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COMPARISON OF SIMPLE REACTION TIME AND CERVICAL PROPRIOCEPTION IN ASYMPTOMATIC YOUNG ADULTS WITH FORWARD HEAD POSTURE (FHP) AND NORMAL HEAD POSTURE (NHP)

Physiotherapy

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ABSTRACT

Background: Proprioceptive afferent input from neck muscles plays an important role in postural control. Forward head posture has the potential to impair proprioceptive information from neck muscles and contribute to postural control deficits in patients with neck pain. **Aim:** To compare simple reaction time and cervical proprioception in asymptomatic young adults with forward head posture and asymptomatic adults with normal head posture. **Methods:** One hundred and sixty, 94 were males and 66 were females with no history of fracture, neuromuscular disorder, or pain in the cervical region, participated in this study. Their mean age, height, and weight were 22 years, 168.78 ($\pm$11.89) cm, and 63.56 ($\pm$12.89) kg, respectively. The purpose and procedures of this study were explained to all subjects, and they provided written informed consent prior to participation. Participants were asked to stand in their comfortable posture in front of a plain and white wall looking forward, hanging their hands at their sides and their right side facing a digital camera of a mobile phone with an ON Protractor mobile application installed and a built in flash, placed on a tripod stand 50 cm apart from the subject. The spinous process of C7 and tragus will be palpated and marked with adhesive skin markers, digital photo is taken and the sagittal-C7-tragus angle will be noted. The angle between a horizontal line crossing the C7 and a line connecting the tragus to C7 will be measured in degrees. Simple Reaction Time was assessed using Deary –Liewald time task. The computer programme was used to record the response time (ms) among the study population. Cervicocephalic relocation test was used for assessing cervical proprioception of participants. **Results:** The mean flexion was 62°, extension was 52°, right lateral flexion was 42°, left lateral flexion was 45°, right rotation was 68°and left rotation was 71°. Flexion and extension was significantly higher of participants with normal head posture as compared to participants with forward head posture (p<0.05). Lateral flexion (both right and left) were significantly higher in participants with forward head posture as compared to participant with normal head posture (p<0.05). No significant difference was observed in rotation (both right and left) when classified according to head posture (p>0.05). Significantly higher percentage of females were there in the forward head posture group as compared to normal head posture group (p<0.05). **Conclusion:** We conclude that, there is no significant difference between Simple reaction time and cervical proprioception in Asymptomatic Young Adults with Forward Head Posture than Asymptomatic Young Adults with normal Head Posture.

KEYWORDS

Cervical proprioception, Simple reaction time, Forward head posture, Normal Head Posture.

INTRODUCTION:

Posture is defined as the positioning of all body segments at a given point (1). An ideally aligned posture is regarded as one in which there is perfect alignment of the weight-bearing segment, and it is commonly described by the vertical line of gravity passing anterior to the knee, posterior to the hip, through the bodies of vertebrae in both the cervical and lumbar spine, through the shoulder joint, and through the external auditory meatus (2–4). Proper posture is achieved by maintaining the musculoskeletal balance associated with minimal stress on the body and is considered an important factor in assessment of health condition. Among many factors, including vision, vestibular function, the somatosensory system, and the musculoskeletal system, proprioception is considered an essential factor for the maintenance of balance (5, 6). However, several factors, including neck pain and/or shoulder pain, can disrupt this balance, leading to development of a postural problem. (5, 7, 8)

Forward head posture (FHP), one of the most common abnormal head postures, is a postural head-on-trunk misalignment, which is defined as a head that is positioned anterior to a vertical line of gravity (9–12). It is commonly quantified by measurement of Craniovertebral (CV) angle, which assesses the head posture (13, 14). FHP can lead to development of several musculoskeletal problems, including neck pain, cervicogenic headache, temporomandibular disorder, and muscular dysfunction (15). The close relation of FHP to chronic neck and shoulder pain has been well documented (14). In addition, FHP caused the inaccurate proprioception rather than proper head posture (16). However, only a few studies investigating the correlation between FHP and proprioceptive function have been reported. Therefore, the

question of whether there is a correlation between head posture and proprioceptive function in the cervical region will be investigated in the current study.

