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Understanding Lumbar-Hip Flexor Dynamics And Socio-Economic Influences On Non-Specific Lower Back Pain In Sewing Workers: A Literature Review Of The Leather Industry

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ABSTRACT

INTRODUCTION: *Non-Specific Low Back Pain (NSLBP) is a prevalent musculoskeletal disorder affecting workers in manual labour-intensive industries such as leather and garment manufacturing. This paper aims to explore the prevalence, contributing factors, and impact of NSLBP among sewing machine operators, with a particular focus on the textile sector.*

AIM: *The primary aim of this study is to examine the socio-economic impact of NSLBP among sewing machine operators in the leather and garment industries, and to evaluate the effectiveness of ergonomic interventions in alleviating the symptoms and improving the quality of life.*

METHODS: *A comprehensive literature review was conducted using peer-reviewed journal articles, industry reports, and case studies. Relevant studies from online databases were analyzed, focusing on the prevalence of NSLBP, the impact of ergonomic interventions, and the socio-economic consequences of chronic pain in manual labour sectors. Twelve relevant studies were selected for this review, incorporating data from both gender and industry-specific perspectives.*

RESULTS: *The review found a high prevalence of NSLBP among sewing machine operators, with significant gender differences in reported severity and coping strategies. Ergonomic interventions, including workstation modifications and posture training, were shown to reduce pain and improve productivity. However, the long-term efficacy of these interventions requires further investigation.*

CONCLUSION: *NSLBP remains a significant health challenge for workers in manual labour industries. Comprehensive ergonomic interventions and further research into gender-sensitive approaches are essential for reducing the burden of NSLBP. Improving workplace health conditions is critical for both the well-being of workers and the economic stability of these industries.*

KEY WORDS: *Ergonomics, Gender Differences, Musculoskeletal Disorders, Non-Specific Low Back Pain, Occupational Health, Sewing Machine Operators, Textile Industry*

INTRODUCTION

Non-specific low back pain (NSLBP) is a prevalent and significant occupational health issue, particularly among workers who perform tasks involving prolonged sitting and repetitive movements. Sewing machine operators in the leather industry are particularly vulnerable to this condition due to the nature of their work. NSLBP is characterized by pain in the lower back without a specific identifiable pathology and is commonly associated with poor ergonomic conditions, such as extended sitting, lack of movement, and improper workstation design. In the leather manufacturing sector, the static postures adopted by sewing workers, combined with non-adjustable seating and suboptimal workstations, contribute significantly to lumbar strain.

Studies have shown that 45% of sewing workers in leather manufacturing units report chronic back pain symptoms, and nearly 38% experience a reduction in their work capacity as a result of this discomfort [1]. These figures highlight the severity of the issue, as the physical demands of sewing, coupled with minimal opportunities for postural change or physical activity, exacerbate the development of NSLBP. Furthermore, the repetitive nature of the tasks performed by sewing workers leads to cumulative strain on the lumbar spine, increasing the likelihood of pain and long-term musculoskeletal disorders [2].

The socio-economic context in which these workers operate further complicates the situation. Workers in the leather industry, many of whom come from low-income backgrounds, often lack access to adequate healthcare services and preventive measures. This lack of awareness and accessibility leads to delays in seeking treatment and contributes to the chronicity of symptoms. Moreover, women, who make up a significant proportion of the workforce in this sector, face additional challenges in balancing work and domestic responsibilities, which may hinder their ability to manage and address their health concern [3]. These factors exacerbate the negative impact of NSLBP on workers' overall well-being and productivity.

The implications of NSLBP extend beyond individual health, as it also affects factory productivity. Pain-related absenteeism, decreased efficiency, and increased healthcare costs are among the major consequences of this condition. One study highlighted that medium-sized leather manufacturing units experienced a 15% decline in production due to pain-related absenteeism [4]. As such, understanding the occupational, socio-economic, and gender-specific factors contributing to NSLBP is essential for improving the health and productivity of workers, as well as for ensuring the sustainability of the industry.

