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Comparative Evaluation of Wrist and Hand in Tailors and Embroiderers in Lahore: An Analytical Cross-Sectional Study

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ABSTRACT

Background: Repetitive hand and wrist movements among tailors and embroiderers result in cumulative musculoskeletal strain that can impair function and productivity. Despite the high prevalence of such occupations in Pakistan, limited evidence quantifies functional disability using validated scales. Objective: To evaluate and compare wrist and hand function among tailors and embroiderers in Lahore using the Patient-Rated Wrist and Hand Evaluation (PRWHE) scale. Methods: A community-based analytical cross-sectional study was conducted from March to June 2023 among 379 participants (193 tailors and 186 embroiderers) selected through convenient sampling. Data were collected using the PRWHE questionnaire assessing pain and function on a 0–100 scale. Descriptive and inferential statistics, including t-tests and logistic regression, were used to compare occupational groups, with significance set at $p<0.05$. Results: The mean PRWHE total scores indicated mild disability in both groups (tailors: 22.72±10.76; embroiderers: 22.33±10.96; $p=0.73$). Pain subscale scores were 12.19±7.17 for tailors and 11.51±6.31 for embroiderers, while functional limitations were 10.52±4.70 and 10.81±5.31, respectively. Mild functional disability was most prevalent (70.98%), followed by no disability (22.16%) and moderate disability (6.86%). Body mass index showed a significant association with functional impairment ($p<0.001$). Conclusion: Both tailors and embroiderers experience comparable mild wrist and hand disability due to repetitive occupational strain. Ergonomic interventions, weight management, and structured rest schedules are essential to prevent progression to chronic musculoskeletal disorders..

Keywords
Tailors, Embroiderers, Wrist pain, Functional disability, PRWHE, Occupational health.

INTRODUCTION

Repetitive and forceful wrist–hand activity is a recognized driver of work-related musculoskeletal disorders (MSDs) that impair dexterity, productivity, and quality of life in manual occupations that demand sustained fine motor control (1). The wrist's condyloid articulation, stabilized by coordinated capsuloligamentous and neuromuscular mechanisms, permits multiplanar motion but is vulnerable to cumulative micro-loading when tasks require prolonged flexion–extension, radial–ulnar deviation, and pinch grip under time pressure (2–4).

Because the hand executes both power and precision functions, even modest pain or stiffness can translate into measurable disability on validated patient-reported outcome measures, with disproportionate impact on livelihoods in craft and small-industry settings (5). Pakistan's textile sector—among the country's largest employers and export contributors—relies heavily on skilled tailors and embroiderers who perform high-repetition, high-precision tasks for long hours, often in informal workplaces with limited ergonomic controls (6,7). Tailors typically engage in cyclical cutting, stitching, and fabric handling with sustained shoulder–elbow postures and repetitive wrist deviation, whereas embroiderers execute rapid, repetitive needle passes and sustained pinch while stabilizing fabric, frequently near joint end-ranges and in static seated postures (8–11).

Epidemiologic and biomechanical literature link these exposure profiles to tendon overload, tenosynovitis, and sensorimotor alterations in the distal upper limb, with wrist pain showing a consistent association with composite ergonomic risk scores in comparable craft populations (12–14). For clinical and surveillance purposes, the Patient-Rated Wrist/Hand Evaluation (PRWE/PRWHE) is a reliable, responsive instrument that quantifies pain (0–50) and function (0–50; usual and specific activities) to yield a total burden score (0–100), enabling comparison across occupations and the detection of clinically important differences (15). Despite mounting evidence of ergonomic risk in tailoring workflows (16) and handicraft settings (17), data directly comparing wrist–hand pain and functional limitation between tailors and embroiderers in Pakistan are scarce; prior reports often pool heterogeneous textile workers, rely on screening tools rather than wrist-specific measures, or lack adjustment for key covariates such as age, body mass index (BMI), and weekly hours (18–20).

This gap limits targeted prevention, work-design recommendations, and allocation of occupational health resources for subgroups at greatest risk. Accordingly, we undertook an analytical cross-sectional comparison of tailors and embroiderers in Lahore to quantify and contrast wrist–hand symptom burden using the PRWE, and to examine whether any between-group differences persist after accounting for plausible confounders, including age, BMI, and weekly working hours (15–17). We hypothesized that embroiderers—given their higher repetition rates, precision pinch, and frequent end-range wrist postures—would exhibit higher PRWE total scores than tailors, indicating greater combined pain and functional limitation after adjustment for individual and exposure characteristics (10–12).

