



A STUDY TO EVALUATE THE EFFECT OF ERGONOMIC TRAINING ON MUSCULOSKELETAL PAIN DURING CLINICAL PRACTICE AMONG STUDENT NURSES IN A SELECTED INSTITUTE, BENGALURU

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DOI: <http://dx.doi.org/10.24327/ijrsr.20261702.0118>

ARTICLE INFO

Article History:

Received 16th January 2026

Received in revised form 27th January 2026

Accepted 17th February 2026

Published online 28th February 2026

Key words:

Ergonomic Training, Musculoskeletal Pain, Student Nurses, Clinical Practice, Numerical Pain Rating Scale

ABSTRACT

Introduction: Musculoskeletal pain (MSP) is a common occupational health issue in nursing due to physically demanding clinical tasks like manual patient handling, maintaining awkward postures, and prolonged standing. Student nurses are particularly vulnerable to work-related musculoskeletal disorders. Ergonomic training is vital to equip nurses with competencies in correct body mechanics, safe lifting techniques, and optimal posture to minimize stress and injury.

Aim: The study aimed to evaluate the effectiveness of ergonomic training on musculoskeletal pain experienced by student nurses during clinical practice. **Methodology:** A pre-experimental one-group pre-test post-test research design was used. A sample of 40 student nurses was selected using convenience sampling in a selected institution in Bengaluru. Data were collected using a self-administered questionnaire, including Sample Characteristic Profile and Numerical Pain Rating Scale (NPRS). The intervention was a 60-minute ergonomics training session. The post-test was conducted after one week of practical application, and adherence to training was documented using a compliance sheet. Data were analysed using descriptive and inferential statistics (paired -test and Chi-square test). **Results:** The study population was predominantly female (98%), aged 18–20 years (55%), and primarily consisted of second-semester B.Sc. Nursing students (55%), with a vast majority (93%) reporting no regular physical exercise. Following ergonomic training, students experienced significant reductions in pain levels specifically in the upper back, lower back, and foot ($p=0.00$), although pain in other body regions showed no statistical change. A significant negative correlation was identified between adherence to the ergonomic training and pain scores in the neck, shoulder, hand, ankle, and foot, indicating that increased compliance with ergonomic principles led to a measurable decrease in pain. Additionally, higher pre-test pain levels were significantly linked to older age, advancement in the nursing course, and a clinical practice duration exceeding 24 weeks ($p=0.00$), while factors such as BMI, posture, and exercise habits did not significantly influence the baseline pain scores. **Conclusion:** The study concludes that ergonomic training was influential in reducing musculoskeletal pain among student nurses, particularly in major load-bearing regions like the back and feet. Furthermore, adherence to the training directly correlated with lower pain levels. These findings emphasize the urgent need to strengthen ergonomics education, especially for older students and those in higher

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INTRODUCTION

Musculoskeletal disorders (MSDs) are a prevalent occupational health issue globally, contributing significantly to disability and human suffering. Within the healthcare sector, nursing is a physically demanding occupation, making nurses highly susceptible to Work-related Musculoskeletal Disorders (WMSDs), particularly back injuries. (Sun et al., 2023), (Attar, 2014)

Tasks that commonly lead to WMSDs in nursing include patient shifting and lifting, pushing or pulling heavy equipment, and maintaining prolonged standing or awkward positions. Student nurses face similar risks during clinical training. (Tinubu et al., 2010) Evidence suggests that up to 90% of nurses experience some form of musculoskeletal pain during their careers, with significant discomfort reported in the lower back, neck, and shoulders. Studies among nursing students show a high prevalence of MSDs, most commonly affecting the lower back, neck, shoulder, and foot regions. (Nemera et al., 2024)

Ergonomics, derived from the Greek words *ergon* (work) and *nomos* (natural laws), is the science of fitting the job and the workplace to the worker's needs. Ergonomic training is proposed as an essential intervention, equipping nurses with skills in correct body mechanics, safe handling, and posture. (EcoOnline, 2025), (Physiopedia, 2024) Although body mechanics are taught in nursing education, observations suggest many students lack adequate knowledge and practical application of ergonomic principles. Implementing effective ergonomic interventions is crucial for improving the physical health, well-being, and productivity of nursing students. (Hamid et al., 2022)

The current study aims to evaluate the immediate effect of a structured ergonomic training session on reducing musculoskeletal pain among student nurses in clinical practice.

