ASSOCIATION BETWEEN CORE STABILITY AND SHOULDER PAIN AMONG SCHOOL TEACHERS: A CROSS-SECTIONAL CORRELATIONAL STUDY

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ABSTRACT

Purpose: Prevalence of shoulder pain is high among school teachers due to the extensive use of black and white boards. Studies have found abdominal muscle weakness is one of the most common causative factor for shoulder pain. This study explored the association between abdominal strength and shoulder pain among school teachers.

Methods: Fourteen school teachers who use black board for longer period during working hours were selected for this cross-sectional correlational study based upon inclusion and exclusion criteria by using convenience sampling method. The Shoulder pain and abdominal strength was measured through VAS and 7-stage abdominal strength test respectively. Mean of three readings were recorded for analysing the correlation using Spearman correlational coefficient between abdominal strength and shoulder pain.

Result: Age, height, weight and BMI of school teachers recruited were 25.9±4.9 years, 164.1±10.7 cm, 55.6 ±7.2 kg and 19.8±3.9 kg/m² respectively. There exists strong negative correlation (ρ=-0.962; p<0.001) between abdominal strength and shoulder pain among school teachers.

Conclusion: Decreased abdominal strength could increase shoulder pain among school teachers. This highlights the demand of abdominal strength training to reduce shoulder pain among school teachers.

Key words: Pain; shoulder pain; abdominal strength; school teacher.

I. INTRODUCTION

The work related musculoskeletal disorder (WRMSD) are the Major cause of early retirement among the school teachers especially below the age of 45 years.¹ In these WRMSD, 70% of cases involving the rotator cuff, 11% were caused by localized tenderness in surrounding muscles, 10% involved acromioclavicular joint pain, 3% involved glenohumeral joint arthritis, and 5% were referred Pain from the neck among primary school teachers.² During daily work tasks such as long working hours, and activities like writing on black board or white board, a specified shoulder-hand angle greater than 90-degree is adapted by the school teachers which further activates trapezius, deltoid, infraspinatus and supraspinatus muscles to stabilize the glenohumeral joint throughout the activity.⁴,⁵

With the increase of computer usage in daily work among school teachers, forward head posture has been hypothesized to increase the considerable load on the non-contractile structures and posterior cervical structures, eventually resulting in neck and shoulder pain. The Individual factors such as age, gender, body mass index, and length of employment are highly associated with higher rate among teachers.³ Studies have shown that female teachers experienced neck and shoulder pain more frequently than their male colleagues.⁶

The mechanical linkages of body segments allow for the sequential transfer of forces and motions when performing dynamic tasks. Core muscles are basically the connecting bridge between the upper body and lower body. Weak core muscles increase the risk of back, shoulder and neck pain⁷,⁸ and unevenly distribute the weight
of upper body on the spine. The optimal functioning of the core is required for the production of strong, functional movements of the extremities. The relationship between shoulder and core has been shown by the activation of core musculature during upper extremity movements in previous studies. Although the inclusion of core stabilization exercises into rehabilitation program for shoulder injury has been advocated, the evidence to show direct effect of core stabilization on shoulder muscle strength and pain is still lacking specifically during acute phase rehabilitation when the shoulder muscle strengthening exercises are painful and/or shoulder immobilization is necessary. Recurrent shoulder pain was reported among school teachers, the influence of abdominal strength over the shoulder pain among school teachers reminded and unmarked. Hence this study explored the association between core stability and shoulder pain among school teachers.

II. MATERIAL AND METHOD

Recruitment

The cross-sectional correlational study was performed on 14 school teachers aged between 20 and 50 years. Being an observational study, the trial registration is not mandatory. Hence, the observational study has not been registered in the clinical trials registry. The study was completed in accordance with the principles of the Declaration of Helsinki (Revised, 2013) and the National Ethical Guidelines for Biomedical and Health Research. The study was performed between November, 2020 and March, 2021. All the school teachers signed the informed consent form before their recruitment in the study.

Sample size estimation and recruitment

Sample size required for this correlational study was performed by using formulae, \[ N = \left(\frac{Z_\alpha + Z_\beta}{C}\right)^2 + 3 + in \] where \( Z_\alpha = 1.96, Z_\beta = 1.28, r = \text{expected correlation coefficient (0.75)}, \) and \( C = 0.5^* \ln\left(\frac{1 + r}{1 - r}\right) \). Thus minimal sample size of 11 was required, and we have recruited 14 school teachers who regularly use blackboard for most of their teaching activities from the recognized school. The teachers with the history of recent fractures or surgeries, degenerative arthritis of shoulder and any conditions that prevent them from being part of the study were excluded.

