

## THE EFFECTIVENESS OF KENDALL EXERCISE VERSUS SCAPULAR STABILIZATION EXERCISE PROGRAM ON PAIN, NECK ALIGNMENT AND FUNCTIONAL ACTIVITIES IN SUBJECTS WITH FORWARD HEAD POSTURE: A COMPARATIVE STUDY

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### ABSTRACT

**Background:** Forward Head Posture (FHP) is a common postural deformity characterized by anterior displacement of the head relative to the body's center of gravity, often resulting from prolonged poor posture, excessive screen use, and muscular imbalances. This misalignment increases cervical loading, leading to pain, restricted motion, and reduced functional ability. Physiotherapeutic interventions such as the Kendall Exercise Program and Scapular Stabilization Exercises (SSE) are widely used to restore postural balance and reduce neck discomfort.

**Objective:** The study aimed to compare the effectiveness of Kendall Exercises and Scapular Stabilization Exercises in improving cervical alignment, reducing pain, and enhancing functional performance among individuals with Forward Head Posture.

**Methods:** A comparative experimental study was conducted on 34 participants aged 20–45 years diagnosed with FHP. Participants were randomly assigned into two groups: Group A (Kendall Exercises, n = 17) and Group B (SSE, n = 17). Both groups received conventional physiotherapy along with their respective exercise interventions three times per week for four weeks. Outcome measures included the Numerical Pain Rating Scale (NPRS), Craniovertebral Angle (CVA), and Neck Disability Index (NDI). Pre- and post-intervention data were analyzed using paired and unpaired t-tests with a significance level set at  $p < 0.05$ .

**Results:** Both groups showed statistically significant improvements in all outcome measures ( $p = 0.001$ ). Between-group analysis revealed that the Kendall group demonstrated greater improvement in CVA ( $p = 0.02$ ) and pain reduction ( $p = 0.026$ ), while NDI improvement was not significantly different between groups ( $p = 0.073$ ).

**Conclusion:** Both exercise programs effectively improved posture, reduced pain, and enhanced functional ability in individuals with FHP. However, Kendall Exercises proved more effective in restoring cervical alignment and reducing pain, suggesting their superiority for targeted correction of Forward Head Posture.

**Keywords:** Forward Head Posture, Kendall Exercise, Scapular Stabilization Exercise, Neck Pain, Postural Correction, Craniovertebral Angle

## INTRODUCTION

Forward Head Posture (FHP) refers to the condition where the head is positioned forward in relation to the body's centre of gravity when viewed from the side, specifically in the sagittal plane.<sup>1</sup> In this posture, the head shifts anteriorly, moving away from its optimal alignment over the spine. This alteration in head position commonly develops gradually as a result of consistently poor postural habits maintained over an extended period.<sup>2</sup> FHP is characterized by distinctive movement patterns in the cervical spine, with increased flexion in the lower cervical vertebrae (C3–C7) and excessive extension in the upper cervical vertebrae (C1–C2). This biomechanical misalignment produces postural imbalance, resulting in anterior displacement of the head. Such a deviation is often accompanied by muscular weakness in the deep cervical flexors and overactivity in the posterior neck musculature, leading to pain, stiffness, and compensatory strain on the spine, shoulders, and thoracic regions.<sup>3</sup>

One of the primary causes of FHP is prolonged poor posture, particularly prevalent in modern lifestyles involving extended screen time, desk work, and mobile device usage. These repetitive habits lead to adaptive muscular imbalances in which anterior muscles, such as the pectoralis major and sternocleidomastoid, become tight and shortened, while posterior muscles, including the upper trapezius and cervical extensors, become weakened and elongated.<sup>4</sup> The resulting imbalance reinforces forward displacement of the head. Weakness of the deep cervical flexors, namely the longus colli and longus capitis, further impairs the ability to maintain neutral alignment, forcing compensatory overactivity of the upper cervical extensors to stabilize the head. Increased thoracic kyphosis contributes additionally by displacing the shoulders and head forward, placing greater mechanical load on the cervical spine.<sup>5</sup>

Weak scapular stabilizers such as the rhomboids, serratus anterior, and lower trapezius exacerbate FHP by allowing the shoulder blades to protract, disrupting normal scapulohumeral rhythm.<sup>6</sup> Technological and occupational factors poor workstation ergonomics, low monitor positioning, and habitual smartphone use further encourage sustained cervical flexion, particularly among younger individuals.<sup>7</sup> Age-related degeneration, muscular atrophy, and reduced postural control also increase vulnerability to FHP.<sup>8</sup> Moreover, injuries such as whiplash, psychological stress, and sedentary behaviour contribute to chronic muscular tension, altered proprioception, and further postural deviation.

