomics concerns must be recognized and addressed to improve productivity, provide a safe and healthy work environment, and shield people from long-term health issues (Sachdeva, Bhateja, and Arora 2020). Throughout epidemiological studies, a variety of occupational risk factors have been extensively documented, such as manual handling, repetitive tasks, and static posture. These studies have shed light on the potentially detrimental impacts of these factors on workers' health and overall well-being. It is imperative to proactively address and mitigate these risks to enhance workplace safety, lessen the likelihood of accidents at work, and avoid musculoskeletal conditions (Ishwarya and Rajkumar 2021). A variety of work-related musculoskeletal diseases (WMSDs), which are typified by soft tissue

discomfort, can be brought on by or made worse by occupational exposures. These conditions are brought on by repeated motions made with poor posture (Altas, Çukurova, and Uzun 2022). They start in the muscles, joints, ligaments, tendons, and bones and last longer than three days because of work-related situations and occurrences. As a consequence, WRMDs reduce productivity and cause limitations at work, unconsciousness, a change in vocation, or even death (Khairy et al. 2019). Upper limb musculoskeletal disorders are now one of the most prevalent occupational health conditions, primarily associated with repetitive movements, prolonged awkward postures, or heavy physical exertion. They have a major impact on worker productivity as well as well-being; research has indicated a high correlation between ergonomic risk factors and the occurrence of Upper extremity musculoskeletal disorders (UEMSDs). UEMSDs are among the most prevalent and expensive occupational health conditions globally. Research, such as the French Pays de la Loire study, indicates that a high proportion of UEMSDs can be attributed to occupational and individual risk factors. The factors that lead to the development of these disorders are high physical effort, low social support, working for long periods with arms elevated above shoulder level, and demographic factors such as age and gender. In particular, the study indicated that approximately 30% of the cases of UEMSDs were attributed to high physical effort, and 7% were attributed to repetitive arm elevation above shoulder level for more than two hours daily (Nambiema et al. 2020). Upper limb musculoskeletal disorders are now one of the most prevalent occupational health conditions, linked primarily to repetitive movement, maintained awkward postures, or high physical exertion. UEMSDs produce important worker productivity as well as well-being side effects, with evidence indicating a strong link between ergonomic risk factors and the onset of UEMSDs (Lu et al. 2022).

Physiotherapists are exposed to ergonomic risks from repetitive movements, awkward postures, lifting heavy loads, extended periods of standing, and the lack of suitable equipment (Fan et al. 2022a). WRMDs are pervasive among those healthcare professionals who have direct contact with patients, such as surgeons, nurses, and physiotherapists. In a prior online survey, the average lifelong occurrence of musculoskeletal pain among physical therapists ranged from 55% to 91%. There is a significant chance of getting musculoskeletal illnesses at work if you perform highly repetitive duties, lift large things, or work in uncomfortable positions (Fan et al. 2022b). Even though physical therapists (PTs) are well-versed in ergonomics and injury prevention, they are nevertheless at a high risk of acquiring WMSD. Studies have examined the prevalence of WMSD, particularly upper limb problems, among PTs (Chen et al. 2022). UEMDs are very common among Pakistani physiotherapists, with neck pain (28.80%), shoulder pain (20.00%), elbow pain (1.60%), and wrist pain (0.60%) reportedly occurring, and there is a need for ergonomic measures and preventive interventions (Shaukat et al. 2025). Another study reported that thumb pain is a common upper limb disorder among physiotherapists in Pakistan, affecting 48.1% of participants, with a higher prevalence in females (52.0%) compared to males (43.3%), primarily due to manual therapy techniques such as mobilization and manipulation (Arshad et al. 2024). Studies show that musculoskeletal disorders are prevalent among physiotherapists in the twin cities of Pakistan, with the most commonly affected areas being the lower back (13.92%), wrist/hands (11.36%), and shoulders (9.94%), impacting daily activities and quality of life (Ali et al. 2023). Despite extensive studies on WRMDs among physiotherapists, few studies have addressed upper limb disorders in Pakistan. The literature does not provide an extensive analysis of ergonomic risk factors leading to these disorders in public and private

Table 1: Characteristics of Participants

Variable	Types	Frequency	Percentage
Gender	Male	61	35.9
	Female	109	64.1
Dominant hand for activity	Right	151	88.8
	Left	12	7.1
	Both hands	7	4.1
Qualification	DPT	127	74.7
	Master	40	23.5
	PhD	3	1.8
Area of expertise	Ortho manual rehabilitation	94	55.3
	Cardiopulmonary rehabilitation	21	12.4
	Neurological rehabilitation	33	19.4
	Sports rehabilitation	22	12.9

clinical practice. The purpose of this study was to evaluate the hazards associated with ergonomics and upper limb musculoskeletal problems among physiotherapists employed in both public and private clinical settings in Pakistan.

