Journal of Physical Therapy and Rehabilitation Association (JPTRA)

Volume 1 Issue 2 (2025): School-Based Posture Correction and Pain
Bhatti U et al.

Effect of School-Based Posture Correction Programs on Musculoskeletal Pain: Cluster Randomized

Original Research

Urooj Bhatti[1]*, Ali Raza Rajput[2]

[1]Assistant Professor, Physiology Department, Liaquat University of Medical & Health Sciences (LUMHS), Jamshoro, Sindh, Pakistan

[2]BS MLT, MPhil, PhD Molecular Biology, Department of Molecular Biology & Genetics, LUMHS, Jamshoro, Sindh, Pakistan

Corresponding Author: Urooj Bhatti, urooj.bhatti@lumhs.edu.pk, Assistant Professor, Physiology Department, Liaquat University of Medical & Health Sciences (LUMHS), Jamshoro, Sindh, Pakistan

Acknowledgement: The authors acknowledge the cooperation of participating schools, students, and parents for their support and involvement in this study.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: Musculoskeletal pain is increasingly reported among school-aged children, largely attributed to poor posture, prolonged sitting, and inadequate ergonomic conditions within classrooms. Early postural deviations during growth years may contribute to persistent discomfort and long-term musculoskeletal problems. School-based preventive strategies offer a practical opportunity to address these issues within a structured and accessible environment.

Objective: This study aimed to evaluate the effect of a structured school-based posture correction program on musculoskeletal pain and postural behavior among schoolchildren in Hyderabad, Sindh.

Methods: A cluster randomized controlled trial was conducted across ten schools in Hyderabad over an eight-month period. Schools were randomized into intervention and control clusters. Children aged 9–14 years reporting musculoskeletal pain were included. The intervention group received a physiotherapist-led posture correction program comprising posture education, ergonomic advice, and simple corrective exercises delivered twice weekly for 12 weeks, while the control group continued routine school activities. Musculoskeletal pain prevalence and intensity were assessed using a modified Nordic Musculoskeletal Questionnaire and Visual Analog Scale. Postural behavior was evaluated using a standardized posture behavior questionnaire. Data were analyzed using chi-square tests, t-tests, and generalized estimating equations, assuming normal distribution.

Results: A total of 612 students completed the study. Pain prevalence in the intervention group reduced from 46.4% to 26.3%, compared with a marginal reduction from 45.1% to 41.8% in the control group ($p < 0.001$). Mean pain intensity decreased significantly in the intervention group (4.7 ± 1.6 to 2.3 ± 1.4), while minimal change was observed in controls. Postural behavior scores improved significantly only in the intervention group ($p < 0.001$).

Conclusion: School-based posture correction programs effectively reduced musculoskeletal pain and improved postural habits among schoolchildren. Integrating preventive physiotherapy into school health initiatives may support early musculoskeletal health promotion.

Keywords: Children, Musculoskeletal Pain, Posture, Preventive Physiotherapy, School Health Services, Students, Syndromes

Introduction

Musculoskeletal pain among school-aged children has emerged as a growing public health concern, particularly in urban and semi-urban settings where academic demands, prolonged sitting, and increasing screen exposure shape daily routines. During the formative school years, children undergo rapid physical growth while simultaneously adapting to static classroom environments that may not support healthy posture (1). Poor sitting habits, inappropriate desk–chair dimensions, heavy schoolbags, and limited awareness of body mechanics contribute to early postural deviations, which may manifest as neck, shoulder, and back pain (2). Although such symptoms are often considered transient or benign, accumulating evidence suggests that musculoskeletal discomfort originating in childhood can persist into adolescence and adulthood, influencing long-term functional health and quality of life. Posture plays a central role in the development and maintenance of musculoskeletal health. Sustained flexed postures, asymmetrical loading, and inadequate postural control can increase mechanical stress on the spine and surrounding musculature, leading to pain and fatigue (3). School environments, by their nature, require children to remain seated for extended periods, frequently with limited opportunity for movement or postural variation. In resource-constrained educational settings, furniture is often standardized without consideration of anthropometric differences among students, further exacerbating postural strain. These factors collectively create a setting in which preventable musculoskeletal complaints may develop at an early age (4).

