

Cervicogenic Headache among Subjects with Forward Head Posture: A Correlational Cross–Sectional Study

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Abstract

Background: Cervicogenic headache (CGH) is a common type of headache that arises from cervical spine pathology, often exacerbated by postural issues such as forward head posture (FHP).

Aim of Study: To investigate the correlation between FHP and the prevalence of CGH among young adults.

Material and Methods: A cross-sectional study was conducted on 343 patients aged 18–26 years with abnormal posture. Cervicogenic headache (CGH) was assessed using classification and confirmation criteria. Cervical posture was measured using craniovertebral angle and flexion rotation tests (FRT). Group comparisons and correlations were analyzed using *t*-tests, ANOVA, and Spearman's correlation.

Results: 15.2% of participants were CGH-positive, and 11.4% had confirmed CGH. No significant differences were found between CGH groups in age, BMI, or craniovertebral angle ($p > 0.05$). However, CGH-positive and confirmed CGH groups had significantly reduced right and left FRT values ($p = 0.0001$). Flexion rotation tests showed strong correlations with CGH status. CGH classification had strong positive correlations with FRT ($r = 0.621$ and 0.591), while CGH confirmation had strong negative correlations ($r = -0.594$ and -0.563). Craniovertebral angle showed no significant correlation.

Conclusion: CGH is strongly associated with limited cervical rotation but not with craniovertebral angle. Flexion rotation tests are valuable in evaluating CGH in patients with abnormal posture.

Key Words: Cervicogenic Headache (CGH) – Forward head posture (FHP) – International Headache Society (IHS) – Craniovertebral Angle (CVA) – Flexion Rotation Test (FRT).

Introduction

CERVICOGENIC headache (CGH) is a subset of secondary headaches that may be caused by musculoskeletal dysfunction of cervical spine, particularly upper cervical segments, or by a serious underlying condition like brain tumors, aneurysm, substance abuse or withdrawal, even an inflammatory or infectious condition. Despite, CGH may be referred pain from nearby structures like the teeth, nose, ears, or neck [1].

Nearly 47% of worldwide population experiences headaches, with CGH accounting for 15–20% of all chronic and recurrent headaches. Where, 2.2–2.5% of adult humans suffering from CGH, noting that women are affected four times more often than males [2]. Classification of CGH was based on a variety of subjective features, where physical examination revealed that cervical function impairment i.e., Atlanto–axial dysfunction was almost involvement [3].

Recently, it was stated that CGH may be distinguished from other headache sorts by one hundred percent sensitivity and ninety–four percent specificity using combination of three cervical spine and musculoskeletal functional special tests those were cervical motor control, upper cervical manual examination, and cervical motor response [4].

Despite the upper cervical spine originating pain from articular joints, intervertebral discs, or surrounding ligaments had historically been associated with CGH. Unless recently, clinicians should take into account the received muscular inputs [5].

According to International Headache Society (IHS), cervicogenic headache associated pain

might be uni or bilateral, affect head or face, but most frequently manifested in occipital, frontal, or retro-orbital regions. In addition, it was distinguished from neck involvement symptoms such as pain with movement, upper cervical compression, and/or prolonged awkward positions [6].

Almost adolescence stage accompanied of multiple bad posture either because of sustained atypical positions or prolonged smartphone usage for extended hours daily, which puts users at cumulative risk for traumatic disorders [7].

The development of neck pain had been linked to FHP; a common postural deviation documented in the literature. FHP was reported to affect 61.3% of individuals with neck discomfort whom were computer-dependent. Deep neck flexors who, suffers from persistent neck pain showed weakening, and presented with FHP when distracted [8].

Material and Methods

This study was carried out at outpatient clinic of Faculty of Physical Therapy, Misr University for Science and Technology, 26th of July Corridor, First 6th of October, Giza Governorate, the clinical part of the study was between January 2023 to September 2024. 343 subjects were recruited for this study.

