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Relationship Between Cervical Range Of Motion And Headache Disability In Patients With Cervicogenic Headache: A Prospective Longitudinal Study

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Abstract

Background: A common type of secondary headache disorder that occurs in the individual with neck pain, restricted cervical mobility, and significant functional disability is cervicogenic headache (CGH). Cervical ROM impairment is often considered to be a main feature of CGH. However, it is unclear how it relates to headache-related disability over time. **Objectives:** To investigate the cervical ROM and headache disability relationship in cervicogenic headache patients and determine the association of improvement of cervical mobility with headache-related disability over time. **Methods:** A prospective longitudinal observational study was conducted to observe 104 patients with cervicogenic headache. Participants were assessed at baseline and at 3 and 6 months. We used cervical range of motion (ROM), the Headache Disability Index (HDI), Neck Disability Index (NDI), the Visual Analogue Scale (VAS), and the Short Form-36 scale (SF-36) as outcome measures. We conducted a series of analyses including repeated-measures ANOVA, Pearson correlation analysis, and multiple linear regression. **Results:** Significant improvements were observed in cervical flexion, extension, and bilateral rotation over the six-month follow-up period (all $p < .001$). HDI, NDI, and VAS scores decreased significantly, while SF-36 scores improved significantly (all $p < .001$). Pearson correlation analysis demonstrated significant negative associations between cervical ROM and headache disability across all assessment periods ($r = -0.630$ to -0.787, $p < .001$). Multiple regression analysis showed that changes in cervical ROM significantly predicted changes in headache disability ($R^2 = .565$, $p < .001$). **Conclusion:** Patients with cervicogenic headache exhibit a strong association between reduced cervical range of motion and increased headache-related disability. Better cervical ROM has strong associations with less disability, indicating that assessment and rehabilitation of cervical mobility is important in the management of cervicogenic headache.

Keywords: Cervicogenic headache, cervical range of motion, headache disability, neck disability, physiotherapy, rehabilitation.

1. Introduction

Cervicogenic Headache: Clinical Overview

Cervicogenic headache (CGH), a type of secondary headache disorder, originates from dysfunctional cervical spine structures like the cervical joints, muscles, ligaments, discs, and neural tissues (Verma et al 2021). The 1st headache is

characterised by unilateral head pain that often begins in the neck and radiates to the frontal, temporal, orbital, or parietal regions (Verma et al., 2021). Due to mirroring symptoms of migraine, the untreated CGH has been grossly under-treated and underdiagnosed, causing a reduction in quality of life and prolonged disability (Verma et al. 2021). The clinical features include pain in the neck, limited movements of the cervical region, tenderness of the cervical muscles, and headache (Saini et al. 2021). Modern evidence indicates that mechanisms of trigeminocervical convergence are responsible for the referral of cervical structures' pain to cranial areas (Piovesan et al., 2024). The impact of CGH goes beyond just pain; it adversely affects a patient's physical, emotional, occupational, and social functioning, all of which together contribute significantly to disability and reduced productivity (Chitlange & Harjpal, 2025).