2. Materials & Methods

2.1. Study Design and Setting

From August 2022 to January 2023, the cross-sectional study was conducted in several clinical settings in Rawalpindi and Islamabad. The project was authorized to move forward with the ERC reference number HR/151/22 by the Margalla Institute of Health Sciences ethical review committee.

2.2. Study Population

Data were collected from male and female physiotherapists aged 24 to 40 years, considering that most females experience menopause and degenerative changes starting around 40 (Kumar and Kamath 2019) with a minimum of one year of experience, working a minimum of five hours per day. Participants were excluded if they were pregnant females, had any systemic disease, or had any history of musculoskeletal trauma or surgery in the past. Using Epitool, the sample size of 230 was determined based on the original study (Nazar, Badshah, and Shamim 2021).

2.3. Assessment of Demographics and Profession-Related Information

The demographics and profession-related information of participants were collected through a self-structured questionnaire. The posture was assessed through a pen-and-paper observational method by using the Rapid Upper Limb Assessment (RULA) sheet.

2.4. Assessment of Upper Limb Musculoskeletal Disorders

A modified Nordic Musculoskeletal Questionnaire (mNMQ) was employed to determine upper extremity musculoskeletal disorders (Palmer et al. 1999). The Nordic Musculoskeletal Questionnaire is used to evaluate musculoskeletal disorders related to the workplace. It consists of two sections: a general questionnaire consisting of 40 forced-choice items that identify the parts of the body that cause musculoskeletal problems; additional

Table 2: Professional characteristics of the study participants.

Factors	Values	Frequency	Percentage
Years of clinical practice	<5	133	78.2
	6-10 years	17	10.0
	11-15 years	17	10.0
	16-20 years	3	1.8
Working hours per day at the clinic	1-3 hours daily	22	12.9
	3to5 hours daily	40	23.5
	5 to 8 hours daily	89	52.4
	>10 hours daily	19	11.2
Treated patients per day	1-3	34	20.0
	4-6	48	28.2
	7-9	39	22.9
	>9	49	28.8
Prefer working	Standing	48	28.2
	Sitting	15	8.8
	Both	107	63.0
Physical activity or stretching during work	Yes	93	54.7
	No	77	45.3
Work demand according to the profession	Strenuous shoulder/ arm Movement	105	61.8
	Frequent use of vibrating tool	9	5.3
	Inconvenient posture	33	19.4
	Prolonged sitting or standing	23	13.5

questions about the neck, shoulders, and lower back that further detail pertinent issues, and three regions (shoulder, elbow, wrist/hand) out of nine regions were included in the mNMQ to assess pain-related symptoms in the upper limb in the last 12 months/seven days.

2.5. Assessment of Upper Limb Ergonomic Risk Assessment

For ergonomic assessment, the RULA Scale was used (McAtamney and Corlett 1993). The goal was to evaluate upper limb and neck loads. Individual body segments, such as the neck, upper limb, and lower limb, were examined in their respective positions; the more each body segment deviated from the neutral posture, the higher the score for that body part. Each of the four action levels that make up the scoring system denotes the urgency of the necessary intervention or posture modification to lower ergonomic risk. The RULA has scores ranging from 1 (negligible) to 7 (very high), with higher scores indicating higher ergonomic risk. The mean score indicates the average postural risk and a higher mean indicates higher musculoskeletal strain that requires attention. A minor danger is represented by Action Level 1 (scores 1-2), where no action is required. A modest risk is indicated by Action Level 2 (scores 3–4), which implies that adjustments could be required. Medium risk is indicated by Action Level 3 (scores 5–6), which calls for immediate adjustments and more research. Lastly, Action Level 4 (score of 7) indicates extremely high risk and calls for quick modifications to be made to reduce any risks.

