ISSN – 2277-7911
Impact Factor – 5.077

YOUNG RESEARCHER
A Multidisciplinary Peer-Reviewed Refereed Research Journal

Oct-Nov -Dec 2022
Vol. 11 No. 4

Working Conditions and Health Status in the Textile Industry Sector of North Solapur Taluks: An Empirical Investigation

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DOI - 10.5281/zenodo.22227379

Abstract:

The textile sector in North Solapur district (Maharashtra, India) is a pivotal hub for powerloom and handloom production. However, informal employment models and substandard occupational environments expose workers to significant physical and physiological hazards. This empirical study examines the interrelationship between workplace physical parameters (airborne cotton dust, ambient noise, illumination, and shift duration) and the physical health outcomes of 240 textile workers in the North Solapur cluster. Standardized clinical evaluations and ergonomic assessments revealed high rates of musculoskeletal disorders (74.6%), chronic respiratory complaints such as byssinosis and bronchitis (41.25%), noise-induced hearing threshold shifts (33.3%), and ocular strain (52.1%). Statistical analysis demonstrates a strong positive correlation between shift lengths exceeding 10 hours and reported chronic health morbidity ($p < 0.001$). The paper outlines policy recommendations for workplace ergonomic redesign, environmental standard compliance, and target healthcare delivery mechanisms.

Keywords: Textile Workers, North Solapur, Occupational Health, Byssinosis, Musculoskeletal Disorders, Ergonomics.

Introduction:

The textile industry represents one of the largest unorganized and semi-organized manufacturing clusters in Western India. Solapur district, particularly the North Solapur tehsils and urban peripheries, is nationally renowned for its Jacquard towel production, chaddars (blankets), and powerloom manufacturing. While this sector provides substantial livelihoods, micro- and small-scale enterprises (MSMEs) often operate outside rigorous regulatory oversight.

Occupational environments in these units feature heavy ambient lint levels, high-frequency mechanical noise, restricted spatial layouts, inadequate ventilation, and poorly calibrated lighting. Workers undergo prolonged static posturing, continuous repetitive movement, and extended shifts without protective personal equipment (PPE). Despite the high regional economic throughput, empirical evidence

quantifying the direct health costs borne by North Solapur textile laborers remains limited. This paper evaluates the structural workplace parameters in North Solapur's textile sector and measures their impact on worker morbidity patterns.

Literature Review:

- **Respiratory Illnesses:** Prolonged exposure to respirable cotton dust ($PM_{2.5}$ and P_{10}) leads to progressive airway constriction, chronic obstructive pulmonary disease (COPD), and byssinosis ("Monday Fever").
- **Ergonomic Strain:** Studies by the *International Journal of Occupational Safety and Ergonomics* show that continuous standing or awkward sitting postures during weaving, spinning, and sorting lead to chronic low back pain, shoulder stiffness, and lower-limb edema.
- **Noise Exposure:** Continuous mechanical noise in powerloom sheds frequently exceeds (85 dBA), accelerating high-frequency hearing loss and psychological stress over 5 to 10 years of exposure.
- **Socioeconomic Vulnerabilities:** Low wage rates, informal contractual arrangements, and lack of employer-provided medical insurance compound occupational risks, discouraging early clinical interventions.

Methodology:

Study Area and Sampling Design:

North Solapur is situated in southeastern Maharashtra, within Solapur district. It lies in the Deccan Plateau region and is closely associated with the urban area of Solapur. North Solapur taluka itself is located at approximately 17°40′09″ N latitude and 75°53′59″ E longitude.

The research was conducted across four major textile manufacturing pockets within North Solapur district: MIDC Solapur, Shelgi, Ashok Chowk, and Old Mill Compound. A cross-sectional design was utilized to survey 240 workers (160 male, 80 female) aged between 18 and 60 years, selected via stratified random sampling across powerloom operator, handloom weaver, spinning, and processing roles.

Data Collection Tools:

1. **Occupational Environment Audits:** Ambient indoor air dust concentrations (mg/m^3), sound intensity levels (dBA using sound level meters), and illuminance (lux) were measured across 20 representative workshop units.
2. **Clinical & Epidemiological Surveys:** Standardized questionnaires assessed self-reported morbidity, shift lengths, occupational duration (in years), and PPE usage patterns.
3. **Ergonomic Assessment:** The Rapid Entire Body Assessment

(REBA) tool evaluated physical stress during active work cycles.

4. **Physiological Measurements:** Spirometry tests (FEV1/FVC ratios) identified airflow limitation patterns among long-term workers.

Physical Working Conditions:

Field measurements across the audited industrial units in North Solapur highlight major non-compliance with statutory safety thresholds:

Table No. 1.1 Physical Working Conditions

Parameter Evaluated	Measured Average (North Solapur Units)	Statutory / Recommended Benchmark	Compliance Status
Indoor Ambient Noise	89.4 - 96.2 dBA	< 85.0 dBA (8hr TWA)	**Non-Compliant**
Respirable Cotton Dust	3.8 - 6.5 mg/m^3	< 0.2 - 0.5 mg/m^3	**Non-Compliant**
Workstation Illumination	120 - 210 lux	300 - 500 lux (Textile weaving)	**Deficient**
Average Shift Duration	10.5 - 12.0 hours/day	< 8.0 hours/day	**Exceeded**
PPE Adoption Rate	11.25%	100%	**Critically Low**

The physical infrastructure across micro-units in North Solapur showed low ceiling heights, poor exhaust ventilation, and minimal space between loom rows. Heat stress was accentuated during summer months, with internal shop floor temperatures averaging.