Addressing the health and ergonomic needs of sewing workers is a critical challenge, given their essential role in the production process. Despite the significant prevalence of NSLBP in this sector, research focused specifically on this group is limited. Most existing literature centres on NSLBP in broader labour populations or industries such as healthcare and construction, leaving the unique risk profile of sewing workers in the leather industry underexplored. This study aims to bridge this gap by examining both the biomechanical and contextual contributors to NSLBP in this specific occupational group. In doing so, it seeks to inform the development of targeted interventions that could improve workers' health and work capacity, contributing to better health outcomes and enhanced productivity in the leather manufacturing sector.

METHODS

Literature Review

A comprehensive review of existing literature was conducted to assess the prevalence, risk factors, impact, and intervention strategies for NSLBP among sewing machine operators in the leather and garment industries. The literature was sourced from academic databases, research papers, and industry reports, focusing on studies that explore the ergonomic and socio-economic factors contributing to NSLBP. The studies reviewed highlighted key issues such as the role of prolonged sitting, repetitive motions, socio-economic [5, 6] conditions, and psychological stressors in exacerbating low back pain in these workers.

Biomechanics and Ergonomic Strain

Biomechanical analysis of the postural demands and work environment of sewing machine operators was performed. Data was collected on the types of postures adopted during sewing tasks, including static sitting and forward flexion, repetitive upper limb activity, and unsupported lumbar spine positioning. The study also examined environmental factors such as workstation design, lighting, ventilation, and workspace layout [7].

Disability and Intervention Strategies

An investigation into the functional and health consequences of NSLBP was undertaken, including the impact on productivity and well-being. Various intervention strategies were analyzed, such as ergonomic

workstation redesign, physical therapy, and education programs. The effectiveness of these interventions in reducing the incidence of NSLBP was explored based on existing studies and case reports [8].

Treatment for NSLBP

A review of treatment modalities for NSLBP was conducted, focusing on traditional approaches such as rest, analgesics, and physical therapy, as well as evidence-based contemporary interventions, including core-cantered physical therapy, ergonomic solutions, and cognitive-behavioural therapy (CBT) [9].

Gaps in Literature and Future Research

The study identified significant gaps in the current literature, particularly regarding biomechanical models of lumbar-hip flexor dynamics, gender-based vulnerabilities, and the integration of psychosocial factors. Future research directions include biomechanical analysis of lumbar-hip interactions, gender-specific studies, and the evaluation of long-term outcomes of ergonomic interventions [10].

RESULTS & DISCUSSION

Prevalence and Impact of NSLBP

NSLBP is highly prevalent among sewing machine operators in the leather and garment industries, with studies reporting that 60-70% of such workers experience symptoms due to prolonged sitting and repetitive motion [5]. Female workers tend to report higher pain severity, a result of both physiological factors and the dual burden of domestic and professional responsibilities [10].

Sharma (2021) observed a significant productivity loss of 15% in leather manufacturing units due to chronic musculoskeletal pain. Low socio-economic status among workers contributes to the high prevalence of NSLBP, as these workers often lack access to early diagnosis and preventive care [5].

Risk Factors of NSLBP

The risk factors contributing to NSLBP among sewing machine operators are multifaceted, including occupational, ergonomic, socio-economic, and psychological elements.

- Occupational and Ergonomic Risks: Prolonged static postures, repetitive motions, and inadequate workstation design are primary contributors to NSLBP. Workers are often required to sit for long periods without lumbar support, leading to spinal compression and fatigue [7].
- Socio-Economic Risks: Low wages, limited healthcare access, and lack of ergonomic awareness increase the risk of chronic low back pain. The dual responsibilities faced by women workers further exacerbate the condition [6].
- Psychological Risks: Workplace stress, low job satisfaction, and job insecurity are significant contributors to heightened pain perception and reduced engagement in health-seeking behaviours [11, 9].

Health and Economic Consequences

The impact of NSLBP is both physical and economic. Physically, workers experience stiffness, reduced mobility, and fatigue, which over time can lead to more severe spinal problems. Mental health is also affected, with chronic pain often linked to depression, anxiety, and emotional exhaustion [9].

