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Effects of Cervical Spine Mobilization on Autonomic Function in Individuals with Forward Head Posture

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KEYWORDS

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DECLARATIONS

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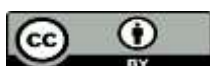
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ABSTRACT

Background: Forward head posture is a prevalent postural issue associated with several systemic effects, such as reduced respiratory capacity and altered cardiovascular function. **Objective:** This study examines the impact of cervical spine mobilization on the parasympathetic nervous system in individuals with FHP. **Methodology:** This descriptive cross-sectional survey was conducted at SUIT, Peshawar in the Department of Physical Therapy. The study was conducted over 6 months on 98 Doctor of Physical Therapy Students. Non-probability convenience sampling technique was used to enroll students of DPT program in 6th, 8th, and 10th semesters at SUIT, Peshawar. After obtaining approval from the university's ethical committee, the consent for participation was secured. Data was collected using a questionnaire that included demographic information filled out by each participant. The osteoporosis knowledge assessment tool was employed, consisting of 20 questions with options for true, false, or don't know. The analysis included demographic data based on age, gender, and semester of the participants, and results were presented in tables and graphs. **Results:** Participants had a mean age of 33.23±9.05 years, with 63.7% being male. Before mobilization, blood pressure was classified into three groups: 35.4% of participants had systolic BP between 100-120 mmHg, 38.1% had BP between 120-130 mmHg, and 26.5% had BP above 130 mmHg. Pulse rate ranged from 60-75 beats per minute (32.7%) to over 100 beats per minute (23.9%). Similarly, respiratory rate ranged from 12-14 breaths per minute (17.7%) to over 18 breaths per minute (17.7%). Post-intervention, significant reductions were observed in BP, PR, and RR ($p < 0.01$), indicating improved parasympathetic function. Cervical spine mobilization effectively enhances parasympathetic nervous system function, leading to reductions in BP, PR, and RR in individuals with FHP. **Conclusion:** These findings suggest that this intervention may serve as a beneficial therapeutic approach for mitigating the systemic effects of FHP and restoring autonomic balance.

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INTRODUCTION

Forward head posture (FHP) is a common postural deviation affecting people of all ages, from children to the elderly. It is defined by the forward positioning of the head and the neck, which often leads to upper cervical spine hyperextension and lower cervical spine flexion. This posture is classified as abnormal when the craniovertebral angle (CVA) is less than or equal to 50 degrees.¹ FHP is often linked to neck pain, this relationship remains controversial.²

Research suggests that individuals with FHP exhibit impaired sensorimotor control and dysfunction of the autonomic nervous system (ANS).² FHP frequently coexists with upper crossed syndrome (UCS), a condition marked by the anterior displacement of the cervical vertebrae and hyperextension of the upper cervical spine. This posture can lead to systemic changes, including reduced respiratory function due to the altered expansion of the upper thorax and constriction of the lower thorax.³ Furthermore, FHP has been found to affect cardiac function, reducing stroke volume and increasing heart rate, which activates sympathetic tone in the body.⁴ FHP has also been linked to impaired static balance control.⁵ In addition to these systemic effects, FHP is associated with musculoskeletal symptoms such as headaches, neck pain, mid-back pain, chest discomfort, and sensations like pins and needles in the upper extremities.⁶ Neck pain related to FHP is widespread globally, with 86.8% of individuals reporting neck discomfort due to this posture.⁷ In Pakistan, a study found that 63.96% of university students, irrespective of gender, suffer from FHP. Factors contributing to FHP, particularly in women, include age, smoking history, high job demands, and a lack of social or professional support.⁶

Cervical spine mobilization is a manual therapy technique that involves low-velocity, passive intervertebral gliding based on patient tolerance.⁸ It differs from cervical manipulation, which uses rapid thrust forces and often produces an audible crack or popping sound.⁹ Both mobilization and manipulation can lead to mechanical and neurophysiological changes, such as pain relief, motor function improvements, and changes in the sympathetic nervous system.¹⁰

Mobilization of the upper cervical spine has shown beneficial effects on the autonomic nervous system (ANS), including stress and fatigue reduction.¹¹ The autonomic nervous system plays a crucial role in maintaining homeostasis and regulating cardiovascular function, body temperature, and blood pressure.¹² Disruptions in the balance between sympathetic and parasympathetic function can lead to various symptoms, such as changes in heart rate, blood vessel dilation, and glandular secretions.¹³ Manual therapists often use a combination of mobilization techniques to restore physiological balance and enhance homeostasis.¹⁴ Considering the musculoskeletal and systemic effects of FHP, this study aims to assess the impact of cervical spine mobilization on parasympathetic nervous system function in patients with FHP.¹⁵

METHODOLOGY

This descriptive cross-sectional survey was conducted at SUIT, Peshawar in the Department of Physical Therapy. The study was conducted over 6 months on Doctor of Physical Therapy (DPT) Students. The sample size was 98 participants with a total population of 130 which was determined by using a sample size calculator i.e. Raosoft calculator. Non-probability convenience sampling technique was used. Participants were enrolled in the study based on the following criteria: All students enrolled in the DPT program at SUIT, Peshawar. Participants from the DPT 6th, 8th, and 10th semesters. Both male and female students Graduates who are no longer enrolled at SUIT, Peshawar. DPT students from the 2nd and 4th semesters at Sarhad University.

