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Ergonomics Analysis of Work-Related Musculoskeletal Disorders in Tailors of Aurangabad District, Maharashtra

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1. Introduction

Tailoring is a prevalent small-scale service industry in which a big number of people from low-income families work. In India, both men and women work in the tailoring industry. Those who work as tailors, embroidery workers, and self-employed tailors are among the members of the Tailoring Workers Forum. Sewing machine operators make up the great majority of workers employed in the textile and garment industries.[1]The activity at the sewing machine, with its high motion sensitivity and difficult gripping positions, necessitates advanced sensor motor skills and configuration knowledge based on the nature of the fabric. Because of the machine's sight requirements, the worker is forced to remain in a static position, which is hazardous to his or her health. Because it necessitates constant visual control and highly concentrated concentration, sitting in a cause a persistent charge on the sense organs in the psychological area.[2] Literature suggested that, Musculoskeletal issues, such as injury to muscles, nerves, tendons, bones, joints of bones, and cartilage, are one sign of health problems induced by occupational activities. Work posture that is not appropriate / ergonomic while completing workplace activities is one of the leading causes of musculoskeletal disorders (MSDs). Scientists and researchers in various nations have established numerous ways of working posture assessment based on each bodily movement in order to produce a safe, comfortable, and healthy work system during work, based on research and complaints about musculoskeletal illnesses.[3]

With respect to the quantity and duration of employment, the chance of developing MSK disorder can also rise. Tailors are creative individuals who sew items that suit their customers appropriately and have good manual and machine skills. They sit in a chair or on the floor for longer periods of time, executing repetitive activities with poor body postures.[4] Tailors experience MSK discomfort as a result of this, as well as pain. Bending their neck forward, elevating their elbows above / below the shoulders, bending their wrist downward and inward, and bending there back forward are the postures people adopt while stitching a garment, and this causes postural discomfort that worsens over time.

MSK disorders cause pain, loss of physical function, and decline in mental health, all of which adversely affect a person’s ability to pursue gainful employment.

2. Need for the study

Tailors are at risk of developing work-related musculoskeletal disorders due to their prolonged sitting and repetitive tasks, which often involve poor body postures. This can result in discomfort and pain in various parts of their body. Common postures, such as bending the neck forward, elevating the elbows above or below the shoulders, bending the wrist downward and inward, and bending the back forward, can lead to postural discomfort that worsens over time. Work-related musculoskeletal disorders are a significant occupational health concern, according to Delleman and Dul. To make the workplace more efficient, safe, and comfortable, ergonomics play an important role in enhancing human performance. Proper assessment and provision of ergonomic solutions can help to reduce the risk of further disorder caused by awkward postures in tailors.

3. Aim of the Study

To evaluate the work organization, workspace conditions, level of bodily discomfort, and ergonomic risk factors faced by individuals employed in tailoring units.

Objectives

1. To assess the socioeconomic status of individuals employed in tailoring shops.
2. To evaluate the work environment and organization in these establishments.
3. To measure the level of physiological pain and identify ergonomic risks experienced by women working in tailoring facilities.
4. To investigate the perceptions of workload and job demands among tailors.
5. To analyze and provide recommendations for improving work postures in the tailoring industry.

Research Question

How do ergonomic interventions and workplace modifications impact the occurrence of musculoskeletal disorders among tailors in Aurangabad city?