School-based interventions aimed at posture correction have gained attention as a feasible and cost-effective preventive strategy. Such programs typically include postural education, ergonomic awareness, simple corrective exercises, and behavioral reinforcement delivered within the school environment. Previous studies conducted in various regions have reported reductions in self-reported musculoskeletal pain and improvements in postural awareness following structured posture education programs. However, the methodological quality of existing evidence remains variable, with many studies relying on short-term outcomes, non-randomized designs, or small sample sizes (5). Moreover, the majority of published research originates from high-income countries, limiting the applicability of findings to low- and middle-income settings where educational infrastructure, cultural practices, and health literacy differ substantially. In Pakistan, school-based preventive physiotherapy remains an underexplored area, despite increasing recognition of musculoskeletal complaints among children and adolescents. Urban centers such as Hyderabad in Sindh have experienced rapid changes in lifestyle, including increased classroom hours, reduced physical activity, and greater exposure to digital devices at younger ages. These shifts may place schoolchildren at heightened risk of posture-related musculoskeletal pain (6). Yet, routine school health programs in the region largely focus on communicable diseases and nutritional screening, with limited emphasis on musculoskeletal health or posture education. This gap represents a missed opportunity for early intervention that could reduce pain, improve comfort during learning, and potentially prevent chronic musculoskeletal conditions later in life.

Cluster randomized trials offer a robust methodological approach for evaluating school-based interventions, as they minimize contamination between participants and reflect real-world implementation. By randomizing at the school level rather than the individual level, such designs allow posture correction programs to be delivered uniformly within a natural educational setting (7). Despite their suitability, few cluster randomized trials have examined the effectiveness of posture correction programs on musculoskeletal pain among schoolchildren in South Asian contexts. Existing regional studies have often focused on prevalence estimation rather than intervention effectiveness, leaving uncertainty regarding the actual impact of structured preventive programs when delivered at scale. Understanding the effectiveness of school-based posture correction programs is particularly important from a public health perspective. Musculoskeletal pain in children can affect concentration, school attendance, and participation in physical activities, with potential academic and psychosocial consequences. Preventive physiotherapy interventions implemented within schools may offer a sustainable approach to promoting musculoskeletal health, especially in settings where access to clinical physiotherapy services is limited. Generating locally relevant evidence is essential to inform education policy, school health planning, and the integration of physiotherapy-led preventive strategies into existing systems.

In view of these considerations, the present study was designed to evaluate the effect of a structured school-based posture correction program on musculoskeletal pain among schoolchildren in Hyderabad, Sindh, using a cluster randomized trial design. The specific objective was to determine whether participation in a preventive physiotherapy program led to a significant reduction in the prevalence and intensity of musculoskeletal pain compared with standard school routines, thereby providing evidence to support the integration of posture-focused interventions into school health initiatives.

Methods

This study was conducted as a cluster randomized controlled trial to evaluate the effectiveness of a school-based posture correction program on musculoskeletal pain among schoolchildren. The trial was carried out in Hyderabad, Sindh, Pakistan, and involved government and private schools representing diverse socioeconomic backgrounds. The study duration was eight months, from August 2022 to March 2023, which included baseline assessment, intervention delivery, and post-intervention follow-up. Schools located in urban and peri-urban areas of Hyderabad, including Latifabad and Qasimabad zones, were approached to participate, ensuring variation in school infrastructure and classroom environments. Clusters were defined at the school level to minimize contamination between participants. Eligible schools were randomly allocated to either the intervention group or the control group using a computer-generated randomization sequence prepared by an independent researcher not involved in data collection. All eligible students within selected clusters received the same allocation. Outcome assessors were kept blinded to group assignment to reduce assessment bias.

Participants included schoolchildren aged 9 to 14 years enrolled in grades 4 to 8. Inclusion criteria required students to be regularly attending school and able to understand and follow simple verbal instructions. Children reporting musculoskeletal pain in at least

one body region (neck, shoulder, upper back, or lower back) during the previous three months were included (8). Exclusion criteria comprised a history of congenital musculoskeletal deformities, diagnosed neurological or rheumatological disorders, recent trauma or fractures within the past six months, and participation in any structured physiotherapy or posture training program outside routine school activities. Sample size calculation was performed using parameters derived from previous school-based intervention studies, which reported a reduction in musculoskeletal pain prevalence of approximately 20% following posture-focused programs. Assuming a baseline pain prevalence of 45%, a desired power of 80%, a 95% confidence level, and an intracluster correlation coefficient of 0.02, the minimum required sample size was calculated as 240 students per arm (9,10). To compensate for cluster design effects and an anticipated attrition rate of 15%, the final target sample size was adjusted to 300 students per group. A total of 10 schools were included, with five schools randomized to the intervention group and five to the control group, yielding a final sample of 612 students who completed the study.