OBJECTIVES

- To assess the effectiveness of ergonomic training on musculoskeletal pain experienced by the student nurses during clinical practice.
- To determine the correlation between post-test musculoskeletal pain level and adherence to ergonomics training scores among student nurses.
- To determine the association between the pre-test musculoskeletal pain scores and selected sample characteristics of student nurses during clinical practice.

REVIEW OF LITERATURE

Musculoskeletal Disorders among Nursing Students

Work-related musculoskeletal disorders (WRMSDs) involve pain or discomfort arising from professional activities. While extensively researched in qualified nurses, data remains limited regarding nursing students. A cross-sectional study at KPGU University, Vadodara, identified a 60% prevalence of MSDs, most frequently affecting the lower back (46%), ankle/feet (17%), neck (12%), and shoulders (10%). (Rajpurohit & Landge, 2024)

Similarly, a study at Princess Nourah Bint Abdulrahman University involving 253 senior nursing students (levels five

to eight) emphasized that students face increased MSD risks during clinical training due to poor ergonomic techniques. The research concluded that the majority of nursing students are at high risk for MSDs primarily due to improper body mechanics and incorrect posture. (Elsayed, 2019)

Effect of Ergonomic Interventions on Musculoskeletal Pain

A study of 30 hospital nurses evaluated the effectiveness of an 8-week ergonomic training program using the Cornell musculoskeletal discomfort questionnaire, Visual Analogue Scale, and Rapid Upper Limb Assessment (RULA). The results demonstrated significant improvements in the experimental group compared to the control group, highlighting the necessity of multicentre approaches and the vital role of occupational therapists in managing work-related musculoskeletal disorders. (Kavitha & Vinodhini, 2017)

A cohort study of 74 operating room nurses in Iran utilized the Nordic Musculoskeletal Questionnaire and Rapid Entire Body Assessment (REBA) to evaluate an ergonomic educational program. The results demonstrated a significant reduction in overall musculoskeletal disorder (MSD) risk scores following the intervention, concluding that ergonomic training effectively reduces work-related discomfort among operating room staff. (Abdollahi et al., 2020)

Ergonomic-based Training and its Effectiveness on Musculoskeletal Pain

A follow-up study (2023–2024) among 367 blue-collar workers investigated the effectiveness of ergonomic posture training utilizing sessions, brochures, and visual cues. Assessments via the VAS Scale and Nordic Musculoskeletal Questionnaire revealed a significant reduction in pain across the neck, shoulders, back, and knees ($p < 0.05$), with disorder prevalence dropping from 53.67% to 29.30%. Despite a meaningful 45.41% decline in incidence (RR = 0.54), the study concluded that long-term success requires combining ergonomic education with engineering and administrative controls rather than relying on training alone. (Can Yildiz & Turkey, 2025)

A descriptive-analytical study of 130 administrative employees evaluated the impact of a two-month ergonomic training program focused on correcting workstation risk factors. Using the Nordic Musculoskeletal Questionnaire (NMQ) and the Rapid Office Strain Assessment (ROSA) tool, researchers found that while age and experience were only significantly linked to neck and upper back pain, the intervention effectively reduced overall ergonomic risk levels. The study concluded that structured education is essential, as workers frequently lack the knowledge required to utilize existing ergonomic equipment effectively to prevent musculoskeletal disorders. (Ghasemi et al., 2024)

METHODOLOGY

Research Design and Setting

A quantitative, pre-experimental one-group pre-test post-test design was utilized. The study was conducted at a selected institute in Bengaluru, with the training administered in the seminar hall and adherence assessed across various wards of the affiliated hospital.

Participants and Sampling

The target population was B.Sc. Nursing students in clinical practice. A sample size of 40 student nurses from 2nd Semester, 6th Semester, and 4th year B.Sc. Nursing students studying at the selected institute and seeking clinical practice at the affiliated parent hospital were selected using non-probability convenience sampling.

