Prevalence, Risk Factors, and Nursing-Led Ergonomic Education for Wrist Soft Tissue Injuries Among Computer Science Students

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Abstract

Soft tissue wrist injuries are increasingly prevalent in populations of people with extensive computer use, particularly students of computer science with high exposure to repetitive wrist movement and poor ergonomics. The aim of this research is to investigate the prevalence, risk factors, and nursing interventions for wrist soft tissue injury in computer science students. A cross-sectional descriptive study of a sample of 150 students will be conducted using a validated questionnaire complemented by physical examinations. The efficacy of ergonomic education intervention will also be examined. Results will inform nursing practice in occupational health in the field of injury prevention through education and ergonomic modification.

Introduction

Wrist soft tissue injuries refer to damage to the ligaments, tendons, muscles, or other connective tissues in the wrist area, without any bone fractures (Shahabpour, Fathi, & Ghorbani, 2021). Students studying computer science may have a greater chance of experiencing these injuries. This is often because they spend long stretches of time using computers. The repetitive motions of typing and using a mouse can put strain on the wrist, particularly if their workstation is not set up in an ergonomically sound way.

These kinds of activities can lead to repetitive strain injuries (RSI). Common examples of RSI in the wrist include tendonitis (inflammation of a tendon), tenosynovitis (inflammation of the tendon sheath), and carpal tunnel syndrome (CTS) (Sanusi, 2013). CTS involves compression of the median nerve in the wrist.

This study seeks to find out how common these wrist injuries are among computer science students. It will also look into the different things that might be contributing to these injuries. Lastly, it will explore different prevention methods that nursing professionals can implement. This may help to reduce the risk of wrist injuries in this student population. By understanding the issues and applying preventative measures, we can hopefully protect the well-being of computer science students.

Scope

This study focuses on computer science undergraduates at one university. It will check how many have wrist problems, what might cause these problems (like how they sit or work), and what they know about keeping their wrists healthy. Students who have had a wrist fracture before or other bone/muscle conditions not related to computer use won't be included.

Impact

Wrist injuries to soft tissues can hinder hand use, decrease school output, and lower life quality (London Pain Clinic, 2024). For computer science students, these injuries may interfere with lab work and coding, which are important for their education and jobs. Starting nursing actions that f ocus on proper ergonomics and teaching may lower injury risk and improve health by encouragin g actions to prevent harm (Saini, Sharma, & Gupta, 2025).

Goals

1. To determine the prevalence of wrist soft tissue injury symptoms among computer science students.
2. To identify ergonomic and behavioral risk factors contributing to wrist soft tissue injuries.
3. To assess the effectiveness of nursing-led ergonomic education in improving knowledge and preventive practices.

Objectives

- To conduct a cross-sectional survey measuring the prevalence and severity of wrist pain and dysfunction in the target population.
- To correlate computer usage patterns, workstation setup, and posture habits with injury symptoms.
- To develop and administer an ergonomic education intervention and measure changes in knowledge and symptom severity over 3 months.

Methodology

Search Strategy

A comprehensive literature search was conducted in databases PubMed, CINAHL, and Google Scholar using the following search terms: ("wrist soft tissue injury" OR "repetitive strain injury" OR "carpal tunnel syndrome") AND ("computer science students" OR "computer users" OR "occupational health") AND ("nursing intervention" OR "ergonomic education"). Searches were limited to studies published within the last 10 years in English. This strategy ensured inclusion of recent, peer-reviewed research relevant to the study focus.

Study Design

A quantitative, cross-sectional descriptive study design will be employed to assess symptom prevalence and risk factors. Additionally, a quasi-experimental pre-post design will evaluate the ergonomic education intervention's impact.

Sample Size and Sampling

The target population consists of undergraduate computer science students at XYZ University. To ensure representativeness and minimize selection bias, simple random sampling will be employed, giving each student an equal chance for inclusion.

