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Correlation of Forward Head Posture and Hand Grip Strength in Young Adults

Clayton Dsilva[1], Dr Amruta Khilwani[2], Dr Albin Jerome[3]

[1]B.P.Th,St. Andrews College of Physiotherapy, Maharashtra University of Health Sciences, Pune, Maharashtra, India.

[2]Assistant Professor, St. Andrews College of Physiotherapy, Maharashtra University of Health Sciences, Pune, Maharashtra, India.

[3]Principal, St. Andrews College of Physiotherapy, Maharashtra University of Health Sciences, Pune, Maharashtra, India.

Abstract

Background: Forward Head Posture (FHP), a postural misalignment of the cervical spine, is increasingly common due to prolonged use of handheld devices, especially among young adults. FHP is known to cause musculoskeletal strain and potentially influence other body systems. While several studies have explored its impact on upper body mechanics, limited research exists on its effect on distal extremity strength, particularly hand grip strength.

Objective: This study aimed to investigate the correlation between craniovertebral angle (CVA), an indicator of FHP, and hand grip strength in young adults.

Methods: A cross-sectional observational study was conducted involving 81 asymptomatic young adults aged 19–24 years (mean age 22.4 ± 1.54) with normal BMI (21 ± 1.5). CVA was measured using MB Ruler software, and hand grip strength was assessed using a Jamar dynamometer. Spearman's correlation was used for statistical analysis.

Results: There was no discernible link between CVA and either hand's grip strength, according to the study.The correlation coefficient was 0.033, indicating a very weak association.

Conclusion: FHP does not significantly impact hand grip strength in asymptomatic young adults with normal BMI. Further studies are needed in older or symptomatic populations to explore long-term effects.

Keywords: Forward head Posture, Craniovertebral Angle (CVA), Young Adults, Hand grip strength, Hand Dynamometer

Introduction:

Body posture refers to the alignment of the body over time[1], while an ideal posture maintains balance with minimal musculoskeletal effort and avoids pain or discomfort[2].Common faulty postures among adolescents include uneven shoulder levels (36%) and forward head posture (FHP) (25%)[3]. FHP is characterized by increased flexion of the lower cervical spine and upper thoracic region[4], with the craniovertebral angle (CVA) representing the alignment of the head and neck. Research indicates that viewing smaller screens can lead to greater cervical flexion, resulting in increased muscle activity in the upper trapezius and splenius capitis muscles.[5][6].

Maintaining neck posture relies on the optimal coactivation of the ventral and dorsal neck muscles, which provide support around the cervical spine. FHP shifts the centre of gravity, increasing stress on the craniovertebral extension muscles and potentially causing musculoskeletal pain[7]. Due to erratic joint motions, it may also restrict the head's and neck's functional range of motion. Prolonged FHP may reduce the number of sarcomeres and shorten muscle fibres, affecting muscular contraction and altering the body's centre of gravity [8].

Grip strength, defined as the force exerted by the fingers and thumb, is often used in rehabilitation to monitor the progress. It is an indirect measure of muscle strength involved in gripping. Various body positions influence grip strength, and a hand's functional position typically involves a power grip[9]. Factors such as height and muscle mass correlate positively with grip strength, which is also influenced by hormonal changes during puberty [10].

The Jamar Dynamometer is considered the gold standard for measuring grip strength with specific recommendations for its use [11]. Hand grip strength reflects the combined contraction of extrinsic and intrinsic hand muscles, and various upper-limb positions can affect this strength [12]. In contrast to the neutral position, the posture of the head—whether flexed, extended, or rotated—significantly affects grip strength [13]. Understanding these relationships is vital for developing preventive measures against the negative effects of FHP on distal extremities.

Materials and Methodology:

A cross-sectional approach was used in this study to evaluate the association between adults' hand grip strength and forward head posture**.** Participants will be recruited from local clinics, universities, and hospitals using recruitment materials that provide information about the study and invite interested individuals to participate.

Once potential participants expressed interest, they underwent an initial screening to ensure eligibility based on predefined inclusion and exclusion criteria. Eligible participants will be given an informed consent form that details the objectives, procedures, potential risks, and benefits of the study. They are given the opportunity to pose inquiries before to signing the permission form, so assuring comprehensive understanding of their participation.