4. Review of Literature

1. **Sayanti Band yopadhyayet.al (2021)** in their study concluded that automobile garage workers in Chetla, Kolkata were examined for the occurrence of musculoskeletal discomfort and factors contributing to it. The study found that knee discomfort was present in 42% of the participants, while 21% reported experiencing low back pain based on the CMDQ tool. The majority of the participants (30.7%) were between 41 to 50 years old with a mean age of 43.35 (SD 13.46) years.[13]
2. **Nazish Anwar et al. in 2020,** conducted a cross-sectional study to check the frequency of work-related musculoskeletal disorders and postural ergonomic risks were assessed among tailors. The study included individuals of both genders, aged 25-60 years, who had been working in small and medium enterprises for more than 6 months. The findings revealed that while most tailors had acceptable work posture, there was a common occurrence of work-related pain in the upper back.[7]
3. **A. Ravisankar et.al (2019)** conducted a study, aimed to assess ergonomic factors in the workplace. The study found that musculoskeletal morbidities were present in 52% of the individuals, and there was a significant association with being a tailor. Therefore, the study concluded that musculoskeletal morbidities were prevalent among the participants, with being a tailor being a significant contributing factor.[9]
4. **Upasana V. Det.al. (2017)** conducted study on the ergonomic evaluation of work-related musculoskeletal disorders among tailors, which included 60 male respondents engaged in the tailoring profession from Pantnagar (Uttarakhand, India). The study revealed that despite working very hard, the tailors were unaware of the risks associated with musculoskeletal discomfort caused by poorly designed workstations, tasks, and awkward working postures.[10]
5. **Nipa V. Patelet.al (2017)** in their cross-sectional study the prevalence of neck pain among tailors in North Gujarat was examined. The study included 100 tailors from the region, and the prevalence of neck pain was determined using the Cornell Musculoskeletal Discomfort questionnaire. The findings revealed a high prevalence of neck pain, with 91% of tailors experiencing it. Additionally, 67% of tailors reported activity limitations.[14]
6. **Banerjee Set.al (2015)** conducted across-sectional study in the urban slums of Chetla, Kolkata. To determine the prevalence and the factors associated with musculoskeletal disorders among the workers involved in tailoring occupation.
7. The study concluded that musculoskeletal disorders were found among 65.45%of tailors.[6]
8. In a study by **Tzu-Hsien Lee et.al (2013),** three construction workers with an average of 40 years of work experience were analyzed for their working postures at a construction site using the OWAS method. The study found that the major poor posture for construction workers was a bent and twisted trunk posture (34%), which fell into action category 3, according to the OWAS assessment.[12]
9. In a systematic review conducted by **Shizheng Du et al. (2011),** the effectiveness of self-management programs in alleviating pain for chronic musculoskeletal conditions in tailors was evaluated. The study included randomized controlled trials from the 1970s to 2010, obtained from Medline and Embase databases. The findings indicated that self-management programs were a safe and effective approach for tailors to manage pain. Moreover, these programs were community-based, providing tailors with practical strategies to cope with their musculoskeletal pain.[8]

10. In their study, **Mandy Lam et.al (2009)** aimed to estimate the work posture of workers in various industries such as steel, construction, and healthcare. They used the OWAS method to identify the most common postures for different body parts and the weight of the load handled. The posture was described with a four-digit code, and the observations were made at constant time intervals. The study found high validity and inter-rater reliability, with Kappa-values above 0.6 and 0.986, respectively[11].
11. In a study conducted **by Oguzhan Erdinc et.al (2008)**, the cross-cultural adaptation, validity, and reliability of the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) in the Turkish language were examined. The study involved 48 Turkish workers as participants. The validity of the T-CMDQ was found to be good, ranging from 0.46 to 0.83 across different body parts. The test-retest reliability of the T-CMDQ was determined to be satisfactory, ranging from 0.56 to 0.97 across the three scales.[15]

5. Methodology

1. **Source of data:** Tailors from Aurangabad city, Maharashtra
2. **Study Design:** Observational Study.
3. **Target Population:** Both male and female who are Tailors
4. **Duration Of Data Collection**:12months
5. **Sample Size:**119
6. **Sample Design:** Non-Probability Sampling.
7. **Sampling technique:** convenience sampling
8. **Material used:**

A. Pen
B. Paper

9. **Tool used:**

1. Informed consent
2. Data collection form
3. Oak Working Posture Analysis System
4. Cornell Musculoskeletal Dis comfort questionnaire

10. **Equipment used:**

1. **Measuring Tape-**To measure the height of an individual, a non-stretchable measuring tape with a height of seventy-five inches or one hundred and eighty-eight centimeters was employed. The person stood against a wall, ensuring that their head and heels were in complete contact with it. A mark was made at the crown of the subject's head, and the distance from the ground to the head's vertex was measured as the individual's height.
2. **Weighing Machine**- To determine the weight of the subject, a standard digital weighing machine was utilized. The weight was measured in kilograms.

11. **Inclusion criteria:**

1. Participants who are willing to participate in the study.
2. Individuals aged 20 years and above.
3. Occupationally identified as tailors.
4. Both male and female participants are included.

12. **Exclusion criteria:**

1. Participants with a previous history of trauma or surgery.
2. Participants with congenital deformities or neurological problems.
3. Participants with systemic illnesses such as rheumatoid arthritis.