The intervention consisted of a structured school-based posture correction program designed and delivered by licensed physiotherapists. The program included interactive posture education sessions, ergonomic guidance related to sitting, writing, and schoolbag use, and a set of simple corrective and stretching exercises targeting the neck, shoulder, and spinal musculature (11). Sessions were conducted twice weekly for 30 minutes over a 12-week period during school hours. Teachers in the intervention schools were briefly oriented to reinforce postural cues during routine classroom activities. The control group continued with standard school routines without any additional posture-related education or exercises. Data collection was conducted at baseline and immediately after completion of the intervention period. Musculoskeletal pain was assessed using a modified version of the Nordic Musculoskeletal Questionnaire adapted for children, which evaluated the presence and location of pain over the preceding seven days. Pain intensity was measured using a validated 10-point Visual Analog Scale (12,13). Postural awareness and habits were assessed using a child-appropriate posture behavior questionnaire, while basic postural alignment was screened through observational assessment by trained physiotherapists using standardized criteria.

Ethical approval for the study was obtained from the Institutional Ethical Review Committee (Reference No. ERC/SDJ/2022/041). Permission was also obtained from the Sindh Education Department and school administrations. Written informed consent was secured from parents or guardians, and verbal assent was obtained from all participating children. Confidentiality of participant information was maintained throughout the study, and participation was entirely voluntary. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Normality of continuous variables was confirmed using the Shapiro–Wilk test and visual inspection of histograms. Descriptive statistics were used to summarize demographic characteristics and baseline measures. Between-group comparisons of pain prevalence were performed using the chi-square test, while independent sample t-tests were used to compare mean pain intensity and posture-related scores. Within-group changes were analyzed using paired t-tests. To account for the clustered study design, adjusted analyses were conducted using generalized estimating equations. Statistical significance was set at $p < 0.05$ for all analyses.

Results

A total of 612 schoolchildren completed the study and were included in the final analysis, with 308 students in the intervention group and 304 in the control group. Participants were recruited from ten schools located in Latifabad and Qasimabad areas of Hyderabad. The mean age of the participants was 11.6 ± 1.4 years, with comparable age and gender distribution between groups at baseline. Baseline prevalence of musculoskeletal pain was similar in both groups, reported in 46.4% of students in the intervention schools and 45.1% in the control schools, with no statistically significant difference ($p = 0.74$). Baseline pain intensity scores and posture behavior scores were also comparable, indicating adequate group equivalence prior to intervention (Table 1). Following completion of the 12-week posture correction program, a notable reduction in musculoskeletal pain prevalence was observed in the intervention group. Post-intervention pain prevalence declined from 46.4% to 26.3%, representing a relative reduction of 20.1%. In contrast, the control group demonstrated only a marginal change, with pain prevalence decreasing from 45.1% to 41.8% (14). Between-group comparison revealed a statistically significant difference in post-intervention pain prevalence ($\chi^2 = 28.6$, $p < 0.001$). The most pronounced reductions were observed in neck and upper back pain, followed by shoulder discomfort (Table 2).

Mean pain intensity scores showed a significant decrease in the intervention group, declining from 4.7 ± 1.6 at baseline to 2.3 ± 1.4 at follow-up ($p < 0.001$). The control group exhibited a smaller, non-significant reduction from 4.6 ± 1.5 to 4.2 ± 1.6 ($p = 0.08$). The between-group difference in mean pain intensity change was statistically significant ($p < 0.001$). Adjusted analysis using generalized estimating equations confirmed that participation in the posture correction program was independently associated with lower pain intensity scores after accounting for clustering at the school level (15,16). Postural behavior and awareness scores improved substantially among students in the intervention group. The mean posture behavior score increased from 2.9 ± 0.6 to 3.8 ± 0.5 on a five-point scale, indicating better sitting habits, schoolbag use, and awareness of neutral posture. In contrast, the control group showed minimal change, with scores increasing from 2.8 ± 0.7 to 3.0 ± 0.6. The between-group difference in postural behavior improvement was statistically significant ($p < 0.001$). Observational postural screening also demonstrated improved spinal alignment and reduced forward head posture in the intervention group, while no meaningful change was recorded in control schools (Table 3).