Inclusion Criteria required student nurses to be in clinical practice, report moderate to severe musculoskeletal pain (NPRS) when screened, and be willing to participate and communicate in English.

Tools for Data Collection

The study utilized a tool comprising three sections:

1. **Section 1: Sample Characteristics** - Collected demographic and clinical data (age, gender, course, BMI, posture, duration of clinical practice, exercise, and type of task performed).
2. **Section 2: Numerical Pain Rating Scale (NPRS)** - An 11-point scale (0-10) used to assess pain intensity in eight body regions (neck, shoulder, wrist, hand, upper back, lower back, ankle, and foot) before and after the intervention. Pain was categorized as mild (1-3), moderate (4-6), or severe (7-10).
3. **Section 3: Compliance Sheet** - A dichotomous questionnaire used to document adherence to ergonomic training practices during one clinical shift.

The tool underwent **content validity** by M.Sc. nursing faculty and physiotherapists. The NPRS has an established high test-retest reliability (above 0.90).

Intervention

The intervention consisted of a 60-minute researcher-led ergonomics training session. The training included instruction and drill on:

- Posture awareness
- Proper body mechanics
- Workstation adjustments
- Safe manual handling and lifting techniques
- Importance of breaks and micro-movements. This was followed by the practical application of these techniques during clinical shifts over one week.

Data Analysis

Data were analysed using descriptive statistics (frequency, percentage, mean, standard deviation) and inferential statistics.

- The Paired t-test was used to compare pre-test and post-test pain scores. Pearson’s correlation (r-value) was used to determine the relationship between post-test pain and compliance scores. The Chi-square test was used to determine the association between pre-test pain scores and sample characteristics. A 0.05 level of significance was established for hypothesis testing.

RESULTS

Section I: Sample Characteristics

The study population primarily consisted of female student nurses (98%) aged 18–20 years (55%), with the majority enrolled in the second semester of the B.Sc. Nursing program (55%). Half of the students had a BMI between 15.0–20.0 kg/m² (50%), while nearly all maintained an erect posture (98%) and did not engage in regular physical exercise (93%). Clinical experience was divided between those with 24 weeks of practice (55%) and those with more than 24 weeks (45%). Regarding clinical duties, 60% of students performed all tasks, while others were specifically involved in pushing wheelchairs or trolleys (20%), patient transfers (5%), or a combination of both (15%).

Section II: Effectiveness of Ergonomic Training

Table 1. Overall Mean, SD and paired t-value of pre and post-test pain scores among student nurses.

Sl No.	Location of Pain	Pre-test mean	Pre-test SD	Post-test mean	Post-test SD	Mean Difference	Paired t-value	Df	p-value	Inference
1.	Neck	2.08	1.98	1.35	1.99	0.73	1.67	39	0.10	NS
2.	Shoulder	2.70	2.28	1.88	1.95	0.83	1.00		0.05	NS
3.	Hand	1.90	1.95	1.25	1.84	0.65	1.75		0.09	NS
4.	Wrist	1.05	1.93	0.45	0.96	0.60	1.73		0.09	NS
5.	Upper back	3.33	2.69	1.53	1.99	1.80	4.53		0.00	S*
6.	Lower back	4.70	2.60	2.95	2.72	1.75	3.88		0.00	S*
7.	Ankle	2.35	3.08	1.35	1.67	1.00	1.81		0.08	NS
8.	Foot	3.98	3.07	1.58	2.09	2.40	4.62		0.00	S*

n = 40

“S*” refers to a significant difference at p<0.05 while “NS” refers to a non-significant difference.

The effectiveness of ergonomic training was evaluated by

comparing pre-test and post-test scores across various body regions. Findings revealed a statistically significant reduction in pain in the upper back (MD=1.80, t=4.53, p=0.00), lower back (MD=1.75, t=3.88, p=0.00), and foot (MD=2.40, t=4.62, p=0.00), highlighting the intervention's positive impact on major load-bearing areas. While pain scores in the neck, shoulder, hand, wrist, and ankle decreased, these changes did not reach statistical significance ($p > 0.05$). Consequently, H_1 is partially accepted, stating that there is a statistically significant difference between the mean pre-test and post-test musculoskeletal pain scores among student nurses following ergonomic training as measured using the numerical pain rating scale.