Cervical Range of Motion Impairments in Cervicogenic Headache

Restriction of the cervical range of motion (ROM) is one of the most apparent physical impairments that people with CGH experience (Anarte-Lazo et al., 2021). Clinical examination studies showed less cervical flexion, extension, lateral flexion, and rotational mobility of the headache populations than asymptomatic individuals (Anarte-Lazo et al, 2021). Changes in cervical flexion and extension after physiotherapy are related to improvement in physical functioning and quality of life (Lendraitiene et al., 2021). Significant reductions in cervical rotation measured through the flexion-rotation test have been documented in cases with CGH, indicating upper cervical dysfunction as an important clinical feature (Saini et al., 2021). Research studying the cervical mobility of headache sufferers shows that restrictions in cervical mobility are often linked to increased symptom severity and functional disability (Bakhtadze et al, 2021; Rostron, 2021). Further evidence has shown cervical musculoskeletal impairments in headache disorders. Individuals with headache conditions exhibit reduced cervical active range of motion, impaired performance on the flexion–rotation test, increased myofascial trigger points, and hypersensitivity to mechanical stimulus in the cervical area. Headache sufferers have been shown to have significantly lower cervical mobility compared to asymptomatic subjects (Ilyas et al. 2022). An increase in the dysfunction of deep cervical muscles has also been related to restricted cervical rotation and a higher headache intensity. The occurrence of headaches has been associated with changes to lateral flexion and the suboccipital region, which impact the biomechanics of the cervical (Bravo-Cucci et al., 2022). According to systematic evidence, the application of Sustained Natural Apophyseal Glide techniques ameliorates cervical mobility, pain, and functional performance in patients with CGH (Cardoso et al., 2022). Meta-analytic results have confirmed a substantial decrease in cervical flexion-extension ROM, side-flexion ROM, rotational ROM, and cervical muscle strength in individuals with CGH (Satpute et al., 2023). A decrease in neck extension and rotation has been associated with an increase in the stiffness of the suboccipital muscles in the population with cervicalgia headache (Tavakkoli & Bahrpeyma, 2023). Self-mobilisation techniques have been shown to improve pain and headache disability via an increase in cervical function (Asoghan et al., 2023). Additional evidence showed that there are associations between the cervical ROM and the severity of TTH (González-González & Herrero, 2024). Research that has been done on rehabilitation over a period of time shows a significant improvement in the cervical mobility after undergoing rehabilitation through traction and exercise (Jellad et al., 2024; Zhang et al., 2024). According to Sarwar et al. (2024), sustained natural apophyseal glide techniques have effectively improved cervical ROM and headache-related outcomes. New evidence shows that individuals with CGH have significantly reduced upper cervical flexion, retraction, and protraction ROM when compared with healthy controls (Satpute et al., 2024). Proprioceptive training methods led to significant improvements in cervical range of motion (ROM) in patients with CGH (Emam et al., 2025).

Headache-Related Disability and Functional Limitations

CGH not only causes pain but also results in considerable functional disability. Daily activities, work activities, social participation, and psychological well-being are commonly impacted in patients (Saini et al., n.d.). Consequently, reliable assessment of the disability has gained importance over headache management. This has led to the wide use of the Neck Disability Index (NDI), Headache Disability Index (HDI), and others (Bakhtadze et al. 2021). Study results showed that increased neck flexibility is often associated with decreased disability and dysfunction caused by headaches (Rostron, 2021). Headache characteristics associated with disability included duration, frequency, intensity, and widespread pain sensitisation (Di Antonio et al., 2022). There are significant changes in headache disability after manual therapy and interferential current interventions (Pérez-Llanes et al., 2022). Further evidence suggests that neck disability is associated with the burden and hypersensitivity of headaches (Liang et al., 2022). Patients with neck pain and sleep disturbances experienced a high burden of headache-related disability (Im et al., 2023). Self-mobilisation programmes have been shown to improve the HDI score of people with CGH (Asoghan et al., 2023). The reliability and validity of the tools used in the analysis of disability have been proven by different cultural populations, which show their clinical usefulness (Kılınç et al., 2024). According to Jellad et al. (2024) and Zhang et al. (2024), long-term rehabilitation interventions improve disability, function and quality of life outcomes. Evidence from meta-analysis suggests headache populations have high neck-related disability levels (Al-Khazali et al., 2024). The recent intervention studies have shown that proprioceptive training, Mulligan mobilisation techniques, and multimodal rehabilitation approaches could reduce disability (Andreev & Eremiev, 2025; Emam et al., 2025; Sillevis et al., 2025).

Relationship Between Cervical Mobility and Disability

An increasing amount of evidence indicates a link between cervical mobility and headache-related disability. Gains in cervical range of motion (ROM) have been related to enhanced physical functioning and quality of life (Lendraitiene et al., 2021). Decreased cervical motion has been correlated with greater disability, longer headaches, and more severe symptoms (Di Antonio et al., 2022). Positive relationships were noted between the activity of the deep cervical muscles, cervical ROM, and functional performance. Changes to the way the neck moves might contribute to headaches and disability burden (Bravo-Cucci et al., 2022). Systematic reviews show that cervical mobility targeted interventions improve pain and function outcomes at the same time (Cardoso et al. 2022; Satpute et al. 2023). Increased cervical muscle stiffness and ROM restrictions can further add to headache-related dysfunction (Tavakkoli & Bahrpeyma, 2023). Enhancement of cervical ROM through mobilization, traction, strengthening and proprioceptive techniques was associated with a decrease in disability and headache intensity (Asoghan et al., 2023; Jellad et al., 2024; Zhang et al., 2024; Sarwar et al., 2024; Emam et al., 2025). Research on both adult and paediatric headaches has shown that reduced cervical mobility is correlated to pain sensitivity and functional limitations (Silva et al., 2025). Based on all findings, cervical mobility is significantly related to headache-related disability.