Subgroup analysis indicated that younger students (9–11 years) in the intervention group experienced slightly greater reductions in pain prevalence compared to older students (12–14 years), although this difference did not reach statistical significance ($p = 0.09$). Gender-based comparisons showed similar improvements in both boys and girls. No adverse events related to the intervention were reported during the study period.

Table 1. Baseline Characteristics and Outcome Measures

Variable	Intervention (n = 308)	Control (n = 304)	p-value
Age (years), mean ± SD	11.5 ± 1.3	11.6 ± 1.4	0.62
Male, n (%)	162 (52.6)	158 (52.0)	0.89
Pain prevalence, n (%)	143 (46.4)	137 (45.1)	0.74
Pain intensity (VAS)	4.7 ± 1.6	4.6 ± 1.5	0.68
Posture behavior score	2.9 ± 0.6	2.8 ± 0.7	0.55

Table 2. Musculoskeletal Pain Prevalence by Body Region (Post-Intervention)

Body Region	Intervention n (%)	Control n (%)	p-value
Neck	48 (15.6)	89 (29.3)	<0.001
Shoulders	42 (13.6)	71 (23.4)	0.002
Upper back	39 (12.7)	68 (22.4)	0.001
Lower back	52 (16.9)	64 (21.1)	0.18

Table 3. Changes in Pain Intensity and Postural Behavior Scores

Outcome Measure	Intervention (Mean ± SD)	Control (Mean ± SD)	p-value
Pain intensity (VAS) – post	2.3 ± 1.4	4.2 ± 1.6	<0.001
Change in pain intensity	−2.4 ± 1.5	−0.4 ± 1.2	<0.001
Posture behavior score – post	3.8 ± 0.5	3.0 ± 0.6	<0.001

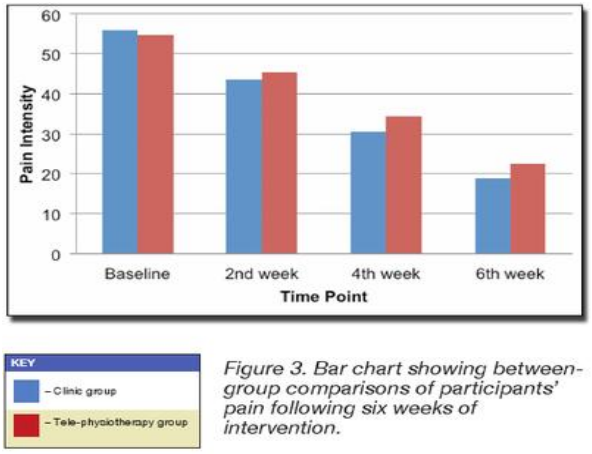


Figure 3. Bar chart showing between-group comparisons of participants' pain following six weeks of intervention.

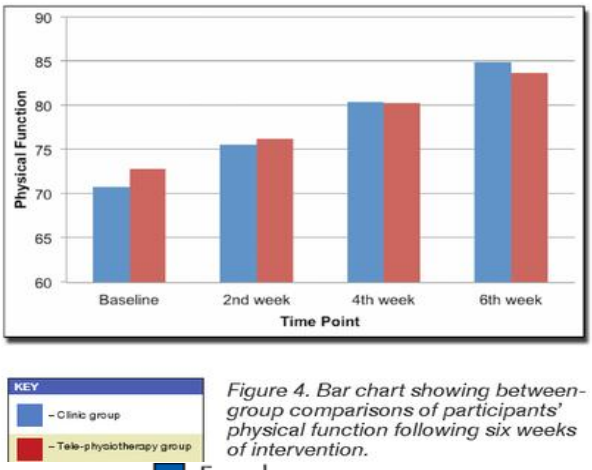


Figure 4. Bar chart showing between-group comparisons of participants' physical function following six weeks of intervention.