Section III: Correlation between post-test musculoskeletal pain levels and adherence to ergonomics training scores among student nurses.

Table 2: Correlation between post-test musculoskeletal pain levels and adherence to ergonomics training.
n = 40

Sl no.	Category	r – value (Pearson Correlation)	p – value
1.	Neck pain vs Compliance	-0.37*	0.020
2.	Shoulder pain vs Compliance	-0.36*	0.024
3.	Hand pain vs Compliance	-0.47**	0.002
4.	Wrist pain vs Compliance	-0.30	0.057
5.	Upper back pain vs Compliance	-0.15	0.351
6.	Lower back pain vs Compliance	-0.31	0.055
7.	Ankle pain vs Compliance	-0.34*	0.031
8.	Foot pain vs Compliance	-0.39*	0.013

* Significant, ** Highly Significant

Analysis of the relationship between post-test pain intensity and ergonomic training compliance among 40 participants depicted in Table 2 revealed significant negative correlations in the neck ($r = -0.37$, $p = 0.02$), shoulder ($r = -0.36$, $p = 0.02$), hand ($r = -0.47$, $p = 0.00$), ankle ($r = -0.34$, $p = 0.03$), and foot ($r = -0.39$, $p = 0.01$). These findings indicate that higher adherence to ergonomic practices effectively reduced pain levels in these specific regions. While correlations for the wrist, upper back, and lower back were not statistically significant ($p > 0.05$), the negative direction of the coefficients suggested a general trend toward decreased pain with better compliance. Consequently, H_2 is partially accepted, stating that there is a statistically significant correlation between post-test musculoskeletal pain levels and adherence to ergonomic training scores among student nurses as measured using the Numerical Pain Rating Scale [NPRS] and compliance sheet.

Section IV: Association of musculoskeletal pain scores with Sample Characteristics

Chi-square analysis demonstrated that age ($\chi^2 = 4.44$, $df = 1$, $p = 0.04$) course of study ($\chi^2 = 32.73$, $df = 1$, $p = 0.00$), and duration of clinical practice ($\chi^2 = 32.73$, $df = 1$, $p = 0.00$) were significantly associated with musculoskeletal pain scores relative to the median (2.60). Specifically, students who were older (≥ 22 years), in higher semesters (6th Sem and 4th Year), and had longer clinical exposure (>24 weeks) were more likely to report higher pain levels. Conversely, BMI, posture, and regular exercise showed no statistically significant association ($p > 0.05$), suggesting these factors did not influence pain distribution in this sample. Hence, H_3 is partially accepted, indicating that selected characteristics such as age, course of study, and duration of clinical practice have a significant association with musculoskeletal pain levels among student nurses

DISCUSSION

The sample primarily comprised female student nurses (98%) aged 18–20 (55%), with the majority enrolled in the second semester of B.Sc. Nursing (55%). Half of the students fell within a BMI range of 15.0–20.0 kg/m², 98% maintained an erect posture, and 93% did not engage in regular physical exercise. Clinical practice was divided between 24 weeks (55%) and >24 weeks (45%), with 60% performing all clinical tasks. These findings are supported by a 2025 narrative review indicating that age, gender, and BMI (both underweight and overweight) are significant individual risk factors for musculoskeletal disorders, and that a lack of regular exercise as seen in 93% of this sample negatively impacts ergonomic posture and symptom management. (Kolovou et al., 2025)

Overall mean pain scores were highest during the pre-test in the lower back (4.70 ± 2.60) and foot (3.98 ± 3.07). Post-intervention scores showed notable reductions across all areas, particularly the upper back (1.53 ± 1.99), lower back (2.95 ± 2.72), and foot (1.58 ± 2.09). Paired t-tests reached statistical significance ($p < 0.05$) for the upper back (4.53), lower back (3.88), and foot (4.62), leading to the partial acceptance of H_1 . These results mirror earlier intervention research, including a quasi-randomized trial where ergonomic education significantly reduced musculoskeletal disorder prevalence across multiple anatomical sites, including the neck, low back, and hand/wrist. (Abdollahi et al., 2020)

