JSSF (11) (1) (2025)

Journal of Sport Sciences and Fitness

https://journal.unnes.ac.id/journals/jssf

The Relationship Between Cervical Curve and Endurance in Upper Trapezius Muscles

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Article's Info

Article's History:
Submitted May 3, 2025
Revised May 28, 2025
Accepted June 5, 2025

Keywords:
cervical curve; upper trapezius; muscle endurance; forward head posture

DOI:
https://doi.org/10.15294/r6x5ct48

Abstract

Introduction: A decrease in the cervical curve due to Forward Head Posture (FHP) can reduce the endurance of the upper trapezius muscle, which plays an essential role in supporting the head. **Objectives:** This study aims to determine the relationship between cervical curve and upper trapezius muscle endurance. **Method:** The study used a quantitative design with a cross-sectional approach, involving 36 Physiotherapy students of Universitas Muhammadiyah Surakarta. Measurement of cervical curve was done with craniovertebral angle (CVA), while muscle endurance was measured through isometric contraction with 90° shoulder abduction. Data analysis used Spearman Rank Correlation test. **Result:** There is a positive and significant relationship between upper trapezius muscle endurance and craniovertebral angle (CVA), with a correlation coefficient of 0.433 and a significance value (p-value) of 0.008. This shows that the better the upper trapezius muscle endurance, the more upright a person's head posture. **Conclusion:** A decrease in cervical curve (FHP) is associated with decreased muscle endurance, which can lead to faster fatigue and muscle soreness. This finding shows the importance of posture management in preventing musculoskeletal disorders, especially in the student population who are often exposed to prolonged device use activities.

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PISSN 2252-6528
EISSN 2745-5718

INTRODUCTION

The cervical spine is a complex bone because it allows a wide range of motion and its main function is to support the weight of the head. This makes the cervical susceptible to various disorders, most of which are caused by abnormal conditions in the cervical (Azimi *et al.*, 2021). Changes in the cervical curve can be influenced by poor posture (Bokaee *et al.*, 2017). One of the posture errors that occur in the cervical area is forward head posture. Forward Head Posture (FHP) is an abnormal posture condition, where the head leans anteriorly in the sagittal plane away from the vertical line of the shoulder. It is characterized by the misaligned position of the head and shoulders (Haryo *et al.*, 2021). Based on previous research, there are several factors that can cause forward head posture deformity including excessive use of technology such as smartphones, BMI, age and gender (Mahmoud *et al.*, 2019; Nitin Worlikar and Rajesh Shah, 2019; Ramalingam and Subramaniam, 2019; Noviati, 2022). As a result, the asymmetrical position of the head and shoulders will cause several symptoms including neck pain, headache, spasm in the muscles around the neck and decreased balance and neck stability (Wijianto, Dewangga and Batubara, 2019; Abd El-Azeim *et al.*, 2022). FHP is common in all age groups, the average age group in men is 22-44 years and the average age group in women is 23-66 years (Nitin Worlikar and Rajesh Shah, 2019). Based on research conducted by Naz, Bashir and Noor, (2018) showed that the prevalence of FHP in students was 63.96%.

Based on research conducted by Lee *et al.*, (2015) shows that FHP conditions cause shortening in several muscles around the neck which include the scaleni muscle, upper trapezius and strenocleidomatoideus muscles. According to research by Mehdikhani *et al.*, (2022) the muscle with the highest sensitivity in the body is the upper trapezius muscle. The upper trapezius muscle itself is a tonic muscle that functions to help maintain head posture, which tends to be forward due to gravity and the weight of the head itself. The upper trapezius muscle plays a role in controlling neck movement. If this muscle experiences stiffness or spasm, the functional ability of the neck to move can be disrupted (Hernata Putri and Sulistyaningsih, 2020). According to previous research, poor posture, such as forward head posture or working for a longer time than the relaxation phase, can cause tension and discomfort in the neck and shoulders. This condition poses a risk of impaired movement and body function, which in turn can reduce performance in activities involving the upper trapezius muscle. These muscle disorders tend to involve tension and shortening. Therefore, prolonged upper trapezius contractions create tension in the muscle tissue and eventually lead to neck pain (Sugijanto and Army, 2015).

Muscle endurance is the ability of a skeletal muscle or group of muscles to contract continuously for a long period of time and recover quickly from fatigue (Lintang, 2017). The upper trapezius muscle is a muscle group that is most susceptible to excessive tension and the appearance of myofascial trigger points, given its role as the main support for head weight in forward head posture conditions (Ravichandran, Karthika Ponni and Antony Leo Aseer, 2016).

Based on research by Sa'bantoro, (2023) states that FHP with upper trapezius muscle spasm has a significant relationship. Continuous muscle tension can cause a decrease in muscle endurance, resulting in faster fatigue, chronic pain, and postural disorders that further aggravate the condition of FHP.