Procedure

Anthropometric measurements which includes, age, height and weight were recorded from the recruited school teachers as a part of initial assessment. In addition to that, duration of working hours and time spent while using the blackboard were also noted. After the above preliminary assessments, they were subject to the standard abdominal strength assessment using 7-stage abdominal strength test and level of their shoulder pain using visual analogue scale (VAS). For measuring abdominal strength assessment using 7-stage abdominal strength test, all recruited school teachers were instructed to lie supine with their knees at right angles and feet flat on the floor. The detailed description of 7-stage abdominal strength test is tabulated in Table 1.

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0</td>
<td>cannot perform</td>
</tr>
<tr>
<td>Level-1</td>
<td>Arms extended, participant curls up so that the wrists reach the Knees.</td>
</tr>
<tr>
<td>Level-2</td>
<td>Arms extended, participant curls up so that the elbows reach the knees.</td>
</tr>
<tr>
<td>Level-3</td>
<td>Arms extended, participant curls up so that the chest touches the knees.</td>
</tr>
<tr>
<td>Level-4</td>
<td>Arms held across the chest, holding the opposite shoulders, the participant curls up so that the forearms touch the thighs.</td>
</tr>
<tr>
<td>Level-5</td>
<td>Hands held behind the head, the participant curls up so that the chest touches the thighs.</td>
</tr>
<tr>
<td>Level-6</td>
<td>Uses the same technique used in Level 5 but the participant completes the curl-up with a 5-lb (2.5-kg) weight held behind the head.</td>
</tr>
<tr>
<td>Level-7</td>
<td>Uses the same technique as Level 5 and Level 6 but with a 10-lb (5-kg) weight.</td>
</tr>
</tbody>
</table>

For carrying out the levels of the test, the participants were instructed to perform one complete sit-up for each of the levels with three attempts at each level was permitted. A single level achievement was considered if a single sit-up was performed in the following prescribed manner, without lifting their feet off the floor. Shoulder pain
was assessed using VAS and the mean of three readings was used in the data analysis to avoid the measurement error.

**Data analysis**

All the data were analyzed using the statistical software, statistical package for the social science (SPSS), IBM SPSS version 20.0 (Armonk, NY: IBM Corp.). The p-value ≤0.05 was considered to be statistically significant. Normality of the collected demographic dimensions and outcome measures were evaluated for their normality using Shapiro-Wilk test. As the demographic dimensions data only follow normal distribution, all the descriptive statistics were expressed in mean ± standard deviation. While the outcome measures were expressed in mean with interquartile range (IQR) and range as they do not follow the normal distribution. Spearman rank correlation coefficient was used to report the bivariate correlation between shoulder pain measured through VAS with abdominal strength measured through 7-stage abdominal strength test. We adopted the correlation criteria according to standard textbook as follows; Correlation is considered as a little or no Correlation, if ρ <0.25, low to fair if ρ is in between 0.25 to 0.50, moderate to good if ρ is in between 0.50 to 0.75, and strong Correlation if ρ is >0.75. Scatter plot with non-linear or curvilinear intercept line was used to report the degree of correlation graphically. Absolute correlation between the dependent variable (shoulder pain) with the independent variable (abdominal strength) was expressed in form of simple linear regression.

### III. RESULTS

Demographic dimensions of age, height, weight, and outcome measures which includes, duration of working hours, blackboard handing hours, shoulder pain measured through VAS and abdominal strength measured through 7-stage abdominal strength test of recruited school teachers were tabulated in Table 2 and Table 3 respectively.