Following consent, participants will attend a single session for data collection, scheduled to allow ample time for all the assessments. During this session, the participants completed a demographic questionnaire that included their name, age, height, weight, and dominant side. The data were securely recorded in the database for further analysis.

a) Measurement of Craniovertebral angle

CVA was measured using the photogrammetric method to determine FHP. The intra-rater and inter-rater evaluations of photogrammetry findings of the cervical spine standing sagittal posture were found to be reliable [14][15]. The CVA is located between a line that passes through the tragus of the ear and a horizontal line at the spinous process of the seventh cervical vertebra. It was evaluated during the subject assumed a standing position, and a lateral view picture was taken from the dominant side using a camera [14]. The tripod was positioned 1.5 meters from the subject, with its base aligned to the subject's shoulder height.Three measurements were taken; then, the numbers were averaged [16]. The CVA was measured using a program known as MB ruler 5.4.

b) Measurement of hand grip strength

A Jamar handheld dynamometer was used to assess hand grip strength in the following manner:

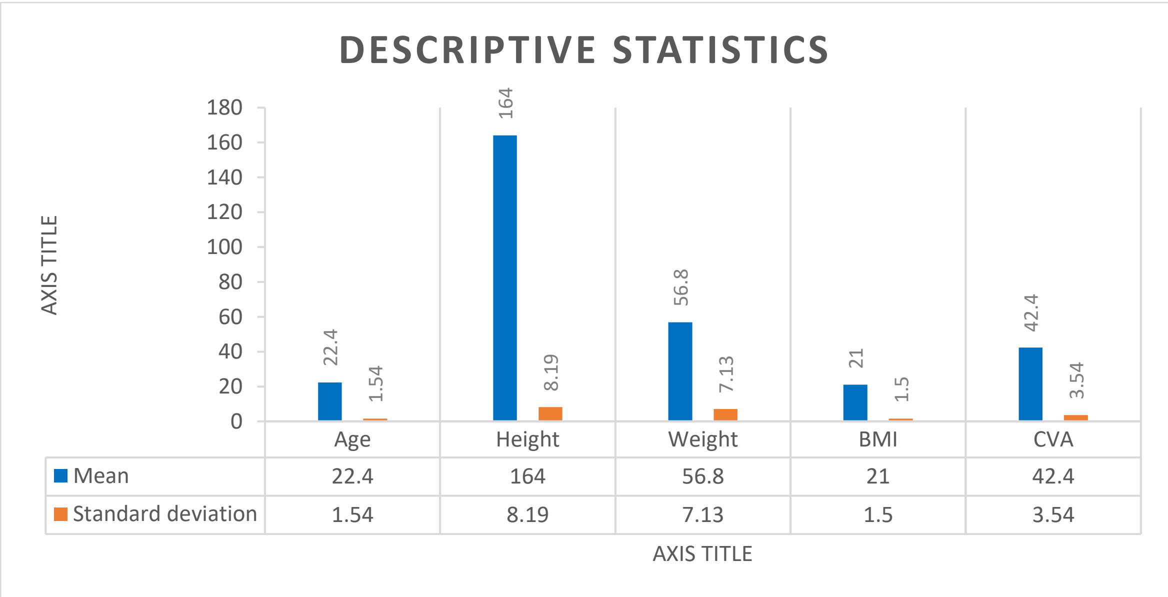
- The grip bar is set such that the instrument weighs and the second finger joint fits snuggly under the handle.Set the dynamometer to zero.
- -The subject held the handgrip dynamometer in line with the forearm at the level of the thigh away from the body.
- -The subject squeezes the handgrip dynamometer as hard as possible without holding their breath (to avoid the Valsalva manoeuvre). The handgrip dynamometer and the hand should not come into contact with the body or any other items.
- Each hand underwent two repetitions of the test.The score was the highest of the two readings (to the nearest kilogram) for each hand added together [17].

Statistical analysis was performed after entering the data into MS Excel and preparing tables and graphs. Jamovi 2.6.13 was used for analysis. The mean ± standard deviation is used to display all data. Statistical significance was set at p value < 0.05. The distribution of the demographic data was evaluated using the Kolmogorov–Smirnov test.This test was designed to determine whether a given dataset followed a normal distribution. The results indicated that the data were non-parametric, meaning that they did not meet the assumptions necessary for parametric statistical tests, which typically assume normality. Given the non-parametric nature of the data, Spearman's correlation coefficient was chosen as the statistical method for analysing the relationship between Craniovertebral Angle (CVA) and handgrip strength. The obtained data were organized in a master chart, various tables, and graphs derived from the statistical analysis for easy interpretation of the results.