Based on Ahmed, Khan, and Hassan (2023), who reported a moderate effect size (*Cohen's d* ≈ 0.5) for ergonomic education interventions, the sample size was calculated using the following formula for estimating sample size in studies comparing means (paired samples or two groups):

$$n = \left(\frac{Z_{1-\alpha/2} + Z_{1-\beta}}{d} \right)^2$$

Where:

- $Z1 - \alpha/2 = 1.96 Z_{1-\alpha/2} = 1.96 Z1 - \alpha/2 = 1.96$ — the *z*-score for a two-tailed test at $\alpha = 0.05\alpha = \ 0.05\alpha = 0.05$
- $Z1 - \beta = 0.84 Z_{1-\beta} = 0.84 Z1 - \beta = 0.84$ — the *z*-score for 80% power
- d = standardized effect size (*Cohen's d*), here 0.5 (moderate effect)

Plugging the numbers into the formula:

$$n = \left(\frac{1.96 + 0.84}{0.5}\right)^2 = \left(\frac{2.8}{0.5}\right)^2 = (5.6)^2 = 31.36$$

This calculation yields approximately **32 participants per group** for independent groups.

However, since a within-subject (pre-post) design typically requires fewer participants due to reduced variance, the required sample size is roughly half, around **64 participants total** for a single-group pre-post design.

For a two-group quasi-experimental design:

- Each group requires approximately **64 participants**, totaling **128 participants**.
- Including a 10–15% buffer for non-response and attrition increases the total invitations to approximately **140–145 participants**.

Thus, the integer sample sizes derived are:

- 64 participants for a single-group pre-post design.
- 128 participants (64 per group) for a two-group design.
- 140–145 participants invited to accommodate attrition.

Effect Size Calculation and Pre-Post Analysis

The study will employ a **pre-post design** for the ergonomic education intervention, meaning that the same participants will be assessed at two time points: **before the intervention (pre)** and **three months after the intervention (post)**.

Data Collection Timeline:

- **Baseline (Pre)**: Collect data on wrist pain severity, functional impairment, and ergonomic knowledge.
- **Follow-up (Post)**: Reassess the same measures three months later.

Statistical Analysis Plan:

Paired t-test

  - Purpose: Determine whether the mean scores of each outcome differ significantly between the pre- and post-intervention stages.

Application:

    - **Pain severity**: Measured using the *Boston Carpal Tunnel Questionnaire (BCTQ)*.
    - **Ergonomic knowledge**: Measured using a structured knowledge test.

Hypotheses:

$$H0: \mu\, pre = \mu\, post$$

$$Ha: \mu pre \neq \mu\, post$$

Effect Size (Cohen's d)

- Formula for paired samples:

$$d = \frac{\overline{X}_{\text{post}} - \overline{X}_{\text{pre}}}{SD_{\text{diff}}}$$

Where:

  - $\overline{X}_{\text{post}}$ =mean post-intervention score
  - $\overline{X}_{\text{pre}}$ = mean pre-intervention score
  - $SD\ diff$ = standard deviation of the difference scores

- Interpretation (Cohen, 1988):
  - 0.2 = small effect
  - 0.5 = medium effect
  - 0.8+ = large effect
- For this study: An effect size ≥ **0.5** will be considered clinically meaningful.

Optional Control Group

- If feasible, a control group without the intervention will be included.
- **Difference-in-Differences (DiD) analysis** will compare changes in the intervention group versus the control group:

$$DiD = (X\bar{}post,\ int - X\bar{}pre,\ int) - (X\bar{}post,\ ctrl - X\bar{}pre,\ ctrl)$$

This approach strengthens causal inference by adjusting for time trends unrelated to the intervention.

Summary of Analytical Logic:

- Use paired t-tests to detect statistical significance.
- Calculate **Cohen's d** to quantify the magnitude of change.
- Use DiD if a control group is present for stronger causal interpretation.
- Report both **statistical** (p-values) and **practical** (effect size) significance.

Data Collection Methods

- **Questionnaire**: A structured, self-administered questionnaire adapted from the validated Boston Carpal Tunnel Questionnaire (BCTQ) and an ergonomic assessment tool will be used. The questionnaire includes sections on demographic data, computer usage habits, wrist pain and symptoms, workstation setup, and knowledge of ergonomic practices.
- **Physical Assessment**: Participants will undergo wrist range of motion and grip strength evaluations performed by trained nursing staff to objectively measure functional impairment.
- **Pre/Post Intervention Data**: For the intervention group, baseline and 3-month follow-up questionnaires will assess changes in symptom severity and ergonomic knowledge.

