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# Corelation Between Shoulder Girdle Postural Impairement and Spinal Curvature Variations

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**ABSTRACT**

This study investigates the correlation between rounded shoulder posture and spinal curvature in individuals aged 20-35 years. Methodology: A randomized controlled trial at Krishna College of Physiotherapy involved 110 participants aged 20-35 years with rounded shoulder posture, altered thoracic kyphosis, and lumbar lordosis. Postural assessments included the Plumb Line method, muscle length and strength testing, and posturography to evaluate stability. Data were analysed using SPSS version 20.0, with descriptive and inferential statistics to examine correlations between postural impairments and spinal curvature. Results: The study revealed significant postural abnormalities: increased thoracic kyphosis (51.8%), shoulder protraction (53.6%), and reduced lumbar lordosis (39%). Muscle length testing showed 49% of participants had a shortened pectoralis minor. Strength testing indicated reduced strength in shoulder retractors and protractors, particularly on the left. Posturography results showed increased instability, with higher centre of pressure, sway area, and velocity in participants with abnormal posture. Conclusion: This study highlights a strong correlation between rounded shoulder posture, spinal curvature variations, and impaired postural control. These abnormalities contribute to muscle imbalances and postural instability. Early intervention, including physical therapy, is crucial for improving function and quality of life. Further studies with larger samples and long-term follow-ups are needed to assess the progression of these postural impairments.

## 1. INTRODUCTION

The posture and mobility of the thoracic spine and shoulder girdle are frequently evaluated during a clinical examination of patients who come with mechanical shoulder discomfort. Normal shoulder girdle function is thought to depend on the thoracic spine's extension motion, and shoulder pain and subacromial impingement may arise as a result of this movement being compromised. It has been demonstrated that in asymptomatic people, limiting thoracic extension motion by altering posture decreases the range of arm elevation that is possible [1].

The shoulder is a complex joint that demands a wide range of motion and performs numerous functional tasks. To accurately assess and understand shoulder pathology, it is crucial to have a thorough knowledge of the intricate network of ligaments, muscles, nerves, blood vessels, and bones. Various joint articulations, unique structural features, and anatomical connections all contribute to the shoulder's function, and any disruption can lead to dysfunction or injury. A physical examination is essential in assessing patients with shoulder-related symptoms [2]

A substantial part of the shoulder girdle muscles is positioned outside the limbs. These muscles function to link the arm and shoulder girdle elements (scapula and clavicle) with the trunk's skeletal structures, including the occipital bone, spine, and ribs [3]. The impact of scapular dyskinesis on subacromial proximities and thoracic kyphosis seems to play a key role in the onset of shoulder issues. Altered scapular movement patterns are believed to contribute to rotator cuff disorders by reducing the space beneath the acromion [4].

Both improper scapular kinematics and static scapular posture can lead to shoulder dysfunction. Otoshi et al. explained the connection

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between aberrant shoulder joint flexion and thoracic kyphosis (TK). While humerus studies have examined the position of the scapula based on surface anatomy, there is a lack of research exploring the relationship between scapular positioning and spinal alignment, including thoracic kyphosis (TK) [5]. As individuals age, degenerative changes like osteoporosis, disc disorders, facet joint arthritis, and the weakening of paraspinal muscles progressively affect the spine and its surrounding structures, disrupting the normal sagittal alignment [6].

The scapula should be ideally positioned in relation to both the thorax and the humerus. Proper alignment with the humerus is crucial for the correct positioning of the glenoid, which is key to ensuring both the mobility and stability of the glenohumeral joint [7]. A shortened pectoralis minor muscle is associated with greater scapular internal rotation and reduced posterior tilting during arm elevation. Thoracic hyper kyphosis while sitting changes the dynamic positioning of the scapula, lowering the acromion and reducing subacromial space, which increases the risk of impingement. The finding that slouched posture during sitting reduces posterior tilting and lateral rotation of the scapula during arm movement supports this theory. However, other studies have failed to provide clear evidence linking scapular posture with subacromial impingement syndrome or shoulder overuse injuries [7].