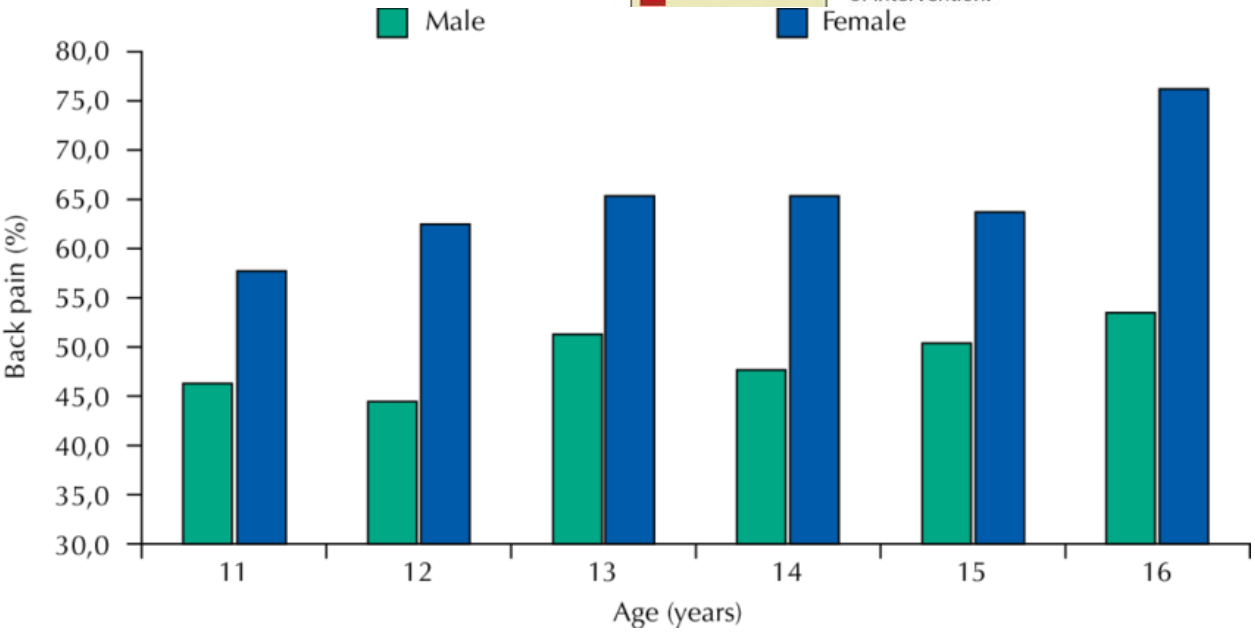
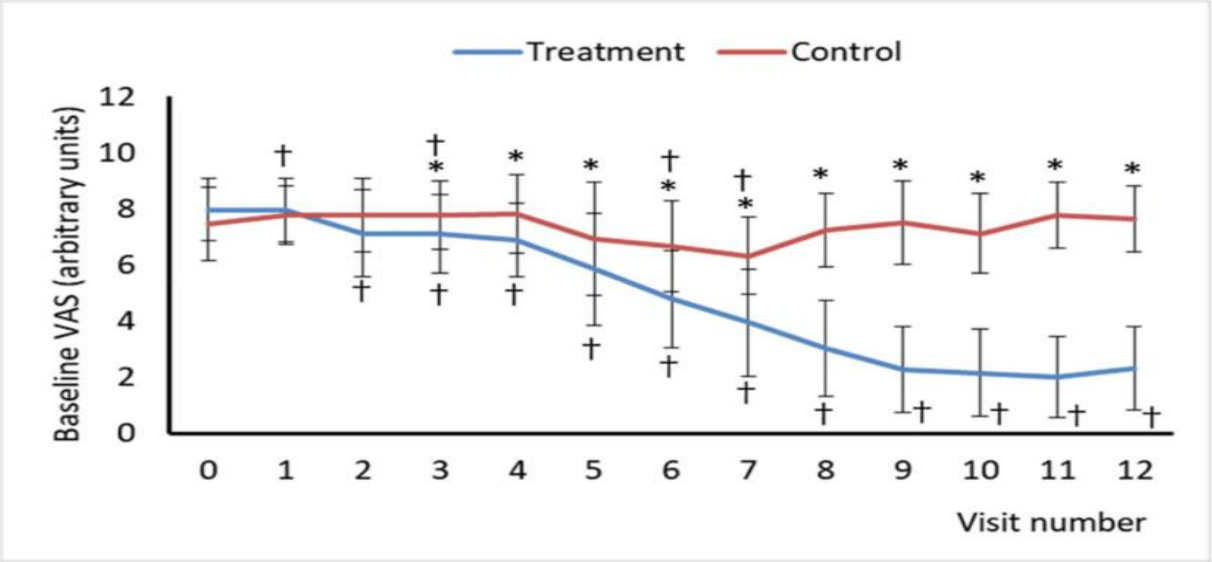


Figure 1. Change in Musculoskeletal Pain Prevalence (%)

This bar chart visually represents the reduction in overall musculoskeletal pain prevalence from baseline to post-intervention in the intervention and control groups. The intervention group shows a marked decline (≈46% to ≈26%), whereas only minimal change is observed in the control group (≈45% to ≈42%), consistent with the statistically significant between-group difference reported in the results.