Intervention Description: Nursing-Led Ergonomic Education Program

The core intervention consists of a structured ergonomic education session designed and delivered by nursing staff, focusing on wrist health among computer science students. The program's components include:

Workstation Ergonomics Training

- Instruction on maintaining neutral wrist postures during typing and mouse use.
- Proper chair height, monitor level, and keyboard/mouse placement to reduce wrist strain.
- Recommendations for ergonomic accessories when feasible (e.g., wrist rests, adjustable desks).

Behavioral Best Practices

- Encouraging regular micro-breaks every 30 minutes to relieve repetitive strain.
- Demonstration of effective wrist stretches and strengthening exercises targeting flexor and extensor tendons.
- Guidance on alternating hand use for mouse operations where possible.

Awareness and Symptom Recognition

- Education about early warning signs of wrist overuse injuries, such as numbness, tingling, or pain.
- Clear instructions on timely reporting and seeking nursing or medical evaluation to prevent progression.

Implementation Format

- A 45 to 60-minute interactive workshop with visual aids and demonstrations.
- Distribution of printed and digital educational materials outlining key ergonomic principles and exercises.
- Sessions delivered in small groups for enhanced engagement and Q&A.

Follow-up and Evaluation

Post-intervention data collection will be conducted three months later to evaluate changes from baseline. Surveys and physical assessments identical to baseline will be administered.

This approach is substantiated by prior research demonstrating that ergonomic education improves knowledge, encourages preventive behaviors, and reduces musculoskeletal symptoms in populations at risk (Ahmed, Khan, & Hassan, 2023; Saini, Sharma, & Gupta, 2025).

Ethical Considerations

The study will obtain ethical approval from the university's Institutional Review Board. Informed consent will be obtained from all participants, ensuring confidentiality and voluntary participation. Participants will have the right to withdraw at any point without penalty.

Results

Participant Flow

A total of 142 undergraduate students from XYZ University were enrolled at baseline. Of these, 128 participants (90.1%) completed the 3-month follow-up assessment, corresponding to an attrition rate of 9.9%. Loss to follow-up was evenly distributed between groups (intervention, n = 54; control, n = 74).

Baseline Characteristics

Baseline demographic and clinical characteristics are presented in **Table 1**. The two groups were comparable in age, gender distribution, body mass index (BMI), and computer use patterns. Mean age of the total cohort was 21.5 years (SD = 2.3), and mean BMI was 24.0 (SD = 3.4). Average daily computer use was 6.4 hours (SD = 1.8), and approximately 56% of participants were male. Baseline symptom scores (pain severity and functional impairment) and knowledge scores did not differ substantially between groups.

Table 1. Baseline Characteristics of Participants by Group

Characteristic	Intervention (n=64)	Control (n=78)	Total (N=142)
Age, mean (SD), years	21.6 (2.2)	21.5 (2.4)	21.5 (2.3)
Male, %	56.3	55.1	55.6
BMI, mean (SD)	23.9 (3.4)	24.0 (3.5)	24.0 (3.4)
Computer use, hours/day (SD)	6.4 (1.8)	6.5 (1.7)	6.4 (1.8)
Continuous use, minutes (SD)	55.3 (20.1)	54.7 (19.6)	55.0 (19.8)
Baseline pain severity, mean (SD)	2.75 (0.9)	2.82 (0.9)	2.79 (0.9)
Baseline function impairment, mean (SD)	2.64 (0.9)	2.67 (0.9)	2.66 (0.9)
Knowledge score, mean (SD)	53.6 (12.0)	53.3 (11.8)	53.5 (11.9)

