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**Protocol**

# Comparative effectiveness of posture correction exercises versus postural awareness on forward head posture, protruded shoulder and thoracic kyphosis in 13-15 year old smartphone users: a randomized controlled trial intervention protocol

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## ABSTRACT

**Background:** Rise in smartphone use among high school students aged 13-15 has leads to musculoskeletal issues like forward head posture (FHP), protruded shoulders, and thoracic kyphosis. To prevent these problems, it's essential to teach students proper posture exercises and raise their awareness about maintaining good posture. Primary objective of this study is to determine the efficacy of posture correction exercises and postural awareness techniques on FHP, protruded shoulder, and thoracic kyphosis.

**Methods:** This randomized clinical trial will assess the impact of an intervention on FHP, protruded shoulders, and thoracic kyphosis in 170 smartphone addicted participants who will be randomly allocated to control and interventional group. Smartphone addiction will be measured using the smartphone addiction scale-short version (SAS-SV), and postural changes will be evaluated with cranio vertebral angle (CVA), the supine method, and an inclinometer measurement before and after the intervention. Follow up will be done after 3- and 6-months post intervention. If data is normally distributed, paired 't' test and independent 't' test will be used for in group and between group analysis, ANOVA with post-hoc test (Bonferroni-t test) for follow up analysis otherwise non parametric equivalent tests will be used. The results will be presented in the form of 95% CI and with $p \leq 0.05$.

**Conclusions:** If postural correction exercises and awareness effectively reduce FHP, protruded shoulders, and thoracic kyphosis in 13-15-year-old smartphone users, integrating these techniques into daily routines could prevent future postural issues related to smartphone addiction.

**Trial registration:** This randomized clinical trial registered prospectively. Registration Number: CTRI/2024/07/069802.

**Keywords:** Kyphosis, Smartphone, Posture, Awareness, Randomized control trial

## INTRODUCTION

Smartphones are now everywhere, with widespread use among young people.[1] This frequent use has led to concerns about potential negative health effects, such as changes in spinal posture.[2] According to Kendall's theory, corrective exercise is one of the interventional techniques that has been recommended for the treatment of FHP, protruded shoulder and thoracic hyper-kyphosis.[3,4] Literature indicates that students with higher postural awareness experience fewer musculoskeletal disorders.[5] This study examines how postural awareness and corrective exercises impact FHP, protruded shoulders, and thoracic kyphosis in 13-15-year-olds who frequently use smartphones, addressing their lack of postural awareness.

## METHODS

A single-blinded, randomized clinical trial will be performed during the period of April 2024 to June 2025, aiming to enlist 170 participants, aged between 13 to 15 years both the genders who are addicted to smartphone according to SAS-SV with FHP, protruded shoulder or thoracic kyphosis.[6] After obtained approval from the institutional ethical board of the Srinivas university (SUEC-Reg. No:26/PHT/EC/2024), Mangalore, this study was registered in clinical trial registry of India (CTRI) with Reg. No: CTRI/2024/07/069802.

Recruitment and treatment will be given in different schools in Mangaluru, Dhakshina Kannada district, Karnataka state in India. Individuals who can read and write English, SAS-SV score of 31 or higher for females and 33 or higher for males, along with a CVA of 31 degrees or more, a protruded shoulder of at least 2.5 cm, and a thoracic kyphosis angle of 40 degrees or more will be included in the study.[6-9] Participants who had underwent previous shoulder surgery, cervical or thoracic fracture, who are with scoliosis, structural kyphosis, psychiatric comorbidity will be excluded.[6,10,11] The study eligibility criteria will be performed by the qualified physiotherapist. A written informed consent form will be given explaining the potential benefits and harms. All the participants will be briefly explained about the procedure, and then the treatment given to the patients.

### *Outcomes*

*CVA-FHP*

MB-ruler software is used to measure the CVA. The camera will be used to take pictures of the participants and set up on a tripod 1.5 meters away from the subjects and 115 cm high. The tripod was taped to the floor, and a spot on the ground will be designated for the subjects to stand on in order to maintain the same distance between them and the camera. The subjects will be photographed from their right side while they stand barefoot and in a standing position. Prior to taking the pictures, reflective markers were taped on the 7$^{th}$ cervical spinous process to facilitate easier and more accurate angular calculations. The participants will be instructed to look forward, stand in a relaxed stance, and place both hands in front of the chests. The horizontal line forms the CVA via C7 and the line that runs from C7 to tragus. It provides details regarding the head's position above the neck. The range of the typical angular value is 25-31 degrees.

