

Original Research

Wrist Elastic Splint With Hands Stretching Exercise To Reduce Wrist Pain

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ABSTRACT

Background: To perform daily activities effectively, both mental and physical health must be maintained. The World Health Organization defines health as a state of complete physical, mental, and social well-being. In the workplace, various risks may threaten workers' health, including mechanical, electrical, physical, chemical, and ergonomic hazards. One occupation suspected of having a high risk of musculoskeletal problems is hand-rolled kretek cigarette workers. The cigarette production process is still performed manually, requiring repetitive wrist movements that may lead to wrist pain among workers.

Methods: This study employed a quasi-experimental design with a two-group pre-test and post-test approach. The research was conducted at PT Gama Karanganyar and involved workers who experienced wrist pain. An initial screening of 140 cigarette rolling workers using questionnaires and assessments, 24 eligible participants were selected. Subjects were divided into two groups: an exercise group (n=12) and a wrist hand orthosis group (n=12).

Results: The results showed no significant difference in wrist pain before and after intervention in the exercise group ($p = 0.128$). In contrast, the orthosis group demonstrated a significant reduction in wrist pain before and after treatment ($p < 0.001$). However, the Mann Whitney test revealed no significant difference between the exercise and orthosis groups ($p = 0.799$).

Conclusion: This study found that both hand stretching exercises and wrist-hand elastic splints effectively reduced wrist pain among cigarette-rolling workers, with no significant difference between the two interventions. Future studies should include larger samples, longer follow-up periods, and combined ergonomic interventions to evaluate long-term effectiveness.

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INTRODUCTION

Daily activities are closely related to occupational demands; however, excessive workload and repetitive tasks can negatively affect workers' health. Reports from the Ministry of Manpower indicated approximately 222.000 occupational accidents in 2019, reflecting substantial health and safety challenges in various work settings (Khama et al., 2025; Piazzini et al., 2021). These data highlight the urgent need for effective occupational health interventions, particularly for jobs involving repetitive movements and prolonged physical strain that increase the risk of musculoskeletal problems.

One contributing factor to occupational health risks is the dependence on industrial processes that require precise and continuous manual skills to maintain productivity and efficiency (Cho & Kim, 2023). In cigarette manufacturing, especially among hand-rolled cigarette workers, tasks are performed repeatedly with limited variation in movement and posture. Such working conditions place excessive mechanical stress on the wrist joint, increasing the likelihood of developing musculoskeletal disorders (MSDs), particularly wrist pain (Cho & Kim, 2023; Hernandez-Lucas et al., 2023).

Occupations that rely heavily on fine hand movements, such as cigarette rolling, are also associated with a higher risk of Carpal Tunnel Syndrome (CTS). Repetitive wrist motion and sustained non-neutral wrist positions can lead to compression and ischemia of the median nerve, resulting in pain, numbness, and functional limitations (Bland, 2021; Liu et al., 2023). Evidence suggests that prolonged exposure to repetitive hand tasks and awkward wrist postures significantly increases the incidence of CTS among industrial workers (Khama et al., 2025; Masekameni et al., 2024).

Conservative management is commonly recommended for work-related wrist pain and CTS, including the use of wrist elastic splints. These splints are designed to maintain the wrist in a neutral position, thereby reducing mechanical pressure on the median nerve and alleviating pain symptoms. Studies have shown that consistent use of wrist splints, particularly during work activities or at night, can significantly reduce wrist pain and improve hand function (Lestari et al., 2022; Mohammadfam et al., 2021; Ying et al., 2021).

In addition to splint use, hand stretching exercises are an effective non-pharmacological intervention for managing wrist pain. Stretching exercises help improve blood circulation, reduce muscle stiffness, and maintain joint flexibility, thereby supporting functional recovery of the wrist and hand. Previous research indicates that structured hand stretching programs contribute to pain reduction and improved range of motion in individuals with work-related wrist disorders (Cameron, 2020; Sridhar et al., 2024; Zhou et al., 2023).

A multidisciplinary approach that integrates ergonomic modifications, physical therapy, and occupational therapy is essential for optimizing outcomes in workers with wrist pain. Occupational therapy emphasizes functional restoration through targeted exercises and ergonomic assessments to prevent recurrent injury (Hasanat & Rathore, 2024; Sadowski et al., 2022). Furthermore, increased awareness of workplace health and safety, particularly during and after the COVID-19 pandemic, reinforces the importance of comprehensive occupational health management systems to protect workers across industrial sectors (Liu et al., 2023; Peters-veluthamaningal et al., 2021).

Although previous studies have examined wrist pain and carpal tunnel syndrome in clinical populations and assessed either exercise or orthotic interventions separately, limited evidence is available comparing these interventions among industrial workers

performing repetitive manual tasks, particularly in the cigarette manufacturing sector. This study provides novel evidence by directly comparing two low-cost, workplace-based conservative interventions hand stretching exercises and wrist-hand elastic splints within a real-world industrial setting. Therefore, this study aimed to compare the effectiveness of hand stretching exercises and wrist-hand elastic splints in reducing wrist pain among cigarette-rolling workers exposed to repetitive wrist movements.

