SHORT REPORT

Cervical joint positioning error and its association with cervical spine mechanics among undergraduate students

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Abstract

A cross sectional analytical study was conducted from September 26 to December 28 2018 at Shifa Tameer-e-Millat University Islamabad with 111 undergraduate students aged 17-26 years as participants. The aim of the study was to establish the normative values of cervical joint positioning error (CJPE) and its association with cervical spine mechanics. Neck discomfort was measured using the neck portion of the "student specific Cornell Musculoskeletal Discomfort Questionnaire" (ssCMDQ) and CJPE was measured via cervico-cephalic relocation test using a goniometer. Non-parametric tests of significance were used because the data was not normally distributed in terms of normality testing. Normative values of CJPE were noted to be highest in flexion (9º±9º), rotation towards left (9º±6º) and right (8º±7º), extension (6º±8º), and lastly lateral flexion towards left (5º±7º) and right (5º±5º). Higher CJPE in all movements was observed among females; however, no significant statistical differences were observed (p>0.05). In terms of correlation, important trends included significantly positive correlation of neck discomfort with CJPE in extension, and of CJPE in lateral flexion towards the left with CJPE in lateral flexion towards the right and flexion (p<0.05).

Keywords: Goniometry, Neck pain, Proprioception.

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Introduction

Neck is the most common site of musculoskeletal discomfort and symptoms, with an occurrence of around 75.7% among healthy young adults.[1] The build-up of this discomfort can lead to neck pain,[2] which is a common symptom worldwide, with a point prevalence ranging from 6%-22% and one year prevalence ranging from 1.5%-75%.[3] Individuals with neck pain have a significantly higher variation in cervical range of motion (ROM), decreased isometric muscle strength and poor cervical joint positioning sense and smoothness of movement.[4,5] Because of a high prevalence of neck pain[3] and associated sensorimotor disturbances,[6] it is imperative to establish normative values for these measures which can be used as reference in terms of assessment, management, and prognosis of patients with neck pain. Even though great emphasis is laid on cervical ROM and isometric muscle strength in terms of cervical spine mechanics and management of neck pain,[4] cervical joint position sense has been neglected previously, and normative values for cervical joint positioning error (CJPE) are still not available in the literature. On the other hand, recent evidence suggest significantly higher values of CJPE in individuals with chronic neck pain and the elderly as compared to healthy young adults.[7] Error measurement would be beneficial for boosting the motor performance of individuals which is otherwise compromised due to chronic neck pain, muscle weakness and postural impairments. For this reason, the purpose of the current study was to establish the normative values of CJPE and determine its association with cervical spine mechanics among healthy males and females.

Methods

A cross sectional analytical study was conducted from September 26 to December 28, 2018, at Shifa Tameer-e-Millat University Islamabad with ethical approval IRB #1114-390-2018, Allied Health Sciences campus, with a sample size of 111 participants (71 males and 40 females). The sample size was calculated using Rao soft sample size calculator[8] with 95% confidence interval and 5% margin of error. Population size was set as per the total population of undergraduate students in the study setting, and the response rate was set at 50%. Participants aged 17 to 26 years were included in the study via consecutive sampling with a negative history of neck pain, cervicogenic headache, neck trauma or surgery, vestibular disorders, and vertebrobasilar insufficiency. Neck discomfort was measured using the neck portion of the "student specific Cornell Musculoskeletal Discomfort Questionnaire" (ssCMDQ). This questionnaire has proved to have a high internal consistency as the Cronbach's alpha value for frequency, discomfort and interference was 0. 711, 0.762

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and 0.81, respectively. The reliability tests also showed the satisfactory outcome of the tool.[9] The questionnaire contains questions about musculoskeletal pain and discomfort over the past week in 20 parts of the body. CJPE was measured via cervicocephalic relocation test using a goniometer.[10] In terms of measuring ROM, the sensitivity of goniometer is observed to be 65% and specificity 94%.[11] Before measuring the error, informed consent was taken from each participant. The protocol was explained to each individual with the confirmation that the benefits will outweigh the harms in the procedure. The participants were selected irrespective of their cast, race, and ethnicity. The participants were seated on a chair in an upright posture with hip and knee flexed to 90 degrees. The subjects were then asked to close their eyes and the head was moved to a position, 50% of the actual ROM and maintained for 3 seconds. The participants were asked to remember the position of the head (reference position), and then it was brought back to neutral position. The participants were then asked to re-position the head to the pre-determined reference position and a difference in terms of angular distance was measured, which was considered as the value of CJPE. The placement of the axis of goniometer was different for every movement direction.[12] The data was statistically analysed using SPSS version 20. The data was not normally distributed ($p<0.05$) in terms of Kolmogrov-Smirnov and Shapiro-Wilk tests, and thus average values were reported in terms of Median ±IQR, and non-parametric tests of significance were used. CJPE scores of male and female participants were compared using Mann-Whitney U test, and Spearman correlation was used to determine the relationship between CJPE and individual factors.