Health Status Analysis:

Musculoskeletal Disorders (MSDs)

Overall, 74.6%(n=179) of sampled workers reported persistent musculoskeletal discomfort lasting over 3 months. REBA scores averaged 8.4, placing workers in a High-Risk Category requiring immediate workplace intervention.

- **Lower Back Pain:** Reported by 68.3% of powerloom operators due to continuous standing on unpadded concrete floors.
- **Neck and Shoulder Strain:** Present in 54.1% of manual Jacquard weavers caused by repetitive overhead string pulling.
- **Wrist and Finger Joint Stiffness:** Predominant among pirn winders and cloth inspectors (39.5%).

Respiratory Morbidity:

Spirometric screening and symptom mapping identified

respiratory impairment in 41.25% (n=99) of subjects.

- **Byssinosis Symptom Complex:** 18.3% of workers reported tightness in the chest and dyspnea on initial workdays following weekly breaks.
- **Chronic Bronchitis:** Prevalent in 22.9% of workers with more than 10 years of service.
- Spirometry results indicated an obstructive lung function defect ($FEV_1/FVC<70\%$) in 28.7% of tested operators.

Hearing Impairment & Ocular Fatigue:

Continuous exposure to unmitigated mechanical loom noise resulted in self-reported severe hearing impairment or tinnitus in 33.3% of workers. Audiometric screening confirmed bilateral sensorineural hearing loss at 4000 Hz frequencies among 27.5% of workers with >8 years of exposure. Sub-optimal illumination combined with fine yarn alignment tasks led to complaints of eye strain, persistent headache, and premature presbyopia in 52.1% of respondents.

Statistical Cross-Tabulation & Association:

Chi-Square tests of independence were performed to examine relationships between tenure, shift hours, and physiological outcomes:

$$X^2 = \Sigma \frac{(O-E)^2}{E}$$

Table No.1.2 Statistical Cross-Tabulation & Association

Variable Pair	Chi-Square	p-Value	Significance
Work Tenure (>8 Yrs) vs. Respiratory Deficit	18.42	< 0.001	Statistically Significant
Shift Duration (>10 Hrs) vs. Severe MSDs	14.15	< 0.001	Statistically Significant
No PPE Usage vs. Ear/Nose/Throat Symptoms	9.88	0.0017	Statistically Significant

(The statistical evidence confirms that cumulative years of exposure and unmitigated daily hours are key determinants of chronic health decline among workers in this industrial sector.)

Socio-economic Determinants of Worker Health:

The adverse health profiles of textile workers in North Solapur are closely tied to regional socioeconomic factors:

1. **Piece-Rate Wage Structure:** Compensation tied directly to linear meter production

incentivizes workers to forego mandatory rest breaks and operate extended shifts (up to 12–14 hours).

2. **Out-of-Pocket Healthcare Costs:** Over 82% of micro-unit workers lack access to Employees' State Insurance (ESI) coverage. Medical expenses consume an estimated $14 - 22\%$ of monthly family earnings.
3. **Housing Conditions:** Workers frequently reside in dense, poorly ventilated housing colonies near industrial zones (e.g., Old Mill lines), leading to continuous environmental exposure to urban and industrial pollutants.

Discussion:

The findings demonstrate a structural deficit in health protection within North Solapur's textile ecosystem. Although the Factories Act (1948) sets standards for industrial units, local powerloom and handloom enterprises often fall under informal thresholds, escaping regular safety inspections.

Compared to larger integrated mills, informal units in North Solapur lack automated dust extraction systems, anti-vibration rubber flooring, and sound-dampening acoustic panels. Consequently, workers absorb physical hazards directly. The resulting disease burden reduces work-life expectancy, increases absenteeism, and perpetuates generational economic vulnerability.

Policy Recommendations and Interventions:

A. Engineering Controls:

- **Ventilation Systems:** Mandate low-cost local exhaust ventilation (LEV) and dust suppression systems in small-scale loom sheds.
- **Ergonomic Upgrades:** Introduce dampening anti-fatigue floor pads, height-adjustable seating, and overhead pulley balance aids for Jacquard weaving.

B. Administrative & Regulatory Enforcement:

- **Work Shift Caps:** Enforce an 8-hour shift ceiling to curb physical exhaustion and chronic joint degradation.
- **Targeted Inspections:** Strengthen the capacity of regional industrial health and safety inspectorates in North Solapur.

C. Medical & Social Protection:

- **ESI Coverage Expansion:** Extend compulsory Employees' State Insurance (ESI) registration to all micro and informal textile units regardless of headcount.
- **Routine Screening Camps:** Conduct biannual spirometry, audiometry, and vision check-ups through local primary health centers (PHCs).

Conclusion:

The textile sector remains a major economic foundation for North Solapur, yet its operational model relies on high human physical costs. Occupational hazards—particularly cotton dust, high noise levels, and excessive shifts—lead to high rates of respiratory, musculoskeletal, and sensory impairment among workers. Addressing these issues requires a multi-pronged strategy: regulatory compliance, low-cost engineering improvements, and expanded healthcare access. Protecting worker health is vital not only for human rights, but also for securing the long-term economic sustainability of Solapur's historical textile industry.

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