

Effectiveness of Combined McKenzie Neck and Chin Tuck Exercises for Forward Head Posture: A Randomized Controlled Trial

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Abstract

Background: Forward Head Posture (FHP) is a common postural disorder among adolescents and is associated with prolonged non ergonomic sitting. Students in Islamic boarding schools are particularly vulnerable because daily learning activities involve prolonged floor sitting.

Objective: To evaluate the effectiveness of combined McKenzie Neck Exercise and Chin Tuck Exercise in improving FHP among students.

Methods: A randomized controlled trial with a pretest and posttest control group design was conducted among 38 students with FHP. Participants were allocated to an intervention group (n = 19) or a control group (n = 19). The intervention group performed combined McKenzie Neck Exercise and Chin Tuck Exercise twice weekly for four weeks, while the control group received postural education. FHP was assessed using the Craniovertebral Angle (CVA) measured with the APECS AI Posture Evaluation application. Data were analyzed using the Wilcoxon Signed Rank test and Mann-Whitney U test (p < 0.05).

Results: Mean CVA increased from $45.84 \pm 3.47^\circ$ to $54.37 \pm 2.71^\circ$ in the intervention group (p < 0.001) and from $44.05 \pm 3.95^\circ$ to $44.47 \pm 4.10^\circ$ in the control group (p = 0.002). The mean improvement was significantly greater in the intervention group ($8.53 \pm 2.04^\circ$) than in the control group ($0.42 \pm 0.51^\circ$) (Z = -5.223, p < 0.001).

Conclusion: Combined McKenzie Neck Exercise and Chin Tuck Exercise was more effective than postural education in improving craniovertebral alignment among students with FHP. These findings support the use of combined corrective exercise in school-based physiotherapy programs.

Keywords

Forward Head Posture; Exercise Therapy; Adolescent; Posture; Neck Muscles

Introduction

Forward Head Posture (FHP) is one of the most common postural disorders among adolescents and young adults and is characterized by anterior displacement of the head relative to the trunk, accompanied by upper cervical extension and lower cervical flexion.^{1, 2} This abnormal alignment alters the biomechanical relationship between the cervical spine and surrounding soft tissues, increasing the mechanical load on cervical joints and muscles.³ Clinically, FHP is commonly evaluated using the Craniovertebral Angle (CVA), with a smaller angle indicating greater anterior head displacement.⁴ Recent evidence indicates that the prevalence of FHP has increased considerably due to prolonged sedentary behavior, excessive smartphone use, computer-based learning, and sustained non ergonomic sitting postures.^{5, 6, 7} Persistent FHP has also been associated with neck pain, reduced cervical range of motion, impaired muscle endurance, altered proprioception, and diminished functional performance, making it an important musculoskeletal health concern among adolescents.^{8, 9}

Students attending Islamic boarding schools (pesantren) represent a population at increased risk of developing FHP because most educational and religious activities are performed while sitting on the floor for prolonged periods.¹⁰⁻¹¹ This sitting posture commonly promotes excessive cervical flexion, posterior pelvic tilt, and thoracic kyphosis, which collectively contribute to progressive anterior displacement of the head.^{12, 11} Previous studies conducted in Indonesian boarding schools have reported a high prevalence of musculoskeletal complaints related to prolonged sitting and poor ergonomic conditions, suggesting that preventive and corrective interventions are needed within this educational setting.^{13, 12} Although ergonomic education may increase awareness of proper posture, it is generally insufficient to reverse established postural adaptations without additional therapeutic exercise.^{14, 15}

The pathophysiology of FHP involves both biomechanical and neuromuscular alterations. Continuous anterior positioning of the head results in adaptive shortening of the upper trapezius, levator scapulae, pectoralis major, and sternocleidomastoid muscles, while simultaneously weakening the deep cervical flexor muscles and lower scapular stabilizers.^{8, 16} These muscular imbalances reduce cervical stability, impair postural control, and increase compressive loading on cervical structures.¹⁷ Consequently, individuals with FHP frequently experience chronic neck discomfort, cervicogenic headache, reduced cervical muscle endurance, and impaired functional activities.^{8, 9, 16} Therefore, effective physiotherapy interventions should address both restoration of cervical alignment and improvement of neuromuscular control.