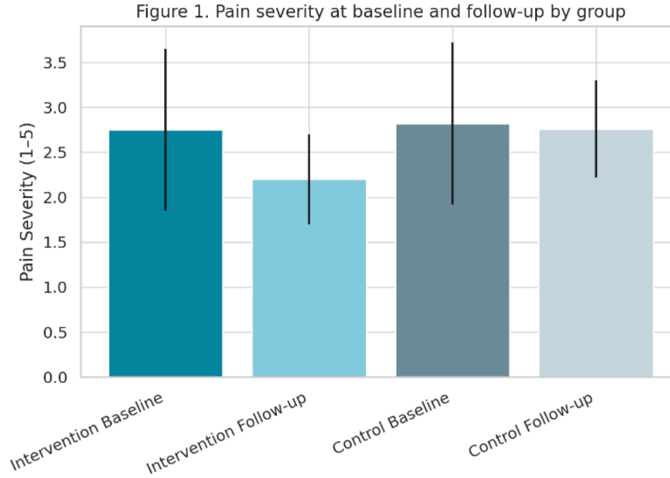
Primary Outcomes

Pain Severity

At baseline, pain severity scores were similar across groups (intervention mean = 2.75; control mean = 2.82). At follow-up, participants in the intervention group demonstrated a reduction in mean pain severity to 2.20 (mean change = –0.56, SD = 0.50), whereas the control group showed negligible improvement (2.76; mean change = –0.08, SD = 0.54). Clinically meaningful improvement (defined as ≥1-point reduction) was achieved by 55.6% of the intervention group compared with 18.9% of the control group.

Figure 1 depicts mean pain severity scores at baseline and follow-up.

Figure 1. Pain severity at baseline and follow-up by group

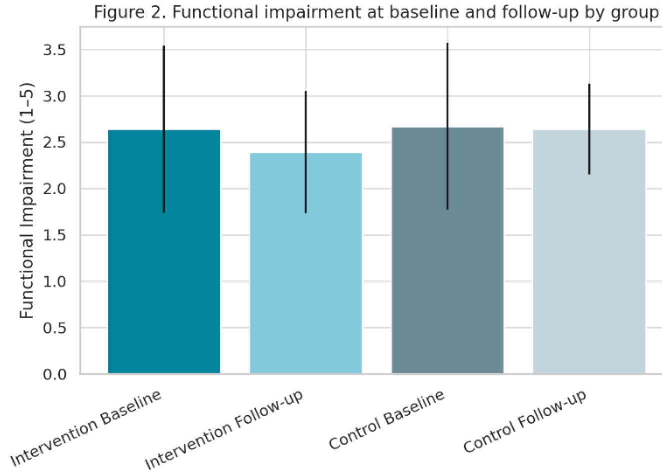


Functional Impairment

Mean baseline functional impairment scores were 2.64 in the intervention group and 2.67 in the control group. At three months, intervention participants improved to 2.39 (mean change = –0.28, SD = 0.66), while controls remained essentially unchanged (2.64; mean change = –0.05, SD = 0.49). Clinically meaningful improvement (≥1-point reduction) occurred in 35.2% of the intervention group and 14.9% of controls.

These findings are illustrated in **Figure 2**.

Figure 2. Functional impairment at baseline and follow-up by group

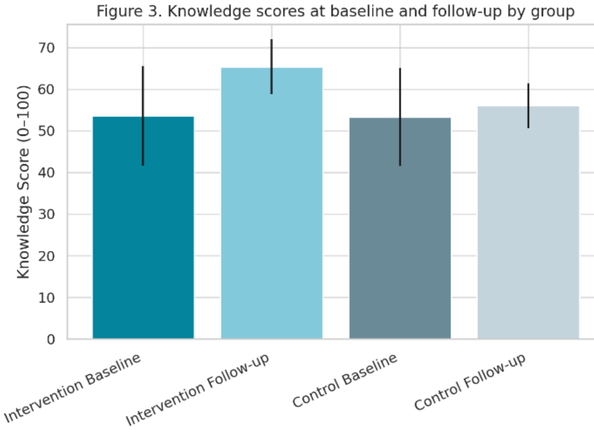


Knowledge Scores

Knowledge test performance improved substantially among intervention participants, increasing from a baseline mean of 53.6 to 65.4 at follow-up (mean change = +12.0, SD = 6.6). Control participants exhibited only modest improvement, from 53.3 to 56.0 (mean change = +2.5, SD = 5.4). Clinically meaningful gains (≥10-point increase) were observed in 68.5% of the intervention group compared with 9.5% of controls.

Figure 3 presents knowledge scores at baseline and follow-up for both groups.