Students enrolled in programs other than DPT. After obtaining approval from the university's research and ethical committee, individuals were selected from the study settings. Consent for participation was secured after explaining the study's aim and methodology, ensuring participants understood their right to opt in or out. Data was collected using a questionnaire that included demographic information filled out by each participant. The osteoporosis knowledge assessment tool (OKAT) was employed, consisting of 20 questions with

options for true, false, or do not know. The first 12 questions assessed knowledge of osteoporosis, questions 13 to 17 focused on attitudes, and the final three questions addressed practices to prevent osteoporosis. Data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. The analysis included demographic data based on age, gender, and semester of the participants, and results were presented in tables and graphs.

RESULTS

The table 1 represents the distribution of gender among participants, showing that 63.7% are male and 36.3% are female. The analysis shows that the mean age of participants included was 33.23±9.05 years. The maximum age of the participant included was 50 years while the minimum age of the participant included was 20 years in table 2. The analysis shows that 44.2% of individuals did not have any underlying medical condition, 26.5% had underlying cardiac issues, 10.6% had underlying respiratory issues, and 18.6% had some other systemic issues. In figure 1, the analysis shows that 35.4% had BP from 100-120 systolic and 70-80 diastolic BP, 38.1% had a BP from 120 to 130 systolic and 80-90 diastolic BP and 26.5% had a BP more than 130 systolic and more than 90 diastolic BP. The analysis shows that 32.7% of subjects had a PR of 60 to 75 beats per minute before cervical mobilizations, 43.4% of subjects had a PR of 75 to 100 beats per minute while 23.9% of subjects had a PR of more than 100 beats per minute in figure 2. The analysis shows that 17.7% of subjects had RR from 12 to 14 breaths per minute, 64.8% of subjects had RR from 14

to 18 breaths per minute and 17.7% subjects had RR more than 18 breaths per minute in figure 3. The significance level ($p < 0.01$) shows that cervical mobilizations have a significant effect on the pulse rate, Blood-pressure and respiratory rate. The negative mean value shows that there was a considerable decrease in the BP, PR and RR after cervical mobilizations in table 4.

DISCUSSION

The study results demonstrate that the mean age of the participants included in the study was 33.23±9.05 years out of which 63.7% of subjects were male while only 36.3% were females. The descriptive analysis of subjects having underlying medical conditions demonstrated that 44.2% of individuals did not have any underlying medical condition, 26.5% had underlying cardiac issues, 10.6% had underlying respiratory issues, and 18.6% had some other systemic issues. The descriptive analysis of BP of the subjects before cervical mobilizations showed that 35.4% had BP from 100-120 systolic and 70-80 diastolic BP, 38.1% had a BP from 120-130 systolic and 80-90 diastolic BP and 26.5% had a BP more than 130 systolic and more than 90 diastolic BP. The descriptive analysis of the PR of the subjects before cervical mobilizations demonstrated that 32.7% of subjects had a PR of 60-75 beats per minute, 43.4% of subjects had a PR of 75-100 beats per minute while 23.9% of subjects had PR of more than 100 beats per minute. The analysis of the RR of the subjects before cervical had RR from 12-14 breaths per minute, 64.8% of subjects had RR from 14-18 breaths per

Table 1. Statistics of age and gender

Age		Mean	Std. Deviation
		33.23	9.05
		Frequency	Percentage
Gender	Male	72	63.7
	Female	41	36.3
	Total	113	100.0

Figure 1. Descriptive statistics of BP before cervical mobilizations

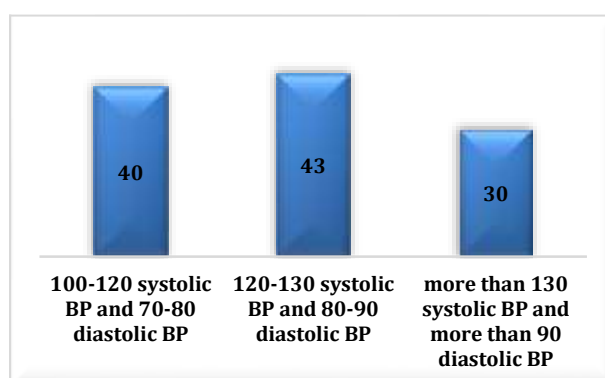


Table 2. Individuals with underlying medical conditions

		Frequency	Percent %	Valid Percent %	Cumulative Percent %
Medical Conditions	No	50	44.2	44.2	44.2
	Cardiac disorders	30	26.5	26.5	70.8
	Respiratory disorders	12	10.6	10.6	81.4
	Other disorders	21	18.6	18.6	100.0
	Total	113	100.0	100.0	