Exercise therapy is considered the primary conservative intervention for correcting FHP because it directly targets the biomechanical and neuromuscular impairments underlying the condition.^{4, 18} McKenzie Neck Exercise aims to restore normal cervical alignment through repeated cervical retraction and extension movements, thereby improving joint mobility and reducing mechanical stress on cervical tissues.^{18, 19} In contrast, Chin Tuck Exercise selectively activates the deep cervical flexor muscles, enhances cervical stability, and improves postural control by reducing excessive activation of superficial cervical musculature.²⁰ Previous studies have demonstrated that each intervention independently improves CVA, cervical muscle function, and postural alignment.^{18, 20, 21, 22, 23} However, evidence regarding the combined application of these interventions remains limited, particularly among adolescent populations with prolonged floor sitting habits.^{21, 24}

To date, most studies have evaluated McKenzie Neck Exercise or Chin Tuck Exercise as separate interventions, whereas evidence investigating their combined effectiveness remains scarce.²⁵ Furthermore, previous studies have primarily involved office workers, university students, or individuals with chronic neck pain, with limited evidence focusing on students attending Islamic boarding schools who are exposed to unique ergonomic demands.¹⁰⁻¹¹ Consequently, it remains unclear whether combining both exercises provides superior correction of FHP in this specific population. Addressing this evidence gap is important for developing evidence-based physiotherapy strategies tailored to educational environments with prolonged floor sitting.

Therefore, this study aimed to evaluate the effectiveness of combined McKenzie Neck Exercise and Chin Tuck Exercise in improving FHP among students at Yambu'ul Qur'an Islamic Boarding School, Kediri. Cervical posture was objectively assessed using the CVA measured with the APECS AI Posture Evaluation application.^{26, 27} The findings are expected to strengthen the evidence supporting combined corrective exercise for FHP and provide practical recommendations for implementing physiotherapy-based postural correction programs in school settings.

Methods

This study employed a true experimental design using a randomized pretest–posttest control group approach to evaluate the effectiveness of combined McKenzie Neck Exercise and Chin Tuck Exercise in improving Forward Head Posture (FHP). The study was conducted at Yambu'ul Qur'an Islamic Boarding School, Kediri, Indonesia, from April 22 to May 20, 2025. Outcome measurements were performed at baseline before the intervention and repeated after completion of the four-week intervention period. The study was reported with reference to the Consolidated Standards of Reporting Trials (CONSORT) 2010 guideline.

The target population comprised students diagnosed with FHP at Yambu'ul Qur'an Islamic Boarding School. A preliminary postural screening identified 70 students with FHP. Participants were recruited using purposive sampling according to predefined eligibility criteria. Sample size was estimated using Federer's formula for experimental studies, which indicated a minimum of 16 participants per group. To anticipate potential attrition during the intervention period, the calculated sample size was increased by approximately 20%, resulting in 19 participants in each group and a total sample of 38 participants. Eligible participants were subsequently allocated into either the intervention group ($n = 19$) or the control group ($n = 19$) through a random allocation procedure.

Participants were eligible if they were active students aged 12–18 years, demonstrated a Craniovertebral Angle (CVA) of $\leq 50^\circ$ indicating FHP, were willing to participate throughout the study period, and agreed to provide informed consent. Participants were excluded if they had congenital or structural cervical deformities, a history of cervical or upper thoracic surgery, severe musculoskeletal or neurological disorders affecting posture, thoracic scoliosis, or any medical condition that prevented safe participation in the exercise program.

The primary outcome was cervical posture measured using the Craniovertebral Angle (CVA). Postural assessment was performed using the APECS AI Posture Evaluation application, a digital posture assessment system that has demonstrated good reliability for evaluating body alignment.^{26, 27} Before image acquisition, reflective anatomical markers were placed on the tragus of the ear and the spinous process of the seventh cervical vertebra (C7). Participants were instructed to perform several gentle cervical flexion and extension movements before assuming their habitual standing posture. Standardized lateral photographs were obtained using a smartphone mounted on a tripod positioned approximately 1.5 m from the participant at shoulder height under identical environmental conditions. The CVA was subsequently measured using the APECS AI application following the standardized assessment procedure.²⁶⁻²⁸

Participants assigned to the intervention group received a combination of McKenzie Neck Exercise and Chin Tuck Exercise for four consecutive weeks with a frequency of two supervised sessions per week. The McKenzie Neck Exercise protocol consisted of cervical retraction, cervical retraction with extension, cervical flexion, and cervical lateral flexion performed in a sitting position. Each movement was completed for three sets of ten repetitions. Chin Tuck Exercise was then performed for five sets of ten repetitions with each contraction maintained for five to ten seconds. The intervention was designed to restore cervical alignment while improving activation and endurance of the deep cervical flexor muscles. Participants allocated to the control group received postural education regarding appropriate sitting posture and ergonomic habits during daily learning activities without additional corrective exercise.