2.6. Data Analysis

Data analysis was conducted using SPSS 21.0 software (SPSS Inc., Chicago, IL, USA). Descriptive statistics, including frequency, percentage, mean, and standard deviation, were

Table 3: Ergonomic Risk.

Rapid upper limb Assessment scale	Frequency	Percentage
Negligible Risk, no action is required	00	00
Low risk, change may be needed	112	65.9
medium risk, further investigation, change soon	49	28.8
Very high risk, implement change now	9	5.3

used in the data analysis process. Both tabular and graphical forms are used to convey the results. The relationship between occupational risk factors and upper limb musculoskeletal problems was examined using the chi-square test. 0.05 was regarded as a significant P-value.

3. Results

In this research study, 230 physiotherapists were invited to participate. Among them, 26 declined to participate in the research, and 204 physiotherapists participated in the study. 34 participants were excluded due to eligibility criteria, and 170 questionnaires were examined. The average age of the participants in the research was 28.21±3.04, with an average BMI of 22.94±3.75. In this study, 64.1% of females and 35.9% of males participated, with a mean age of 28.22±3.75. In the current study, the respondents had working experience <5 years more (78.2%) as compared to those who had >5 years (21.8%) of experience. The participants' characteristics are presented in Table 1. The professional traits of physiotherapists are presented in Table 2.

The present study employed a standardized Nordic questionnaire to determine the prevalence of ULMDs. In the research, 106 (62.4%) of the respondents experienced difficulty with the upper limb in the last 12 months. Region-wise, difficulty in the last 12 months was ranked as 43.5% in the shoulder, 22.9% in the elbow, and 38.8% in the wrist. In our study, 25.3% of research participants had trouble in the shoulder, 4.7% in the elbow, and 18.8% in the wrist during the last 7 days. In the previous 12 months, 21.8% of physiotherapists reported being unable to perform their regular duties because of shoulder discomfort, 10% reported elbow pain, and 25.3% reported wrist pain. According to the findings, upper limb pain was ranked from shoulder to wrist to elbow.

Postural assessment on the RULA scale shows that all the participants have a mean of 4.26±1.18. According to the results of the fast upper limb evaluation, 112 (65%) physiotherapists were deemed to be at low risk, and adjustments could be recommended (Table 3). Furthermore, 9 (5.3%) physiotherapists in the sample showed extremely high risk, necessitating an urgent adjustment, whereas 49 (28.8%) physiotherapists demonstrated medium risk, requiring further research to modify the position soon.

WRULDs were substantially correlated with ergonomic risk (9.488) (p-value<0.05), according to the chi-square test analysis. A significant association between ergonomic risk variables and upper limb musculoskeletal diseases was shown using the Chi-square test, indicating that a higher incidence of musculoskeletal issues is linked to increasing ergonomic risk. According to the chi-square test analysis, the elbow was not shown to be substantially related to ergonomic hazards (p-value>0.05), however, the shoulder and wrist were (p-value<0.05).

Table 4: Association of ergonomic risk with different regions of the upper limb.

Ergonomic risk (n=170)							
		Negligible	LOW	Medium	Very high	r value	P-value
Shoulder	Yes	-	41	25	8	10.835	0.004
	No	-	71	24	1		
Elbow	Yes	-	23	11	5	5.789	0.055
	No	-	89	38	4		
Wrist and hand	Yes	-	36	25	4	6.235	0.044
	No	-	76	24	4		
Frequency of upper limb musculoskeletal disorders						9.488	0.009

4. Discussion

To lower the risk of musculoskeletal illnesses associated with the workplace, ergonomic examination is becoming crucial. Physiotherapists have a high prevalence of WRMSDs, according to previous research, but little is known about their ergonomic risk in a real-world work environment. The purpose of the current study was to determine the ergonomic risk that physiotherapists face during clinical sessions and the relationship between ergonomic risk and possible upper limb illnesses connected to the workplace. By identifying the ergonomic risk, solutions for correct posture could be developed in the workplace. In the study, posture assessment was performed by using the RULA sheet in the clinical setups of physical therapy. This is crucial to lowering the likelihood of musculoskeletal issues and creating a work environment that is ideal for physical therapists.

The gender distribution of the study is consistent with the study conducted by Munir et al., in which 82.96% were females and 17.4% were male (Ahmad et al. 2022a). A similar distribution of more females than males was also supported by past studies (Ramanandi 2021), (Fan et al. 2022a).