Table 3. Paired sample t-test applied before and after cervical mobilizations

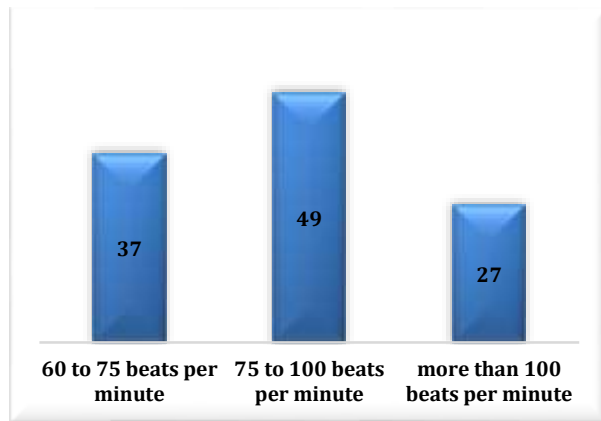
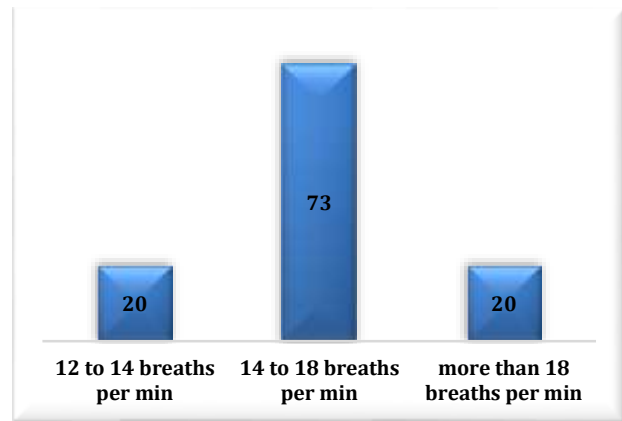
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	S.D	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	BP	-.35	1.24	.12	-.58	-.12	-3.0	112	.003
Pair 2	PR	-.35	1.20	.11	-.58	-.13	-3.1	112	.002
Pair 3	RR	-.41	.99	.09	-.59	-.22	-4.4	112	.000

minute and 17.7% of subjects had RR more than 18 breaths per minute. The paired t-test was applied to find that there was a significant impact of cervical mobilizations by comparing pre and post-interventional values of BP, PR and RR, the test had a significance level of $p < 0.01$, hence proving that cervical mobilizations have a significant impact of parasympathetic nervous system functioning. A similar study was conducted by Rechberger V et al. in 2019 to determine the impact of osteopathic manipulations on the ANS. The results demonstrated that research utilizing high-velocity and low-amplitude interventions saw a significant alteration in the autonomic nerve system. Although research on cranial osteopathic methods was lacking, manipulation of the sub-occipital area was found to significantly alter the autonomic nervous system.¹⁶ Lack of evidence prevented studies assessing the effects of mobilizations in the cervical and thoracic regions from providing adequate results. None of the research

mentioned that osteopathic manipulations or mobilizations trigger the autonomic nervous system's sympathetic or parasympathetic divisions.¹⁷ This study indicated the activation of ANS, yet did not conclude which part of the autonomic system becomes activated, either sympathetic or parasympathetic. This literature gap was filled by the authors of the current study providing sufficient research-based evidence.

CONCLUSION

This study demonstrates that cervical spine mobilization significantly stimulates parasympathetic nervous system activity, resulting in reductions in blood pressure, pulse rate, and respiratory rate (RR) in individuals with forward head posture. These findings suggest that cervical mobilization can effectively restore autonomic balance by enhancing parasympathetic function, which may help mitigate the systemic effects of FHP, such as altered cardiovascular and respiratory

Figure 2. Statistics of PR before cervical mobilization**Figure 3.** Statistics of RR before cervical Mobilization

performance. Given the widespread prevalence of FHP and its associated musculoskeletal and systemic issues, cervical mobilization offers a valuable therapeutic intervention for improving both postural and autonomic function. Further research is warranted to explore the long-term impact of this intervention and optimize treatment protocols for different patient populations.

DECLARATIONS

Consent to participate: Written consent had been taken from patients. All methods were performed following the relevant guidelines and regulations.

Availability of data and materials: Data will be available on request. The corresponding author will submit all dataset files.

Competing interests: None

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Authors' contributions: All authors read and approved the final manuscript.

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