To compensate for the changed line of gravity, people develop rounded shoulders and hyper kyphosis, which further impairs their condition. Even though the majority of earlier studies focused on thoracic kyphosis and the connection between FHP and RSP [8]. Changes in scapular kinematics, or scapular dyskinesis (such as downward rotation, anterior tilt, and protraction), play a role in impingement syndrome by reducing the subacromial space. Since the position and movement of the scapula are essential for shoulder function, this study aimed to compare scapular position and dyskinesis between individuals with rounded shoulder postüre [9].

In asymptomatic individuals, the degree of forward head posture tends to increase with age, which may be associated with changes in the musculoskeletal system [10]. Proper posture is generally considered a state of musculoskeletal equilibrium, where the body experiences minimal stress or strain [11]. RSP measurement was conducted using the supine position. Male participants were instructed to remove their shirts, while female participants were asked to expose their dominant shoulder girdle. The subjects were then instructed to position their arms neutrally and relax comfortably in a supine position. For RSP assessment, vernier callipers were used to measure the distance between the acromion of the shoulder joint and the table surface three times. The measurements were averaged for analysis, with a greater distance indicating more severe RSP.

Most research has concentrated on the relationship between forward head posture and rounded shoulders in patients with neck and shoulder pain. Therefore, a study specifically examining rounded shoulders and spinal curvatures was necessary. This study aimed to investigate the correlation between rounded shoulders and spinal curvature in the selected population.

## 2. MATERIALS AND METHODS

### *2.1. Participants*

This study investigates the relationship between rounded shoulder posture and spinal curvature in individuals aged 20-35 years. A randomized controlled trial was conducted at Krishna Physiotherapy College, Karad with 110 participants. 110 participants aged 20-35 years with rounded shoulder posture participated in the study.

Participants were randomly selected based on the inclusion and exclusion criteria and during the screening phase, participants underwent a comprehensive musculoskeletal assessment. Individuals aged 20-35 years with clinically diagnosed rounded shoulders, increased degree of rounded shoulders and variations in thoracic kyphosis and lordosis were included in the study. The sample population was selected based on the inclusion criteria and exclusion criteria. A consent form was filled by those who were willing to participate in the study.

This study was conducted in accordance with ethical standards and received the necessary permissions and approvals. The participant gave informed consent through a voluntary consent form covering the study details, risks, benefits, confidentiality, and participant rights. The study strictly adhered to the ethical principles of the Declaration of Helsinki and prioritized the rights and well-being of the participant in the design, procedures, and confidentiality measures.

### *2.2. Data Collection Tool*

#### *2.2.1. Plumb Line*

The posture of the subjects was evaluated by three experimenters while the subjects stood comfortably and quietly in front of and next to a plumb line suspended from the ceiling.

Participants were instructed to wear a bathing suit or similar attire to ensure the necessary areas of assessment. The evaluation was based on specific anatomical landmarks, including the earlobe, the seventh cervical vertebra, the acromion process, the thoracic spine, and the lateral malleolus. Normal posture, as described by Kendall and McCreary, is characterized by a vertical line that passes through several anatomical landmarks: the earlobe, the seventh cervical vertebra, the acromion process, the greater trochanter, just in front of the knee's midline, and slightly ahead of the lateral malleolus. From the sagittal view, deviations such as a forward head posture (where the head shifts forward at the earlobe), rounded shoulders (where the acromion moves forward), and increased thoracic kyphosis (an exaggerated curve in the thoracic spine) can be observed from both the left and right sides. The plumbline method was employed to assess the posture of 30 male and 30 female aged 20-35 years. White adhesive labels were placed on key anatomical landmarks, including the greater trochanter, posterior superior iliac spine, lateral femoral epicondyle, centre of the shoulder joint, and anterior superior iliac spine before conducting the postural evaluation. Measurements of lumbar lordosis curvature, pelvic alignment, and hip joint axis were taken to classify the posture in terms of lumbar lordosis.

