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Original Article

Frequency of Musculoskeletal Discomfort among Software Engineers working in Information Technology Companies

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ABSTRACT

Objective: To determine the frequency and most affected body region of musculoskeletal discomfort among software engineers working in IT companies.

Study Design: Cross-sectional study.

Place and Duration of Study: Different IT companies in Islamabad, Pakistan from Aug 2020 to Feb 2021.

Methodology: The study was conducted on 105 software engineers working in different IT companies in Islamabad. The Cornell Musculoskeletal Discomfort Questionnaire was used to determine the most common areas of discomfort. The sampling technique used in the study was non-probability convenient sampling. The inclusion criteria was software engineers of either gender, age range 22 to 40 years with a total of 40 working hours per week and working for more than 6 months in the company. Whereas participants already diagnosed with musculoskeletal discomfort or history of musculoskeletal trauma, injury or systemic illness were excluded from the study.

Results: Out of total 105 participants 86(81.90%) were males and 19(18.10%) were females. The most affected body region for the musculoskeletal discomfort reported by the participants was the neck, and the second most affected region was the lower back. Slightly uncomfortable behavior was reported by majority of the participants followed by moderate and very uncomfortable behavior because of pain. Another interesting finding of the study was that majority of the participants reported no interference to the work performance because of pain and discomfort.

Conclusion: The study results concluded that frequency of musculoskeletal (MSK) discomfort was high among software engineers. This discomfort commonly manifests in areas such as the neck, lower back, shoulders, upper back, and wrists, highlighting the need for improved ergonomic practices and preventive measures within this profession.

Keywords: Ergonomic, Injury, Musculoskeletal, Pain, Software.

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INTRODUCTION

The world is advancing in information technology and there has been dramatic increase, seen in occupational use of information technology (IT) in recent decades.[1] Being the backbone and playing a major role, software engineers are considered valuable for the IT world.[2] There work is contingent on or determined by computer usage.[3]

Prolonged use of computers is found to be a potential risk factor for musculoskeletal discomfort globally.[4] Also in many countries like Thailand, Iran, India, Estonia, Turkey, Malaysia, and the United States of America research have been done and concluded that musculoskeletal disorders (MSD) were common among office workers using computer for hours.[5] The physical health of workers and financial burden on the governmental and non-governmental organizations are highly affected by an increase in MSD and sick leaves, and the root cause is the usage of computers for hours.[6]

Some of the principal grounds playing a role in musculoskeletal disorders of computer users are harmful working conditions and postural demands of the work place.[7] In many workplaces across Pakistan, ergonomic equipment is not readily available, and cultural norms often prioritize long, continuous work hours with little emphasis on taking breaks or staying physically active.[8] Occupational ergonomic stressors such as repetitive stereotyped motions, forceful exertions, non-neural vibrations and combinations of these exposures are causally related to MSD.[9] In the early seventies, complaints of arm, neck and shoulder (CANS) were recognized as an important cause of work disability.[10]

Rapid advancement in the field of information technology in modern workplaces has drastically transformed the work environment. Software

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engineers, as key players in the IT industry, often find themselves engaged in prolonged computer usage, sedentary behavior, and repetitive tasks, which significantly contribute to the prevalence of musculoskeletal (MSK) discomfort. The recent shift towards remote work has introduced new ergonomic challenges, necessitating an updated understanding of MSK discomfort in diverse work environments. Technological advancements and changing work practices further complicate these dynamics, requiring continuous assessment of their impact on musculoskeletal health. Moreover, addressing MSK discomfort is economically beneficial, as it can reduce healthcare costs, absenteeism, and turnover rates. Therefore the objective of this study was to determine the frequency and the most affected body region of musculoskeletal discomfort among software engineers working in IT companies.

METHODOLOGY

The cross sectional study was conducted for a period of 6 months from August 2020-February 2021 on software engineers working in different IT companies of Islamabad, Pakistan. The sample size was calculated using G-power with an effect size of 0.20, an alpha error probability of 0.05, and a power of 0.60, which indicated that 125 participants would be required. Questionnaires were distributed to this group, and 105 participants met the inclusion criteria. Therefore, the final sample analyzed consisted of 105 participants. The study title was approved from Departmental Research Committee (Ref# DPT/2017/R/0010) and data was collected using a non-probability convenient sampling technique.

Inclusion Criteria: Software engineers of either gender with age ranging from 22 to 40 years with a total 40 working hours per week and working for more than 6 months in the company.

Exclusion Criteria: Participants diagnosed with musculoskeletal discomfort or history of musculo-skeletal trauma, injury or systemic illness were excluded from the study.