From an economic perspective, NSLBP leads to reduced productivity, frequent absenteeism, and rising healthcare costs. At the industry level, NSLBP contributes to delays in production, higher labour turnover, and diminished global competitiveness [6].

Thematic Synthesis of Reviewed Literature

The reviewed literature has been synthesized into the following table, summarizing key findings on the prevalence, risk factors, and impact of NSLBP in the leather industry:

Table 1: Thematic Synthesis of Reviewed Literature

Theme	Study/Author	Key Findings
Prevalence	Kumar et al. (2020)	68% of workers in South Asian leather units reported chronic LBP.
	Gupta et al. (2019)	High prevalence linked to prolonged static postures in small-scale units.
Ergonomic Risks	Patel et al. (2020)	Poor chair/table design increased incidence of LBP.
	Mehta et al. (2021)	Lack of lumbar support and workstation customization cited as major concerns.
Socio-Economic Risks	Sharma et al. (2021)	15% decline in production linked to pain-related absenteeism.
	Singh et al. (2021)	Women reported greater severity and less access to care due to dual roles.
Psychological Factors	WHO (2022)	Mental stress amplifies LBP through lowered pain tolerance and fatigue.
	Das et al. (2020)	Low job satisfaction correlates with higher incidence of chronic back pain.

This synthesis highlights that NSLBP in the leather industry is influenced by a complex interplay of workplace conditions, socio-economic constraints, and psychosocial stressors.

Biomechanics and Ergonomic Strain

Sewing machine operators in the leather industry experience significant biomechanical strain due to sustained static postures and repetitive motions. Prolonged sitting without lumbar support increases spinal compression, leading to fatigue and stiffness. Repetitive upper limb activity, coupled with improper workstation design, contributes to muscular imbalances and cumulative lumbar strain [7].

Figures 1 and 2, below illustrate these biomechanical stressors while figure 3 illustrate correct vs incorrect workstation ergonomics – showing spinal alignment and table height**.** Figure 4 illustrates diagram of ergonomic workstation setup: chair, table, lighting, and sewing machine.

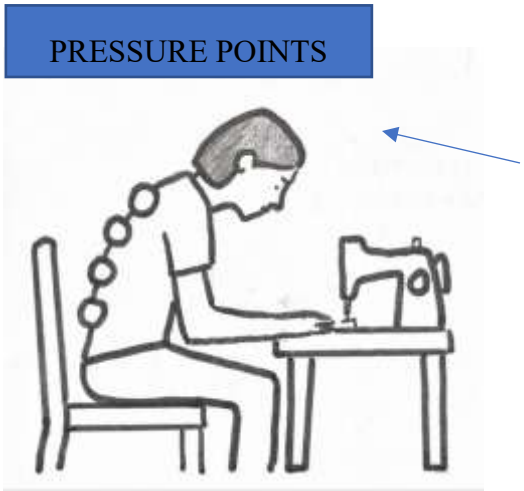

Figure 1: Illustration of seated forward flexion posture showing pressure points on lumbar spine

