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Prevalence of Musculoskeletal Disorders in Cotton Spinning Floor Charkha Female Weavers Using the Nordic Musculoskeletal Questionnaire

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Abstract: ***Weaving is a physically demanding occupation associated with prolonged static postures and repetitive upper-limb activity, which predispose workers to work-related musculoskeletal disorders (WMSDs). Cotton spinning by floor charkha is commonly performed by women in Malegaon under ergonomically poor conditions, yet local epidemiological data are scarce. This cross-sectional study analysed the prevalence, distribution, and severity of musculoskeletal pain among cotton spinning floor charkha female workers using the Nordic Musculoskeletal Questionnaire (NMQ) and the Numerical Pain Rating Scale (NPRS). A total of 136 female workers aged 30–45 years, with more than 2 years of experience and working 4–9 hours per day, were recruited by random sampling in Malegaon. Sociodemographic data were collected, NMQ was administered for 12-month and 7-day symptom prevalence, and NPRS (0–10) quantified pain intensity in each affected region. Data were analysed using SPSS 30 with descriptive statistics. The mean age of participants was 37.85 ± 4.55 years and the mean work experience was 9.33 ± 3.79 years. Over the previous 12 months, the right shoulder (99.2%), lower back (94.8%), neck (71.3%), and upper back (52.2%) were the most frequently affected sites. Pain preventing normal work in the last 12 months was most often reported in the right shoulder (14.7%) and lower back (5.8%). During the last 7 days, right shoulder (75.0%) and lower back (70.5%) remained the principal pain regions. Severity profiling showed high proportions of moderate–severe pain in the lower back (54.4% moderate, 38.2% severe) and right shoulder (68.4% moderate, 30.1% severe). These findings demonstrate a very high burden of WMSDs among cotton spinning floor charkha female weavers, especially in the dominant shoulder and lumbar spine, and highlight the urgent need for ergonomic modification, posture education, adequate rest breaks, and targeted occupational health interventions.***

Keywords: Work-related musculoskeletal disorders; cotton spinning; floor charkha; Nordic Musculoskeletal Questionnaire; female weavers; NPRS

1. Introduction

Traditional weaving remains a major source of rural employment in India and other developing countries, with women forming a large proportion of the handloom workforce.

Cotton spinning on floor charkha is widely practised in Malegaon, where women frequently combine domestic responsibilities with prolonged sitting work in forward-bent postures.

Such work involves repetitive upper-limb movements, pinch grip, and trunk flexion without back support, creating multiple biomechanical stressors on the cervical, thoracic, and lumbar spine, shoulders, and upper extremities.

Work- related musculoskeletal disorders (WRMSDs) are well recognised across weaving communities and have been linked to static loading, awkward postures, repetitive tasks, and long working hours.

Previous studies on handloom and textile workers have consistently reported high prevalence of pain in the neck, shoulders, upper and lower back, and wrists, with significant functional limitation and productivity loss.

However, most existing research focuses on other loom types and regions; there is limited evidence specifically addressing floor charkha-based cotton spinning by female workers in Malegaon, whose tools, floor-level workstations, and task patterns differ from those of weavers elsewhere.

In this context, understanding the true prevalence and severity of musculoskeletal complaints in this subgroup is essential for planning appropriate ergonomic and health-promotion strategies.

Aim

To analyse the prevalence of musculoskeletal disorders in cotton spinning floor charkha female workers using the Nordic Musculoskeletal Questionnaire (NMQ).

Objectives

- To assess musculoskeletal pain in cotton spinning female weavers (yarn preparation / floor charkha workers) using the NMQ.
- To evaluate pain intensity in affected body regions using the Numerical Pain Rating Scale (NPRS).

2. Materials and Methods

Study design and setting

An experimental, cross-sectional study was conducted over three months in the textile city of Malegaon, Maharashtra, among cotton spinning floor charkha female workers.

Sample size and sampling

Sample size was calculated using Cochran's formula assuming 50% prevalence, 95% confidence level, 5% margin

of error, and a finite population of 500 yarn workers, yielding a required sample of 136 participants.

Random sampling was used to recruit eligible workers from the community.