The study protocol was authorized by the faculty of physical therapy's research ethical committee (NO: P.T.REC/012/004542) and registered on [ClinicalTrials.gov](https://clinicaltrials.gov) Identifier: NCT04722913.

The G*Power software (version 3.0.10) was applied to calculate the sample size. Correlation one group model was selected. Considering a power of 0.80, (two tails) and alpha level of 0.05. Three-

hundred, forty-three participants were selected randomly.

Between the ages of 18 and 25 years, 343 individuals of both sexes were recruited in the study. They complained of neck pain. If they had cervical spine injuries i.e., fractures, sprain, strain or whiplash, also cervical spondylosis, obvious spinal deformities, neurological and/or neuromuscular disorders, tempo-mandibular joint 'TMJ' dysfunction, torticollis, and cervicothoracic and/or lumbar kyphoscoliosis, they weren't included in the study.

Evaluative procedures:

Forward head posture (FHP) was assessed by craniovertebral angle (CVA) that was calculated by taking a line from C7 to tragus of the ear and horizontal line from C7, as shown in Fig. (1). Participant was instructed to stand in a relaxed position at the marker on the floor, making cervical flexion and extension to be relaxed, three images were taken for each participant and these images were uploaded on the software to be analyzed [9].

FRT was carried out for diagnosing CGH. FRT was performed with participant relaxed in supine, then passively took participant cervical spine into full flexion. End-range cervical flexion imparts ligamentous tension that impedes movement at vertebral segments below C2 Fig. (2). After maintaining flexion position, participant head was rotated to each side until participant reports pain or researcher determined the end of motion has been achieved. It was determined if a restriction in ROM was present. In cases of CGH, the FRT usually reveals a unilateral ROM restriction on the symptomatic side. This test was considered positive if the estimated ROM was reduced by more than 10° from anticipated normal range of 44° [10].

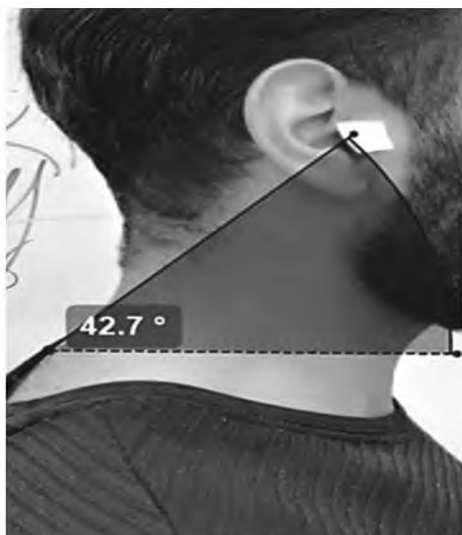


Fig. (1): CVA angle assessment.



Fig. (2): Flexion rotation test.

Three-hundred thirty-four participants had undergone checklist for CGH confirmation involving presence of:

- Any headache fulfilling criterion C in the major criteria of CHISG.
- Clinical, laboratory and/or imaging evidence of a disease or lesion within the cervical spine or soft tissues of the neck known to be able to cause headache.

Inclusion criteria:

Each participant, who had included according to the following criteria:

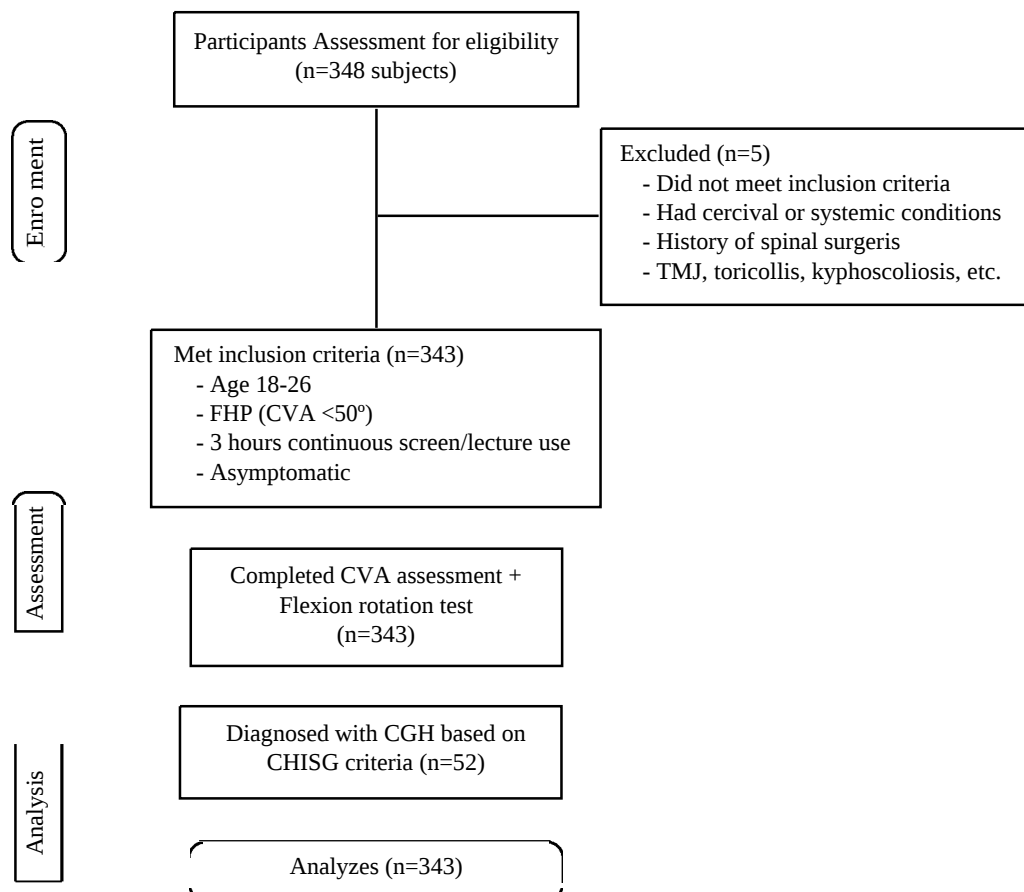
Adolescent physical therapy students of both genders, Participants age ranged between 18 and 25 years old [11], Participant' allocated from Misr University, Cairo Governate, Egypt, Participants whom were taking consecutive lectures for three hours, or worked forward for three hours or more on laptop [12], Asymptomatic forward head posture 'FHP' with craniovertebral angle (CVA) <50° [13], Subjects suffered from neck pain, BMI was calculated according to formula:

$$\text{BMI} = \frac{\text{Weight (Height)}^2}{(\text{Kg/m}^2)} \quad (\text{Abbasi et al., 2018})$$

Exclusion criteria:

The study excluded the participant if has one or more of the following criteria:

Participants with history of significant medical diagnosis that might be potential contraindications to cervical spine physical examination including cancer, osteoporosis, nerve root manifestation, infectious and/or inflammatory diseases, Participants potential contraindications to cervical spine physical examination that might affects cervical spine stability, i.e., whom with potential vertebrobasilar insufficiency manifestations [14], Participants with neck pain or cervical spine injuries i.e., fractures, sprain, strain or whiplash, also cervical spondylosis, obvious spinal deformities, neurological and/ or neuromuscular disorders, Participants potential contraindications to cervical spine including temporomandibular joint 'TMJ' dysfunction, torticollis, and cervicothoracic and/or lumbar kyphoscoliosis, Participants with rheumatic disease and/or balance disorders [15], Participants whom undergone any previous spine, shoulders or abdominal surgeries.