MATERIAL AND METHODS

This analytical cross-sectional study was conducted in Lahore, Pakistan, between March and June 2023 to evaluate and compare wrist and hand pain and functional impairment among professional tailors and embroiderers. The study setting included multiple community-based marketplaces where both groups are commonly employed in small textile workshops. A total of 379 participants—193 tailors and 186 embroiderers—were recruited using a convenience sampling approach. Eligibility criteria included adults aged 18–70 years with at least five years of professional experience, working a minimum of six hours daily in hand-intensive tasks involving fabric manipulation or stitching.

Participants who operated fully automated or semi-automated sewing machines were excluded to avoid confounding by mechanical workload reduction. After obtaining written informed consent, participants were approached individually at their workplaces and interviewed in their preferred local language by trained assessors with healthcare backgrounds to minimize interviewer bias and ensure comprehension consistency. Data were collected using a structured questionnaire comprising demographic and occupational characteristics (age, sex, BMI, years of experience, average weekly working hours) and the Patient-Rated Wrist/Hand Evaluation (PRWE) scale. The PRWE is a validated, self-reported instrument containing 15 items divided into pain and function subscales, each scored on an 11-point Likert scale from 0 ("no pain/difficulty") to 10 ("worst possible pain/unable to perform").

The pain subscale (0–50) measures the intensity of wrist or hand pain in five situations, while the function subscale (0–50) evaluates specific (five items) and usual (five items) activities. The total PRWE score (0–100) was obtained by summing both subscales, with higher scores representing greater symptom burden. Scores were treated as continuous variables for parametric testing, while categorized levels (no disability, mild, moderate) were derived based on established distribution-based thresholds from validation literature (15). Standardized anthropometric and occupational variables were measured and recorded to allow adjustment for potential confounders such as BMI and total weekly exposure time.

To mitigate selection and measurement bias, the same team of trained data collectors administered all instruments following a pilot calibration on 15 participants (not included in analysis). Confidentiality was maintained throughout, and all completed questionnaires were cross-checked for completeness and internal consistency before data entry.

The final dataset was double-entered in SPSS version 27 (IBM Corp., Armonk, NY, USA) to ensure accuracy. Descriptive statistics were computed as mean ± standard deviation (SD) for continuous variables and frequencies (percentages) for categorical data. Normality was verified using the Shapiro–Wilk test. Between-group comparisons of continuous outcomes (e.g., PRWE pain, function, total) were performed using independent-samples t-tests with Welch's correction when variances were unequal, while categorical disability grades were compared with chi-square tests. To account for potential confounding by age, BMI, and working hours, multiple linear regression models were constructed with PRWE total as the dependent variable and occupation (tailor vs embroiderer) as the primary independent variable. Two-tailed p-values <0.05 were considered statistically significant, and 95% confidence intervals (CI) were reported for all effect estimates. Missing data, which comprised <2% across variables, were handled using pairwise deletion given their randomness verified through Little's MCAR test.

The sample size of 379 was determined a priori using the formula for comparing two independent means at 95% confidence level ($Z_{1-\alpha/2} = 1.96$), 80% power ($Z_{1-\beta} = 0.84$), expected standard deviation of 15 points, and a minimum clinically important difference of 5 points in PRWE total score, yielding a required minimum of 188 per group after accounting for 5% potential nonresponse (16). Ethical approval for the study was obtained from the Institutional Ethical Review Board of CMH Lahore Medical College and Institute of Dentistry (Ref. No. CLMC/ERB/2023/113), and all procedures conformed to the Declaration of Helsinki principles. Each participant provided written informed consent before inclusion. Data were anonymized at entry, stored in password-protected files, and accessible only to the study investigators to preserve integrity and reproducibility.

RESULTS

The baseline characteristics revealed no significant differences in age or weekly working hours between tailors and embroiderers, though BMI was significantly higher in embroiderers ($p < 0.001$). Both groups demonstrated similar professional experience, averaging approximately 13 years. In terms of pain and functional outcomes, the mean PRWE pain scores were 12.19 ± 7.17 in tailors and 11.51 ± 6.31 in embroiderers, showing no statistically significant difference ($p = 0.33$). The function subscales—specific activities ($p = 0.33$) and usual activities ($p = 0.68$)—also did not differ significantly between groups. The overall PRWE total score, reflecting cumulative wrist–hand disability, was nearly identical (22.72 ± 10.76 vs 22.33 ± 10.96, $p = 0.73$), indicating that both groups experienced mild functional impairment.