The participant flow from initial screening to final analysis is presented in Figure 1. A total of 70 students with forward head posture were initially screened, of whom 32 were excluded because they did not meet the eligibility criteria. The remaining 38 eligible participants were allocated equally to the intervention group ($n = 19$) and control group ($n = 19$). All participants completed the intervention, with no participants lost to follow-up. Consequently, 19 participants from each group were included in the final analysis.

The study protocol received ethical approval from the Health Research Ethics Committee of the Institute of Technology, Science, and Health RS dr. Soepraoen Malang (Approval No. KEPK-EC/567/IV/2025). All participants voluntarily agreed to participate before enrolment.

Statistical analyses were performed using IBM SPSS Statistics software. Descriptive statistics were used to summarize participant characteristics and outcome measurements. Data normality was evaluated using the Shapiro–Wilk test. Because the outcome data were not normally distributed, within-group comparisons between pretest and posttest CVA measurements were analyzed using the Wilcoxon Signed Rank test, whereas differences between groups were analyzed using the Mann–Whitney U test. Statistical significance was established at $p < 0.05$. All enrolled participants completed the intervention and were included in the final statistical analysis.

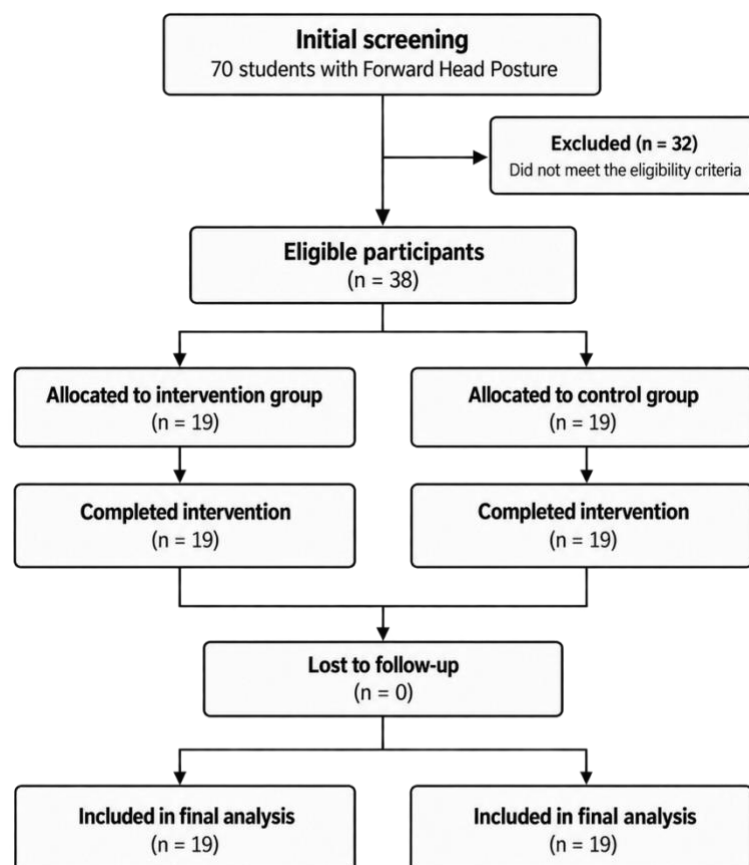


Figure 1. Participant Flow and Group Allocation

Results

A total of 70 students with Forward Head Posture (FHP) were screened for eligibility. After application of the predefined inclusion and exclusion criteria, 38 eligible participants were enrolled in the study and allocated into the intervention group ($n = 19$) and the control group ($n = 19$). All participants completed the four-week intervention and post-intervention assessment. No participants withdrew or were lost to follow-up, resulting in a 100% completion rate. The participant recruitment and follow-up process is summarized in the CONSORT participant flow described in the Methods section.

To describe the study population, baseline demographic characteristics of all participants are presented in Table 1. These data provide an overview of participant age and sex distribution before the intervention.