FHP often coexists with rounded shoulders, where the scapulae abduct and tilt anteriorly, and the humeral heads shift forward.<sup>6</sup> This pattern tightens the pectoralis major and minor while lengthening and weakening the rhomboids, middle and lower trapezius, and serratus anterior. These imbalances increase the mechanical

load on the cervicothoracic junction and upper back muscles, potentially leading to shoulder impingement, thoracic outlet syndrome, and even respiratory dysfunction due to restricted rib cage mobility.<sup>9</sup> Effective correction thus requires stretching shortened anterior muscles, strengthening posterior stabilizers, and integrating ergonomic education and functional retraining to achieve lasting postural realignment.<sup>1</sup>

In neutral head posture, the head aligns vertically over the acromion with balanced muscular support between anterior and posterior neck musculature. The cervical spine's natural lordotic curve allows efficient load distribution and minimal strain.<sup>10</sup> However, even slight anterior deviation dramatically increases cervical loading each inch of forward displacement adds approximately 10 pounds (4.5 kg) of mechanical stress—causing overuse of posterior cervical muscles and compression of discs and joints.<sup>8</sup> Such abnormal mechanics disrupt proprioception, impair neuromuscular control, and predispose to pain, headaches, temporomandibular dysfunction, and even reduced respiratory efficiency.<sup>6-8</sup>

Epidemiological studies report that FHP is increasingly prevalent among adults aged 20–45 years, largely due to sedentary lifestyles and excessive electronic device use. Prevalence rates of up to 66–77% have been reported among university students, with a higher incidence among females, possibly due to differences in muscle strength and postural control. Recent global data indicate that nearly 75% of the population spends most of their time using high-technology devices, further exacerbating postural strain.<sup>11,12</sup> The condition manifests through various symptoms, including neck and shoulder pain, cervicogenic headaches, restricted cervical motion, and sensory disturbances such as numbness or tingling in the upper limbs due to neural compression. Prolonged muscular strain also leads to chronic fatigue, poor concentration, and impaired respiratory mechanics, ultimately reducing functional capacity and quality of life.<sup>12</sup>

Physiotherapy plays a vital role in managing and correcting FHP by addressing muscular imbalance, joint stiffness, and postural dysfunction.<sup>8,9</sup> Interventions typically involve stretching of tight anterior muscles (pectorals, sternocleidomastoid, upper trapezius, levator scapulae) and strengthening of weakened posterior muscles (deep cervical flexors, rhomboids, and thoracic extensors). Postural training, ergonomic modification, manual therapy, and proprioceptive re-education form essential components of treatment to restore alignment and improve function.<sup>7</sup>

Among physiotherapeutic interventions, two prominent exercise-based programs the Kendall exercise program and Scapular Stabilization Exercises (SSE) have demonstrated efficacy in correcting FHP. The Kendall program, derived from the postural correction principles of Florence and Henry Kendall, emphasizes strengthening of the deep cervical flexors (longus colli and longus capitis) and scapular retractors (rhomboids, lower trapezius) while stretching tight anterior structures such as the pectoralis and upper trapezius.<sup>13</sup> This approach restores vertebral alignment, muscular balance, and postural control, reducing pain and fatigue and improving cervical mobility.

Scapular Stabilization Exercises, by contrast, focus on the coordinated activation of the middle and lower trapezius, rhomboids, and serratus anterior to enhance scapular positioning and shoulder girdle stability. Strengthening these muscles supports thoracic extension, promotes upright posture, and indirectly improves cervical alignment by reducing compensatory strain on the neck.<sup>14</sup> Together, these exercises enhance functional movement efficiency and mitigate the musculoskeletal stress associated with FHP.

Therefore, the present study aims to compare the effectiveness of the Kendall Exercise Program and Scapular Stabilization Exercises in improving posture, reducing neck pain, and enhancing cervical function among individuals with Forward Head Posture. While both approaches have proven beneficial independently, direct comparative evidence remains limited. This investigation seeks to identify which protocol offers greater efficacy in postural correction and functional recovery, thereby guiding physiotherapy practice in the evidence-based management of Forward Head Posture.

## METHODOLOGY

**Study Design:** This study was designed as a comparative experimental study aimed at evaluating and comparing the effectiveness of Kendall Exercises and Scapular Stabilization Exercises (SSE) on pain, posture, and neck disability among young adults with Forward Head Posture (FHP).