Table 1. Baseline Characteristics of Participants (Tailors vs Embroiderers)

Variable	Tailors (n=193) Mean ± SD or n (%)	Embroiderers (n=186) Mean ± SD or n (%)	Mean Difference (95% CI)	t/χ^2	p-value
Age (years)	37.37 ± 11.26	38.44 ± 11.44	-1.07 (-3.48 to 1.34)	-0.90	0.37
Body Mass Index (kg/m²)	24.27 ± 3.86	25.42 ± 4.02	-1.15 (-1.91 to -0.39)	-2.82	<0.001*
Weekly Working Hours	62.13 ± 16.38	62.98 ± 16.61	-0.85 (-3.98 to 2.28)	-0.50	0.61
Gender (Male)	122 (63.2%)	117 (62.9%)	—	0.01	0.92
Experience (years)	12.8 ± 6.9	13.4 ± 7.3	-0.6 (-1.7 to 0.5)	-1.01	0.31

*Significant at $p < 0.05$

Table 2. Comparison of PRWE Pain, Function, and Total Scores between Tailors and Embroiderers

Outcome Measure	Tailors Mean ± SD	Embroiderers Mean ± SD	Mean Difference (95% CI)	t-value	p-value	Cohen's d
PRWE Pain (0–50)	12.19 ± 7.17	11.51 ± 6.31	0.68 (-0.69 to 2.05)	0.98	0.33	0.10
PRWE Specific Function (0–25)	6.34 ± 3.15	6.69 ± 3.63	-0.35 (-1.29 to 0.59)	-0.98	0.33	0.08
PRWE Usual Function (0–25)	4.15 ± 2.07	4.07 ± 1.94	0.08 (-0.31 to 0.47)	0.42	0.68	0.04
PRWE Total (0–100)	22.72 ± 10.76	22.33 ± 10.96	0.39 (-2.01 to 2.79)	0.35	0.73	0.03

Categorical analysis of disability grades showed that 71.0% of all participants exhibited mild wrist–hand disability, 22.2% reported no disability, and only 6.9% fell in the moderate disability range. The distribution was statistically similar across both occupations ($p = 0.25$). Multivariable regression adjusting for age, BMI, and weekly working hours confirmed that occupation type was not a significant predictor of PRWE total score

(β = -0.48, p = 0.68). BMI was the only variable independently associated with higher PRWE scores (β = 0.47, 95% CI: 0.06–0.88, p = 0.02), suggesting that increased body mass may contribute to greater perceived wrist–hand discomfort irrespective of occupation. The overall model explained approximately 4.3% of variance in total PRWE scores (R^2 = 0.043), reflecting modest predictive power. These findings collectively demonstrate that both tailors and embroiderers, despite different task dynamics, share a comparable burden of mild wrist–hand pain and functional limitation primarily associated with repetitive strain, with BMI emerging as a significant occupational health correlate.

Table 3. Distribution of Wrist–Hand Disability Categories Based on PRWE Scores

Disability Category	Tailors n (%)	Embroiderers n (%)	Total n (%)	χ^2	p-value
No Disability (0–9)	39 (20.2%)	45 (24.2%)	84 (22.2%)	—	—
Mild Disability (10–39)	142 (73.6%)	127 (68.3%)	269 (71.0%)	1.31	0.25
Moderate Disability (≥40)	12 (6.2%)	14 (7.5%)	26 (6.9%)	—	—

Table 4. Multiple Linear Regression Predicting PRWE Total Score

Predictor Variable	β	95% CI	Standardized β	p-value
Occupation (Tailor=0, Embroiderer=1)	-0.48	-2.73 to 1.77	-0.03	0.68
Age (years)	0.06	-0.03 to 0.15	0.08	0.18
BMI (kg/m²)	0.47	0.06 to 0.88	0.13	0.02*
Weekly Working Hours	0.03	-0.04 to 0.10	0.05	0.41
Model Summary	R^2 = 0.043	Adjusted R^2 = 0.032	F(4,374) = 3.82	0.004