Results

A total of 111 participants were included in the study, out of which 71 (64%) were males and 40 (36%) were females. The average values of age, weight, height, neck discomfort, and BMI of the participants was 21±2 years, 60±13kg, 170.18±12.70 cm, 1.5±3, and 20.51±4.47, respectively. Normative values of CJPE were noted to be highest in flexion (9º ±9º) (Table 1). A higher CJPE in all movements was observed among females as compared to males; however, no significant statistical differences were observed (Table I). Important trends in terms of correlation included significantly positive correlation of neck discomfort with CJPE in extension, along with age in lateral flexion towards the left and weight in rotation towards the right ($p<0.05$) (Table 2).

Table-1: Median values of cervical joint positioning error, and gender-based comparison.

Variable		Cervical Joint Positioning Error (CJPE)					
		Flexion	Extension	Rotation (R)	Rotation (L)	Lat Flexion (R)	Lat Flexion (L)
Age (years)	Correlation Coefficient	-0.033	0.130	-0.005	0.017	0.116	0.192
	Sig. (2-tailed)	0.728	0.175	0.959	0.859	0.226	0.044
Weight (kg)	Correlation Coefficient	0.081	0.000	-0.189	-0.110	-0.076	-0.106
	Sig. (2-tailed)	0.398	0.999	0.046	0.249	0.430	0.270
Height (cm)	Correlation Coefficient	0.126	0.054	-0.0666	-0.160	0.023	-0.059
	Sig. (2-tailed)	0.189	0.570	0.492	0.093	0.809	0.538
BMI (kg/m^2)	Correlation Coefficient	0.003	0.004	-0.178	-0.058	-0.154	-0.082
	Sig. (2-tailed)	0.973	0.964	0.061	0.545	0.106	0.394
Neck Discomfort	Correlation Coefficient	0.021	0.228	-0.017	-0.051	-0.010	0.123
	Sig. (2-tailed)	0.828	0.016	0.863	0.596	0.917	0.198

Table-2: Cervical joint positioning error correlation with age, weight, height, Body mass index and neck discomfort.

Direction of Movement	Cervical Joint Positioning Error (CJPE) Median (IQR)			
	Median	Male	Female	*p*-value
Flexion	9 (9)	9 (8)	10 (11)	0.420
Extension	6 (8)	5 (7)	7 (7.8)	0.265
Rotation Right	8 (7)	8 (7)	7.5 (6.8)	0.978
Rotation Left	9 (6)	8 (7)	10 (6)	0.051
Lateral Flexion Right	5 (5)	5 (5)	4.5 (6)	0.894
Lateral Flexion Left	5 (7)	4 (7)	5 (8)	0.243

Discussion

Existing literature has found impaired cervical joint positioning sense in individuals with chronic neck pain and the elderly, with significantly higher values of CJPE as compared to healthy young adults.[12] However, the current study shows that cervical joint positioning sense is altered even among asymptomatic healthy young adults,[13] signifying the importance of establishing normative values to be used as a reference. The current study also presents the normative values of CJPE for healthy young adults; which was highest in flexion (9º±9º), followed by rotation towards the left (9º±6º) and right (8º±7º), extension (6º±8º), and lastly lateral flexion towards the left (5º±7º) and right (5º±5º). A study conducted by Ghamkhar L et al explored the relationship between joint positioning sense and neck flexor endurance and found no significant correlation between neck flexor endurance and CJPE, both in asymptomatic and chronic neck pain patients.[14] Moreover, no significant association was noted between neck pain and CJPE in chronic neck pain patients in Ghamkhar L et al's study,[14] which is in accordance with the findings of the current study, showing no significant correlation between neck discomfort and CJPE among healthy young adults, except for CJPE in extension which was observed to be significantly positively correlated with neck discomfort. The current study also adds to the evidence by demonstrating higher values of CJPE

among females as compared to males; however, the differences were not significant. A study conducted by Vuillerme N et al showed that cervical joint positioning sense is significantly more impaired in older adults as compared to young adults,[15] but the current study was unable to show any significant trend, because of a limited inclusion criteria in terms of age, as the focus in the current study was on undergraduate students. Another study conducted by Treleaven J et al demonstrated a high positive prediction value (88%) of CJPE in determining the impairment in balance and smooth pursuit neck torsion test, which is used for cervical dizziness, suggesting that in patients with whiplash associated disorders, it is imperative to consider CJPE in addition to measures of standing balance and smooth pursuit neck torsion test to identify impairments in the postural control system.[16]

Conclusion

Cervical joint positioning sense is altered even among healthy young adults, which signifies the importance of establishing normative values to be used as a reference. It can be concluded that neck discomfort has a significantly positive correlation with CJPE in extension and females have greater values of CJPE in all movement directions; however, the differences are not significant.

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