Greiner et al. conducted a study on hand-intensive healthcare professions such as physiotherapy. Their study concluded that there was a high prevalence of 78.1% of WRULDs within the past 12 months (Greiner, Nolan, and Hogan 2019). Campo et al. found that 75% of orthopedic physical therapists had hand pain within the past 12 months (Campo et al. 2019). In PTs, the absolute identified area of WRMSD occurrence within 12 months was the upper limb compared to the lower limb (Ahmad et al. 2022a).

A study on physiotherapists by Rahimi et al. showed trouble in the shoulder (50.2%), elbow (21.6%), and 37.9% in the wrist within the past 12 months (Rahimi et al. 2018). Past literature showed that in the past 7 days, 29.55% of physiotherapists had trouble in the shoulder, 12.2% in the elbow, and 20.4% in the wrist (Rahimi et al. 2018). Similarly, in the study conducted by Ahmad et al., pain limits activity to around 28.1% in the shoulder, 9.6% in the elbow, and 20 in the wrist. The worst to least affected areas within the past 7 days were 34.8% shoulder, 18.5% wrist, and 7.4% elbow (Ahmad et al. 2022b). Other studies also show similar prevalence in order of shoulder > wrist > elbow (Rahimi et al. 2018, Ramanandi 2021).

The ergonomic risk was evaluated by using the RULA sheet. The mean grand score of RULA was 4.26 ±1.178, which means that change may be needed, and there was a low ergonomic risk. This indicates that further investigation and possible ergonomic adjustments are needed, such as improving workstation design, posture correction, or modifying work tasks to reduce musculoskeletal strain. Kothari et al. evaluated the risk of musculoskeletal disorders among

nursing professionals by using RULA and rapid entire body assessment (REBA). The mean grand score of RULA turned out to be 3.63. Their study suggested that nursing professionals have high work demands, such as transferring patients, so they needed changes in work posture (Kothari et al. 2022). Thirteen healthcare professions were identified in a systemic review that showed ergonomic risk according to the RULA score and the need to change the work posture (Kakaraparthi et al. 2022). A pilot study was conducted by Zhang to study ergonomic analysis in physical therapy during different manual tasks. The participants performed three manual tasks in an experimental setting. Their results showed that physiotherapists were at risk in all the manual tasks of the study. The RULA score turned out to be high, which indicated that the posture needed to be further investigated (Zhang et al. 2022).

In the study, all physical therapists were at ergonomic risk. Further investigation was required, and changes were needed in the working posture. Only 5.2% were placed in the high-risk category, the rest of the participants still exhibited mild to moderate ergonomic risks, meaning that there was some kind of intervention or posture adjustment required for everyone. Fan LJ et al. conducted a study examining ergonomic risk factors and work-related musculoskeletal disorders in clinical physiotherapy. The findings revealed that all therapists were susceptible to ergonomic risks, and their postures during work were deemed unacceptable (Fan et al. 2022a). McLaren et al. evaluated the ergonomic risk by using the RULA sheet in dental students. In their study, no participant was found to have an acceptable posture (McLaren and Parrott 2018). In the current study, 65.9% of physical therapists showed low risk, 28.8% showed medium risk who needed further investigation to change the working posture soon, and 5.3% showed very high risk who needed to change the working posture immediately. In a study conducted by Armijos et al., 85% of surgeons' postures were at level 4, and 15% were at level 3. According to the RULA approach, modifications must be made right away. In a past study, 58.9% had moderate risk levels and needed further investigation to implement the postural changes (Armijos and Miroslava 2021).

The current study found a significant association between ULMDs and ergonomic risk with a p-value of 0.009. This result was supported by a study conducted by Muthukrishnan et al.; in their study, nurses were reported to have musculoskeletal disorders associated significantly with ergonomic risk factors. The study reported that nurses must do a variety of physically challenging tasks throughout a typical shift, including moving patients onto beds, transporting and repositioning patients between chairs and beds, and regularly maintaining bent-forward or twisted positions, which showed moderate to high ergonomic risk (Muthukrishnan and Maqbool Ahmad 2021). A high level of association between the ergonomic risk factors and the upper limb musculoskeletal ailments of the physiotherapists suggests that ineffective ergonomic approaches like protracted unsanitary postures, repeated motion, and physical exertion are significantly associated with the onset and intensification of musculoskeletal ailments in the upper limbs (Odebiyi and Okafor 2023), (Keir et al. 2021). These results highlight the significance of intervention in ergonomic hazards at work since poor ergonomics may cause discomfort, pain, and long-term health problems, especially in risky professions like physiotherapy (Prall and Ross 2019). There is a need for intervention measures that focus on posture improvement, minimization of repetitive movements, and ergonomic education to avoid the development of musculoskeletal disorders and improve the overall health and performance of physiotherapists (Fan et al. 2022a).