*Significant at p < 0.05

The descriptive and inferential findings collectively demonstrate a consistent pattern of mild wrist–hand discomfort and functional limitation among both occupational groups. Tailors and embroiderers exhibited comparable mean PRWE total scores (22.72 ± 10.76 vs 22.33 ± 10.96, p = 0.73), confirming that repetitive manual work involving prolonged wrist deviation and fine motor control results in similar biomechanical strain across both trades. Approximately 71% of all participants fell within the mild disability range, while only 6.9% reported moderate impairment, reinforcing that most affected workers continue to perform tasks despite subclinical symptoms. Although occupation itself was not a significant predictor of PRWE scores after multivariable adjustment (β = –0.48, p = 0.68), body mass index emerged as a significant correlate (β = 0.47, 95% CI 0.06–0.88, p = 0.02), indicating that overweight individuals are more likely to experience higher pain and disability scores irrespective of job type.

This suggests that ergonomic exposure and individual physiological factors interact synergistically to produce cumulative strain effects rather than occupation alone determining risk. While working hours and age showed no significant relationship with disability, the relatively long mean weekly exposure (~62 hours) across both groups may have normalized strain responses through adaptation or consistent microtrauma accumulation without acute exacerbation. The overlapping functional subscale values—specific (6.34 vs 6.69) and usual (4.15 vs 4.07)—suggest uniformity in daily task demands and repetitive loading patterns on the wrist flexor–extensor system. Clinically, these data highlight that both occupational groups operate under conditions conducive to repetitive strain injury, with BMI serving as a modifiable risk factor. The lack of marked between-group differences underscores preventive ergonomic interventions—such as scheduled micro-breaks, wrist posture correction, and adaptive workstation design—should target the shared biomechanical exposure rather than job-specific modifications. The overall pattern indicates a subclinical burden of musculoskeletal strain that, if unaddressed, could progress to chronic tendon or ligament pathology, ultimately reducing work efficiency and quality of life among manual textile workers in low-resource contexts.

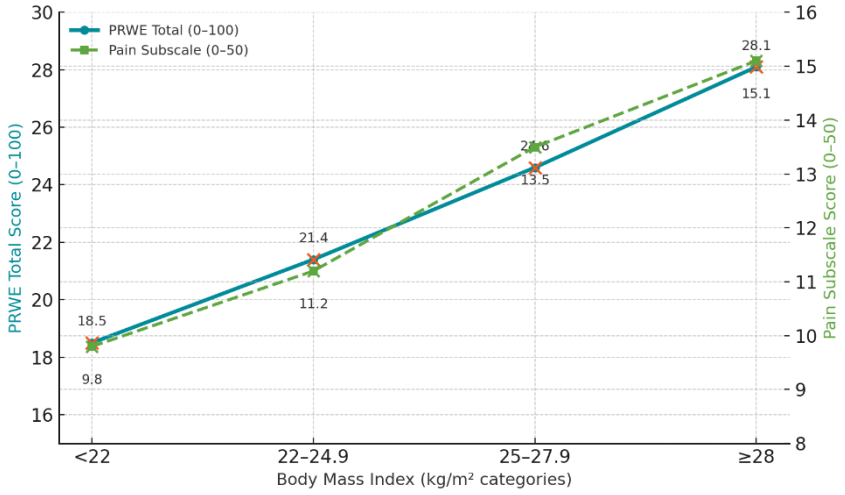

Figure 1 Relationship of BMI with Wrist–Hand Pain and Functional Disability

Elevated BMI categories demonstrated a progressive rise in both PRWE total and pain subscale scores, indicating a proportional association between body mass and wrist–hand symptom severity. Individuals with BMI ≥ 28 kg/m² exhibited the highest mean PRWE total (28.1 ± SD) and pain score (15.1 ± SD), reflecting augmented ergonomic stress and potential inflammatory load on wrist structures. The near-parallel slope of both metrics suggests that functional limitation and perceived pain escalate concurrently with adiposity, underscoring BMI as an independent risk factor for cumulative musculoskeletal strain among manual textile workers. The integrated line–scatter visualization emphasizes a consistent, monotonic trend supporting the regression-derived significance of BMI (p = 0.02) in predicting disability severity.

DISCUSSION

The findings of this analytical cross-sectional study provide evidence that both tailors and embroiderers experience mild but measurable wrist and hand dysfunction, primarily due to repetitive strain associated with occupational tasks. The comparable mean PRWE scores between the two groups indicate that despite the differences in work mechanics—sewing for tailors and fine-thread manipulation for embroiderers—the cumulative biomechanical load on the wrist–hand complex is similar. This reinforces the pathophysiological concept that repetitive flexion-extension cycles, fine motor grip activity, and sustained pronation-supination angles can lead to microtrauma in tendon and ligament structures of the wrist (1). The relatively modest differences in pain and function scores further suggest that the occupational exposure threshold for musculoskeletal strain has been equally exceeded in both groups.