**Table 2:** Demographic dimensions of the school teachers recruited (n=14)
<table>
<thead>
<tr>
<th>Demographic dimensions</th>
<th>Mean±SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>25.9±4.9</td>
<td>20 to 37</td>
</tr>
<tr>
<td>Height</td>
<td>164.1±10.7</td>
<td>147.3 to 185.4</td>
</tr>
<tr>
<td>Weight</td>
<td>55.6±7.2</td>
<td>48 to 68</td>
</tr>
<tr>
<td>BMI</td>
<td>19.8±3.9</td>
<td>11.2 to 27.4</td>
</tr>
</tbody>
</table>

**Table 3:** Descriptive statistics of working hours, blackboard handing hours, shoulder pain-VAS with abdominal strength
<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Median (IQR)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working hours</td>
<td>480 (360, 480)</td>
<td>300 to 720</td>
</tr>
<tr>
<td>Board handling hours</td>
<td>240 (150, 300)</td>
<td>25 to 360</td>
</tr>
<tr>
<td>Shoulder pain - VAS</td>
<td>6 (5, 7.5)</td>
<td>3 to 8</td>
</tr>
<tr>
<td>Abdominal strength</td>
<td>2 (0.5, 2)</td>
<td>0 to 3</td>
</tr>
</tbody>
</table>

The degree of Correlation between abdominal strength and shoulder pain- VAS with abdominal strength was tabled in Table 4 with their graphical representation in Figure 1.

**Table 4:** Correlation between abdominal strength and shoulder pain.
<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Spearman rank correlation coefficient (ρ)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder pain - VAS</td>
<td>- 0.962</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Abdominal strength</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** ρ is >0.75 - Strong Correlation

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The simple regression equation describing the absolute correlation between between the dependent variable (shoulder pain) with the independent variable (abdominal strength) is,

Shoulder pain = 8.047 - 1.558 (Abdominal strength);

F(1, 11) = 161.63, p < 0.001, R^2 = 0.936. There exists good association between both the variables.

IV. DISCUSSION

A strong negative correlation exists between abdominal strength measured through 7-stage abdominal strength test and shoulder pain measured through VAS. This study was intend to study the correlation between the trunk stability through abdominal strength and the shoulder pain. Fourteen female school teachers mean age of 25.9±4.9 years were recruited. The shoulder pain was measured by VAS scale and the abdominal strength by 7 stage abdominal strength test. The study indicates that there is strong negative correlation reported in school teacher who participated in this study. In other words the school teachers who had poor abdominal strength reported with severe shoulder pain. This clearly goes parallel with motor control theory which states that better the proximal stability will aid to efficient distal mobility.

Ali cagdas yorukoglu et. al\(^{15}\) conducted a study to find out relation between rotator cuff injury and core stability and stated that the neuromuscular system should be considered as a whole, and addition of core stabilization exercises are effective in rehabilitation programme after rotator cuff repair.\(^{15}\) Similar report was proposed by Ahmed Radwan et. al\(^{7}\) in his study that there is a relationship between shoulder dysfunction and core stability and also stated that Overhead athletes often present with injury to the glenohumeral joint secondary to inherent instability. However, little is known about the relationship between core stability and shoulder dysfunction among athletes.

Tuğçe Özekli Mısırlıoğlu et al\(^{9}\) conducted a similar study to find the effect of core stabilization exercise program on shoulder rehabilitation in females. His study aimed to evaluate the effect of core stabilization exercises and to explore the immediate effect of core muscles-activated posture on shoulder maximal voluntary isometric contraction (MVIC) strength. Study results showed that six-week core stabilization exercise program had a significant positive effect on the shoulder MVIC strength.\(^{9}\)

Jason Brumitt et al\(^{8}\) conducted a study on Integrating Shoulder and Core Exercises When rehabilitating Athletes Performing Overhead Activities. Those Athletes performing overhead activities are at risk of sustaining both overuse and traumatic shoulder injuries. Study states that integrated core and shoulder exercise may help to fill the gap between shoulder rehabilitation and lateral functional exercises. Therefore, better abdominal strength is more effective for rehabilitation.\(^{8}\)

Since school teaching is one of profession holding occupational threats which leads to repeated shoulder injury and pain and such population does have poor focus on core stability and fitness. The small sample size and
single centre study were the limitations of the study. Though the sample size was small, it is sufficiently powered (>90%). To the best of our knowledge that this is the first study, determining the correlation between shoulder pain and abdominal strength among the school teachers. The study further can be extended in large sample size, and also in college and university faculty members.

Based on our study result, we recommend to implement core stability through abdominal strength training to be part of rehabilitation training and fitness programme in order to prevent shoulder repeated trauma in school teachers.

V. CONCLUSION

Negative correlation exists between shoulder pain and abdominal strength among the school teachers. We recommend abdominal strengthening to prevent repeated shoulder injuries and pain in school teachers.

REFERENCES

11. ICMR. National Ethical Guidelines for Biomedical and Health Research.