Procedure

Ethical clearance for the study were obtained from the Institutional Ethical Committee. All potential participants who work as tailor’s were undergo a screening process to determine their suitability based on the inclusion and exclusion criteria. Prior to their inclusion in the study, written informed consent were obtained, and a detailed explanation of the study's purpose and procedures were provided to the participants. Demographic data of each participant were collected for further analysis. The Oak Working Posture Analysis

System and Cornell Musculoskeletal Discomfort questionnaire were used as outcome measures. These measures were explained to the participants in the local language, and photographs were taken to analyze their work-related postures.
A trained therapist was calculating the scores obtained from the assessments and discuss with each participant the areas of concern that stand out. The therapist were explore potential options for overcoming these issues and improving their work conditions.

Figure 1 Tailor in Lateral view

Figure 2 Posture Analysis in Posterior view

Outcome Measures

1. The OWAS Method

It is developed by O. Karhu from Finland, is a working posture analysis system. It serves as a tool to identify body postures that may contribute to muscle problems. The method comprises two parts: an observation technique to assess work postures in daily routines, and criteria for redesigning work postures and obtaining reliable results after basic OWAS training. It utilizes a four-digit code to sequentially describe the back, arm, leg, and weight when manually handling materials. OWAS demonstrates excellent inter-rater reliability (0.986) and validity (0.802).

2. The Cornell Musculoskeletal Discomfort questionnaire (CMDQ)
It is a comprehensive questionnaire consisting of 54 items. It includes a body chart and questions about the occurrence of musculoskeletal ache, pain, or discomfort in 20 different body parts over the past week. The CMDQ has been widely used to evaluate musculoskeletal pain in various occupational groups, such as healthcare providers and machine operators. The questionnaire demonstrates good validity, ranging from 0.617 to 0.917, and reliability, ranging from 0.589 to 0.972.

Statistical Analysis
SPSS version 23 was utilized to analyze the data. The statistical analysis was conducted using the Spearman Correlation test and Kruskal Wallis Test was administrated for the analysis of data. The variables that were included in the data analysis were gender, age. Statistical significance was determined by considering p-values less than 0.05 2 tailed significance test were considered as indicative of significant findings.

6. Results

The observational study was conducted among 119 tailors from Aurangabad city. The study included 119 tailor worker from which 61 were females and 58 were males, who are professionally engaged in tailoring. The age range of the participants was 20 years and above, with a mean 34.83± 6.69age of years. Statistical analysis of the scores using the OWAS Method revealed that Trunk, arm and Lower body i.e.63%, 50%& 40% respectively are the three areas need to be look carefully. The Spearman Correlation test was performed, resulting in a p-value of 0.001, indicating a higher prevalence among male compared to females.

Table 1: Baseline Characteristics of Tailors

OUTCOME	MEAN ± SD
Age	**34.83± 6.69**
Male	**58**
Female	**61**
OWAS	
1. Trunk	**2.53 ±1.1**
2. Arm	**2.01± 0.8**
3. Lower body	**1.6 ± 0.3**
4. Load	**1 ± 0**
CORNELL	
1. Neck	**7.81± 3.7**
2. Shoulder	**9.3±6.2**
3. Upper back	**7.73±4.2**
4. Upper arm	**6.34±6.7**
5. Lower back	**7.57±4.3**
6. Forearm	**4.70±6.1**

7. Wrist	6.02±5.2
8. Hip	5.55±6.9
9. Thigh	8.76±7.6
10. Knee	9.23±7.6

Mean of cornell scale in Neck 7.8±3.7, Shoulder 9.3±6.2, Upper back 7.73±4.2, Upper arm 6.34±6.7, Lower back 7.57±4.3, Forearm 4.70±6.1, Wrist 6.02±5.2, Hip 5.55±6.9, Thigh 8.76±7.6, and Knee 5.55±6.9.

Table 2: OWAS Scale & Code Wise Distribution of the Tailor Worker

OWAS CODE TRUNK	Frequency	PERCENTAGE
1	28	23.52%
2	28	23.52%
3	34	28.57%
4	29	24.39%
Total	119	100%

(code1: straight, code 2: bent over 20 degree, code 3: twisted over 20 degree, code 4: bent and twisted over 20 degree)
According to OWAS Scale in trunk 28(23.52%) then straight arm bend over, 34(28.57%) twisted over 20 degree and 29(24.39) bent and twist over 20 degree in tailor worker.

OWAS CODE ARM	Frequency	PERCENTAGE
1	39	32.77%
2	40	33.61%
3	40	33.61%
Total	119	100%

(code1: both arms below shoulder level, code 2: one arm above shoulder level, code 3: both arm above shoulder level)

According to OWAS Scale in arm 39(32.77%) both arms below shoulder level then one arm above shoulder level, 40(33.61) and 40(33.61%) Both arms above shoulder in tailor worker.