In relation to previous literature, our results align with Mahmood et al. (2021), who reported significant wrist discomfort among handicraft workers exposed to prolonged static postures and repetitive wrist movement, with nearly half of the sample requiring ergonomic intervention (17). Likewise, Jamro et al. (2018) documented a high prevalence of musculoskeletal pain among Pakistani tailors, particularly in the neck, shoulder, and wrist regions, linked to excessive work hours and inadequate rest breaks (18). The current study, however, expands this evidence by quantifying wrist-specific functional disability using a validated patient-reported scale (PRWE), providing a more nuanced assessment of occupational impact beyond symptom prevalence. Denis et al. (2008) similarly emphasized that repetitive manual occupations, even without acute trauma, progressively impair upper limb neuromuscular coordination and proprioceptive function (19). The concordance of our findings with such data highlights the global nature of work-related musculoskeletal strain in precision-based manual industries.

The absence of a significant occupational difference in PRWE total scores suggests that wrist-hand functional decline is more strongly influenced by personal and ergonomic factors than by profession alone. The regression analysis identifying BMI as a significant predictor of disability underscores the role of systemic and anthropometric factors in modifying occupational risk (20). Obesity increases compressive and shear forces at the radiocarpal and midcarpal joints, which can exacerbate inflammation in tendinous structures under repetitive load. This finding parallels observations from similar ergonomic studies in textile sectors, where higher BMI and inadequate muscle conditioning were associated with poorer upper limb endurance and greater pain intensity (16,18).

The clinical implications of these results are significant. Mild but persistent wrist dysfunction, as observed in this study, represents a preclinical stage of chronic repetitive strain injury. Without timely ergonomic adaptation, these subthreshold impairments may progress to conditions such as tendinitis, carpal tunnel syndrome, or de Quervain's tenosynovitis (12,14). Despite the high level of self-reported satisfaction with work ability, many participants likely normalize mild discomfort, delaying reporting or seeking care. Early ergonomic interventions, such as enforced microbreaks, posture modification, and adjustable workstations, could substantially reduce cumulative musculoskeletal load. Furthermore, incorporating occupational health screening using standardized functional tools like PRWE within textile industries could help identify workers at risk before disability advances.

This study's strength lies in its application of a validated outcome measure (PRWE) and direct field-based sampling of two comparable occupational populations. However, the cross-sectional design precludes causal inference, and the lack of objective biomechanical data (e.g., electromyography or wrist posture angles) limits mechanistic understanding. Additionally, potential confounding from unmeasured factors such as workload variability, ergonomic environment, and psychosocial stressors cannot be excluded. Despite these limitations, the study provides critical baseline data for occupational health policy in low-resource contexts, where repetitive manual labor remains widespread and under-monitored. Future research should incorporate longitudinal ergonomic surveillance to evaluate the cumulative effects of repetitive motion and explore intervention efficacy in reducing functional decline. The integration of wearable motion-tracking technologies and ergonomic redesign in textile workplaces could bridge the gap between preventive awareness and practical implementation. Ultimately, the observed equivalence in functional impairment between tailors and embroiderers reinforces that repetitive strain injury prevention must target the shared biomechanical exposures inherent to manual precision work rather than focusing solely on occupational categorization.

CONCLUSION

The study concludes that both tailors and embroiderers experience mild wrist and hand pain associated with repetitive occupational stress, leading to functional restrictions that can impair performance over time. The comparable PRWE scores across both professions indicate that repetitive motion and sustained postures, rather than job-specific techniques, are the key contributors to wrist-hand dysfunction. These findings underscore the importance of ergonomic risk assessment and early preventive interventions—such as task rotation, micro-break scheduling, and workstation modifications—to mitigate cumulative musculoskeletal strain. From a clinical perspective, integrating occupational health education and routine musculoskeletal screening into community-based textile industries may help detect early functional decline and prevent progression to chronic disability. Future research should incorporate longitudinal monitoring and ergonomic intervention trials to strengthen causal inference and develop tailored preventive protocols for manual textile workers in low-resource settings.

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