MATERIAL AND METHODS:

This cross sectional study was conducted at the Physiotherapy School & Centre, Topiwala National Medical College Mumbai over a period of six months after getting approval from institutional ethics committee.

Inclusion Criteria
I. Young Adults 18-30 yrs
II. Forward Head Posture & Normal Head Posture
III. Both Genders
IV. Normal Corrected Vision

Exclusion Criteria
I. History of any Musculoskeletal, Neurological and Cardiopulmonary conditions
II. Cervical spine instability
III. Trauma to cervical spine
IV. Cervical spine surgery
V. Congenital spinal deformities
VI. Patients with impaired cognition
VII. Vertigo
VIII. Impaired vision

160 participants with no history of fracture, neuromuscular disorder, or pain in the cervical region, participated in this study. The purpose and

procedures of this study were explained to all subjects, and they provided written informed consent prior to participation.

Study Procedure:

For selecting the subjects, participants were asked to stand in their comfortable posture in front of a plain and white wall looking forward, hanging their hands at their sides and their right side facing a digital camera of a mobile phone with an ON Protractor mobile application installed and a built in flash, placed on a tripod stand 50 cm apart from the subject. The spinous process of C7 and tragus was palpated and marked with adhesive skin markers, digital photo was taken and the sagittal-C7-tragus angle was noted. The angle between a horizontal line crossing the C7 and a line connecting the tragus to C7 was measured in degrees. According to Nemmer et al a young healthy adult is expected to exhibit an average normal head posture within a 10° range from 49° to 59° of the C7-tragus angle. Therefore, subjects encountering angles less than 49° were considered as FHP in this study.(4)

Simple Reaction Time was assessed using Deary –Liewald time task. The procedure of the task was explained orally to the participants. Participants were be seated comfortably on a chair with a backrest in front of a laptop with the screen at—or slightly below—eye level, at least 20 inches (51 cm) from your eyes—about an arm's length distance. One white square was positioned in the center of a laptop screen, set against a blue background which was shown to the participant. The stimulus is the appearance of a diagonal cross within the square. Each time a cross appears, participant have to respond by pressing a key with the index /middle finger of their preferred hand as quickly as possible after which it disappears and another cross appears shortly after. Twenty trials were performed. This entire process takes around 10-15 minutes.

The computer programme was record the response time (ms) and the interstimulus interval (the time interval between each response and when the next cross appeared) and error (%) for each trial that was used for analysis.

Cervicocephalic relocation test was conducted for assessing cervical proprioception of participants. The participant was asked to be seated blindfolded on a chair with a backrest with their arms hanging by their sides, keeping the shoulders against the backrest, and place the rear of their heels on the floor facing a white, plain wall. The target (40cm diameter circle with concentric circles at every 1cm) was placed at 90cm distance on a wall. The participants were instructed to memorize the neutral head position. The participant perform a maximal rotation of the head to left or right for approximately two seconds, then attempt to find the initial reference position with a maximum of precision. The point was recorded. A mean of 6 trials was taken for both side rotations. If the mean value were higher than a threshold value of 4.5 degrees, the subject was considered as inaccurate. This takes around 10-15 minutes to complete the process.

The entire procedure takes approximately 25-30 minutes. The Simple Reaction Time using Deary –Liewald time task was correlated with the Cervical Proprioception using Cervicocephalic Relocation Test scores.

Statistical Method:

Data were analyzed using SPSS version 25 for Windows (version 25, 2017, IBM Corporation, Armonk, New York, United States). Data presented as Median (IQR) or frequency (%). Normality of continuous data was assessed with Shapiro Wilk test. As data was not normally distributed, data was compared between 2 head posture groups using Mann Whitney U test. Cross tabulations were computed for categorical data and compared using Fisher's exact test. Spearman correlation was used to analyze correlations. $P < 0.05$ was considered to be statistically significant.