Research Gap

Although considerable documentation exists showing cervical ROM deficits and headache-associated disability, the current literature demonstrates important deficiencies. The majority of studies focus on treatment efficacy, diagnostic utility, cervical biomechanics, or cross-sectional comparisons. They do not longitudinally address the relationship between cervical ROM and headache disability (Anarte-Lazo et al., 2021; Cardoso et al., 2022; Satpute et al., 2023). Multiple studies have reported improvements in mobility and disability after intervention, yet very few have actually explored whether improvements in cervical ROM can be predicted from the reduction in headache-related disability over time (Jellad et al., 2024; Sarwar et al., 2024). In addition, much of the existing evidence has focused on the outcome of interventions rather than a clinical correlate of disability like cervical mobility.

Rationale of the Study

The relationship between cervical mobility deficits and functional disability in individuals with CGH is not clear because this finding is always observed. Determining whether decreased cervical ROM is associated with greater headache-related disability could allow for improved clinical assessment, prognosis, and rehabilitation planning. The findings from this research might enhance existing biomechanical models of CGH. Furthermore, the findings may help design targeted physiotherapy interventions with the goal of restoring cervical function and decreasing disability (Piovesan et al., 2024; Patil et al., 2024; Chitlange & Harjpal, 2025). Accordingly, the current study aims to study cervical range of motion and headache disability among patients suffering from cervicogenic headache in a prospective longitudinal study.

Objectives

1. To examine the relationship between cervical range of motion and headache disability in patients with cervicogenic headache.
2. To assess changes in cervical range of motion over the study period in patients with cervicogenic headache.
3. To determine whether improvements in cervical range of motion are associated with reductions in headache-related disability over time.

Hypotheses

1. **H_1:** There will be a significant negative relationship between cervical range of motion and headache disability in patients with cervicogenic headache.
2. **H_2:** Cervical range of motion will improve significantly over the study period in patients with cervicogenic headache.
3. **H_3:** Improvements in cervical range of motion will be significantly associated with reductions in headache disability over time in patients with cervicogenic headache.

2. Materials and Methods

Study Design

This study used a prospective longitudinal observational design to test the relationship between cervical range of motion (ROM) and headache-related disability in patients with cervicogenic headache (CGH). The participants underwent a baseline assessment and were followed prospectively at 3-month and 6-month intervals to observe longitudinal changes in cervical mobility, headache disability, pain intensity, neck-related disability, and quality of life (Verma et al. 2021, Piovesan et al. 2024).

Study Setting

The study took place in the outpatient physiotherapy and rehabilitation department of a tertiary health care institution specializing in the evaluation and management of musculoskeletal and headache disorders. Participant recruitment and follow-up assessments were carried out between baseline and the 6-month follow-up (Jellad et al, 2024).

Participants
Participation was offered to adult patients suffering from cervicogenic headache, according to clinical and diagnostic criteria. Participants who met the criteria were assessed at baseline and followed for six months (Verma et al., 2021; Piovesan et al., 2024).

Sample Size Estimation
Using G*Power version 3.1, the sample size was estimated for correlation. Assuming a moderate effect size ($r = 0.30$), a significance level (α) of 0.05, and statistical power of 80% ($1-\beta = 0.80$), the minimum required sample size was calculated to be 84 participants. A sample size of 100 was set, assuming 20% dropout during the follow-up period. A total of 120 patients were screened for eligibility. Due to non-fulfilling of inclusion criteria and refusal to take part, sixteen patients were excluded. As a result, 104 subjects were enrolled who completed the baseline and 3- and 6-month follow-up assessments. A total of 104 participants were analysed finally.