After getting informed written consent, a self-structured questionnaire was distributed to collect the demographic data of the participants. The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) was used to assess the musculoskeletal discomfort in participants across 11 body regions. The first component was related to the ache, pain and discomfort experienced in the last working week. The category had 5 options ranging from never, 1-2 times last week, 3-4 times last week, once every day and several times every day. The second component of the questionnaire was related to the severity of the ache, pain and discomfort. The category had 3 options starting from slightly uncomfortable, moderately uncomfortable and very uncomfortable. The third component was associated with interference with ability to work due to ache, pain and discomfort. The category had 3 options not at all, slightly interfered and substantially interfered. Results were analyzed by summing the rating value for each person. This questionnaire is highly valid and reliable with Cronbach's alpha coefficient of 0.986.[11,12]

Data was analyzed through Statistical Package for Social Sciences (SPSS) software version-20. Quantitate variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages.

RESULTS

Out of total 105 participants 86(81.90%) were males and 19(18.10%) were females. Mean age of the participants were 28.51±4.80 (years). Neck pain was the most common type of musculoskeletal discomfort, affecting nearly 62.8% of participants during the past workweek. Additionally, 57.1% of people reported experiencing lower back pain in the last week. Other common areas of discomfort included the right shoulder, left shoulder, and upper back as shown in Table-I. On the other hand, discomfort in the right and left forearm and left upper arm was less frequent, with less than 10% of participants experiencing pain in these areas daily.

Table-I: Descriptive Statistics of Pain, Ache or Discomfort experienced during Last Week among Different Regions of the Body (n=105)

	Pain, Ache and Discomfort in Last Week				
Body Regions	**Several Times Everyday**	**Once Everyday**	**3-4 Times Last Week**	**1-2 Times Last Week**	**Never**
Neck	6(5.7%)	11(10.5%)	14(13.3%)	35(33.3%)	39(37.1%)
Right Shoulder	6(5.7%)	5(4.8%)	11(10.5%)	24(22.9%)	59(56.2%)
Left Shoulder	6(5.7%)	5(4.8%)	9(8.6%)	22(21.0%)	63(60.0%)
Upper Back	6(5.7%)	1(1.0%)	13(12.4%)	19(18.1%)	66(62.9%)
Lower Back	9(8.6%)	6(5.7%)	14(13.3%)	31(29.5%)	45(42.9%)
Right Upper Arm	0(0%)	1(1.0%)	4(3.8%)	15(14.3%)	85(81.0%)
Left Upper Arm	1(1.0%)	0(0%)	3(2.9%)	13(12.4%)	88(83.8%)
Right Forearm	3(2.9%)	1(1.0%)	3(2.9%)	6(5.7%)	92(87.6%)
Left Forearm	4(3.8%)	0(0%)	4(3.8%)	5(4.8%)	92(87.6%)
Right Wrist	2(1.9%)	2(1.9%)	5(4.8%)	18(17.1%)	78(74.3%)
Left Wrist	3(2.9%)	5(4.8%)	6(5.7%)	13(12.4%)	78(74.3%)
Buttocks	1(1.0%)	3(2.9%)	5(4.8%)	11(10.5%)	85(81.0%)
Knees	2(1.9%)	5(4.8%)	3(2.9%)	17(16.2%)	78(74.3%)

Overall, most participants reported slight discomfort in various body parts, with the neck, right shoulder, left shoulder, and lower back being the most commonly affected areas. When it came to severe

discomfort, lower back was the common area as reported by the participants as shown in Table-II. Additionally, moderate discomfort was also observed in lower back, neck, and knees.

Table-II: Discomfort Level (Question- How Uncomfortable was Ache, Pain or Discomfort if experienced during Last Week) (n=105)

	Discomfort Level			
Body Regions	**Very Uncomfortable**	**Moderately uncomfortable**	**Slightly Uncomfortable**	**Not at all**
Neck	9(8.6%)	16(15.2%)	39(37.1%)	41(39.0%)
Right Shoulder	6(5.7%)	9(8.6%)	30(28.6%)	60(57.1%)
Left Shoulder	7(6.7%)	6(5.7%)	29(27.6%)	63(60.0%)
Upper Back	9(8.6%)	8(7.6%)	22(21.0%)	66(62.9%)
Lower Back	18(17.1%)	17(16.2%)	23(21.9%)	47(44.8%)
Right Upper Arm	0(0%)	6(5.7%)	14(13.3%)	85(81.0%)
Left Upper Arm	0(0%)	5(4.8%)	12(11.4%)	88(83.8%)
Right Forearm	3(2.9%)	3(2.9%)	7(6.7%)	92(87.6%)
Left Forearm	4(3.8%)	4(3.8%)	5(4.8%)	92(87.6%)
Right Wrist	0(0%)	10(9.5%)	16(15.2%)	79(75.2%)
Left Wrist	1(1.0%)	8(7.6%)	17(16.2%)	79(75.2%)
Buttocks	2(1.9%)	7(6.7%)	10(9.5%)	86(81.9%)
Knees	2(1.9%)	12(11.4%)	13(12.4%)	78(74.3%)

Majority of the participants reported no interference to the work performance because of pain and discomfort as shown in Table-III. Additionally, discomfort in the lower back and neck caused moderate degrees of interference for nearly one third of the participants. On the other hand, issues with the right forearm, left forearm and left and right upper back had little effect on their job performance.