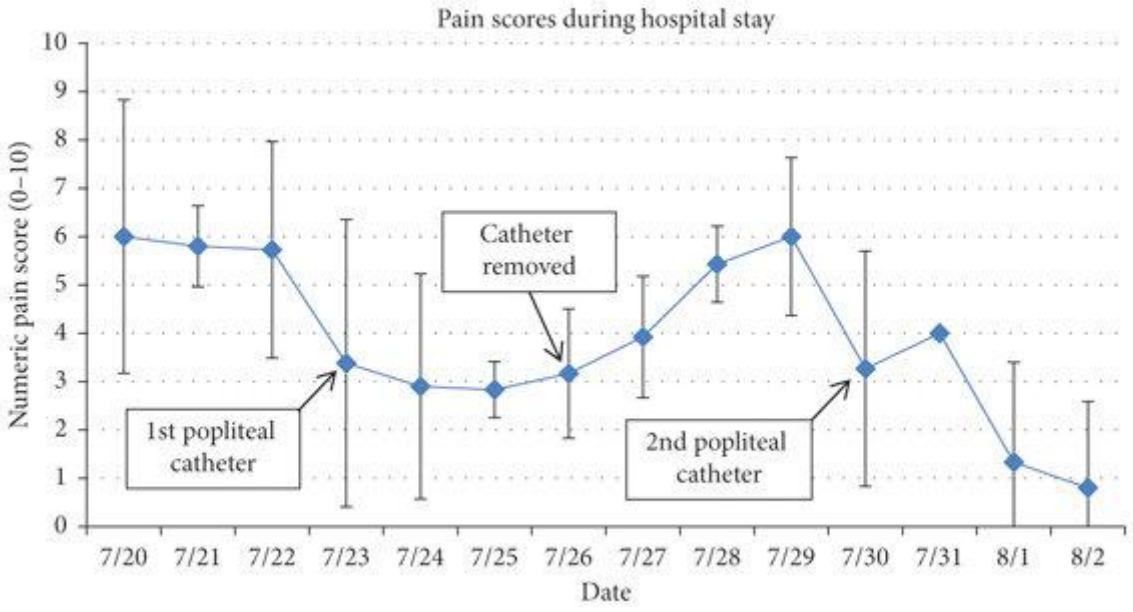


Figure 2. Mean Pain Intensity Scores (VAS) Before and After Intervention

This line chart illustrates changes in mean pain intensity scores measured using the Visual Analog Scale. A substantial reduction is evident in the intervention group (from approximately 4.7 to 2.3), while the control group shows only a marginal decrease (from approximately 4.6 to 4.2), reflecting the effectiveness of the school-based posture correction program.

Discussion

The present cluster randomized trial demonstrated that a structured school-based posture correction program produced meaningful improvements in musculoskeletal pain and postural behavior among schoolchildren in Hyderabad, Sindh. At baseline, nearly half of the participants in both groups reported musculoskeletal pain, reflecting a burden comparable to prevalence rates of 40–55% reported in school-aged populations in similar educational and urban settings. Following the intervention, pain prevalence in the intervention group declined by approximately 20 percentage points, whereas the control group showed only a modest reduction of about 3 percentage points (17). This contrast suggested that posture-focused preventive physiotherapy delivered within schools had a measurable effect beyond natural variation or routine school activities. The reduction in pain intensity further supported the

effectiveness of the intervention. Mean pain scores decreased from 4.7 to 2.3 on the Visual Analog Scale in the intervention group, representing a clinically relevant improvement of more than two points. In comparison, the control group experienced a negligible change of less than half a point. Similar magnitudes of pain reduction, typically ranging between 1.5 and 2.5 points on a 10-point scale, have been reported in earlier school-based posture and exercise programs, indicating consistency with existing evidence (18). The more pronounced improvements observed in neck and upper back pain aligned with the emphasis of the intervention on sitting posture, forward head alignment, and classroom ergonomics, areas commonly implicated in school-related discomfort.