**Population:** The study population consisted of young adults aged 20–45 years who presented with nonspecific neck pain and postural abnormalities consistent with FHP.

**Duration of Study:** The total duration of the study was one year, which included participant recruitment, baseline assessment, intervention, and post-intervention evaluation.

**Sample Size:** total of 34 participants were selected and randomly divided into two equal groups — Group A (Kendall Exercise group, n=17) and Group B (Scapular Stabilization Exercise group, n=17).

**Sampling Design:** Participants were selected using a simple random sampling method.

**Treatment Duration:** Each participant underwent their respective exercise program three days per week for four weeks.

**Materials:** Assessment form, consent form, stationery, universal goniometer, chair, Theraband, and plinth were used during the study.

**Selection Criteria:** Participants included in the study were young adults aged between 20 and 45 years, comprising both male and female individuals. Eligible participants had a pain rating of more than 3 on the Numeric Pain Rating Scale (NPRS), a craniovertebral angle of 50 degrees or less, and a history of nonspecific neck pain for less than three months. Only those who were willing to participate and provided written informed

consent were enrolled in the study. Individuals were excluded if they had cervical radiculopathy, a history of temporomandibular joint (TMJ) surgery, cervical or shoulder neurological movement disorders, or any active infection or inflammatory arthritis. Participants with a history of cervical nerve root injection, recent injury or surgery involving the cervical spine, diagnosed cervical spondylosis, or ankylosing spondylitis were also excluded from the study.

## Outcome Measures

**1. Numerical Pain Rating Scale (NPRS):** The NPRS is an 11-point self-reported scale ranging from 0 (“no pain”) to 10 (“worst imaginable pain”) used to assess pain intensity. It can be administered verbally, in writing, or digitally, requiring minimal training. It demonstrates excellent test–retest reliability (ICC: 0.86–0.95) and overall reliability  $>0.95$ , making it a sensitive and valid measure for detecting pain changes and evaluating therapeutic outcomes.

**2. Craniovertebral Angle (CVA):** The CVA is a standard measure of forward head posture, defined by the angle between a horizontal line through the C7 spinous process and a line connecting C7 to the tragus of the ear. A CVA less than  $48^{\circ}$ – $50^{\circ}$  indicates forward head posture. Measurements were taken using a modified universal goniometer with participants in a natural standing position. The CVA is a highly reliable and valid tool (ICC: 0.879–0.991) for assessing postural alignment.

**3. Neck Disability Index (NDI):** The NDI is a ten-item questionnaire evaluating neck pain-related disability. It covers both subjective symptoms (pain intensity, headaches, sleep, concentration) and functional activities (lifting, work, driving, recreation, reading). Each item is scored from 0 (no disability) to 5 (complete disability), yielding a total score of 0–50. Disability levels were classified based on the total score obtained, where a score of 0–4 indicated no disability, 5–14 represented mild disability, 15–24 indicated moderate disability, 25–34 corresponded to severe disability, and a score of 35 or above denoted complete disability. The NDI demonstrates high internal consistency ( $\alpha = 0.93$ ) and test–retest reliability (ICC: 0.30–0.90).

**Procedure:** Ethical approval was obtained before initiating the study. Eligible participants were screened as per inclusion and exclusion criteria, and written informed consent was secured. Baseline assessments were conducted for all participants using NPRS, CVA, and NDI. Participants were then randomly assigned to one of two groups: Group A: Kendall Exercise Program ( $n=17$ ), Group B: Scapular Stabilization Exercise Program ( $n=17$ ). Both groups received conventional physiotherapy, including cervical isometric exercises and application of a hot pack, alongside their respective exercise interventions performed three times per week for four weeks. post-intervention assessments were conducted using the same outcome measures.

## Intervention:

### Group A: Kendall Exercise Training Group<sup>13</sup>



Duration: 4 weeks (3 sessions per week)

- Stretching of Cervical Extensors – Sitting with head flexed forward, hands on the occiput, maintaining the position for 30 seconds; 3 repetitions.
- Strengthening of Deep Cervical Flexors – Supine position, chin tucked, head lifted slightly for 2–8 seconds; 12 repetitions.
- Shoulder Retraction Strengthening – Standing with a Theraband, pulling the band backward, holding for 2–8 seconds; 12 repetitions.
- Stretching of Pectoralis Muscle – Hands placed on occiput, arms abducted and externally rotated; hold for 30 seconds, 3 repetitions.