### *2.2.2. Muscles Length Testing*

A measuring tape was used to assess the length of the Pectoralis Minor (PML). Participants were instructed to lie on their sides, with their arms resting at their sides and their gaze directed forward. The measurement was taken between two key landmarks: the inferior edge of the fourth rib and the medial-inferior angle of the coracoid process. The fourth rib was identified by locating the anterior inferior edge of the ribs, about one finger's width away from the sternum. An inch tape was then used to measure the PML while the participants were at rest [22]

### *2.2.3.Manual Muscle Testing*

In this technique, muscle strength will be assessed using Manual Muscle Testing (MMT) grades. According to the grading scale, a grade of 0 indicates no contraction or response, while grade 1 is characterized by a slight flicker of muscle contraction. Grade 2 refers to a full range of motion with gravity eliminated, grade 3 represents a full range of motion against gravity, grade 4 denotes a full range of motion against gravity with minimal resistance, and grade 5 indicates a full range of the TCS region were exposed for the posture

motion against gravity with maximal resistance. These grades should be carefully recorded during the assessment.

### *2.2.4.Posturography*

A misaligned or impaired spine (such as in cases of scoliosis, kyphosis, or forward head posture) can disrupt postural control, as proper spinal alignment is essential for balance. The Visual feedback posturography (VFP)test can help assess how these misalignments affect postural sway. Additionally, VFP serves as an effective screening tool for detecting early signs of postural issues in both the spine and shoulders. For instance, individuals exhibiting asymmetrical movements or significant side differences may be flagged for further evaluation of potential spinal or shoulder problems.

### *2.3. Satistical Analysis*

Data collected was registered in an excel sheet and the statistical analysis was conducted using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA). For the purpose of describing the characteristic of research sample, descriptive statistics were used. Participants descriptive data are presented as mean, percentage, standard deviation, p value calculation of range of motion also the descriptive strategies for statistic was used as bar diagrams, tables and percentages.

## 3. RESULTS

Table no.1interprets that decreased lordosis was seen in 39% in total individuals in which females are affected more by 69.7% as compared with male that is 30.2%. along with that we have seen reduced lumbar curve in later view as well as posterior view and internally rotated arm in anterior view. Increased kyphosis was seen in total 51.8% in individual in which males are affected more by 61.4% as compared with female that is 38.5%. along with that we have seen exaggerated lumbar curve in later view as well as posterior view and rounded shoulder in anterior view. 37.2% total individual had shoulder retraction in which 36.5% in male and 63.4 % in female along with we have seen shoulder retraction is reduced and scapular spine is seen prominent.53.6% total individual had shoulder protraction in which 52.5% in male and 47.4 % in female along with we have seen shoulder retraction is increased and inferior angle is seen prominent (Table 1).

**Table 1.** Postural Disorders and the Distribution of Affected Individuals by Gender and View

| Postural Condition | Total Individuals Affected | Males affected | Females affected | Lateral view | Posterior view | Anterior view |
|---|---|---|---|---|---|---|
| **Decreased Lordosis** | 43(39%) | 13(30.2%) | 30(69.7%) | Reduced lumbar curve | Reduced lumbar curve | Internally rotated arm |
| **Increased Kyphosis** | 57(51.8%) | 35(61.4%) | 22(38.5%) | Exaggerated lumbar curve | Exaggerated thoracic curve | Rounded shoulders |
| **Shoulder Retraction** | 41(37.2%) | 15(36.5%) | 26(63.4%) | Shoulder Retraction reduced | Scapular spine seen prominent | |
| **Shoulder protraction** | 59(53.6%) | 31(52.5%) | 28(47.4%) | Shoulder Retraction increased | Inferior angle is seen prominent | |