Flow chart of the participants

Statistical analysis:

The statistical analysis was conducted by using statistical SPSS Package program version 25 for Windows (SPSS, Inc., Chicago, IL). Quantitative data reported as the mean and standard deviation for patient's demographic data and forward head posture measurements. Qualitative data expressed as the frequency and percentage for distributions of criteria for CGH classification and confirmation of CGH. Unpaired *t*-test used to compare between positive and negative cervicogenic headache groups for forward head posture measurements. One-way analysis of variance used to compare among confirmation of CGH categories for forward head posture measurements. Spearman rank correlation coefficient was performed to compute the relation and direction between CGH and cervical posture in abnormal posture patients. All statistical analyses were significant at level of probability ($p \leq 0.05$).

Results

The descriptive statistics of participants in whole study population group is presented in Table (1). In the current study, 343 patients with abnormal posture were participated and their age (years) ranged from 18.00 to 26.00 years with mean value of age 21.05 ± 2.15 years. The mean value of weight (kg) was 74.21 ± 5.84 kg with ranged from 56.00 to 92.50 kg. The mean value of height (cm) was 166.60 ± 3.60 cm with ranged from 153.00 to 173.00 cm. The mean value of BMI (kg/m^2) was 26.74 ± 2.06 kg/m^2 with ranged from 21.05 to 35.65 kg/m^2 . The mean value of craniovertebral angle (degree) was 41.61 ± 5.19 degree with ranged from 28.70 to 49.90 degree. The mean value of right flexion rotation test (degree) was 38.74 ± 5.88 degree with ranged from 20.00 to 46.00 degree. The mean value of left flexion rotation test (degree) was 40.83 ± 3.47 degree with ranged from 22.00 to 46.00 degree.

The distribution of criteria for CGH classification (Table 1) for categories positive and negative were 52 (15.20%) and 291 (84.80%), respectively. More than half and quarter of the participants belonged to negative cervicogenic headache (84.80%) and then positive cervicogenic headache (15.20%). The distribution of CGH confirmation (Table 1) categories for negative, partial, and confirmed were 295 (86.00%), 9 (2.60%), and 39 (11.40%), respectively. More than half and quarter of the participants belonged to negative (86.00%), followed by confirmed (11.40%), and then partial (2.60%) of CGH confirmation.

The comparative mean values of clinical general characteristic related to cervicogenic headache

are presented in Table (2). The statistical analysis revealed no significant differences ($p > 0.05$) between positive and negative cervicogenic headache groups in mean values of patient's age ($p = 0.474$), weight ($p = 0.487$), height ($p = 0.247$), and BMI ($p = 0.786$).

The comparative mean values of forward head posture measurements related to cervicogenic headache (CGH) are presented in Table (2). The statistical analysis revealed no significant differences ($p > 0.05$) in mean values of patient's craniovertebral angle ($p = 0.933$), while there were significant difference in patient's right flexion rotation test ($p = 0.0001$) and left flexion rotation test ($p = 0.0001$) between positive and negative cervicogenic headache groups related to criteria for CGH classification. There was no significant differences ($p > 0.05$) in mean values of patient's craniovertebral angle ($p = 0.865$), while there were significant difference in patient's right flexion rotation test ($p = 0.0001$) and left flexion rotation test ($p = 0.0001$) among negative, partial, and confirmed groups related to confirmation of CGH.

The bi-variate correlation between criteria for CGH classification and cervical posture measurement in abnormal posture patients group are presented in Table (3). The results of these correlational analyses revealed there were significantly ($p < 0.05$) positive strong relation between criteria for CGH classification with right flexion rotation test ($r = 0.621$; $p = 0.0001$) and left flexion rotation test ($r = 0.591$; $p = 0.0001$). However, there was no significantly ($p > 0.05$) relation between criteria for CGH classification and craniovertebral angle ($r = 0.002$; $p = 0.969$). These significant positive correlations mean that change in the criteria for CGH classification is consistent with change of right and left flexion rotation tests. The direction of the relations between criteria for CGH classification and right flexion rotation test (Fig. 3) and left flexion rotation test (Fig. 4) showed that by increase criteria for CGH classification, right and left flexion rotation tests increased (positive relation) in abnormal posture patients. But, non-significant relation means that change in the criteria for CGH classification isn't consistent with change craniovertebral angle in abnormal posture patients.