The high prevalence of Forward Head Posture (FHP) and its impact on upper trapezius muscle function shows the need for serious attention to posture disorders caused by habits and non-ergonomic body positions. FHP can cause changes in the cervical curve and cause disturbances in the neck muscles, especially the upper trapezius muscles which play an important role in maintaining stability and head movement. This strain and decreased muscle endurance can lead to fatigue, chronic pain, and decreased overall postural function. Therefore, this study has a high urgency to analyze the relationship between cervical curve and upper trapezius muscle endurance. The results of this study are expected to provide a deeper understanding of the mechanism of these disorders and become the basis for developing effective intervention strategies for the prevention and treatment of musculoskeletal disorders due to non-ergonomic postures.

METHOD

This study is a quantitative study with an analytical observational correlational study design that uses a cross-sectional study approach, namely measurements taken at one specific time to assess the relationship between cervical curve to upper trapezius muscle endurance.

The sample collection technique used in the study is purpose sampling, where the selection of samples is based on certain criteria in accordance with the research objectives. After that, the sample will be observed to see if there is a relationship of the variables studied. This research has passed the ethical feasibility test from the research ethics commission of FIK Muhammadiyah University Surakarta with "No.746/KEPK-FIK/XII/2024".

The time of this research was conducted in April 2025 at the physiotherapy neurology laboratory of Surakarta Muhammadiyah University. The population in this study was 4th semester students of physiotherapy study program, Faculty of Health Sciences, Universitas Muhammadiyah Surakarta with a total of 40 people. After the population is entered into the slovin formula to get the number of samples that will be respondents in this study, namely 36 people.

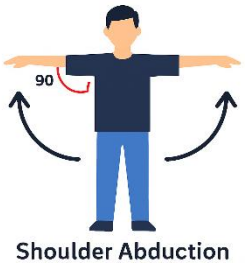

Figure 1. Upper trapezius muscle endurance measurement

Endurance measurement using a stopwatch. Based on research conducted by Kara, Harput and Duzgun, (2021) in the 90^{o} abduction movement, the upper trapezius muscle contracts more than the other trapezius muscles. The study used Maximal Voluntary Isometric Contractions (MVICs) to assess muscle strength. In addition, research conducted by Deeney and O'Sullivan, (2017) also used isometric endurance times for the upper trapezius. Based on this research, this study uses isometric endurance contraction with 90 degrees shoulder abduction. Meanwhile, to measure the curve of the cervical using craniovertebral angle with a goniometer.

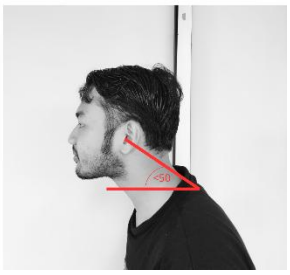

Figure 2. Cervical curve measurement

Craniovertebral angle is the angle formed from the intersection of the horizontal line passing through the C7 spinous processus with the line leading to the ear tragus. If the cervical angle is less than 50°, the individual is categorized as having Forward Head Posture (FHP) (Goswami and Contractor, 2022).

The equipment used during this study included a stopwatch, goniometer, stadiometer, chair, bed, digital scales, and stationery. Data collection techniques carried out from the beginning to the end of the study began with observations for 3 months involving assistance from experts. Furthermore, population and sample determination were carried out, as well as subject selection by giving consent through informed consent. The study was conducted for one day, and then the data obtained were processed using the IBM SPSS Statistics 20 application.

Data analysis techniques performed include: (1) descriptive test with the aim of knowing the frequency of age and duration of device use, pain intensity, degree of cervical vertebrae curve, gender and upper trapezius muscle endurance of research subjects, (2) normality test carried out on the degree of cervical vertebrae curve and upper trapezius muscle endurance using the saphiro wilk test, (3) data analysis using the Spearman Rank Correlation test to assess whether there is a relationship between cervical vertebrae curve and upper trapezius muscle endurance.

RESULT AND DISCUSSION

Result

The characteristics of the research subjects are shown in table 1. Based on age characteristics, in the group with 19 years of age there were 17 samples (47.2%), at the age of 20 years there were 15 samples (41.7%), at the age of 21 years there were 3 samples (8.3%), and at the age of 22 years there were 1 sample (2.8%). The sample totaled 36 people.

Table 1. Characteristics of Research Subjects

Variable	N	%
Age (years)		
19	17	47.2
20	15	41.7
21	3	8.3
22	1	2.8
Gender		
Male	7	19.4
Female	29	80.6
Duration of Device Use (hours)		
<5 hours	7	19.4
5-6 hours	8	22.2
>6 hours	21	58.4
Body Mass Index (BMI)		
Underweight (<18,5)	3	8.3
Normal (18,5-24,9)	20	55.6
Overweight (25-29,9)	8	22.2
Obesity I (≥30)	5	13.9
Craniovertebrae angle		
Normal (>50^{o})	29	80.6
FHP (<50^{o})	7	19.4
Pain Level (NRS)		
0 (no pain)	11	30.6
1-3 (mild pain)	6	16.7
4-6 (moderate pain)	16	44.4
7-10 (severe pain)	3	8.3
Upper trapezius muscle endurance		
<30 seconds	0	0
30-120 seconds	4	11.1
>120 seconds	32	88.9

Based on gender characteristics, male subjects totaled 7 samples (19.4%) and female subjects totaled 29 samples (80.6%). Based on the characteristics of the duration of device use, subjects with an average duration of less than 5 hours totaled 7 samples (19.4%), subjects with an average duration between 5-6 hours totaled 8 sample (22.2%) and subjects with an average duration of more than 6 hours totaled 21 samples (58,4%). Based on the characteristics of Body Mass Index (BMI), subjects with underweight conditions amounted to 3 samples (8.3%), subjects with normal conditions amounted to 20 samples (55.6%), subjects with overweight

conditions amounted to 8 samples (22.2%), and subjects with obesity conditions amounted to 5 samples (13.9%).