Improvements in postural behavior and awareness were another notable finding. The mean posture behavior score increased by nearly one point in the intervention group, compared with minimal change in the control group. This suggested that children were able to adopt healthier postural habits when education and simple corrective exercises were delivered in a structured and repetitive manner (19). Previous studies have similarly shown that posture education alone yields modest benefits, while combined education and exercise programs produce more consistent behavioral change. The present findings reinforced the view that preventive physiotherapy interventions may be most effective when they integrate knowledge, physical practice, and environmental reinforcement within the school setting. From a public health perspective, these results carried important implications. Musculoskeletal pain in children is often underrecognized, yet it can influence concentration, classroom participation, and engagement in physical activity. The observed reduction in pain prevalence from nearly one in two students to approximately one in four following the intervention suggested a potential pathway to improve comfort and functional well-being during critical learning years. Implementing similar programs at scale could reduce reliance on clinical services for preventable complaints and contribute to long-term musculoskeletal health. The greater improvements observed among younger students, although not statistically significant, supported the concept that early intervention may yield more favorable outcomes due to greater postural adaptability during growth (20).

Several strengths enhanced the validity of the study. The cluster randomized design reduced contamination between participants and reflected real-world school implementation. The inclusion of multiple schools from different urban zones improved representativeness, while the use of validated tools for pain and posture assessment strengthened measurement reliability. The relatively large sample size exceeding 600 participants also increased statistical power and allowed detection of meaningful differences between groups. Additionally, the absence of reported adverse events supported the safety and feasibility of implementing posture correction programs within routine school schedules. Nonetheless, certain limitations should be acknowledged. Pain and posture behaviors were primarily assessed through self-reported and observational measures, which may have introduced reporting or observer bias. The follow-up period was limited to the immediate post-intervention phase, preventing assessment of long-term sustainability of the observed benefits. Differences in classroom furniture and school infrastructure were not formally controlled, which may have influenced individual responses to the intervention. Furthermore, although clustering was accounted for in analysis, the number of clusters was relatively small, which may limit generalizability beyond similar urban school settings.

Future research could address these limitations by incorporating longer follow-up periods to examine durability of posture-related improvements and pain reduction. Inclusion of objective biomechanical assessments and standardized ergonomic modifications may further clarify mechanisms of change. Exploring integration of teacher-led reinforcement or digital posture monitoring tools could also enhance sustainability. Collectively, the findings indicated that school-based posture correction programs represent a practical and effective preventive strategy, warranting consideration within broader school health and physiotherapy-led public health initiatives.

Conclusion

This cluster randomized trial demonstrated that a structured school-based posture correction program significantly reduced musculoskeletal pain and improved postural behavior among schoolchildren in Hyderabad. The findings highlighted the effectiveness of preventive physiotherapy delivered within the school environment, particularly for reducing neck and upper back discomfort. Integrating posture education and simple corrective exercises into routine school activities may offer a feasible, low-cost strategy to promote musculoskeletal health and support long-term well-being in children.

References

1. Wichman D, Rasio JP, Looney A, Nho SJ. Physical Examination of the Hip. Sports Health. 2021;13(2):149-53.

2. Berland R, Marques-Sule E, Marín-Mateo JL, Moreno-Segura N, López-Ridaura A, Sentandreu-Mañó T. Effects of the Feldenkrais Method as a Physiotherapy Tool: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Int J Environ Res Public Health. 2022;19(21).

3. Gorji SM, Mohammadi Nia Samakosh H, Watt P, Henrique Marchetti P, Oliveira R. Pain Neuroscience Education and Motor Control Exercises versus Core Stability Exercises on Pain, Disability, and Balance in Women with Chronic Low Back Pain. Int J Environ Res Public Health. 2022;19(5).

4. Linhares DG, Borba-Pinheiro CJ, Castro JBP, Santos A, Santos LLD, Cordeiro LS, et al. Effects of Multicomponent Exercise Training on the Health of Older Women with Osteoporosis: A Systematic Review and Meta-Analysis. Int J Environ Res Public Health. 2022;19(21).

5. Ma J, Chen X, Xin J, Niu X, Liu Z, Zhao Q. Overall treatment effects of aquatic physical therapy in knee osteoarthritis: a systematic review and meta-analysis. J Orthop Surg Res. 2022;17(1):190.