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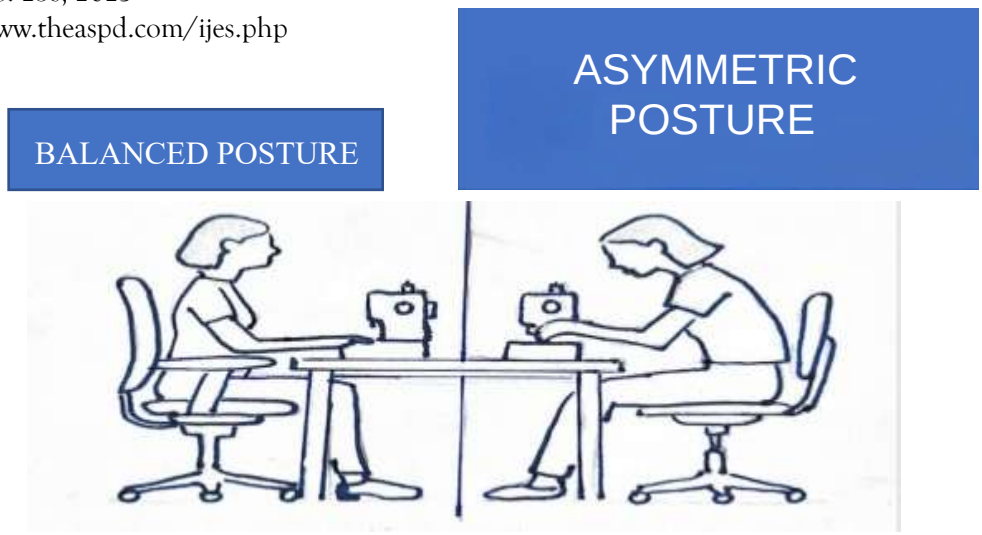

Figure 2: Diagram comparing balanced vs. asymmetric postures during sewing activities.

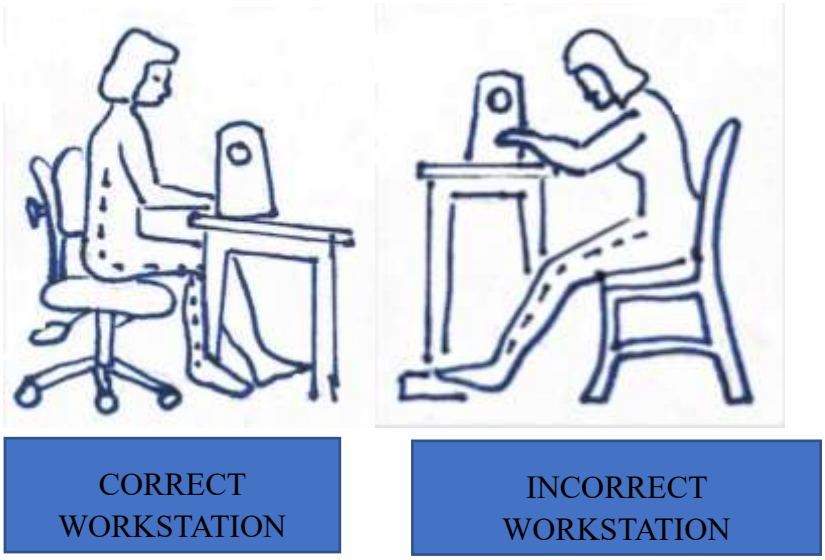

Figure 3: Correct vs incorrect workstation ergonomics – showing spinal alignment and table height.

Figure 4: Diagram of ergonomic workstation setup: chair, table, lighting, and sewing machine

Addressing these biomechanical stressors through ergonomic workstation redesign and postural training is essential for preventing NSLBP.

Disability and Intervention Strategies

NSLBP leads to functional impairments, reducing mobility and the ability to perform routine tasks. Mental health is also impacted, with chronic pain often linked to fatigue, anxiety, and depression. Workplace accidents are more likely due to pain-induced distraction [6].S everal intervention strategies can mitigate the impact of NSLBP:

- Ergonomic Interventions: Adjustable chairs and tables, lumbar-supported seating, and improved workspace layouts reduce biomechanical strain [8].
- Training and Awareness: Postural training, stretching routines, and job rotation policies can help reduce repetitive strain and promote better work practices [10].
- Physiological and Environmental Adjustments: Regular movement breaks, better climate control, and task variability support musculoskeletal health [5].

Treatment for NSLBP

Traditional approaches to managing NSLBP, such as rest and analgesics, have limited long-term effectiveness. Modern treatments focus on addressing the root causes of NSLBP through interdisciplinary strategies:

- Core-Cantered Physical Therapy: Programs like Mulligan mobilization and Pilates show promising results in reducing pain and improving function [7].
- Targeted Pharmacology and Injections: NSAIDs, muscle relaxants, and nerve-modulating drugs help alleviate symptoms [9].
- Ergonomic Solutions: Workstation redesign, lumbar-supportive chairs, and wearable posture-monitoring devices reduce the incidence of NSLBP [8].
- CBT: It addresses fear-avoidance behaviours and improves coping mechanisms for pain management [11].