Participants
Inclusion criteria were: females aged 30–45 years, minimum 2–3 years of continuous work experience, regular/full-time work for at least the last 2 years, daily working hours 4–9 hours, and willingness to participate. Exclusion criteria comprised temporary or part-time workers, workers on long-term medical leave, those with recent fractures or surgeries, and known significant cardiac or respiratory disease affecting musculoskeletal status.

Instruments
Sociodemographic proforma: age, height, weight, BMI, years of work, daily working hours, and work characteristics.

Nordic Musculoskeletal Questionnaire (extended NMQ): reliable and valid screening instrument (reliability ≈ 0.9) for reporting musculoskeletal pain in nine body regions over the last 12 months and last 7 days.

Numerical Pain Rating Scale (NPRS): 0–10 scale (0 = no pain; 10 = worst pain imaginable) with established reliability (0.67–0.84) for quantifying pain intensity.

Questionnaires were explained in the local language (Urdu/Mother tongue) to ensure comprehension; trained investigators assisted participants where needed.

3. Procedure

Ethical approval was obtained from the institutional ethics committee before data collection.

House-to-house visits were conducted in relevant localities to identify and screen potential participants according to inclusion and exclusion criteria.

The purpose and procedures of the study were explained, and written or thumb-impression informed consent was obtained from all participants.

Demographic and work-related data were recorded using a structured proforma. The NMQ body diagram was then used to identify painful body regions; for each marked region, participants reported whether pain had occurred in the last 12 months and the last 7 days, and whether it had prevented normal work in the previous 12 months.

Immediately after each positive response, pain severity in that region was rated on the NPRS from 0 to 10, with the scale explained using simple verbal anchors and daily-life examples.

All responses were recorded on pre-designed data sheets and later entered into an electronic database with unique participant codes to ensure confidentiality.

4. Statistical Analysis

Data were analysed using SPSS version 30.0, with Microsoft Excel 2024 and Microsoft Office 2021 used for tables and graphs. Categorical variables were expressed as frequencies and percentages. Quantitative variables (age, BMI, work experience, working hours) were summarized as mean, standard deviation, and range.

No inferential comparative tests were planned, as the primary objective was descriptive prevalence estimation.

5. Results

Sociodemographic characteristics
A total of 136 female cotton spinning floor charkha workers participated. The mean age was 37.85 ± 4.55 years (range 30–45). The mean height was 156.50 ± 7.50 cm and mean weight 63.28 ± 14.16 kg, resulting in a mean BMI of 26.02 ± 6.36 (range 10.27–48.70).

Participants had an average work experience of 9.33 ± 3.79 years (4–20 years) and worked a mean of 5.93 ± 1.16 hours per day (4–9 hours), often interspersed with short breaks for household activities.

Twelve-month prevalence of musculoskeletal pain
In the preceding 12 months, the most commonly affected region was the right shoulder (n = 135, 99.2%), followed by the lower back (n = 129, 94.8%) and neck (n = 97, 71.3%).

Upper-back symptoms were reported by 71 participants (52.2%), while moderate frequencies were seen for right wrist/hand (33.0%) and knee (22.7%).

Less frequently affected regions included left elbow (10.0%), ankle/foot (14.7%), and hip/thigh (1.4%).

Overall, pain was markedly concentrated in the dominant upper limb and spinal regions. Pain preventing normal work (last 12 months) Pain severe enough to prevent normal work in the last 12 months was less frequent but still notable. Right-shoulder symptoms prevented work in 20 participants (14.7%), lower-back pain in 8 (5.8%), and upper-back pain in 3 (2.2%).

Right elbow and right wrist/hand each contributed to work restriction in 2 participants (1.4%).

No activity-limiting pain was reported for the neck, left-sided upper limb, hip/thigh, knee, or ankle.

Seven-day prevalence of musculoskeletal pain
Pain during the last 7 days followed a similar distribution. Right-shoulder pain was reported by 102 participants (75.0%) and lower-back pain by 96 (70.5%).

Upper-back symptoms occurred in 58 participants (42.6%), and neck pain in 48 (35.2%).