The bi-variate correlation between confirmation of CGH and cervical posture measurements in abnormal posture patients group are presented in Table (3). The results of these correlational analyses revealed there were significantly ($p < 0.05$) negative strong relation between confirmation of CGH with right flexion rotation test ($r = -0.594$; $p = 0.0001$)

and left flexion rotation test ($r=-0.563$; $p=0.0001$). However, there was no significantly ($p>0.05$) relation between confirmation of CGH and craniovertebral angle ($r=-0.009$; $p=0.862$). These significant positive correlations mean that change in the confirmation of CGH is consistent with change of right and left flexion rotation tests. The direction of the relations between confirmation of CGH and right

flexion rotation test (Fig. 5) and left flexion rotation test (Fig. 6) showed that by increase criteria for CGH classification, right and left flexion rotation tests decreased (negative relation) in abnormal posture patients. But, non-significant relation means that change in the criteria for CGH classification isn't consistent with change craniovertebral angle in abnormal posture patients.

Table (1): Descriptive statistic of participants in study population group (n=343).

Quantitative variables*	Mean $\pm$ SD	Minimum	Maximum
Age (year)	21.05 $\pm$ 2.15	18.00	26.00
Weight (kg)	74.21 $\pm$ 5.84	56.00	92.50
Height (cm)	166.60 $\pm$ 3.60	153.00	173.00
BMI (kg/m ²)	26.74 $\pm$ 2.06	21.05	35.65
Craniovertebral angle	41.61 $\pm$ 5.19	28.70	49.90
Right flexion rotation test	38.74 $\pm$ 5.88	20.00	46.00
Left flexion rotation test	40.83 $\pm$ 3.47	22.00	46.00
Qualitative variables**	Number	Percentage	
<i>Criteria for CGH classification:</i>			
Positive	52	15.20%	
Negative	291	84.80%	
<i>Confirmation of CGH:</i>			
Negative	295	86.00%	
Partial	9	2.60%	
Confirmed	39	11.40%	

* Quantitative data variables are expressed as mean $\pm$ standard deviation.

** Qualitative data variables are expressed as frequency and percentage.

Table (2): Comparisons mean values of clinical general characteristic and forward head posture measurements related to cervicogenic headache (CGH).

Items	Cervicogenic headache (n=343)			p-value
Clinical general characteristics	Positive (n=52)	Negative (n=291)		
Age (year)	21.25±2.15	21.02±2.15		0.474
Weight (kg)	73.62±6.76	74.32±5.67		0.487
Height (cm)	166.17±2.68	166.68±3.74		0.247
BMI (kg/m ²)	26.66±2.41	26.76±2.00		0.786
Criteria for CGH classification	Positive (n=52)	Negative (n=291)		
Craniovertebral angle	41.55±5.59	41.62±5.12		0.933
Right flexion rotation test	26.21±5.00	40.98±1.78		0.0001*
Left flexion rotation test	35.21±4.59	41.84±1.96		0.0001*
Confirmation of CGH	Negative (n=295)	Partial (n=9)	Confirmed (n=39)	
Craniovertebral angle	41.63±5.13	42.30±2.70	41.31±6.03	0.865
Right flexion rotation test	40.80±2.43	27.55±6.38	25.74±4.59	0.0001*
Left flexion rotation test	41.75±2.16	36.33±3.80	34.97±4.81	0.0001*

Data are expressed as mean $\pm$ standard deviation (SD). p-value: Probability value. * Significant ($p<0.05$).

Table (3): Correlation between cervicogenic headache (CGH) and cervical posture in abnormal posture patients group.