Inclusion Criteria
- Adults aged 18–65 years.
- Clinical diagnosis of cervicogenic headache.
- Presence of restricted cervical mobility and headache-related disability.
- Ability to participate in follow-up assessments.
- Provision of written informed consent (Saini et al., 2021; Satpute et al., 2023).

Exclusion Criteria
- Migraine, tension-type headache, or other primary headache disorders.
- Previous cervical spine surgery.
- Cervical fracture, tumour, infection, inflammatory disease, or severe cervical pathology.
- Neurological disorders affecting cervical function.
- Inability to complete follow-up assessments (Verma et al., 2021; Piovesan et al., 2024).

Recruitment Procedure
All prospective subjects were screened by a qualified physiotherapist. Those eligible were approached, and written informed consent was acquired from them. The baseline assessments took place before enrolment, and then participants were followed prospectively at 3 and 6 months.

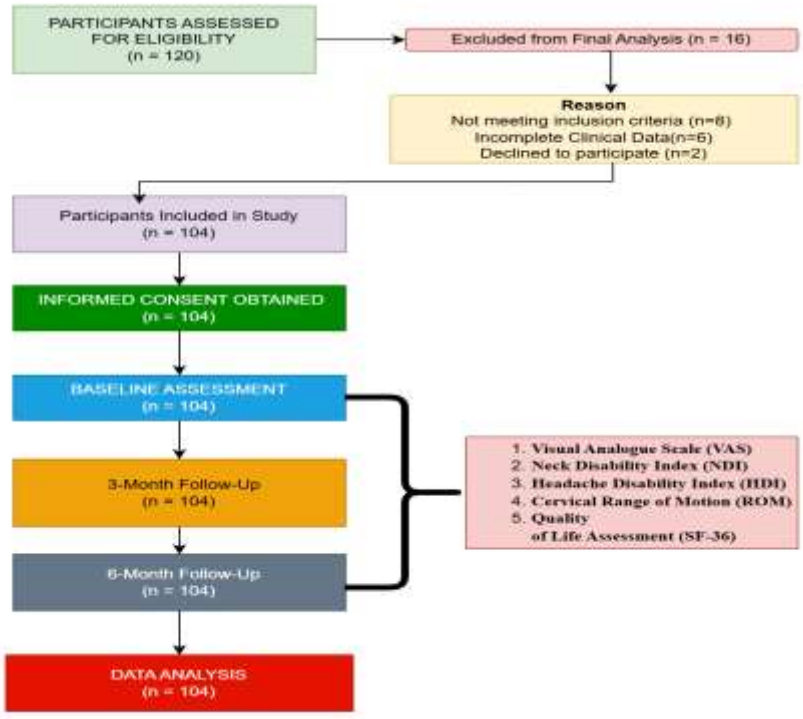

Figure 1. Participant flow diagram

Outcome Measures

Cervical Range of Motion Assessment
Cervical flexion, extension, right and left lateral flexion, and right and left rotation were assessed using a Cervical Range of Motion (CROM) goniometer. The Flexion-Rotation Test was additionally performed to assess upper cervical mobility (Ilyas et al., 2022; Satpute et al., 2024).

Headache Disability Index (HDI)
Headache-related disability was assessed using the Headache Disability Index (HDI), a validated measure of the functional and emotional impact of headache disorders (Kılınç et al., 2024).

Neck Disability Index (NDI)
Neck-related disability was measured using the Neck Disability Index (NDI), a reliable and valid instrument for evaluating functional limitations associated with neck pain and cervicogenic headache (Bakhtadze et al., 2021).

Visual Analogue Scale (VAS)
Pain intensity was measured using a 10-cm Visual Analogue Scale (VAS), with higher scores indicating greater pain severity (Saini et al., 2021; Jellad et al., 2024).
Quality of Life Assessment (SF-36)
Health-related quality of life was assessed using the Short Form-36 (SF-36) questionnaire, which evaluates physical, emotional, and social health domains (Lendraitiene et al., 2021).

Procedure
Data were collected at three time points: baseline, 3 months, and 6 months. At each assessment, participants completed the HDI, NDI, VAS, and SF-36 questionnaires, while cervical ROM measurements were recorded using standardised procedures. All assessments were conducted by trained assessors blinded to previous results.