Table-III: Interference with Ability to work due to Ache, Pain or Discomfort during last Week (n=105)

	Interference with Work		
Body Regions	**Substantially interfered**	**Slightly interfered**	**Not at all**
Neck	8(7.6%)	30(28.6%)	67(63.8%)
Right Shoulder	5(4.8%)	19(18.1%)	81(77.1%)
Left Shoulder	5(4.8%)	18(17.1%)	82(78.1%)
Upper Back	7(6.7%)	20(19.0%)	78(74.3%)
Lower Back	9(8.6%)	31(29.5%)	65(61.9%)
Right Upper Arm	2(1.9%)	6(5.7%)	97(92.4%)
Left Upper Arm	2(1.9%)	5(4.8%)	98(93.3%)
Right Forearm	0(0%)	4(3.8%)	101(96.2%)
Left Forearm	1(1.0%)	5(4.8%)	99(94.3%)
Right Wrist	0(0%)	14(13.3%)	91(86.7%)
Left Wrist	1(1.0%)	13(12.4%)	91(86.7%)
Buttocks	2(1.9%)	9(8.6%)	94(89.5%)
Knees	0(0%)	12(11.4%)	93(88.6%)

DISCUSSION

Musculoskeletal (MSK) discomfort is a significant health concern among software engineers, primarily due to the nature of their work.[13-15] As more people spend significant portions of their day engaged in computer-related tasks, the risk of experiencing symptoms in areas such as the neck, shoulders, back, and wrists has risen considerably.[16] This discomfort is primarily due to factors like prolonged sitting, repetitive movements, and often suboptimal ergonomic setups.[17]

Current study results showed increased musculoskeletal discomfort in the neck region followed by lower back. This aligns with a study by Kamakshi Ghaie *et al.,* where majority of the computer users reported experiencing musculoskeletal discomfort, with the neck, shoulders, and lower back being the most commonly affected areas.[18] Another study by Magdalena Plandowska *et al.,* found that participants working for long hours on computers experience frequent neck and back pain, attributing it to prolonged sitting and inadequate ergonomic setups.[19] These findings highlight the occupational hazards inherent in software engineering roles, where extended periods of static postures and repetitive movements are common.

Current study results reported slightly uncomfortable behavior in the majority of the participants followed by moderate and very uncomfortable behavior because of musculoskeletal pain. Similar results were reported by a study conducted by Alistair J. Turvill *et al.,* in which participants engaged in sedentary or repetitive tasks reported that musculoskeletal discomfort resulted in slight to moderate discomfort.[20] Another important finding of the current study results suggested that majority of the participants reported that pain and discomfort doesn't interfere with their ability to work followed by slight interference responses. Melek Ardahan *et al.,* conducted a study on Turkish computer users and office workers and reported that excessive computer use negatively interferes with their ability to work efficiently and reduces their work performance.[21] Another study by Bilge Basakci Calik *et al.,* reported similar findings where majority of the participants stated that musculoskeletal pain in any region doesn't interfere with their daily activities and work life.[13]

Despite all the important findings suggested by the study it had few limitations. First, the sample size was not large enough to generalize the results and it was only conducted in Islamabad. Less number of female participants were involved in this study as compared to males because of the more tendency of males in the software engineering profession in Pakistan. Components such as BMI of participants, daily working hours, and computer usage time were not measured during the date collection.

CONCLUSION

The study concluded that frequency of musculoskeletal discomfort was high among software engineers. This

discomfort commonly manifests in areas such as the neck, lower back, shoulders, upper back, and wrists, highlighting the need for improved ergonomic practices and preventive measures within this profession. These include providing adjustable chairs and desks, conducting ergonomic workstation assessments periodically, and encouraging organizations to enforce mandatory breaks during long work hours. Simple changes, such as ensuring that employees can adjust their workstation to suit their posture and introducing scheduled stretching or activity breaks, could significantly reduce the risk of musculoskeletal disorders.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

FS & HS: Data acquisition, data analysis, critical review, approval of the final version to be published.

BR & II: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

NA & ZM: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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