Cervical posture	Criteria for CGH classification		Confirmation of CGH	
	<i>r</i> -value	<i>p</i> -value	<i>r</i> -value	<i>p</i> -value
Craniovertebral angle	0.002	0.969	-0.009	0.862
Right flexion rotation test	0.621	0.0001*	-0.594	0.0001*
Left flexion rotation test	0.591	0.0001*	-0.563	0.0001*

r: Spearman correlation coefficient value. *Significant: ($p < 0.05$).

p-value: Probability value.

NS: Non-significant.

Strong correlation (± 0.50 to ± 1); Moderate correlation (± 0.30 to ± 0.49); Low correlation ($< \pm 0.29$).

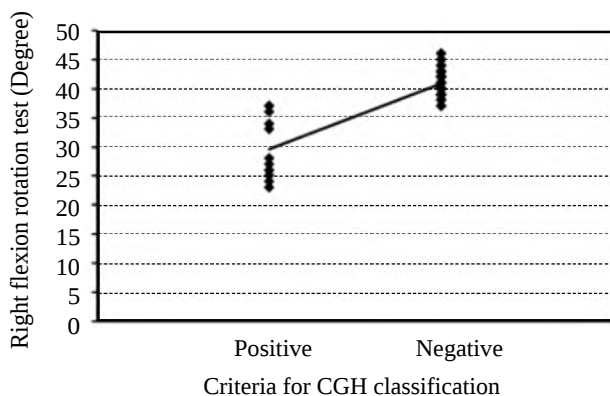


Fig. (3): Scatter plot between criteria for CGH classification and right flexion rotation test.

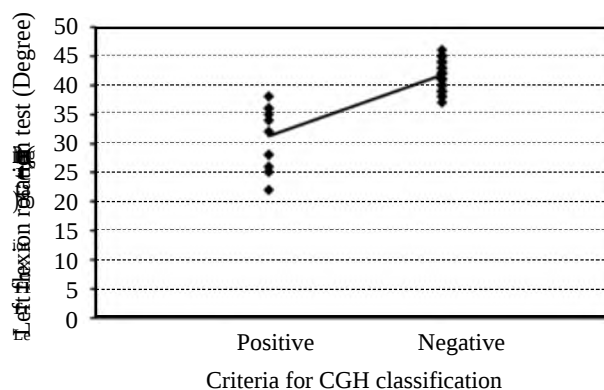


Fig. (4): Scatter plot between criteria for CGH classification and left flexion rotation test.

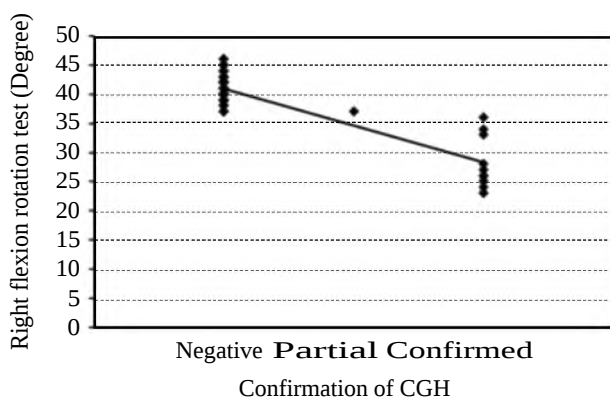


Fig. (5): Scatter plot between confirmation of CGH and right flexion rotation test.

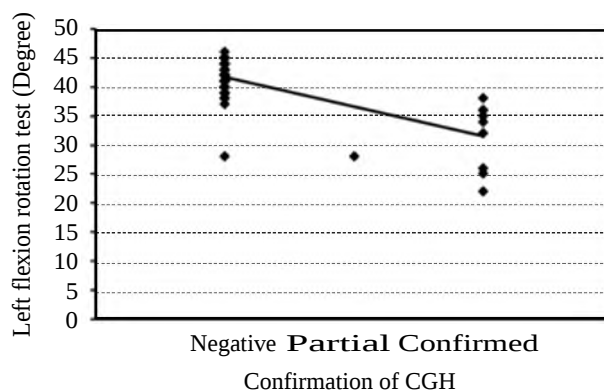


Fig. (6): Scatter plot between confirmation of CGH and left flexion rotation test.