*Supine method-protracted shoulder*

Using the supine method, the shoulder protrusion will be measured. With their arms by their sides and their elbow bent and resting against the side of their abdomen, participants will be asked to lie supine on a standard treatment plinth in their natural, relaxed posture. An inch tape is used by the examiner to measure the linear distance from posterior aspect of acromion process to the table. Participants with protruding shoulders are included if the distance was greater than 2.5 cm. mean value will be documented after 3 measures are registered (Figure 3).

### *Spinal inclinometer - thoracic kyphosis*

Spinal inclinometer was used to measure the thoracic kyphosis. Instruction such as "leave your arms by your sides and face the wall" will be given to them. The bubble inclinometer was zeroed on a vertical wall before measurements were taken because it is gravity dependent. At C7 spinous process the pencil mark was placed and inclinometer's cephalic foot was initially positioned. The lower thoracic spine will be examined in the same manner, with the inclinometer's caudal foot positioned on the pencil mark designated for T12. Make sure the recorder's eyes are on the same horizontal plane as the inclinometer. By calculating the difference between the two readings from the inclinometer, the thoracic kyphosis measure was determined (Figure 2).

### *Sample size*

Population based proportion method is used to determine sample size. With 95% confidence interval, sample size comes to be 85 in each group. Including 20% drop out.[12]

### *Randomization and blinding*

The participants will be allocated to study using simple randomization. The assessor will be blinded. They will be randomised to either experimental group/ control using lottery method. Eighty-five participants in each group will be allocated. Experimental group (postural correction exercises) and control group (posture awareness), consort flow chart used to represent participants assignment.

### *Interventions*

All included participants have been allocated into two group: Experimental group (postural correction exercises) and control group (posture awareness), after taking the written informed consent based on Helsinki declaration 2013. Before starting the treatment, every individual has been physically examined for articular, muscular, and neural components. The intervention will be given by qualified physiotherapist.

*Control group*

Participants will be getting postural awareness and list of exercises along with description for each exercise in the pamphlet form. They will be instructed to complete 3 sets of stretching exercises, each will be held for 30 sec, and 3 sets of strengthening exercises, consisting of 12 repetitions at home with 30 sec rest period. All exercises should be done for 4 days/ week for 4 weeks. At end of each week, group members will be contacted to ensure that they are completing exercises, receiving supervision and receiving guidance.

*Postural correction exercises group*

The postural correction group receives exercises based on postural abnormalities present in the 13-15 years old smartphone addicted individuals. The postural abnormalities like FHP, protruded shoulder and thoracickyphosis assessed by using CVA measurement, supine method and inclinometer respectively. The main exercise used in this group is stretching and strengthening exercises. Stretching of sternocleidomastoid, pectorals and upper trapezius will be given, 3 sets with each stretch will be held for 30 seconds. Strengthening of deep cervical flexors, shoulder retractors and cervical extensors will be given, 3 sets, consisting of 12 repetitions with 30 second rest period. All the exercise will be done for 4 days/ week for 4 weeks (Table 1).