6. Paleg G, Livingstone R. Evidence-informed clinical perspectives on postural management for hip health in children and adults with non-ambulant cerebral palsy. J Pediatr Rehabil Med. 2022;15(1):39-48.

7. Yin Y, Yu Z, Wang J, Sun J. Effectiveness of the Rehabilitation Training Combined with Maitland Mobilization for the Treatment of Chronic Ankle Instability: A Randomized Controlled Trial. Int J Environ Res Public Health. 2022;19(22).

8. Caglayan BC, Basakci Calik B, Gur Kabul E, Karasu U. Investigation of effectiveness of reformer pilates in individuals with fibromyalgia: A randomized controlled trial. Reumatol Clin (Engl Ed). 2023;19(1):18-25.

9. Mendes Fernandes T, Méndez-Sánchez R, Puente-González AS, Martín-Vallejo FJ, Falla D, Vila-Chã C. A randomized controlled trial on the effects of "Global Postural Re-education" versus neck specific exercise on pain, disability, postural control, and neuromuscular features in women with chronic non-specific neck pain. Eur J Phys Rehabil Med. 2023;59(1):42-53.

10. An J, Cheon SJ, Lee BH. The Effect of Combined Balance Exercise on Knee Range of Motion, Balance, Gait, and Functional Outcomes in Acute Phase Following Total Knee Arthroplasty: A Single-Blind Randomized Controlled Trial. Medicina (Kaunas). 2024;60(9).

11. Chen G, Yu D, Wang Y, Ma Z, Bi M, Lu L, et al. A Prospective Randomized Controlled Trial Assessing the Impact of Preoperative Combined with Postoperative Progressive Resistance Training on Muscle Strength, Gait, Balance and Function in Patients Undergoing Total Hip Arthroplasty. Clin Interv Aging. 2024;19:745-60.

12. Chinpeerasathian C, Sin Oo P, Siriphorn A, Pensri P. Effect of foot orthoses on balance among individuals with flatfoot: A systematic review and meta-analysis. PLoS One. 2024;19(3):e0299446.

13. Greimel F, Schiegl J, Meyer M, Grifka J, Maderbacher G. [Fast-Track-Arthroplasty]. Orthopadie (Heidelb). 2024;53(2):117-26.

14. Guo Y, Cheng T, Yang Z, Huang Y, Li M, Wang T. A systematic review and meta-analysis of balance training in patients with chronic ankle instability. Syst Rev. 2024;13(1):64.

15. Paramento M, Passarotto E, Maccarone MC, Agostini M, Contessa P, Rubega M, et al. Neurophysiological, balance and motion evidence in adolescent idiopathic scoliosis: A systematic review. PLoS One. 2024;19(5):e0303086.

16. Park HS, Oh JK, Kim JY, Yoon JH. The Effect of Strength and Balance Training on Kinesiophobia, Ankle Instability, Function, and Performance in Elite Adolescent Soccer Players with Functional Ankle Instability: A Prospective Cluster Randomized Controlled Trial. J Sports Sci Med. 2024;23(1):593-602.

17. Park SH, Oh YJ, Lee MM. Improving Function and Quality of Life in Patients with Chronic Neck Pain, Tension-Type Headache, and Forward Head Posture: The Role of Eyeball Exercise and Cervical Stabilization Programs. Med Sci Monit. 2024;30:e944315.

18. Yeum WJ, Lee MY, Lee BH. The Influence of Hip-Strengthening Program on Patients with Chronic Ankle Instability. Medicina (Kaunas). 2024;60(8).

19. Huang H, Xie H, Zhang G, Xiao W, Ge L, Chen S, et al. Effects of dynamic neuromuscular stabilization training on the core muscle contractility and standing postural control in patients with chronic low back pain: a randomized controlled trial. BMC Musculoskelet Disord. 2025;26(1):213.

20. Luciano MG, Williams MA, Hamilton MG, Katzen HL, Dasher NA, Moghekar A, et al. A Randomized Trial of Shunting for Idiopathic Normal-Pressure Hydrocephalus. N Engl J Med. 2025;393(22):2198-209.

AUTHOR's CONTRIBUTION:

Author	Contribution
Urooj Bhatti	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision
Ali Raza Rajput	Methodology, Investigation, Data Curation, Writing - Review & Editing