Discussion

Cervicogenic headache (CGH) is a common type of headache that originates from the cervical spine, often associated with neck pain and restricted neck movement. Forward head posture (FHP), a postural deviation where the head protrudes forward, is frequently linked to neck dysfunction and pain [16].

While some studies suggest that FHP may contribute to CGH, others argue that cervical mobility

and muscle function play a more significant role. This study investigates the relationship between FHP, cervical mobility, and CGH, aiming to clarify whether FHP is directly associated with CGH or if other factors, such as reduced cervical mobility, are more critical. By exploring these relationships, the study provides insights into the assessment and treatment of CGH, particularly in individuals with abnormal cervical posture [17].

Cervical mobility should be a key focus in the evaluation of patients with CGH. The flexion ro-

tation test (FRT) appears to be a reliable tool for identifying cervical dysfunction in this population. While forward head posture (FHP) is a common postural deviation, its role in CGH may be less direct than previously thought. Clinicians should consider other factors, such as muscle tone and joint mechanics, when assessing and treating patients with CGH. Physical therapy interventions aimed at improving cervical mobility and neuromuscular control may be more effective in managing CGH than interventions focused solely on correcting FHP.

The current study aimed to explore the association between cervicogenic headache (CGH) and forward head posture (FHP).

The primary question of the research was whether FHP was associated with CGH, and the study seeks to provide evidence to support the assessment and treatment of abnormal cervical posture in patients with CGH. The results of this study, which involved 343 participants with abnormal posture, divided into groups based on the presence or absence of CGH.

In agreement with the current studies, regarding Cervical Mobility and CGH, Hall et al. [18] found that restricted cervical mobility, particularly at the C1-C2 segment, is a key feature of CGH. They reported that the flexion-rotation test (FRT) had high sensitivity and specificity for diagnosing CGH, which aligns with findings that participants with CGH had significantly reduced FRT values compared to those without CGH [19].

However, the lack of a significant correlation between forward head posture (FHP) and CGH is somewhat surprising. While FHP is often implicated in cervical dysfunction and pain, this study suggests that FHP alone may not be a direct predictor of CGH. Instead, other factors, such as muscle tone, joint mobility, and neuromuscular control, may play a more critical role in the development of CGH.

Zito et al. [17] also reported that patients with CGH exhibited a reduced cervical range of motion (ROM), particularly in rotation and flexion-extension. This supports the observation that cervical mobility is a critical factor in CGH.

In contrast to the current study regarding Cervical Mobility and CGH, Jull et al. [18] found that while cervical mobility was reduced in patients with CGH, it was not the sole determinant of headache symptoms. They emphasized the role of muscle control and neuromuscular coordination in the

development of CGH, which partially aligns with the findings but suggests that cervical mobility alone may not be sufficient to explain CGH.

Sjaastad et al. [19] argued that CGH is primarily a disorder of the upper cervical joints and that cervical mobility tests, such as the FRT, may not capture the full complexity of CGH. This challenges the reliance on the FRT as a primary diagnostic tool for CGH.

Regarding forward Head Posture and Cervical Dysfunction, Kim et al. [16] supported the results by finding that FHP was associated with increased muscle tension in the cervical extensors and reduced cervical ROM. While they did not directly link FHP to CGH, they suggested that FHP could contribute to cervical dysfunction, which is consistent with our findings that FHP may play an indirect role in CGH.

Also, Lee et al. [21] reported that FHP leads to altered muscle activation patterns in the cervical and scapular regions, which could contribute to neck pain and dysfunction. This supports the hypothesis that FHP may contribute to cervical dysfunction, even if it is not directly correlated with CGH.