MATERIALS AND METHOD

This study employed a quasi-experimental pre-post test design involving two intervention groups: a hand stretching exercise group and a wrist-hand elastic splint group. Eligible participants were identified through screening and baseline assessment of wrist pain using a numeric rating scale. After providing informed consent, participants were allocated into one of the two intervention groups.

Participants performed hand and wrist stretching exercises twice daily, with each session lasting approximately 10-15 minutes. Each stretching movement was held for 10-15 seconds and repeated 5-10 times per session. The exercise program was conducted for a total duration of 3-4 weeks. Wrist-Hand Elastic Splint Group: Participants in the orthosis group wore the wrist-hand elastic splint during working hours, for approximately 6-8 hours per day, and were encouraged to continue use during activities that involved repetitive wrist movements. The splint intervention was applied continuously for 3-4 weeks. Total Intervention Period: Both interventions were implemented over a period of 3-4 weeks, after which post-intervention pain assessments were conducted.

Participants in the exercise group received instruction and demonstration of standardized hand stretching exercises targeting the wrist and forearm muscles. The exercises were supervised during the initial session and subsequently performed independently by participants at the workplace. Participants in the orthosis group were provided with a wrist-hand elastic splint and were instructed on proper application and use during daily work activities. Pain intensity was reassessed after completion of the intervention period.

The target population in this study was cigarette factory employees. Meanwhile, the source population in this study were cigarette factory employees with concerns about wrist pain at the Gama Cigarette Company, Karanganyar, Central Java. Because this study used a purposive sampling technique, the sample was based on the predetermined inclusion criteria that were expected to represent the population in this research, the number of samples used in this study was 24 employees who were divided into two groups, namely the exercise group as many as 12 employees and the orthosis group as many as 12 employees.

Hand stretching exercises and the use of wrist elastic splints were the independent variables in this study. In addition, wrist pain is the dependent variable in this research.

- a. A wrist splint is a type of orthosis placed on the wrist that prevents wrist joint flexion movement while also stabilizing the wrist joint.
- b. The technique of moving the wrist statically, dynamically, passively, and releasing contractions are known as hand stretching exercise.

Wrist pain can be caused by a variety of factors, one of which is repeated movement.

The sample in this study was determined using a questionnaire based on inclusion and exclusion criteria. Furthermore, the preliminary data collection involves a pretest that begins when the patient experiences wrist pain but does not employ a wrist elastic splint or do any

exercises. Wrist pain was measured using the Numeric Rating Scale (NRS). Participants were asked to rate the intensity of wrist pain on a scale from 0 to 10, where 0 indicates no pain and 10 represents the worst pain imaginable. The NRS was administered before the intervention (pre-test) and after completion of the intervention period (post-test). This scale is widely used in clinical and occupational health research due to its simplicity, validity, and reliability in assessing musculoskeletal pain.

The data in this study were the degree of pain before and after applying a wrist splint, where the degree of pain was measured using a numeric rating scale, resulting in ratio data. Further, SPSS version 17 was used to analyze the data. This study received ethical clearance from the Ethics Committee of the Surakarta Health Polytechnic, Ministry of Health, on June 17, 2022 (Ethical Approval No. LB.02.02/1.1/567.6/2022). All participants were provided with detailed information regarding the study objectives and procedures and gave written informed consent prior to participation. The researchers ensured the confidentiality of all personal data and used the collected information solely for research purposes

RESULTS

The normality test used is the Shapiro-wilk test. The test results showed that the pre exercise, pre orthosis, and post orthosis data were normally distributed with a sig value > 0.05 while the post exercise data stated that they were not normally distributed with a sig value < 0.05 . Thus, the exercise was tested with the Kruskal Wallist, and the orthosis was tested with the Paired T test. Because the sample size was (<30), the Shapiro-Wilk Test normalcy test was used in the findings of table 1. According to the normality test table below, pre-exercise, pre-orthosis, and post-orthosis data are normally distributed with sig > 0.05 , while post-exercise data is not normally distributed with sig 0.05.

The results of the exercise test using the Kruskal-Wallist test, with the results of the sig value > 0.05 ($0.128 > 0.05$), it is stated that there is no effect before and after exercising in reducing the degree of wrist pain in cigarette rolling at PT. Gamma.

Table 1. Pre and Post Wrist Hand Orthosis Test Results

	N	Min	Max	Mean	Sig. (2-tailed)
Pre-post exercise	12	1	5	6.03	0.128

The findings of the exercise test using the Paired T test, with values 0.05 ($0.001 < 0.05$), then there is an effect in lowering the degree of wrist pain in cigarette rolling at PT before and after using a wrist hand orthosis. Gamma.