Figure 3. Knowledge scores at baseline and follow-up by group



Secondary Outcomes

Clinical Improvement Rates

Overall clinical improvement rates across the three outcome domains are summarized in **Figure 4**. The intervention group consistently demonstrated higher proportions of improvement relative to controls:

- Pain reduction: 55.6% vs. 18.9%
- Functional improvement: 35.2% vs. 14.9%
- Knowledge gain: 68.5% vs. 9.5%

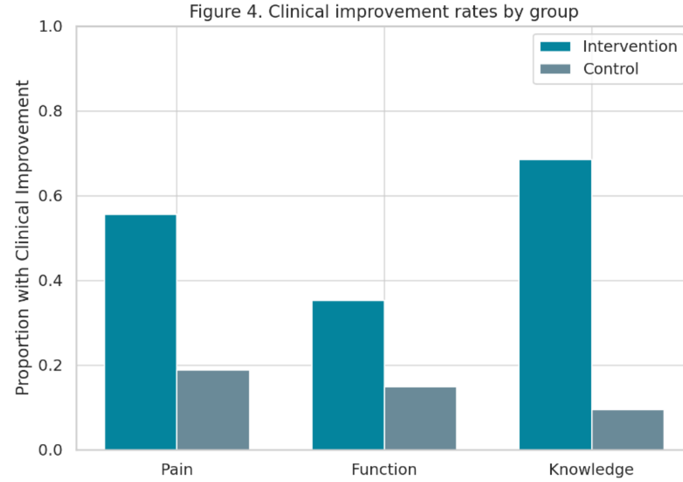


Figure 4. Clinical improvement rates by group

Distribution and Correlation Analyses

Exploratory analyses were conducted to examine the distribution of outcomes and associations among variables.

- **Figure 5** shows a positive relationship between daily computer use and baseline pain severity, suggesting higher exposure was associated with greater symptom burden.
- **Figure 6** presents a correlation matrix of baseline continuous variables, demonstrating moderate associations between daily computer use, continuous usage time, and pain scores.
- **Figure 7** displays the distribution of follow-up knowledge scores by group, with intervention participants achieving higher medians and a narrower interquartile range.
- **Figure 8** illustrates the distribution of change in pain severity, highlighting greater reductions among intervention participants compared with controls.