Pearson correlation analysis revealed a significant negative relationship between ergonomic compliance and pain scores in the neck ($r = -0.37$, $p = 0.02$), shoulder ($r = -0.36$, $p = 0.02$), hand ($r = -0.47$, $p = 0.00$), ankle ($r = -0.34$, $p = 0.03$), and foot ($r = -0.39$, $p = 0.01$). This confirms that higher adherence led to lower pain intensity, supporting the partial acceptance of H_2 . These findings align with recent research stating that better ergonomic practices are significantly associated with a lower incidence of musculoskeletal disorders, particularly in the neck and shoulders. (AzizAli & Sreedharan, 2024)

Chi-square analysis indicated that age ($\chi^2 = 4.44$, $df = 1$, $p = 0.04$), course of study ($\chi^2 = 32.73$, $df = 1$, $p = 0.00$), and duration of clinical practice ($\chi^2 = 32.73$, $df = 1$, $p = 0.00$) were significantly associated with pain scores. Students aged ≥ 22 years, those in higher semesters, and those with >24 weeks

of exposure reported higher pain. Conversely, BMI, posture, and regular exercise showed no significant association ($p > 0.05$). These results are consistent with a cross-sectional study on undergraduate nursing students, which found that higher academic years and older age increased pain prevalence, while BMI and physical activity levels had no significant impact. (Kandasamy et al., 2023)

Implications:

- In nursing practice, the consistent application of ergonomic principles, such as proper body mechanics and safe patient transfer techniques, should be prioritized alongside the regular use of assistive devices like mechanical lifts and slide sheets. Implementing scheduled stretching breaks and fostering a culture of teamwork during demanding tasks are essential to reducing physical strain.
- Regarding nursing education, ergonomics should transition from theoretical instruction to a continuous, skill-based curriculum utilizing simulation-based learning and periodic clinical competency assessments.
- Nursing administration must establish institutional safety standards, ensure the availability of adjustable-height equipment and protective footwear, and maintain robust incident reporting systems for monitoring musculoskeletal health.
- Finally, nursing research should expand to larger, longitudinal studies across diverse specialties such as ICU and paediatrics while exploring various instructional strategies and qualitative barriers to long-term ergonomic compliance.

Limitations

- The study's generalizability is limited by a small sample size, a single-institution setting, and the use of convenience sampling.
- Methodologically, the research lacked a control group and a pilot study, while the seven-day follow-up period was insufficient to evaluate long-term impact.
- Subjective bias may have influenced results due to self-reported pain scales and single-shift adherence observations.
- Additionally, the lack of formal ergonomic training for the researchers, the use of multiple data collectors, and uncontrolled variations in clinical workload represent further constraints on the study's precision.

Recommendations

- Future research should utilize larger, more diverse samples and employ randomized controlled trials (RCTs) to establish stronger causal relationships.
- Longitudinal follow-up is recommended to assess the sustained effects of training, alongside comparative studies between student nurses and clinical staff.
- Exploring technology-enhanced methods, such as simulation, virtual reality, or mobile learning, may improve engagement,
- Mixed-methods approaches could provide deeper in-

sights into the qualitative challenges and facilitators of ergonomic practices in real clinical settings.

CONCLUSION

The study successfully evaluated the effect of ergonomic training on student nurses. The main conclusion is that the 60-minute ergonomic training intervention was effective in achieving a statistically significant reduction in musculoskeletal pain, particularly in the upper back, lower back, and foot. Furthermore, adherence to the training principles was significantly correlated with reduced pain in several body regions. The high-risk groups identified were older students and those in higher semesters/longer clinical duration.

These findings strongly advocate for the mandatory and continuous incorporation of skill-based ergonomic training and adherence checks throughout the nursing curriculum to prevent WMSDs and promote long-term occupational health for future nursing professionals.

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How to cite this article:

Blaze Asheetha Maria Rosario et al. (2026). A study to evaluate the effect of ergonomic training on musculoskeletal pain during clinical practice among student nurses in a selected institute, bengaluru. *Int J Recent Sci Res*.17(02), pp.658-663.