OWAS CODE LOWER BODY	Frequency	PERCENTAGE
1	99	83.19%
2	20	16.80%
Total	119	100%

(code1: standing straight, code 2: both legs bent over 135 degree)

According to OWAS Scale in lower body 99(83.19%) standing straight then both legs bent over 135degree in tailor worker.

OWAS CODE LOAD	Frequency	PERCENTAGE
1	119	100%
2	0	0%
3	0	0%
Total	119	100%

(code1 :< 10 kg, code 2:10to 20kg, code 3 :> 20kg)

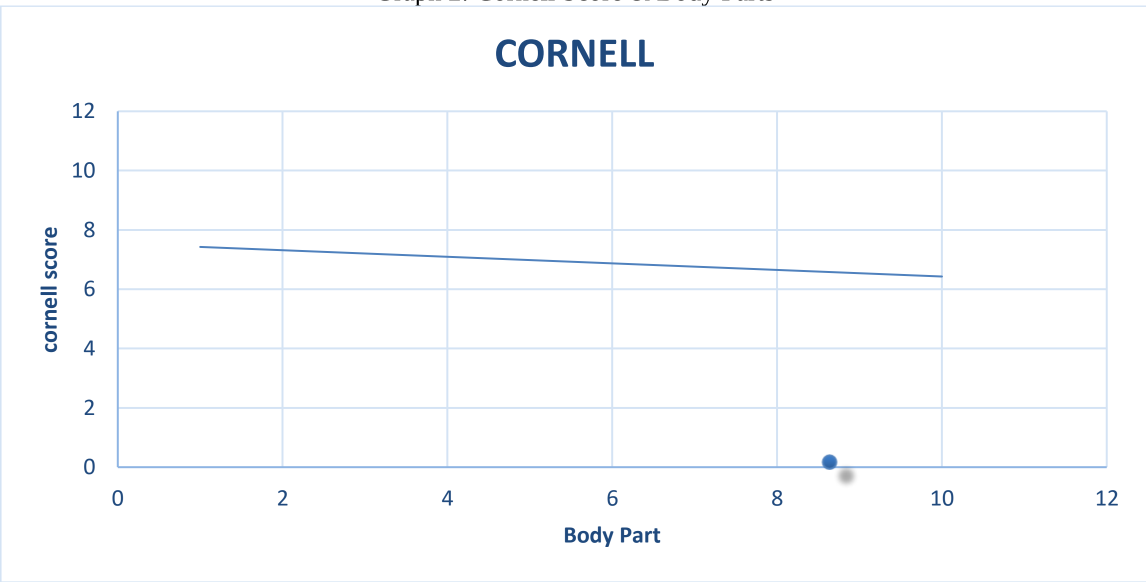
According to OWAS Scale in load 119(100%) < 10 kg in tailor worker.

Table 3: Baseline Characteristics of Tailors suing OWAS Scale

OWAS	Mean ± SD	P value
1. Trunk	**2.53 ±1.1**	**<0.0001**
2. Arm	**2.0 ± 0.8**	
3. Lower body	**1.6 ± 0.3**	
4. Load	**1 ± 0**	

Table 3 shows according to OWAS scale Work-Related Musculoskeletal Disorders In neck and trunk was 34% in Tailors Of Aurangabad District,Maharashtra.

Graph 2: Cornell Score & Body Parts



The correlational method was elevated as a favorable correlation between ergonomic studies of musculoskeletal conditions in tailors. The P value is less than 0.0001 and the R value is 0.1570, indicating that the difference is highly significant.