Treatment Protocol
Participants received regular physiotherapy management, as prescribed by their treating physiotherapists according to the individual's clinical presentation and standard department practice. The physiotherapy programme mostly involved manual therapy techniques, cervical mobilisation, soft tissue techniques, cervical traction, therapeutic exercises, postural correction exercises, and home exercise recommendations, which aimed to improve cervical mobility, reduce pain, and improve functional outcomes. It was based on patient needs and the clinical reaction of the patient as decided by the treating clinician. To maintain cervical comfort and prevent limitations, participants undertook regular exercise that included stretching, postural correction, and cervical muscle strengthening during the daily routine. If Necessary, Home Exercise Programs Were Also Prescribed. The normal clinical practice followed up management throughout the study period. The current study did not examine the effectiveness of a specific treatment intervention. Instead, it observed changes in cervical range of motion, headache-related disability, neck disability, pain intensity, and quality of life over six months prospectively. Figure 2 shows the participant's example physiotherapy procedures.

Figure 2. Physiotherapy treatment procedures used for patients with cervicogenic headache.

Follow-Up Assessments
Participants submitted to follow-up evaluations at 3 and 6 months after baseline. Changes in cervical ROM, headache disability, neck disability, pain intensity and quality of life were recorded and compared at each assessment period (Jellad et al., 2024).

Statistical Analysis
Data were analysed using IBM SPSS Statistics software. Descriptive statistics were calculated for demographic and clinical characteristics. Repeated-measures analysis of variance (ANOVA) was used to evaluate changes in outcome measures across baseline, 3-month, and 6-month assessments. Pearson correlation analysis was performed to determine the relationship between cervical ROM and headache disability. Multiple linear regression analysis was conducted to identify whether cervical ROM predicted headache-related disability. Statistical significance was established at $p < 0.05$.'

Ethical Considerations
The Institutional Ethics Committee approved the study before its commencement. All participants provided signed informed consent. Data were treated confidentially, and anonymity was maintained throughout the study as per the Declaration of Helsinki and institutional ethical guidelines.

3. **Results**

Table 1: *Demographic and Baseline Clinical Characteristics of Participants (N = 104)*

Variable	Mean ± SD	Range
Age (years)	42.62 ± 12.99	20–65
Male	53 (51.0%)	
Female	51 (49.0%)	
Cervical Flexion (°)	32.47 ± 4.67	25–40
Cervical Extension (°)	40.13 ± 6.45	30–50
Right Cervical Rotation (°)	50.25 ± 6.24	40–60
Left Cervical Rotation (°)	50.07 ± 6.05	40–60
Headache Disability Index (HDI)	69.51 ± 9.10	55–85
Neck Disability Index (NDI)	32.12 ± 4.56	25–40
Visual Analogue Scale (VAS)	7.51 ± 1.11	6–9
Short Form-36 (SF-36)	48.36 ± 7.55	35–60

Table 2: *Repeated Measures ANOVA Results for Cervical Range of Motion, Disability, Pain, and Quality of Life Across Baseline, 3 Months, and 6 Months (N = 104)*

Outcome Measure	Baseline Mean ± SD	3 Months Mean ± SD	6 Months Mean ± SD	Baseline vs 3M MD (95% CI)	Baseline vs 6M MD (95% CI)	3M vs 6M MD (95% CI)	F (Time)	p	Partial η^2
Cervical Flexion (°)	32.47 ± 4.67	38.41 ± 4.78	43.39 ± 4.75	5.94 (5.61,6.28)	10.92 (10.48,11.37)	4.98 (4.66,5.30)	2573.07	<.001	.962
Cervical Extension (°)	40.13 ± 6.45	45.82 ± 6.60	50.87 ± 6.66	5.68 (5.39,5.98)	10.73 (10.30,11.16)	5.05 (4.69,5.40)	2588.02	<.001	.962
Right Cervical Rotation (°)	50.25 ± 6.24	57.91 ± 6.45	63.78 ± 6.76	7.66 (7.28,8.05)	13.53 (13.01,14.05)	5.87 (5.56,6.17)	3169.82	<.001	.969
Left Cervical Rotation (°)	50.07 ± 6.05	57.64 ± 6.06	63.45 ± 6.24	7.57 (7.17,7.96)	13.39 (12.91,13.86)	5.82 (5.48,6.16)	3203.54	<.001	.969
Headache Disability	69.51 ± 9.10	49.60 ± 9.97	34.82 ± 10.61	19.91 (19.18,20.65)	34.69 (33.59,35.80)	14.78 (14.00,15.56)	4540.48	<.001	.978