Recent pain in right wrist/hand (15.4%), right elbow (8.8%), and left wrist/hand (8.0%) was less common, and only 1.4%

of participants reported knee or ankle pain, with no hip/thigh complaints.

Pain severity (NPRS) by region

Pain severity categorised as no pain, mild (1–3), moderate (4–6), and severe (7–10) showed distinct region-specific patterns. In the neck, 41.9% reported moderate pain and 29.4% mild pain, with no severe cases.

The right shoulder showed the heaviest burden, with 68.4% experiencing moderate pain and 30.1% severe pain; only 1 participant reported no pain in this region.

In the left shoulder, most participants (83.8%) reported no pain, and only 2.9% had moderate pain.

Elbow and wrist symptoms were typically mild to moderate; for the right elbow, 18.4% reported moderate and 2.2% severe pain, while for the right wrist/hand, 21.3% had moderate and 1.5% severe pain.

Back pain was substantial. In the upper back, 36.8% reported moderate and 8.1% severe pain.

The lower back showed the highest intensity profile: 54.4% reported moderate and 38.2% severe pain, with only 5.1% reporting no pain.

Knee pain was present at moderate level in 15.4% and severe in 2.2%, while hip/thigh and ankle/foot pain were rare and largely mild.

Overall, the lower back and right shoulder emerged as the most severely affected regions, both in terms of prevalence and intensity of pain.

6. Discussion

This study demonstrates a very high prevalence of musculoskeletal symptoms among cotton spinning floor charkha female workers, with almost all participants reporting pain in at least one body region over the preceding 12 months and the majority reporting multi-site involvement.

The dominant right shoulder and lower back were particularly affected, with close to universal 12-month prevalence and high rates of moderate–severe pain.

These findings are consistent with previous work among traditional weavers, which has identified lower back, shoulders, neck, and upper back as the main problem areas due to prolonged sitting, forward trunk flexion, and repetitive upper-limb tasks.

Studies from handloom and textile sectors have reported 12-month WRMSD prevalence around 80–85%, with lower back and shoulder symptoms especially common, mirroring the pattern observed in this Malegaon cohort.

The high severity of lower-back and right-shoulder pain in the present sample likely reflects the combination of sustained floor-level sitting without back support, continuous charkha wheel rotation with the dominant arm, and repetitive fine hand movements during yarn preparation.

Compared with some reports where low-back pain predominates as the leading complaint, the current study shows an even higher relative burden on the dominant shoulder, suggesting tool-specific and technique-specific risk factors in floor charkha operation.

The relatively low prevalence of knee, hip, and ankle symptoms may relate to the mainly static lower-limb position, whereas the upper body and spine absorb most of the mechanical load.

Importantly, although only a minority reported pain that actually prevented normal work, the high proportion of moderate–severe pain indicates a substantial subclinical and chronic burden that may progress to disability if unaddressed.

The pattern of continuous or recurrent symptoms over 12 months and 7 days suggests that musculoskeletal complaints are persistent rather than episodic.

These results emphasise the need for occupation-specific ergonomic interventions for cotton spinning floor charkha workers. Potential measures include provision of padded floor seating with lumbar support, optimisation of wheel and spindle height relative to the worker, promotion of neutral wrist and shoulder postures, scheduled micro-breaks, task variation, and structured education on posture and stretching. Given that most women also perform domestic tasks, interventions should consider total daily workload rather than occupational exposure alone.

7. Conclusion

Cotton spinning floor charkha female weavers in Malegaon experience a very high prevalence of musculoskeletal disorders, with nearly universal involvement of the right shoulder and lower back and substantial contributions from neck and upper-back pain.

Pain is not only common but frequently moderate to severe in intensity, particularly in the lumbar spine and dominant shoulder, and in a notable proportion of workers it interferes with normal work activities.

These findings indicate that repetitive upper-limb activity, prolonged floor sitting with forward trunk flexion, and non-ergonomic workstations impose a considerable biomechanical load on this vulnerable workforce.

There is an urgent need for ergonomic modifications, targeted posture-correction and exercise programmes, appropriate rest-break scheduling, and broader occupational health initiatives to reduce musculoskeletal strain and improve functional capacity and quality of life among cotton spinning floor charkha female weavers.