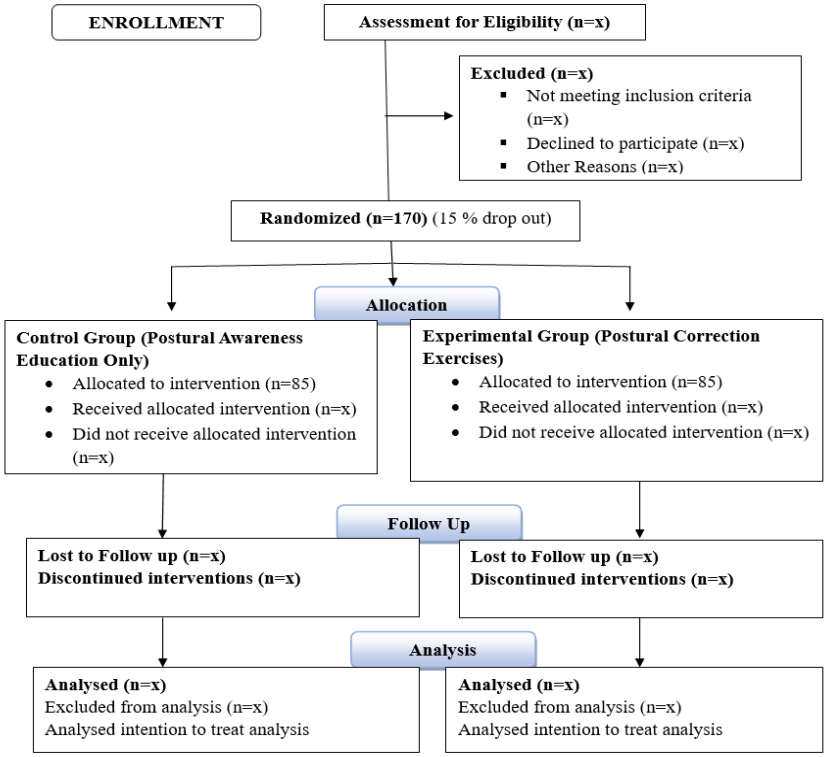


**Figure 1: Consort flow diagram for RCT/transparent reporting of trials.**

**Table 1: Exercise protocol for postural correction exercises.**

| Technique | Procedure | Dosage |
|---|---|---|
| **Sternocleidomastoid stretching** | Participants will first adopt a correct posture. Then, they will lower their shoulder by placing their left arm behind their body, tuck their chin, and gently bring their right ear towards their right shoulder. Next, they will tilt their head upwards towards the ceiling until they feel a gentle stretch on left side. They will hold this position for 30 seconds before switching sides and repeating. | 3 sets of stretching exercise, each will be held for 30 seconds with 30 second rest period |
| **Pectoralis stretching** | To stretch the pectoralis muscles, participants will stand next to a door or in a wall corner, keeping a straight back. They will lift one arm against the wall, ensuring the elbow and shoulder form a 90-degree angle. | 3 sets of stretching exercise, each will be held for 30 seconds with 30 second rest period |
| **Upper-trapezius stretching** | Participants will be instructed to sit and stretch their right upper trapezius to its pain free range by rotating to left side followed by flexion to the same side. | 3 sets of stretching exercise, each will be held for 30 sec with 30 second rest period |
| **Deep cervical flexor strengthening** | Participants will lie on their back with their head touching the floor. The exercise will involve gradually lifting the head off the floor while keeping it tucked in, and holding this position for different durations as they progress | 3 sets of strengthening exercises, consisting of 12 repetitions with 30 second rest period |
| **Shoulder retractor strengthening** | Participants will be in standing position and shoulder retraction done using TheraBand, followed by shoulder retraction in prone with weights. | 3 sets of strengthening exercises, consisting of 12 repetitions with 30 sec rest period |
| **Cervical retractor strengthening** | Participants should position the resistance band behind the head. Place hands against the wall. Neck should be slightly flexed forward and tilt head backward to overcome the band's resistance | 3 sets of strengthening exercises, consisting of 12 repetitions with 30 sec rest period |


**Figure 2 (a and b): Measurement of thoracic kyphosis by spinal inclinometer.**

**Figure 3: Measurement of protruded shoulder in supine position.**

Statistical analysis will be conducted using statistical package for social science (IMB SPSS statistic windows version 25.0). Descriptive statistics for the sample were calculated for demographic characteristics. The collected data will be assessed for their normality using Shapiro-Wilk test. If the data follows normal distribution, the descriptive statistics will be expressed in mean±standard deviation or else it will be expressed in median and inter quartile ranges. Between groups comparison will be done using Student-unpaired t test which will be used to present statistical significance if the data is normally distributed. In contrast, if the data deviates from normality, non- parametric tests (Mann Whitney u test) will be used to demonstrate the statistical significance. Follow up analysis will be done by using ANOVA with post-hoc test (Bonferroni-t test). The level of significance will be set at $p<0.05$.

## DISCUSSION

This paper investigates how postural correction exercises and postural awareness training impact FHP, protruded shoulders, and thoracic kyphosis in 13-15-years-olds who are frequent smartphone users. As the first randomized controlled trial (RCT) targeting this age group and addressing smartphone addiction-a known contributor to postural abnormalities-this research is pioneering.

It appears that among teenagers between the ages of 11 and 17, the relationship between thoracic kyphosis and FHP is positively correlated in a statistically significant way.[7] Protruded shoulder, elevated thoracic kyphosis, and FHP could occur alone or in combination.[13] While existing studies have explored postural correction exercises and postural awareness separately on these postural abnormality, this study is unique in comparing both methods to assess their individual and combined effects on postural issues related to excessive smartphone use.[5,14] By integrating and contrasting these interventions, the research aims to provide a thorough understanding of their impact on postural correction.

The effectiveness of these interventions will be measured at several points: at baseline (pre-intervention), immediately after the intervention, and at 3- and 6-months follow-up. This approach will allow for a comprehensive evaluation of both immediate and long-term effects on participants' posture.

## CONCLUSION

If postural correction exercises and postural awareness prove effective in reducing FHP, protruded shoulders, and thoracic kyphosis in this age group, incorporating these practices into students' daily routines could help prevent future postural issues related to smartphone use.

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*Ethical approval: The study was approved by the Institutional Ethics Committee*

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