In contrast, Fernández-de-las-Peñas et al. [22] found a significant association between FHP and CGH. They reported that patients with CGH had a smaller craniovertebral angle (CVA) compared to healthy controls, suggesting that FHP is a direct contributor to CGH. This contradicts the finding that there was no significant correlation between CVA and CGH.

Yip et al. [23] also reported that FHP was more prevalent in patients with CGH and suggested that postural correction should be a key component of CGH management. This contrasts with the study conclusion that FHP may not be a direct predictor of CGH.

Regarding Muscle Tone and CGH, Park et al. [24] found that patients with CGH had higher muscle tone in the suboccipital and upper trapezius muscles compared to healthy controls. This aligns with the study suggestion that muscle tone and neuromuscular control may play a more significant role in CGH.

But regarding Posture and Pain, Griegel-Morris et al. [25] found that poor posture, including FHP, was associated with increased neck pain and disability. However, they did not specifically link FHP

to CGH, suggesting that while FHP may contribute to neck pain, it may not be directly related to headache symptoms. This partially contradicts our findings, as it implies that FHP could still play a role in cervical dysfunction, even if it is not directly linked to CGH.

Conclusion:

CGH is strongly associated with limited cervical rotation but not with craniovertebral angle. Flexion rotation tests are valuable in evaluating CGH in patients with abnormal posture.

Recommendation:

It is necessary to carry out additional research in various age groups.

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الصداع «عنق المصدر» بين الأشخاص الذين يعانون من قوام الرأس الأمامي: دراسة ارتباطية مقطعية

الخلفية: الصداع العنقي المنشأ هو نوع شائع من الصداع ينشأ نتيجة لاضطرابات في العمود الفقري العنقي، وغالباً ما يتفاقم بسبب مشكلات وضعية مثل وضع الرأس المتقدم.

الهدف: هدفت هذه الدراسة إلى التحقيق في العلاقة بين وضع الرأس المتقدم وانتشار الصداع العنقي المنشأ بين البالغين الشباب.

الطرق والاساليب: تم إجراء دراسة مقطعية شملت ٢٤٣ مريضاً تتراوح أعمارهم بين ١٨ و ٢٦ عاماً ويعانون من وضعية جسمية غير طبيعية. تم تقييم الصداع العنقي باستخدام معايير التصنيف والتأكيد. كما تم قياس وضعية الرقبة باستخدام زاوية القحف الفقرية واختبار الدوران أثناء الثنى. تم استخدام اختبارات «تى» وتحليل التباين ومعامل ارتباط سبيرمان لتحليل الفروقات والعلاقات بين المتغيرات المنشأ.

النتائج: بلغت نسبة المرضى المصنفين إيجابياً للصداع العنقي ١٥,٢ ٪، وتم تأكيد الإصابة في ١١,٤ منهم. لم تُسجل فروق معنوية بين مجموعات المرضى من حيث العمر أو مؤشر كتلة الجسم أو زاوية القحف الفقرية ($p>0.05$). لكن المجموعات المصابة بالصداع العنقي أظهرت انخفاضاً كبيراً في قيم اختبار الدوران أثناء الثنى ($p=0.0001$). أظهرت اختبارات الدوران أثناء الثنى ارتباطات قوية بحالة الصداع العنقي، حيث كان هناك ارتباط إيجابي قوى مع التصنيف ($r=0.621$ و $p=0.0001$)، وارتباط سلبي قوى مع التأكيد ($r=0.594$ و $p=0.0001$). بينما لم يكن هناك ارتباط معنوي مع زاوية القحف الفقرية.

الخلاصة: يرتبط الصداع العنقي بشكل كبير بانخفاض مدى دوران الرقبة، لكنه لا يرتبط بشكل معنوي بوضعية الرأس الأمامي كما تُقاس بزاوية القحف الفقرية. يُعد اختبار الدوران أثناء الثنى أداة فعالة في تقييم الصداع العنقي لدى المرضى ذوي الوضعية غير الطبيعية.