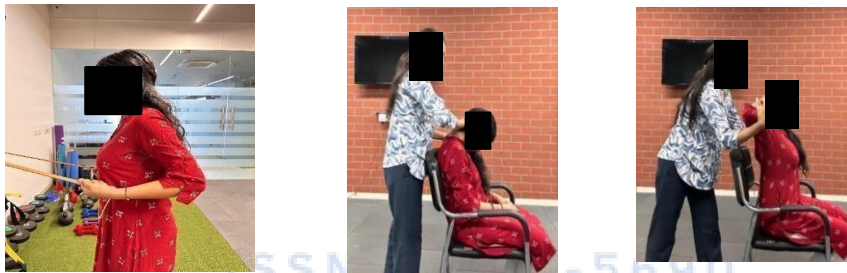


Figure 1: Kendall exercises

#### Group B: Scapular Stabilization Exercise Program<sup>14</sup>

Duration: 4 weeks (3 sessions per week, 2 sets of 8 repetitions)

1. Shoulder Shrugs – Elevate shoulders toward ears, relax, and repeat.
2. Push-Up Plus – Standing against wall, push trunk away, then protract scapulae.
3. Upright Press-Ups – Sitting, press hands on chair arms to lift body, emphasizing scapular depression.
4. Shoulder Blade Squeeze – Prone, shoulders at 90°, elbows flexed, squeeze scapulae for 10 seconds.
5. Elevation of Arm Above Head – Prone, lift hands, head, and shoulders together; hold 10 seconds.



Figure 2: Scapular Stabilization Exercise Program

## RESULTS

The collected data were analyzed using IBM SPSS Statistics version 25.0. Descriptive statistics, including mean and standard deviation, were calculated for all continuous variables. The Shapiro–Wilk test was applied to assess the normality of data distribution. To ensure baseline comparability between groups, the Chi-square test was used for categorical variables such as gender, while the independent t-test was applied for comparing

baseline continuous variables. For within-group comparisons of pre- and post-intervention values, the paired t-test was used to evaluate the effectiveness of each intervention program. Between-group comparisons of post-intervention outcomes were performed using the unpaired (independent) t-test. A p-value less than 0.05 was considered statistically significant for all tests.

**Table 1: Demographic Data of Participants (N = 34)**

Parameter	Group A (n=17)	Group B (n=17)	Chi-square Test	p-value
Age (years)	30.76 ± 5.57	31.35 ± 6.99	0.2456	0.489
Gender (Male/Female)	8 / 9	7 / 10	0.1587	0.6903

Table 1 presents the demographic characteristics of the study participants. The mean age of participants in Group A was 30.76 ± 5.57 years, while Group B had a mean age of 31.35 ± 6.99 years, with no statistically significant difference (p = 0.489). Gender distribution was also comparable, with Group A comprising 8 males and 9 females, and Group B having 7 males and 10 females (p = 0.6903). This indicates that both groups were well matched for demographic variables at baseline.

**Table 2: Comparison of Outcome Measures Between Group A and Group B**

Outcome Measure	Group A (Mean ± SD)	Group B (Mean ± SD)	Between group analysis	Significance
Craniovertebral Angle (°) – Pre	45.58 ± 2.47	45.82 ± 2.40	0.7486	Not significant
Craniovertebral Angle (°) – Post	52.23 ± 1.78	50.52 ± 1.17	0.02	Significant
<b>Within-group Analysis (p-value)</b>	0.001	0.001	—	Extremely significant
Numeric Pain Rating Scale – Pre	6.35 ± 1.11	6.47 ± 1.88	0.7721	Not significant
Numeric Pain Rating Scale – Post	2.70 ± 1.10	3.88 ± 0.92	0.026	Significant
<b>Within-group Analysis (p-value)</b>	0.001	0.001	—	Extremely significant
Neck Disability Index – Pre	24.35 ± 3.58	24.70 ± 3.83	0.7849	Not significant
Neck Disability Index – Post	12.35 ± 3.42	15.35 ± 4.31	0.073	Not significant
<b>Within-group Analysis (p-value)</b>	0.001	0.001	—	Extremely significant

Table 2 summarizes the comparison of clinical outcome measures between the two groups. Both Group A (Kendall Exercise Training) and Group B (Scapular Stabilization Exercise Program) showed significant within-group improvements ( $p = 0.001$ ) in craniovertebral angle, Numeric Pain Rating Scale (NPRS), and Neck Disability Index (NDI). Between-group analysis revealed that Group A demonstrated greater improvement in craniovertebral angle ( $p = 0.02$ ) and pain reduction ( $p = 0.026$ ) compared to Group B. Although post-treatment NDI scores favored Group A, the difference did not reach statistical significance ( $p = 0.073$ ). These findings indicate that both interventions were effective, with Kendall Exercise Training showing slightly superior outcomes.