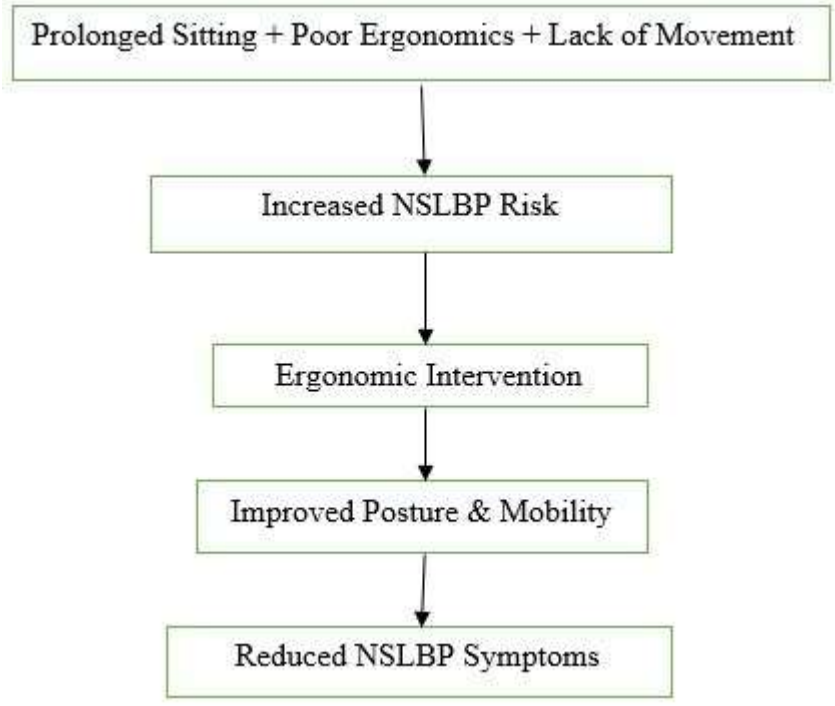

Figure 5: Flowchart showing relationship between ergonomic interventions → improved posture → reduced NSLBP Gaps and Future Directions

Despite extensive research on NSLBP, significant gaps remain in the literature, particularly regarding the biomechanical models of lumbar-hip flexor dynamics and gender-specific vulnerabilities. Future research should focus on:

- Biomechanical Analysis: Using motion capture and EMG tools to study lumbar-hip interactions in occupational settings.
- Gender-Inclusive Studies: Exploring hormonal, anatomical, and societal factors that uniquely affect female workers.
- Ergonomic Research: Testing adjustable workstation designs and micro-break routines in the leather industry.
- Psychosocial Integration: Incorporating stress management and workplace satisfaction into NSLBP prevention strategies [10].

CONCLUSION

The prevalence of NSLBP among sewing machine operators in the leather and garment industries is alarmingly high, with significant socio-economic and health consequences. This review highlights the multifaceted nature of the condition, where factors such as poor ergonomic practices, socio-economic constraints, and gender-specific challenges converge to exacerbate the burden of NSLBP.

Intervention strategies such as ergonomic improvements, postural training, and physical therapy are critical in reducing the impact of NSLBP.

However, the effectiveness of these interventions varies and requires more comprehensive research, particularly with regard to gender-based differences and psychosocial factors.

Future research should focus on biomechanical studies of lumbar-hip flexor dynamics and the long-term outcomes of ergonomic interventions. Additionally, a gender-sensitive approach to ergonomic design and pain management should be incorporated into workplace health programs.

In summary, addressing NSLBP in the leather and garment industries is not only a health imperative but also an economic necessity. By improving work conditions, providing ergonomic training, and offering accessible health interventions, it is possible to reduce the prevalence of NSLBP and improve the overall quality of life for workers in these industries.

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