Index (HDI)									
Neck Disability Index (NDI)	32.12 ± 4.56	20.49 ± 5.15	12.97 ± 5.43	11.63 (11.12,12.13)	19.14 (18.50,19.79)	7.52 (7.11, 7.93)	3956.69	<.001	.975
Visual Analogue Scale (VAS)	7.51 ± 1.11	4.59 ± 1.30	2.68 ± 1.39	2.92 (2.72, 3.12)	4.83 (4.59, 5.07)	1.90 (1.71, 2.10)	1536.29	<.001	.937
SF-36 Quality of Life	48.36 ± 7.55	63.48 ± 7.90	76.40 ± 8.65	15.13 (14.36,15.89)	28.05 (26.91,29.19)	12.92 (12.14,13.71)	2806.36	<.001	.965

($p < .001$).

Table 3: *Pearson Correlation Between Cervical Range of Motion and Headache Disability at Baseline, 3 Months, and 6 Months (N = 104)*

Cervical ROM Variable	HDI Variable	r	p
Flexion_B	HDI_B	-0.787	**<0.001**
Extension_B	HDI_B	-0.757	
RotationR_B	HDI_B	-0.657	
RotationL_B	HDI_B	-0.775	
Flexion_3M	HDI_3M	-0.746	
Extension_3M	HDI_3M	-0.630	
RotationR_3M	HDI_3M	-0.723	
RotationL_3M	HDI_3M	-0.752	
Flexion_6M	HDI_6M	-0.636	
Extension_6M	HDI_6M	-0.726	
RotationR_6M	HDI_6M	-0.698	
RotationL_6M	HDI_6M	-0.685	

All correlations were statistically significant at p < .001. R = Right; L = Left; B = Baseline.

Table 4 *Multiple Linear Regression Analysis Predicting Headache Disability Index Change (HDI Change) from Changes in Cervical Range of Motion Variables (N = 104)*

Predictor	B	SE B	β	t	p	95% CI for B
Constant	55.831	16.885		3.307	.001**	[22.328, 89.335]
Flexion Change	1.682	0.516	.310	3.254	.003**	[0.540, 3.212]
Extension Change	0.916	0.425	.354	2.546	.023*	[0.213, 2.102]
Right Rotation Change	1.452	0.456	.298	3.687	.001**	[1.624,0.142]
Left Rotation Change	0.952	0.348	.210	2.856	.030*	[0.124, 1.687]

R	R^2	Adjusted R^2	SEE	F (4, 99)	p	Durbin-Watson
.752	.565	.545	8.242	15.54	<.001***	2.188

4. Discussion

The current investigation studied how cervical ROM relates to headache-related disability in patients with cervicogenic headache at 6-month follow-up. The results indicated a significant increase in cervical range of motion, and considerable reductions in headache and neck disability, pain intensity, and health-related quality of life. According to repeated measures ANOVA, significant changes were observed in all outcome measures from baseline to 3 months and 6 months ($p < .001$). The cervical flexion improved by 10.92°, the extension improved by 10.73°, right rotation improved by 13.53%, and left rotation improved by 13.39% after a period of six months. At the same time, there was a significant decrease by 34.69 points in the headache disability index (HDI), 19.14 in the neck disability index (NDI), 4.83 in the visual analogue scale (VAS), and 28.05 in the quality of life index (S-F 36). The correlation analysis reveals a strong negative association between headaches and cervical range of motion. Greater cervical mobility is often associated with lower HDI scores. The strongest associations found were at baseline for cervical flexion ($r = −0.787$) and left rotation ($r = −0.775$), demonstrating a close association between movement restriction and headache disability. Also, that change in cervical ROM (i.e., total angular displacement of the cervical spine) was a significant predictor of change in headache disability, accounting for 56.5% ($R^2 = .565$) of the variance in HDI. The findings support the three hypotheses of the