Based on the characteristics of the craniovertebrae angle (CVA), normal subjects totaled 29 samples (80.6%) and those with FHP totaled 7 samples (19.4%). Based on the characteristics of pain levels, subjects who did not experience pain amounted to 11 samples (30.6%), experiencing mild pain amounted to 6 samples (16.7%), moderate pain amounted to 16 samples (44.4%), and severe pain amounted to 3 samples (8.3%). Based on the characterization of upper trapezius muscle endurance, subjects who had an endurance value of less than 30 seconds amounted to 0 samples (0%), 30 seconds to 120 seconds amounted to 4 samples (11.1%), and more than 120 seconds amounted to 32 samples (88.9%).

Table 2 presents the results of the normality test on endurance data. From the normality test conducted, the p value = 0.000 was obtained. Based on the results of the normality test, it is known that the data is not normally distributed. Due to data that is not normally distributed, non-parametric tests are used to test hypotheses and use Shapiro-Wilk because the number of samples is less than 50 samples.

Table 2. Normality Test

Variable	Shapiro-Wilk	Sig. (p-value)	Description
Upper trapezius muscle endurance	0.857	0.000	abnormal

Table 3 Spearman correlation test results between the variables of endurance upper trapezius muscle and craniovertebral angle (CVA), obtained a correlation coefficient of 0.433 with a significance value (p-value) of 0.008. This shows that there is a positive and significant relationship between endurance of the upper trapezius muscle and CVA at a significance level of 0.01. Thus, the higher a person's endurance, the tendency to have a greater CVA angle (more upright head posture).

Table 3. Spearman Rank Correlation Test

	Upper trapezius muscle endurance	CVA	Sig. (p-value)
Upper trapezius muscle endurance	1.000	0.433	0.008
CVA	0.433	1.000	0.008

Discussion

Based on the results of this study, there were 7 samples who experienced FHP with an age range of 19 to 21 years. Where there is a decrease in the cervical vertebra curve so that the head deviates anteriorly in the sagittal plane. This can be caused by the use of laptops and smartphones with an average of more than 5 hours a day in samples experiencing FHP conditions. The use of laptops and smartphones continuously moves the neck forward which puts pressure on the upper back muscles and causes forward head posture (Arooj *et al.*, 2022). In addition, based on previous research, the duration of prolonged smartphone use can affect the frequency of neck pain with the correlation between the two variables being unidirectional,

which means that the longer the smartphone is used, the higher the frequency of neck pain (Ramalingam and Subramaniam, 2019; Wibisono, 2023). Based on this study of 36 samples, there were 25 samples who experienced pain ranging from mild to severe pain.

In this study, subjects who experienced a decrease in the cervical vertebra curve had female gender. Where out of 36 subjects there were 7 people who experienced a decrease in the cervical curve and all seven subjects were female. This is also in line with research conducted by Arooj *et al.*, (2022) which shows that the prevalence of women is proven to be higher in FHP (56-58.95%) compared to the incidence rate that occurs in men (51.78%).

In this study, the sample amounted to 7 students with the following BMI classification: 1 sample with underweight conditions, 3 samples with normal conditions, 2 samples with overweight conditions and 1 sample with obesity conditions. Based on research conducted by Noviati, (2022) there is a positive relationship between Body Mass Index (BMI) and Craniovertebral Angle (CVA), which is indicated by above-normal BMI values in the overweight-obesity category in line with the average CVA below 50, according to FHP criteria.

In this study, the sample amounted to 7 students who experienced FHP with the classification of upper trapezius muscle endurance as follows: 0 samples with endurance less than 30 seconds, 3 samples with endurance 30-120 seconds, and 4 samples with endurance more than 120 seconds. Based on research conducted by Lee *et al.*, (2015) shows that FHP conditions cause shortening in several muscles around the neck which include the scaleni muscle, upper trapezius and strenocleidomatoideus muscle. When muscles become shorter or longer compared to their resting position, their ability to produce force is also reduced. Continued muscle tension can cause a decrease in muscle endurance, resulting in faster fatigue, chronic pain, and postural disturbances that further aggravate the condition of FHP.

CONCLUSION

The study concludes that there is a positive and significant relationship between upper trapezius muscle endurance and cervical posture (CVA), indicating that better muscle endurance is associated with a more upright head posture. Future research is recommended to use a longitudinal design to assess changes over time, especially after posture correction interventions.

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