The study found an association between ergonomic risks and shoulder pain with a

significant p-value of 0.004, and between the ergonomic risk and wrist with a p-value of 0.044; however, our study found no significant association (p-value >0.05) between ergonomic risk and elbow pain. These results were in line with previous literature. The chi-square test analysis in the study of Rafie et al. revealed that there was a significant association (p-value<0.05) between the RULA score and shoulder disorder among dentists while there was no significant association found between wrist and elbow. Additionally, their research revealed that all of their participants were at risk, and dentists who had poor posture or required postural modifications were at greater ergonomic risk (Rafie et al. 2015). Research by Pourmahabadian et al. looked at the ergonomic risk related to musculoskeletal problems of the upper limbs in the pharmaceutical sector. While the study identified no significant connection (p-value>0.05) with the elbow, the RULA risk score was shown to be strongly linked (p-value<0.05) with the shoulder and wrist (Pourmahabadian, Akhavan, and Azam 2008). A study was conducted by Ganiyo et al. to evaluate musculoskeletal disorders and their correlation with work-related hazards among healthcare professionals. Their study found that WMSDs were very high among physiotherapists, which may be due to manual techniques such as mobilization and manual massage of lifting patients. Their study found a significant association (p-value <0.05) between shoulder problems with lifting or transferring patients and working or reaching away from the body. A significant association (p-value <0.05) was found between forceful excretion and wrist problems. Elbow musculoskeletal disorders were found to have no association (p value>5) with forceful exertion (Ganiyu et al. 2015).

In the current study, the number of participants who qualified under inclusion criteria was less than the required sample, and there was a cultural constraint to evaluate the female posture in the workplace. It is recommended from the study that there should be possible control measures and implementation of a properly designed ergonomic program to further reduce the risk hazards at the workstation. Moreover, the postures of physical therapists in Pakistan need improvement. Further investigation of posture can help ergonomists develop work-friendly equipment for the physical therapist to prevent musculoskeletal disorders.

One of the limitations of this research was the smaller-than-anticipated sample size based on stringent inclusion criteria. The 26 non-participating physiotherapists might have refused due to reasons like insufficient time, lack of research interest, concerns about privacy and confidentiality, or health or work-related problems. Moreover, cultural restraints limited the assessment of female physiotherapists' working postures within clinics. Future studies need to emphasize applying ergonomic control strategies and creating workplace interventions specific to PTs in Pakistan. Incorporating ergonomically designed equipment can potentially reduce WRMSDs and enhance working conditions.

5. Conclusions

According to the study's findings, physiotherapists frequently suffer from upper limb disorders. The shoulder was the most commonly affected region. The ergonomic risk was common among physiotherapists; there is a need to implement postural change for most of these professionals. Although 5.3% of the physiotherapists were very highly exposed to risk, many (28.8%) were moderately exposed, and 65% were moderately low but may still require modification. This indicates that ergonomic risk is distributed across various levels, so preventive intervention is necessary even in the mildest form. It was also found that there existed a positive relationship between ergonomic risk and musculoskeletal disorders of the upper limb. The upper limb, shoulder, and

wrist regions exhibited substantial association, while the elbow did not reveal substantial association with the RULA risk score.

Conflict of Interest

All the authors declare no conflicts of interest.

Funding

There were no funding contributions for this research from any source.

Study Approval

This study was approved by the Margalla Institute of Health Sciences, Islamabad, Pakistan.

Consent Forms

Every participant signed a consent form before participating in the research.

Authors Contributions

SN conceptualized the study, FK AK, HR, and MA did the experimental part and analysis of the results, SN supervised the whole project and wrote the final manuscript.

Data Availability

All the data relevant to this study is with the authors.

Acknowledgments

The corresponding author acknowledges the contribution of all the authors for their support and assistance throughout the project.

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