study and suggest the restoration of cervical mobility in cervicogenic headache. The study's most valuable finding is the consistently negative relationship between cervical ROM and headache disability at baseline and at 3-month and 6-month assessments. The more the patients had movement restrictions, the more disabled they became. This we noted in the HDI, i.e., human development index. Further, we noted that improvement in mobility was helpful for HDI reductions. Many studies have reported cervical dysfunction as a prominent feature of cervicogenic headache. As per Verma et al. (2021), reduced mobility of the cervical spine is a characteristic feature of cervicogenic headache. In a systematic review and meta-analysis of 62 studies, Anarte-Lazo et al. (2021) similarly displayed significantly less cervical ROM and neck strength in cervicogenic headache individuals compared with controls. According to Satpute et al. (2023), there is a significant decrease in the cervical flexion, extension, and rotating flexibility of patients with cervicogenic headache. According to Tavakkoli and Bahrpeyma (2023), cervical extension and rotation ROM were significantly lower in those with cervicogenic headache, which is in line with the present findings. Accordingly, Satpute et al. (2024) established that the upper cervical flexion and extension ROM is significantly restricted in individuals with cervicogenic headache. Silva et al. (2025) brought these findings to paediatrics and showed reduced cervical mobility and upper cervical rotation in children and adolescents with headache disorders. The significant negative correlations found in the present study may not imply that cervical mobility impairment is simply a symptom associated with headache; instead, it may directly cause headache severity disability. The conclusion proves that cervical ailment plays a significant role in the presentation of cervicogenic headache. The extent of improvement seen in cervical ROM and disability outcomes highlights the clinical relevance of restoring cervical movement in cervicogenic headache patients. The improvements were not limited to mobility only but also included reduction of pain, recovery of function, and enhancement of quality of life. A reduction in HDI scores from 69.51 to 34.82 corresponds to a clinically significant improvement. At the same time, the NDI scores were down by roughly 60%, VAS scores dropped significantly, and SF-36 scores improved significantly. According to these findings, restoring cervical mobility may produce generalized effects on several health aspects. To support this, several intervention studies. The authors reported that improvement in cervical rotation after McKenzie therapy was associated with a decrease in headache disability. (Saini et al 2021) According to the study by Cardoso et al. in 2022, Sustained Natural Apophyseal Glide (SNAG) improved Flexion rotation test performance. Similarly, pain intensity and functional outcomes changed significantly. Pérez-Llanes et al. (2022) noted a decrease in the disability caused by headache due to therapy. Similar benefits have been reported following self-mobilisation programs. Such interventions include cervical traction (Jellad et al., 2024), reverse headache SNAG (Sarwar et al., 2024), gaze direction identification (Emam et al., 2025), Mulligan techniques (Andreev & Eremiev, 2025), and multimodal physiotherapy (Sillevis et al., 2025). The findings of the studies above suggest that cervical mobility interventions are effective in improving disability and function. The regression results of the present study further highlight the clinical importance of restoring mobility. Changes in cervical ROM explained more than half of the variance in improvement of HDI, suggesting that gaining mobility may lessen disability and may therefore be a key therapeutic target. These findings are well aligned with the rest of the literature on cervical musculoskeletal dysfunction and headache disorders. Studies show that restricting cervical ROM increases the frequency, intensity, and disability of headaches. According to Lendraitiene et al. (2021), physiotherapy leads to significant improvements in cervical ROM and quality of life in migraine. Di Antonio et al. (2022) observed reduced cervical ROM along with an increase in headache-related disability across all phases of the migraine cycle. García-Pérez-de-Sevilla et al. (2022) found a positive relationship between cervical rotation ROM and muscular function of the cervical region and negative associations with headache intensity. Cervical mobility was one of the strongest factors that were associated with the presence and severity of headaches. A study by González-González and Herrero (2024) found that the taller the subjects, the more “toxicity” their cervical spine endured. A study by Olesiejuk et al. (2025) demonstrated that a greater cervical range of motion (ROM) resulted in a decrease in the intensity and frequency of headaches. The current study’s findings regarding disability were found to be corroborated by research confirming that the use of HDI and NDI is an important outcome measure in headache populations. According to Bakhtadze et al. (2021), Liang et al. (2022), Im et al. (2023), Kılınç et al. (2024), and Al-Khazali et al. (2024), headache burden is significantly associated with disability measures. Moreover, systematic reviews conducted by Patil et al. (2024), Chitlange and Harjpal (2025), and Castaldo et al. (2025) concluded that physiotherapy methods aimed at enhancing cervical musculoskeletal function are effective in reducing headache symptoms and disability. Consequently, there is longitudinal evidence in support of the fact that cervical mobility is an important determinant of headache-related disability. Various biomechanical and neurophysiological mechanisms may explain the link between cervical ROM and headache disability. Cervicogenic headache is thought to originate from the dysfunction of cervical joints, muscles, ligaments, as well as neural structures that converge in the trigeminocervical complex (Verma et al., 2021; Piovesan et al., 2024). A limited range of motion in the cervical spine can create excessive mechanical stress on the upper cervical segments, generating nociceptive input from zygapophyseal joints, intervertebral discs, muscles, and surrounding soft tissues. This nociceptive information joins with trigeminal afferents in the trigeminocervical nucleus, allowing pain to refer into the head and face. Reduced mobility may cause headaches and may also worsen headaches. Muscle dysfunction is also important. According to KILINÇ and Karaduman (2021), there is a relationship between cervical biomechanics and musculoskeletal impairment. In addition, García-Pérez-de-Sevilla et al. (2022) stated that there is an association between the functionality of the deep cervical muscles and the severity of headaches. According to a study by Satpute et al. (2023), people with cervicogenic headache show a marked decrement in the strength of cervical muscles. Thus, the impairment of the muscle may limit the