**Table 2.** Muscle length test

| Muscles | Measurement in cm | No of people |
|---|---|---|
| Pectoralis minor muscle | Less than 13 | 54(49%) |
| | 13 | 43(39%) |
| | More than 13 | 13(11.8%) |
| Rhomboid major muscle | Less than 7 | 17(15.4%) |
| | 7 | 37(33.6%) |
| | More than 7 | 56(50.9%) |

***Interpretaiıon***

The table provides data on the measurements of two muscles: **Pectoralis Minor Muscle:** From the assessment, it was found out that 54 individuals had length less than 13cm (49%) and 43 individuals having a length of 13cm (39%) and 13 individuals having more than 13cm in length (11.8%)**Rhomboid major muscle:** From the assessment, it was found out that 17 individuals had length less than 7cm (15.4%) and 37 individuals having a length of 7cm (39%) and 56 individuals having more than 7cm in length (50.9%)

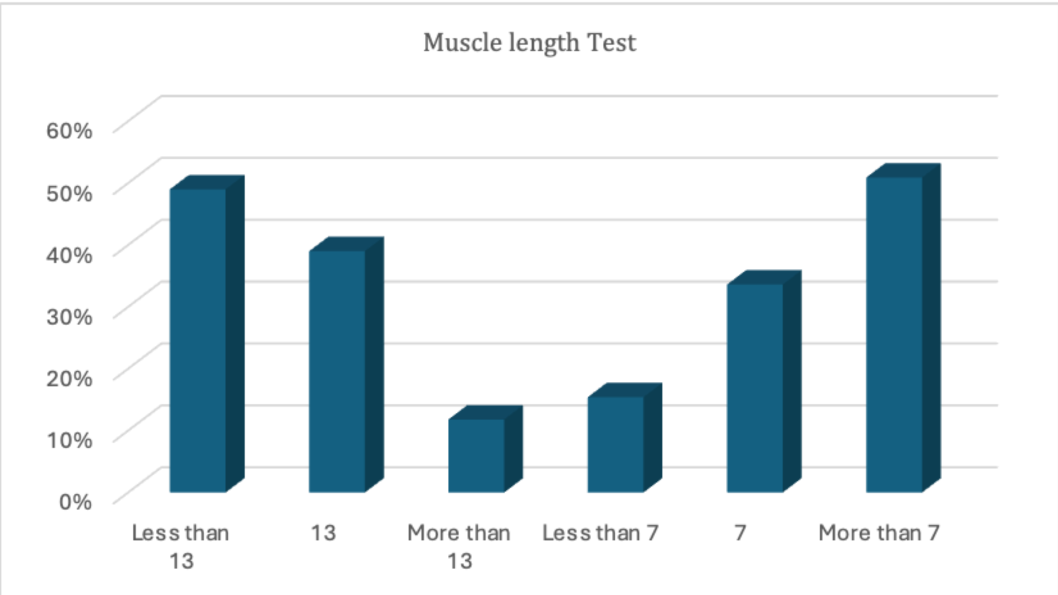


**Figure 1.** Muscle length test

**Table 3.** Muscle strength testing (manual muscle testing)

| Muscles | RIGHT | LEFT |
|---|---|---|
| Protractors | 3.80±0.3948 | 3.25±0.6272 |
| Retractors | 3.90±0.3014 | 3.49±0.5543 |

***Interpretation***

Manual muscle testing was performed on both sides of the body, and the results show that the muscle strength of the right shoulder protractors is 3.80 ± 0.3948, while the left shoulder protractors have a strength of 3.25 ± 0.6272. For the retractors, the right side has a muscle strength of 3.90 ± 0.3014, and the left side has a strength of 3.49 ± 0.5543 (Table 3).