RESULTS:

Table 1: Gender Distribution Among The Study Population

Gender distribution	Forward head posture (%)	Normal head posture (%)	P value
Males	38.7	78.7	0.001
Females	61.3	21.3	

A cross sectional study was conducted on 160 asymptomatic people. From the 160 participants, 94 were males and 66 were females.

Significantly higher percentage of females were there in the forward head posture group as compared to normal head posture group ($p < 0.05$) [Table 1].

From 160 participants, 148 had right dominance and 12 had left dominance. No significant difference in dominance was observed when classified according to head posture ($p > 0.05$) [Table 2].

Table 2: Dominance Among The Study Population

Dominance	Forward head posture (%)	Normal head posture (%)	P value
Right	88.7	96.3	0.131
Left	11.3	3.7	

The median height was 165 cm, weight was 62 kg and BMI was 22.4 kg/m². Height was significantly higher of participants with normal head posture as compared to participants with forward head posture ($p < 0.05$). No significant difference in weight or BMI was observed when classified according to head posture ($p > 0.05$) [Table 3].

Table 3: Anthropometry Among The Study Population

Anthropometry	Forward head posture (median±SD)	Normal head posture (median±SD)	P value
Height (cm)	163±11.2	168±10.3	0.030
Weight (kg)	59±9.8	64.5±10.2	0.105
BMI (kg/m²)	22.2±5.2	22.5±3.4	0.579

The mean flexion was 62°, extension was 52°, right lateral flexion was 42°, left lateral flexion was 45°, right rotation was 68° and left rotation was 71°. Flexion and extension was significantly higher of participants with normal head posture as compared to participants with forward head posture ($p < 0.05$). Lateral flexion (both right and left) were significantly higher in participants with forward head posture as compared to participant with normal head posture ($p < 0.05$). No significant difference was observed in rotation (both right and left) when classified according to head posture ($p > 0.05$) [Table 4].

Table 4: Cervical Range Of Motion Among The Study Population

Cervical range of motion	Forward head posture (mean±SD)	Normal head posture (median±SD)	P value
Flexion (°)	58 (16)	65 (10)	0.001
Extension (°)	51.5 (5)	52 (5)	0.013
Right lateral flexion (°)	46 (10)	42 (5)	0.001
Left lateral flexion (°)	47 (11)	43.5 (5)	0.001
Right rotation (°)	68.5 (16)	68 (14)	0.143
Left rotation (°)	70.5 (16)	71 (12)	0.706

The median craniovertebral angle was 49.1°. Craniovertebral angle was significantly higher in participants with normal head posture as compared to participants with forward head **posture ($p < 0.05$) [Fig 1].**
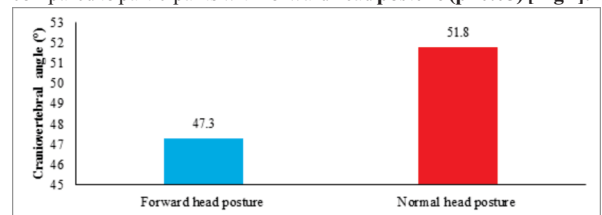

Fig 1

The median response time was 314ms. Though response time was higher in participants with forward head posture as compared participants with normal head posture, this difference was not significant ($p > 0.05$) [Fig 2].
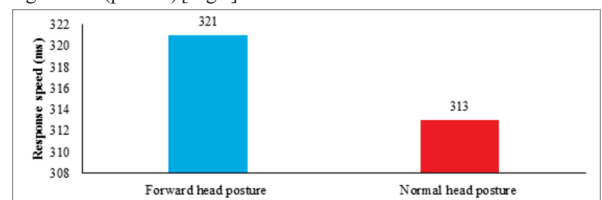