7. Discussion

The present study aimed to investigate the impact of ergonomics in preventing musculoskeletal disorders (MSDs) among tailors in the Aurangabad district of Maharashtra. The findings of this study contributed to the growing body of knowledge on occupational health and provided insights into the importance of implementing ergonomic interventions in the tailoring profession. The results of our study revealed a significant association between poor ergonomic practices and the prevalence of MSDs among tailors. The majority of the participants reported experiencing discomfort and pain, particularly in the neck, back, and wrists. These findings were consistent with previous research highlighting the occupational hazards faced by tailors due to their prolonged sitting, repetitive tasks, and awkward body postures. **Saha and Dey (2015)** conducted a systematic review on ergonomic interventions for sewing machine operators in garment industries. Their findings supported the effectiveness of ergonomic interventions in reducing musculoskeletal disorders among garment workers. This study agreed with the focus on ergonomics as a preventive measure.**Das, Ganguli, and Ghosh (2016)** examined the impact of ergonomic interventions on reducing musculoskeletal discomfort among Indian garment workers. Their study demonstrated positive outcomes in terms of reducing discomfort and improving working conditions through ergonomic interventions. This study aligns with the importance of ergonomics in mitigating musculoskeletal issues.Ergonomics interventions play a crucial role in reducing the risk of MSDs and improving overall occupational health among tailors. By optimizing work organization, workspaces, and task design, tailored ergonomic solutions can be implemented to minimize the strain on the musculoskeletal system. Our study emphasizes the need for tailored interventions to address the specific ergonomic challenges faced by tailors, such as providing adjustable workstations, supportive seating, and proper lighting.Furthermore, raising awareness and educating tailors about the importance of maintaining good posture, taking regular breaks, and performing stretching exercises can contribute to reducing the occurrence of MSDs. Implementing ergonomic training programs and workshops can empower tailors to adopt healthy work practices and promote a safe working environment.

Kumar, Morishima, and Nag (2002) conducted a case study on ergonomic interventions to prevent musculoskeletal disorders in small-scale industries, including the garment industry. Their study showcased the positive impact of ergonomic interventions in improving working conditions and reducing the prevalence of musculoskeletal disorders. This study agrees with the positive influence of ergonomics on preventing disorders.
Raghavan and Sain (2006) focused on ergonomic interventions and prevention of musculoskeletal disorders in the Indian handloom sector. Their case study highlighted the effectiveness of ergonomic interventions in reducing musculoskeletal problems among handloom workers. This study supports the positive role of ergonomics in preventing disorders.**Manjunath, Prakash, and Dhar (2005)** examined the impact of ergonomic interventions in reducing musculoskeletal disorders among women sewers in the unorganized sector. Their study provided evidence of the positive effects of ergonomic interventions in alleviating musculoskeletal issues among the target population. This study aligns with the benefits of implementing ergonomic measures.

It is noteworthy to mention that the successful implementation of ergonomic interventions required collaboration between employers, policymakers, occupational health professionals, and tailors themselves. Employers were required to prioritize the well-being of their employees by investing in ergonomic improvements and providing necessary resources. Policymakers could contribute by establishing guidelines and regulations regarding ergonomic standards in the tailoring industry. While our study provided valuable insights into the impact of ergonomics in preventing MSDs among tailors, there were certain limitations that should be acknowledged. The sample size was limited to the Aurangabad district, which may have limited the generalizability of the findings to other regions. Additionally, the study focused on self-reported data, which may have been subject to recall bias and subjective interpretation.

In conclusion, our study highlighted the significance of incorporating ergonomics into the tailoring profession to prevent and reduce the occurrence of musculoskeletal disorders. The findings emphasized the need for tailored ergonomic interventions, education, and awareness programs to improve the working conditions and overall well-being of tailors. Further research was warranted to explore the long-term effects and sustainability of ergonomic interventions in this occupational group. By addressing these concerns and implementing effective ergonomic strategies, we could promote a healthier and safer working environment for tailors, enhance their productivity, and contribute to the overall well-being of the workforce in the tailoring industry.
In summary, the reviewed studies consistently demonstrated the agreement that ergonomic interventions played a crucial role in preventing and reducing musculoskeletal disorders among garment workers. They collectively supported the effectiveness of ergonomic measures in improving working conditions and mitigating the prevalence of musculoskeletal issues in this occupational group.

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SR.NO	OUTCOMEMEASURE	SCORE
1	OvakoWorkingPostureAnalysisSystem[11]	
2	CornellMusculoskeletalDiscomfortquestionnaire[15]	

Assessment of works pace and work organization		
1.	Years of Experience (Years)	
2.	Duration of Work	
3.	Working hours	
4.	Specific break in tervals	
5.	Break of fixed duration	
6.	Working Pattern	

Work Space Design		
1.	Having sufficient space to work	
2.	Works pace permit stable neutral posture	
3.	Work motorized	
4.	Sea height adjustable	

5.	Chair have backrest	
6.	Work surface appropriate for visual and manual requirements	
Periodicity of Body Discomfort and Pain Relieving Techniques		
1.	I-Beginning of the day	1-Changeposture
2.	II-Midmorning	2-Applypainrelievingbalm
3.	III-Lunchtime	3-Cessationfromwork,
4.	IV-End of the day	4-Absenteeism,
5.		5-Completerest.

Signature of the physiotherapist

Annexure-Iii

Cornell musculoskeletal discomfort questionnaire.