Figure 1: Demographic Data

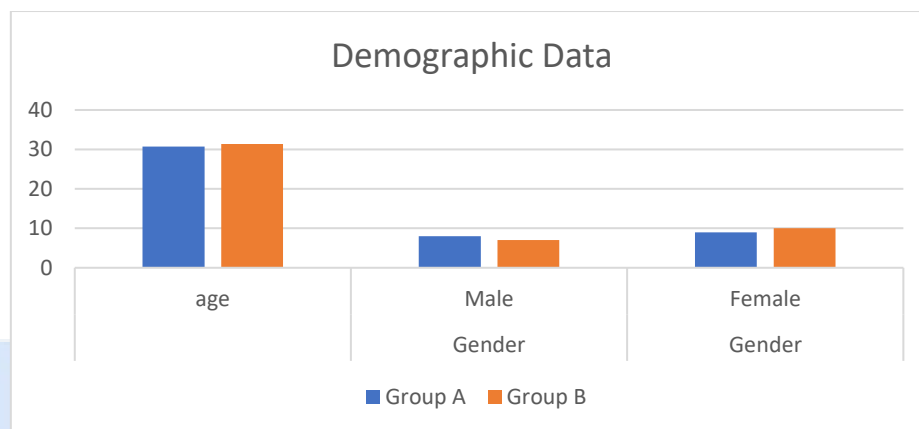
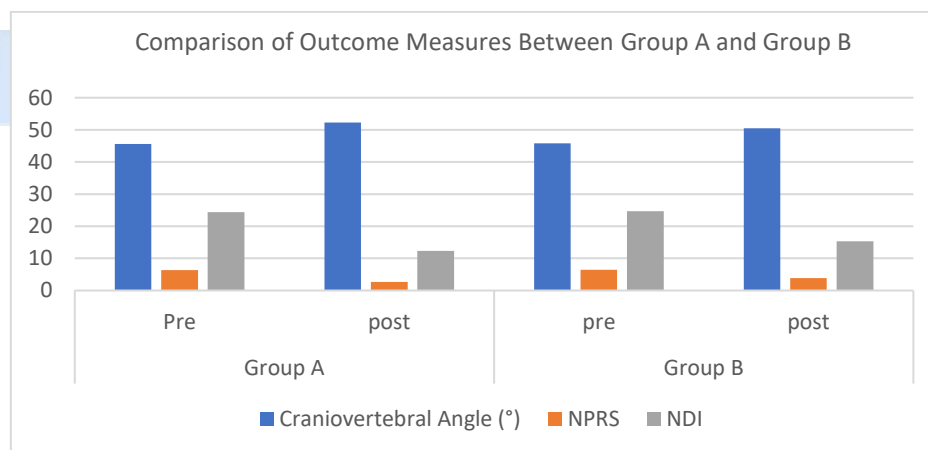


Figure 2: Comparison Of outcome measures between group A and group B



## DISCUSSION

The findings of the present study revealed that both the Kendall Exercise Program (Group A) and the Scapular Stabilization Exercise Program (Group B) were effective in improving symptoms of Forward Head Posture (FHP), including pain reduction, improved craniovertebral angle (CVA), and enhanced functional abilities. However, Group A, which underwent the Kendall exercise protocol, demonstrated greater improvements in CVA and pain intensity on the Numeric Pain Rating Scale (NPRS) compared to Group B. Although both interventions led to significant decreases in Neck Disability Index (NDI) scores, the difference between the two groups was not statistically significant, suggesting that both exercise programs effectively improved



functional activity in individuals with FHP. These findings emphasize that structured exercise interventions targeting cervical and scapular muscle groups play a vital role in postural correction and pain management.