Fig 2

The median right-side rotation was 5.9° and median left-side rotation was 6.2°. Though rotation (both left and right) was higher in participants with forward head posture as compared to participant with normal head posture, this difference was not significant (p>0.05) [Fig 3].
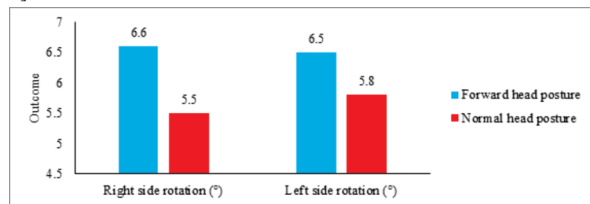

Fig 3

DISCUSSION

The purpose of our study was to compare simple reaction time and cervical proprioception in forward head and normal head individuals.160 participants participated in the study, out of which 80 were forward head individuals and 80 normals. They were assessed for cervical proprioception using Cervico-Cephalic relocation test and 6 trails was recorded. Further, simple reaction time was calculated using Deary-Liewald Software.

Cervical proprioception and simple reaction time in females with forward head was more as compared to males (pvalue- 0.001). No significant difference was found in cervical proprioception and simple reaction time in subjects with right and left hand dominance (p-value 0.131), age (p-value 0.055).

Considering the anthropometric data, mean height was 165 cm, weight 62 kg, and BMI 22.4 kg/m^2,Out of which, height was significantly higher of participants with normal head posture (p-value 0.030) whereas, weight and BMI had no significance (p-value 0.105) and (p-value 0.579) respectively.

Flexion and extension was significantly higher in participants with normal head posture (pvalue- 0.001) and (0.013) respectively. Lateral flexion (both right and left) were significantly higher in participants with forward head posture as compared to normal head posture (pvalue- 0.001) for both right and left lateral flexion. No significant difference was observed in rotations (both right and left) when classified according to head posture, (p value- 0.143) and (pvalue- 0.706) respectively. This correlates with a study that concluded, FHP mediated the relationship between thoracic kyphosis and cervical ROM, specifically general cervical rotation and flexion. Their results not only support the justifiable attention given to addressing FHP to improve cervical impairments, but they also suggest that addressing thoracic kyphosis impairments.(17-19)

The craniovertebral angle was found to be significantly higher in participants with normal head posture as compared to participants with forward head individuals. (p-value-0.001). Also, the median response speed was found to be higher in participants with forward head posture as compared to participants with normal head posture, but the difference was not statistically significant (p-value 0.194).

For Cervico-cephalic relocation test the median right side location was 5.9 degree and median left side rotation was 6.2 degree. Both right and left side rotations were found to be higher in participants with forward head posture, but the difference was not statistically significant (p-value-0.240) and (pvalue-0.153) respectively. This correlates with the findings of E.Sajjadi et al that FHP has no effect on cervical joint position sense. [17] In other words, due to changes in muscle length and orientation followed by a change in joint position, as a result of poor habitual posture, the outcome of bad variables overcomes good variables, when performing a particular task more than once.

The factors that could have led to an altered or increase in the reaction time during the time of test involves presence of external disturbances like sound, light or presence of pain at the time of study, and importantly mental and physical alertness was cautiously avoided.

FHP is associated with reduced proprioception. This result implies that the change in the muscle length caused by FHP decreases the joint position sense. Also, proprioception becomes worse as FHP becomes more severe.

CONCLUSION
- There was no significant increase in simple reaction time in forward head individuals.
- There was significant difference in cervical proprioception in forward head individuals.

Hence we conclude that, there is no significant difference between Simple reaction time and cervical proprioception in Asymptomatic Young Adults with Forward Head Posture than Asymptomatic Young Adults with normal Head Posture.

Conflict Of Interest: Nil

Funding: Nil

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