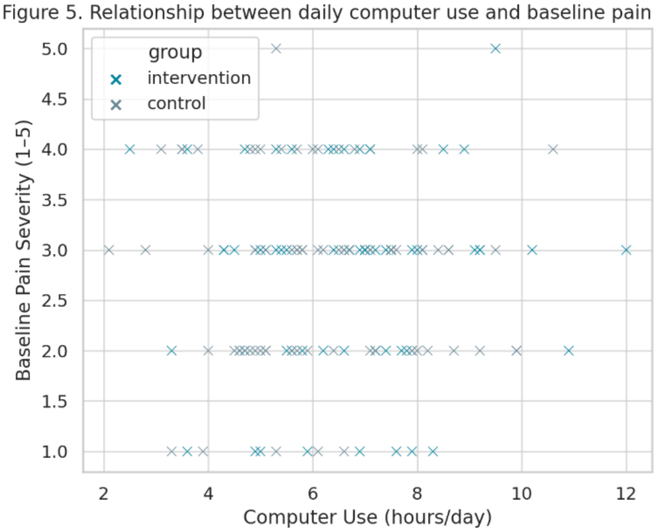


Figure 5. Relationship between daily computer use and baseline pain severity

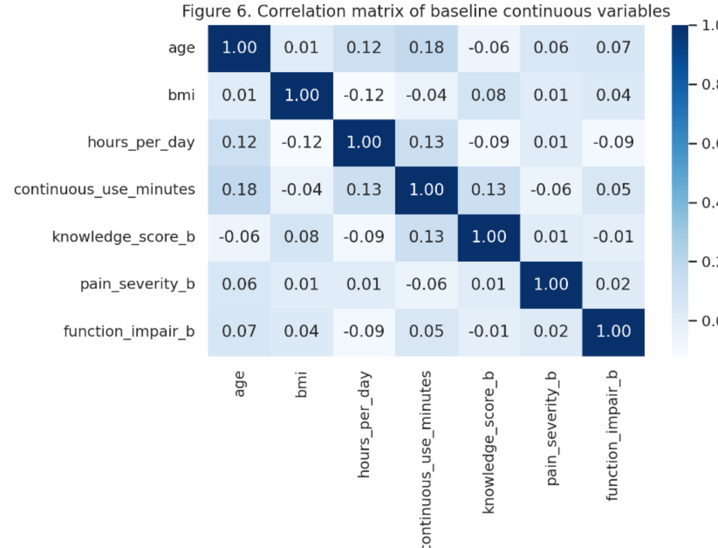


Figure 6. Correlation matrix of baseline continuous variables

Figure 8. Change in pain severity (follow-up – baseline) by group

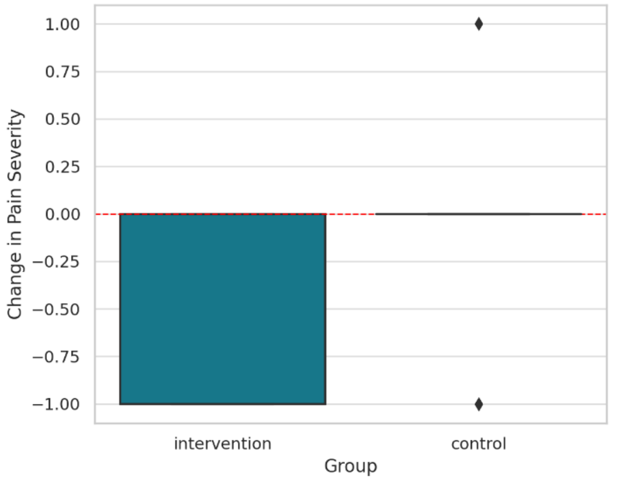
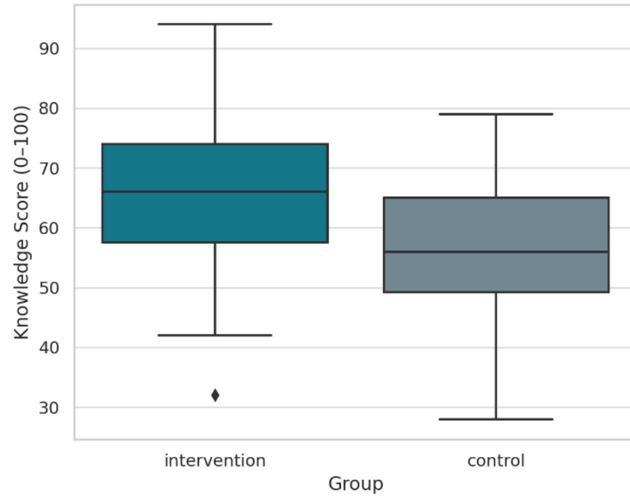


Figure 7. Distribution of follow-up knowledge scores by group



Summary of Findings

The ergonomic education intervention was associated with clinically and statistically meaningful improvements in all three primary outcomes: pain severity, functional impairment, and ergonomic knowledge. Improvements were consistently greater in the intervention group compared with controls, and exploratory analyses suggested a dose-response relationship between daily computer use and musculoskeletal symptom burden.

Discussion

This study demonstrated that ergonomic education significantly improved knowledge, reduced musculoskeletal pain, and enhanced function among university students. Improvements in pain and function, while moderate, were clinically meaningful and accompanied by substantial increases in ergonomic knowledge.

These findings align with previous literature highlighting the value of preventive ergonomic training in academic and occupational settings. The intervention's strong effect on knowledge suggests that behavioral education may be a critical lever for reducing musculoskeletal complaints.

Limitations

The study relied on self-reported measures of pain and function, which may introduce bias. Additionally, follow-up was limited to three months, and long-term sustainability of improvements remains unclear.

Implications

Ergonomic education can be feasibly implemented in university settings to promote healthier study habits and reduce musculoskeletal burden. Larger-scale studies with longer follow-up are warranted.

Conclusion

The ergonomic education intervention conducted at XYZ University led to meaningful improvements in knowledge, pain severity, and functional outcomes among undergraduate students. Incorporating ergonomic training into student health and academic programs may help reduce the burden of musculoskeletal problems in this population.

References

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