The results of the current study are consistent with the findings of **Leong et al. (2020)**<sup>15</sup>, who reported that the Kendall exercise program significantly improved cervical range of motion (CROM) and reduced neck pain in individuals with postural dysfunctions. Similarly, **Akuthota and Nadler (2004)**<sup>16</sup> highlighted that deep cervical flexor strengthening exercises improved postural control and reduced the severity of FHP, supporting our finding that the Kendall exercise protocol effectively enhances cervical alignment and reduces pain. **Yoo et al. (2015)**<sup>17</sup> also observed that participants with FHP who followed the Kendall exercise regimen exhibited significant improvements in cervical alignment and pain relief, aligning with the outcomes of our study. In addition, **Kuru et al. (2018)**<sup>18</sup> found that a combination of cervical and scapular stabilization exercises improved both neck pain and postural alignment among office workers, further reinforcing that both the Kendall and scapular stabilization approaches contribute to symptom relief in FHP.

The superior results observed in the Kendall group may be attributed to the direct focus of these exercises on the deep cervical flexors and extensors, which are essential for maintaining cervical spine stability and alignment. The program also includes stretching of the tight pectoral and cervical extensor muscles and strengthening of the weak deep flexors, thus correcting the muscle imbalance commonly associated with FHP. This approach helps restore the normal curvature of the cervical spine and reestablishes postural equilibrium, thereby reducing strain on the surrounding musculature and alleviating pain. The improvement in CVA observed in the Kendall group indicates enhanced postural control and alignment, which can be linked to better neuromuscular coordination and proprioceptive feedback mechanisms.

In contrast, the Scapular Stabilization Exercise (SSE) program primarily targets the scapulothoracic muscles, including the middle and lower trapezius and serratus anterior. These muscles are responsible for maintaining proper scapular alignment, which indirectly affects cervical posture. The current study found that while SSEs effectively reduced neck pain and improved CVA, the magnitude of improvement was comparatively lower than that seen with the Kendall exercises. This observation aligns with **Mohamed Elgendy (2024)**<sup>19</sup>, who demonstrated that incorporating scapular stabilization exercises with postural correction significantly enhanced craniovertebral angle and scapular positioning in FHP patients. Similarly, **Kang (2022)**<sup>20</sup> found that SSEs combined with thoracic extension exercises improved cervical posture and respiratory function, emphasizing the role of the scapula-thoracic relationship in maintaining overall postural stability.

The underlying mechanism explaining these improvements is the reduction of excessive upper trapezius activation and enhancement of lower trapezius and serratus anterior strength, leading to better scapular positioning and reduced cervical load. Studies by **Imamura et al. (2020)**<sup>21</sup> and **Jeong et al. (2016)**<sup>22</sup> also reported significant reductions in neck pain and disability scores after SSE intervention, corroborating the findings of this research. Furthermore, **Harman et al. (2005)**<sup>23</sup> and **Takasaki et al. (2021)**<sup>24</sup> established that

improved scapular mechanics alleviate cervical stress and improve posture by restoring muscle balance in the upper quadrant, reinforcing the clinical importance of scapular stabilization in FHP rehabilitation.

Despite the positive outcomes, the comparatively greater improvement in the Kendall exercise group suggests that direct activation of deep cervical flexors may have a more immediate and profound effect on correcting FHP. This is supported by **Lee et al. (2021)<sup>25</sup>**, who concluded that a structured Kendall exercise regimen led to significant enhancements in craniovertebral angle and pain reduction in young adults with FHP. Therefore, exercises focusing on cervical alignment may yield faster and more targeted improvements than those focusing solely on scapular stabilization.

Clinically, these findings highlight the importance of integrating cervical strengthening and scapular stabilization exercises in postural rehabilitation programs. While Kendall exercises primarily address cervical alignment through targeted muscle activation, SSEs complement this by stabilizing the scapula and reducing compensatory muscle overactivity. A combined approach may therefore produce optimal outcomes in patients with FHP.

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The present study has some limitations, including a relatively small sample size and a short intervention duration of four weeks, which may limit the generalizability of findings. Future research should consider larger sample sizes, longer follow-up periods, and the inclusion of additional outcome measures, such as electromyographic analysis, to assess muscle activation patterns during postural correction.

## CONCLUSION

The findings of this study demonstrate that both Kendall exercises and scapular stabilization exercises are effective in the rehabilitation of Forward Head Posture by enhancing muscular balance, improving postural alignment, and reducing associated discomfort. However, Kendall exercises proved to be significantly more effective, particularly in improving craniovertebral angle, alleviating pain. This can be attributed to their focused activation and strengthening of deep cervical flexors and key postural muscles. While scapular stabilization exercises contribute meaningfully to scapular mechanics and upper thoracic posture, they may not address cervical impairments with the same specificity. Therefore, Kendall exercises should be considered a more targeted and effective intervention for individuals presenting with Forward Head Posture.

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