**Table 4.** Postural Parameters in Individuals with Retracted/Protracted Shoulders and Kyphosis/Lordosis

| Parameter | Values (Retracted/Protracted Shoulders + Kyphosis/Lordosis) | Normal range |
|---|---|---|
| Centre of pressure (COP) | 7.5cm | <4.5 cm |
| COP Velocity | 2.3cm/s | < 2.0 cm/s |
| Total Path Length (TPL) | 9.1CM | <7.0 cm |
| Sway Area | 5.0cm | <4.0 cm |
| Max Sway in Ant/Post Direction. | 5.8cm | <3.0 cm |
| Max Sway in Med/Lateral Direction | 4.2 cm | < 3.0 cm |

The higher COP suggests that maintaining stable posture is challenging due to the altered alignment of the shoulders and spine. Increased velocity indicates that the individual has less control over their posture, requiring more compensatory movements. A longer path length reflects greater instability and difficulty in maintaining proper posture, often due to misalignment. A larger sway area suggests that balance control is compromised, likely due to postural misalignment. Increased sway in the anterior/posterior direction suggests difficulty in posture control, possibly due to excessive spinal curvature (kyphosis/lordosis). Increased sway in the medial/lateral direction may indicate uneven weight distribution, caused by abnormal shoulder and spinal positioning. The posturography results demonstrate that individuals with retracted/protracted shoulders and kyphotic/lordotic spinal changes experience substantial difficulties in maintaining balance. The higher COP, increased sway, and longer path length reflect instability and the need for frequent adjustments to compensate for postural misalignments. Corrective interventions such as physical therapy to improve posture and strength are recommended to restore stability and reduce the compensatory movements seen in these results (Table 4).

**Table 5.** Comparison of Postural Stability Parameters Between Male and Female Participants

| Parameter | Male (Values) | Female (Values) |
|---|---|---|
| **Centre of Pressure (COP)** | 3.75 cm | 3.75 cm |
| **COP Velocity** | 1.15 cm/s | 1.15 cm/s |
| **Total Path Length (TPL)** | 4.55 cm | 4.55 cm |
| **Sway Area** | 2.5 cm | 2.5 cm |
| **Max Sway in Ant/Post Direction** | 2.9 cm | 2.9 cm |
| **Max Sway in Med/Lateral Direction** | 2.1 cm | 2.1 cm |

The data provides an analysis of balance and postural control parameters for both males and females.The COP is consistent for both males and females at 3.75 cm, suggesting that both genders maintain their balance at similar points on the ground. Both groups have a COP velocity of 1.15 cm/s, meaning the rate at which their center of pressure shifts while standing remains the same for both genders.The total path length is identical for males and females at 4.55 cm, which indicates the distance the centre of pressure covers during a specific time frame, reflecting the level of balance instability or movement.Both genders show the same sway area of 2.5 cm, which quantifies the range within which the centre of pressure moves, offering insight into posture stability.The maximum sway in the forward and backward direction is 2.9 cm for both males and females, meaning the forward-backward motion of the centre of pressure is the same for both. Likewise, the maximum sway in the side-to-side direction is 2.1 cm for both genders, indicating that both groups exhibit the same range of lateral movement in maintaining postüre (Table 5).

## 4. DISCUSSION

The purpose of this study is to correlation between shoulder girdle postural impairment and spinal curvature variations. In this110 individuals were approached. After the selection of participants as per the criteria of the study, they were informed about the study and written consent was taken. Our investigations examined Plumb Line, Muscles length testing, Muscles strength testing.

The connection between spinal alignment and joint function has been extensively studied, particularly the relationship between the lumbar spine and hip, known as hip-spine syndrome (HSS). First described in 1983 by Offierski and MacNab, HSS includes four subtypes: simple, secondary, complex, and misdiagnosed. Along with HSS, there has been research into how the thoracic spine relates to shoulder function [5]

Otoshi et al. investigated how thoracic kyphosis (TK) impacts shoulder flexion range of motion (ROM). Lewis et al. compared shoulder movement in natural versus erect thoracic postures and found that even a small change in TK could enhance shoulder ROM. When slouched, the reduced ROM at the shoulder may result from the scapula shifting into a protracted, anteriorly tilted, and medially rotated position, which can restrict shoulder elevation. Studies have shown that slouching leads to less posterior tilting of the scapula and reduced shoulder abduction compared to an erect posture. Additionally, in individuals with increased TK, forward and downward scapular rotation depresses the acromial process and alters the orientation of the glenoid fossa [5]