Results:

Descriptive Statistics

Figure 1: Descriptive Statistics of Participant Demographics and Craniovertebral Angle.



	Age	Height	Weight	BMI	CVA
Mean	22.4	164	56.8	21	42.4
Standard deviation	1.54	8.19	7.13	1.5	3.54

In the above graph, the mean age of subjects is 22.4 ± 1.54, the mean height is 164 ± 8.19, the mean weight is 56.8 ± 7.13, the mean BMI is 21 ± 1.5.the mean CVA is 42.2 ± 3.54 degrees. Gender distribution in this study was specifically, 25.31% of the subjects were male, while 56.6% were female. In this study, 71.88% of the participants were right-dominant, while 10.12% were left-dominant.

The CVA and grip strength of the right and left hands were compared using Spearman's correlation analysis. Spearman’s Rho in right hand grip was 0.052 which indicates and very weak positive correlation with CVA and the Spearman's Rho in left hand grip showed -0.037 which indicates a weak negative correlation with CVA and the P values of Right and Left handgrip are 0.644 and 0.746 respectively (<0.05) Hence they are also not statistically significant.

Table 1: Correlation Analysis Between CVA and Combined Handgrip Strength

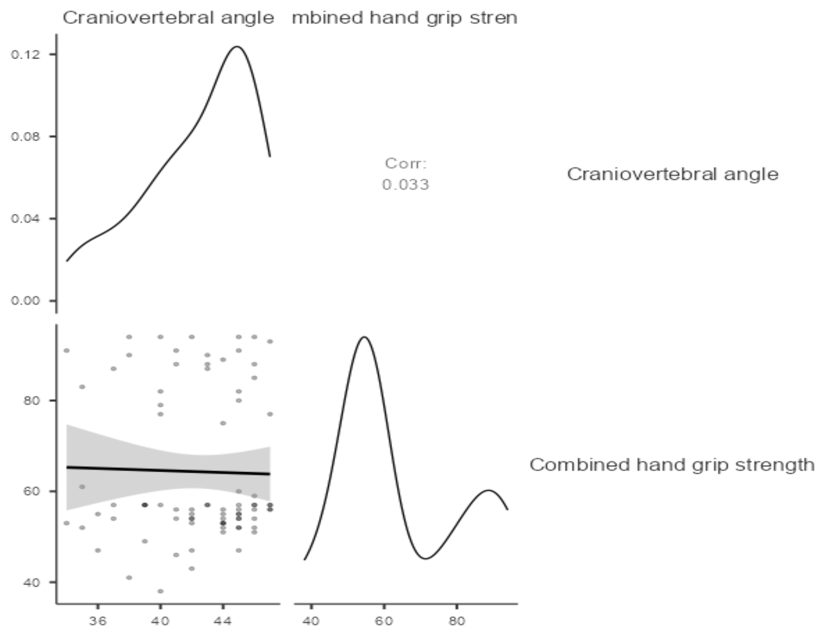
		CVA	Combined Handgrip Strength
Combined hand grip strength	**Spearman's rho**	0.033	—
	df	79	—
	p-value	0.769	—
	N	81	—

The table presents the results of a Spearman's rank correlation analysis examining the relationship between CVA (Craniovertebral Angle) and combined handgrip strength.

1. **Spearman's rho**: The correlation coefficient is 0.033, indicating a very weak positive correlation between CVA and combined handgrip strength.
2. **p-value**: The p-value of 0.769 suggests that this correlation is not statistically significant, as it is well above the common alpha level of 0.05. This means there is no evidence to suggest a meaningful relationship between the two variables in this sample.
3. **Degrees of Freedom (df)**: The analysis was conducted with 79 degrees of freedom, which is typical for correlation analyses with a sample size of 81.

A correlation analysis between CVA and Combined Hand Grip Strength was performed, and the results obtained were similar to those obtained before, with Spearman's rho of 0.033 and P value of 0.769, and there was no significant relationship between CVA and Combined Hand Grip Strength.