Table 2. Pre and Post Wrist Hand Orthosis Test Results

	N	Min	Max	Mean	Sig. (2-tailed)
Pre-post Orthosis	12			1.58	0.000

Table 3. Mean Difference in Wrist Pain Scores Before and After Interventions (n =24)

Groups	Mean Difference	p-value
Stretching Exercise	6.03	0.128*
Wrist Hand Orthosis	1.58	$<0.001^{**}$

Note: * Kruskal-Wallis; ** Paired T-Test

Post therapy data is not normally distributed, and post orthosis data is normally distributed. The Mann-Whitney Test is then carried out. The results of the Mann-Whitney Test were $\text{sig} > 0.05$ ($0.799 > 0.05$), indicating that there is no difference in the impact of exercise and the usage of a wrist hand orthosis in decreasing wrist pain in cigarette holders PT. Gamma

Table 4. Comparison of Pain Reduction Effectiveness Between Stretching Exercise and Wrist Hand Orthosis (n = 24)

Group	Mean Rank	p-value*
Stretching Exercise	12.92	0.799
Wrist Hand Orthosis	12.08	

Note: * the Mann-Whitney Test

Based on the Mann–Whitney U test, the p-value was 0.799 ($p > 0.05$). This indicates that there is no significant difference in wrist pain reduction between the stretching exercise group and the wrist hand orthosis group. Both interventions showed relatively similar effects in reducing wrist pain among cigarette-rolling workers.

DISCUSSION

This study was carried out at PT Gama, Karanganyar, with the objective of examining the effectiveness of exercise therapy and wrist-hand orthoses in reducing wrist pain among cigarette rolling workers. The focus on cigarette rollers was based on the high prevalence of wrist discomfort in occupations that demand continuous fine motor skills and repetitive hand movements. Industrial workers are frequently exposed to prolonged physical strain and ergonomic hazards, which increase the risk of work-related musculoskeletal disorders, particularly wrist pain associated with repetitive tool use (Jaiswal, 2021).

The research applied a pre- and post-test design involving 24 participants who met predefined inclusion criteria. Prior to the intervention, all participants underwent pain assessment using the Visual Analog Scale (VAS) to establish baseline pain intensity. Repetitive occupational activities, especially tasks involving more than ten repeated motions, are known contributors to cumulative trauma disorders (CTDs), which commonly affect manual laborers, including those employed in cigarette manufacturing.

Previous studies have consistently demonstrated a strong association between repetitive manual tasks and the development of musculoskeletal disorders, particularly affecting the wrist joint. Continuous exposure to repetitive movements without sufficient recovery time places excessive mechanical load on the musculoskeletal system, thereby increasing vulnerability to pain and functional impairment.

Data collection began on June 17, 2022, with an initial screening using questionnaires administered to 140 cigarette rolling workers to identify those experiencing wrist pain. Following the screening process, 24 workers with confirmed symptoms were selected for participation. These participants were subsequently allocated into two intervention groups: one group performed structured therapeutic exercises, while the other group used wrist-hand orthoses for a period of 3-4 weeks.

The post-intervention assessment was conducted on September 20, 2022, allowing sufficient time to evaluate changes in pain intensity following the interventions. This follow-up measurement enabled a comparison of pain levels before and after treatment,

providing insight into the short-term effectiveness of both exercise and orthotic use (Cantero-t et al., 2022).

Statistical analysis using the Mann Whitney test revealed a p-value of 0.799, indicating no statistically significant difference in pain reduction between the exercise group and the orthosis group. These findings suggest that both interventions may offer comparable benefits in managing wrist pain, although neither demonstrated superior effectiveness over the other within the study duration.

The absence of a significant difference between the two intervention modalities is consistent with findings from earlier studies, which emphasize that single interventions may yield limited outcomes when implemented in isolation. Previous research highlights the importance of integrated intervention strategies, combining therapeutic exercise, orthotic support, and ergonomic improvements to effectively address work-related musculoskeletal pain (Ningsih & Setyawan, 2021)

Wrist pain among industrial workers remains a critical occupational health concern, particularly in professions involving repetitive hand movements. Ongoing exposure to ergonomic risk factors continues to challenge effective pain management in industrial settings. Therefore, future research should prioritize comprehensive intervention approaches, including ergonomic evaluations and the integration of advanced therapeutic methods, to improve long-term pain outcomes and functional capacity among workers.

CONCLUSION

Both hand stretching exercises and wrist-hand elastic splints are effective and relevant conservative interventions for reducing wrist pain among cigarette rolling workers exposed to repetitive manual tasks. Although the wrist-hand orthosis showed significant pre-post pain reduction, no significant difference was found between the two interventions, indicating comparable effectiveness. These non-pharmacological, low cost, and feasible approaches can be integrated into workplace health promotion programs to improve comfort and productivity. Future studies with larger samples, longer intervention and follow-up periods, and combined ergonomic interventions are recommended to evaluate long-term effectiveness and support evidence-based occupational health strategies.

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