The findings of this study support the idea that patients with neck pain experience changes in the alignment of both the shoulder girdle and cervical spine compared to those without symptoms. The weak correlation between cervical spine and shoulder girdle alignment and the severity of pain and disability implies that neck pain or dysfunction may be partially linked to alignment issues, which are likely influenced by multiple factors [16]. The noteworthy findings of this study include an increased anterior tilt and decreased upward rotation of the scapula, along with reduced clavicle elevation. These results are novel and have not been previously reported in individuals with neck pain [17].

The group's main effect was significant, according to the data (P = 0.029). The Least Significant Difference (LSD) post-hoc analysis showed no significant difference between the shoulder and pelvic groups (P = 0.537), however there were significant differences between the combined groups for the shoulder girdle group (P = 0.048) and the pelvic girdle group (P = 0.011). The maximal voluntary ventilation of the combined exercise group was higher than that of the other groups. For all three groups, time had a substantial main effect (P = 0.000). Moreover, a significant interaction between time and group was seen for the outcome measure (P = 0.000). The use of thorough correction exercises to treat problems concurrently is supported in part by these findings [18].

The study referenced provides insights into the repeatability and applicability of visual feedback posturography (VFP) for assessing postural control. This technique can be used to detect postural abnormalities, including those related to the shoulder and spine, by tracking the movement and accuracy of the center of gravity (COG) marker. Here's how you can use this study to identify postural abnormalities in the shoulder and spine [19].

Incorporating postural control into the study of the relationship between shoulder girdle postural issues and spinal curvature changes is highly valuable. It offers a precise and objective way to evaluate the impact of spinal abnormalities on overall posture and how shoulder dysfunction may serve as a compensatory mechanism for spinal misalignments. This method can aid in identifying early signs of postural imbalances, track changes over time, and inform rehabilitation strategies aimed at improving both spinal and shoulder function.

The quality of life (QoL) for individuals with postural impairments and spinal curvature variations, such as thoracic kyphosis (TK) and rounded shoulders, may be significantly hampered due to the combination of physical discomfort, limited functional capacity, and long-term musculoskeletal complications. Here’s how these factors could influence quality of life. Chronic postural issues may also contribute to structural changes in the spine, shoulder girdle, and surrounding muscles, leading to degenerative conditions such as arthritis, muscle imbalances, or nerve impingement. These conditions can progressively worsen, making treatment more difficult and affecting a person's long-term functional capabilities, more comprehensive understanding of the relationship between shoulder girdle posture and spinal alignment.

## 5. Conclusion

In conclusion, the combination of physical and psychosocial challenges arising from postural impairments and spinal curvature issues can significantly affect the quality of life. Early intervention through physical therapy, posture correction exercises, and pain management can play a crucial role in improving functional capacity, reducing discomfort, and enhancing overall well-being.

Limitations of these study were a smaller sampler size and a smaller geographical area. In this study participants selected between age 20-35 so the further attempts can select younger as well as older population. The study does not address the long-term impact of postural impairments on shoulder and spinal health, which would require follow-up studies to evaluate the persistence of these impairments and their progression over time. Addressing these limitations in future studies will help to further validate the findings and offer a more comprehensive understanding of the relationship between shoulder girdle posture and spinal alignment.

## Conflict of Interest

The authors declare that there are no conflicts of interest related to publication of this article.

## Ethics Committee

The Institutional Ethics Committee has hereby given permission to initiate the research project (Protocol Number 653/2022-2023)titled.

## Author Contributions

Conception and design of the study: APS, SS; Data collection: APS, SS; Data analysis and interpretation: APS; Drafting the article and/or its critical revision; APS; Final approval of the version to be published: SS. All authors have read and agreed to the final version of the manuscript.

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