Table 1. Baseline Characteristics of Participants ($n = 38$)

Variable	Category	n	%
Age (years)	12	6	15.8
	13	8	21.1
	14	5	13.2
	15	10	26.3
	17	6	15.8
	18	3	7.9
Sex	Male	20	52.6
	Female	18	47.4

The participants were predominantly 15 years of age (26.3%), while the sex distribution was relatively balanced, comprising 52.6% males and 47.4% females. Overall, the study population represented adolescents with characteristics appropriate for evaluating the effectiveness of corrective exercise in FHP.

The primary outcome of this study was the change in Craniovertebral Angle (CVA) following the intervention. Within-group comparisons between pretest and posttest measurements are presented in Table 2.

Table 2. Comparison of Pretest and Posttest Craniovertebral Angle Within Each Group

Group	Pretest (Mean $\pm$ SD)	Posttest (Mean $\pm$ SD)	p value
Intervention	45.84 $\pm$ 3.47	54.37 $\pm$ 2.71	<0.001
Control	44.05 $\pm$ 3.95	44.47 $\pm$ 4.10	0.002

Participants who received combined McKenzie Neck Exercise and Chin Tuck Exercise demonstrated a marked increase in mean CVA after the four-week intervention. In contrast, the control group showed only a slight improvement despite achieving statistical significance. The magnitude of change observed in the intervention group was substantially greater than that observed in the control group.

To determine whether the intervention produced greater improvement than postural education alone, changes in CVA between groups were analyzed using the Mann–Whitney U test. The results are presented in Table 3.

Table 3. Between-Group Comparison of Changes in Craniovertebral Angle

Group	n	Mean Change $\pm$ SD	Mean Rank	Z	p value
Intervention	19	8.53 $\pm$ 2.04	28.89		
Control	19	0.42 $\pm$ 0.51	10.11		
Mann–Whitney U test				-5.223	<0.001

SD: Standard deviation.

The intervention group demonstrated a significantly greater improvement in CVA than the control group. Participants receiving combined McKenzie Neck Exercise and Chin Tuck Exercise achieved a mean increase of $8.53 \pm 2.04^\circ$, whereas the control group improved by only $0.42 \pm 0.51^\circ$. The Mann–Whitney U test indicated a statistically significant difference between groups ($Z = -5.223$, $p < 0.001$), indicating that the combined exercise program was associated with greater improvement in cervical alignment than postural education alone.

No participants discontinued the intervention, no adverse events were reported during the study period, and complete outcome data were available for all enrolled participants. Therefore, all 38 participants were included in the final statistical analysis.

Discussion

This study demonstrated that a four-week program combining McKenzie Neck Exercise and Chin Tuck Exercise was more effective than postural education alone in improving Forward Head Posture (FHP) among students at an Islamic boarding school. Participants who received the combined intervention showed greater improvement in Craniovertebral Angle (CVA), indicating more favorable restoration of cervical alignment. These findings support the study objective and suggest that integrating cervical mobility exercises with deep cervical flexor training provides greater postural correction than educational intervention alone.

The improvement observed in the intervention group is consistent with previous studies reporting that McKenzie-based exercises effectively restore cervical sagittal alignment by promoting repeated cervical retraction and extension movements, thereby reducing mechanical stress on cervical structures and improving spinal mobility.^{18, 19, 22, 29} Similarly, Chin Tuck Exercise has been reported to selectively activate the deep cervical flexor muscles, improve cervical stability, and enhance postural control through normalization of neuromuscular function.^{20, 30, 31} The present findings complement these previous reports by demonstrating that combining both interventions may produce greater postural improvement than implementing either strategy in isolation. Although previous investigations have generally evaluated McKenzie Neck Exercise or Chin Tuck Exercise separately, evidence regarding their combined application remains limited, particularly among adolescents in Islamic boarding schools.²¹ Therefore, the present study contributes additional evidence supporting the integration of these complementary exercise approaches in corrective physiotherapy programs.

Several biomechanical and neuromuscular mechanisms may explain the superior outcomes observed in the intervention group. Repeated cervical retraction and extension movements performed during McKenzie Neck Exercise facilitate restoration of physiological cervical lordosis while reducing prolonged mechanical loading on cervical joints, ligaments, and surrounding soft tissues.^{18, 19} At the same time, Chin Tuck Exercise preferentially activates the deep cervical flexor muscles, which play an essential role in maintaining cervical segmental stability and postural control.^{20, 31} Improved activation of these muscles reduces compensatory overactivity of superficial cervical muscles, including the sternocleidomastoid and upper trapezius, thereby improving muscular balance and cervical alignment.³² These complementary mechanisms provide a plausible explanation for the greater improvement in CVA observed following the combined intervention.