Figure 2: Correlation between Craniovertebral Angle and Combined Hand Grip Strength



This graph represents a relationship between the craniovertebral angle and combined hand grip strength.

1. Craniovertebral angle (on the y-axis): This is a measure of neck posture or alignment.

2. Combined hand grip strength (on the x-axis): A measure of physical strength, with higher values indicating greater hand grip strength.
3. Scatter plot with a linear trend line: There is a scatter of data points with a fitted regression line in the bottom left plot.
4. Smoothed density plots: The curves on both the vertical (y-axis) and horizontal (x-axis) show the distribution of the craniovertebral angle and hand grip strength, respectively.
5. Correlation (Corr: 0.033): The correlation value between these two variables is displayed as 0.033, indicating a very weak positive correlation, which suggests that there is no relationship between craniovertebral angle and combined hand grip strength.

- Interpretation:- The distribution of the craniovertebral angle (on the left side) seems to have a peak around a specific value, with a rise and fall pattern indicating most individuals have values clustered near this peak.
- The hand grip strength distribution shows a similar peak pattern, though the correlation suggests that variations in hand grip strength are not strongly associated with changes in the craniovertebral angle, the regression line suggests little to no linear relationship between these two variables as the slope is nearly flat.
- In summary, the data indicates that changes in craniovertebral angle and combined hand grip strength are not significantly related to each other.

Discussion:

The purpose of this study was to examine the correlation between forward head posture (FHP) and hand grip strength in young adults, specifically exploring whether variations in craniovertebral angle (CVA) due to FHP affect hand grip strength. Forward head posture (FHP) is characterized by increased flexion of the upper thoracic region and lower cervical spine, as well as increased extension of the upper cervical spine [4]. Hand grip strength is calculated by combining the contraction of intrinsic and extrinsic hand muscles, which causes the hand joints to flex [12].

The patients were young and asymptomatic that is why there was no significant change in the handgrip strength and the participants age is still young until the negative effects of FHP are displayed. The lack of link between FHP and handgrip strength may potentially be explained by the postural deformity not being severe enough to generate distal alterations.

The participants in this study did not experience extended work hours, which could have notable impacts on both their posture and hand strength. Long work hours, especially in desk jobs, are linked to bad ergonomic habits like slouching or extended periods of head bending, leading to forward head posture. Likewise, the absence of extended work hours, leading to physical fatigue and musculoskeletal strain, along with repetitive or prolonged hand tasks typical in longer workdays, may lead to a reduction in grip strength brought on by strain or misuse of the muscles.

Additionally, Zafar and Alghadir have written articles providing support indicating that the forward head posture did not impact hand grip strength, and there was no connection between the CVA value, a measure of FHP, and grip strength [18].

Sawyer's findings, which showed no discernible variation in the strength of the teres minor, infraspinatus, posterior deltoid, serratus anterior, and lower trapezius muscles between the FHRSP group and the normal posture group, corroborated the current findings. This suggests that FHRSP had no effect on the strength of the proximal shoulder muscles and, in turn, had no effect on the distal hand muscles, as indicated by hand grip strength [19].

Additionally, their results aligned with Wong et al.'s research, which also indicated that head and neck positions did not impact the strength of the elbow and hand muscles[20].

Additionally, Talati et al. suggested that the lack of correlation between forward head posture (FHP), thoracic kyphosis, and lumbar lordosis in adults aged 18-35 years could be a possible explanation for the lack of relationship between CVA and a lack of hand grip strength[21].

Thoracic hyper kyphosis causes the scapulae to protract [22], which can impair the rotator cuff's length tension relationship and jeopardize the arm's proximal stability [23]. This affects the function of the upper limbs and could indirectly affect grip strength. These results contradict the current study's findings, which may have resulted from using young persons who had not yet experienced pain or degenerative changes or who had not been subjected to extended work hours.

In summary, this study suggests that in young adults with a normal BMI and without chronic postural strain, FHP does not have a significant effect on hand grip strength. The findings emphasize the complexity of the relationship between posture and muscular performance, indicating that more pronounced or chronic postural deviations may be necessary to observe measurable impacts on grip strength. Understanding these dynamics is essential for developing effective interventions aimed at mitigating the long-term effects of poor posture on musculoskeletal health.

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