Although the control group demonstrated a statistically significant improvement after receiving postural education, the magnitude of change was considerably smaller than that observed in the intervention group. This finding suggests that increasing postural awareness alone may not be sufficient to reverse established musculoskeletal adaptations associated with FHP within a relatively short intervention period.³³ Corrective exercise provides active mechanical loading and neuromuscular stimulation that cannot be achieved through education alone.³⁴ Similar observations have been reported in previous randomized studies showing that structured exercise programs produce greater improvements in cervical alignment than educational interventions.¹⁴ Consequently, postural education should be considered a complementary strategy rather than a substitute for therapeutic exercise when managing FHP.

An important contribution of this study is the inclusion of students from an Islamic boarding school, a population that has received relatively little attention in previous physiotherapy research. Unlike office workers or university students, boarding school students commonly spend prolonged periods sitting on the floor during educational and religious activities, creating unique ergonomic demands that may increase the risk of developing FHP.^{10 - 11} The findings therefore provide evidence that may support the development of school-based physiotherapy programs specifically designed for educational environments characterized by prolonged floor sitting. Nevertheless, caution is required when generalizing these findings to populations with different demographic characteristics, occupational exposures, or habitual postural behaviors.

From a clinical perspective, the combined exercise program offers several practical advantages. Both McKenzie Neck Exercise and Chin Tuck Exercise require minimal equipment, are inexpensive to implement, and can be performed safely within school settings under appropriate supervision.³⁵ Incorporating these exercises into routine physiotherapy services or school health promotion programs may help improve cervical alignment and potentially reduce the long-term risk of musculoskeletal disorders associated with sustained poor posture.³⁶

The present study has several limitations that should be acknowledged. First, participants were recruited from a single Islamic boarding school using a relatively small sample, which may limit the generalizability of the findings. Second, the intervention period was limited to four weeks; therefore, the long-term sustainability of postural improvement could not be determined. Third, the study focused exclusively on changes in CVA and did not evaluate additional clinical outcomes such as neck pain intensity, cervical muscle endurance, functional disability, or quality of life. Future studies involving larger multicenter populations, longer follow-up periods, and broader clinical outcome measures are recommended to further clarify the effectiveness and long-term benefits of combined corrective exercise for individuals with FHP.¹⁵

Conclusion

The present study demonstrated that a four-week program combining McKenzie Neck Exercise and Chin Tuck Exercise was more effective than postural education alone in improving Forward Head Posture among students at Yambu'ul Qur'an Islamic Boarding School. Participants receiving the combined exercise program achieved greater improvement in Craniovertebral Angle, indicating better restoration of cervical alignment following the intervention.

These findings suggest that combining cervical mobility exercises with deep cervical flexor strengthening represents an effective physiotherapy approach for correcting FHP in adolescents. Because the intervention is simple, inexpensive, and requires minimal equipment, it may be incorporated into school-based physiotherapy services and health promotion programs to reduce the risk of posture-related musculoskeletal disorders associated with prolonged floor sitting.

The findings should be interpreted within the context of the study limitations, particularly the relatively small sample size, the single-center setting, and the short intervention period. Future studies involving larger multicenter populations, longer follow-up periods, and additional clinical outcome measures are recommended to further evaluate the long-term effectiveness and clinical applicability of combined corrective exercise for individuals with FHP.

Author Contribution

Tiara Putri Kusuma Wardani: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing Original Draft.
Dwi Agung Prasetyo: Conceptualization, Methodology, Validation, Supervision, Writing Review and Editing.
Angria Pradita: Data Curation, Writing Review and Editing.
Sartoyo: Writing Review and Editing, Supervision.
Mohammad Asy'ari: Project Administration, Resources.
Muhamad Khozine: Project Administration, Resources.

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Conflict of Interest Statement

The authors declare that there are no financial, professional, or personal relationships that could have influenced the work reported in this manuscript. No competing interests exist.

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Ethics Statement

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Health Research Ethics Committee of Institut Teknologi, Sains, dan Kesehatan RS dr. Soepraoen Kesdam V/BRW, Malang, Indonesia (Approval No. KEPK-EC/567/IV/2026). Written informed consent was obtained from all participants prior to enrolment. For participants younger than 18 years of age, informed consent was also obtained from their parents or legal guardians before participation.

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