movements and cause pain. Changing cervical proprioception may be another mechanism. According to Emam et al. (2025), proprioceptive training was effective in improving cervical ROM and decreasing headache symptoms. In addition, Barzaghideanu et al. (2025) have proposed that cervical dysfunction may cause central sensitisation, autonomic dysregulation and overall functional disturbances away from the cervical area. A role may also be played by structural factors. In their study, Tavakkoli and Bahrpeyma (2023) stated that patients with cervicogenic headache show increased stiffness of the suboccipital muscles, while Rios-Peralta et al. (2026) showed that the changes to the cervical biomechanics increase the mechanical loading of the cervical structures. The improvement of cervical alignment was related to decreases in disability and pain, according to Katz et al (2026). In brief, the current evidence supports a model where restrictions in cervical mobility cause discomfort through mechanical, muscular, proprioceptive, and neurophysiological mechanisms. Restoring cervical range of motion could reduce noxious input, restore neuromuscular control, reduce central sensitisation, and ultimately improve function and quality of life.

Clinical Implications for Physiotherapy Practice, Strengths of the Study, Limitations of the Study, and Recommendations for Future Research

The present study's results indicate practical implications for physiotherapy professionals. The observation of a significant negative correlation between cervical range of motion (ROM) and headache disability indicates that examining cervical mobility and restoring cervical ROM must be an important part of the management of cervicogenic headache. Increases in cervical flexion, extension, and rotation were accompanied by significantly decreased headache disability, neck disability, and pain intensity, reflecting the clinical importance of focusing on mobility. A physiotherapist may use the cervical ROM assessment not only for assessment but also for the prognosis of functional recovery. This study's longitudinal prospective design with repeated measurements over a six-month period was its major strength, because it allows the evaluation of temporal changes in naturalistic cervical mobility and headache-related disability. The validity and clinical relevance of the results were further confirmed through objective outcome measures used, which were HDI, NDI, VAS, and SF-36. There are, however, some limitations. Due to the observational design, it does not allow inference of causation, nor do they study the treatment causing the benefit. Moreover, the participant pool was obtained from a single clinical setting. Future studies should be based on multicentre longitudinal studies, which shall include more participants with diverse backgrounds. Randomised controlled trials may be done to see if targeted cervical mobility interventions could tackle headache disability. ROM-disability relationship on cervicogenic headache was associated with several other mechanisms, including biomechanical, neuromuscular, and psychosocial mechanisms, and could be optimised for rehabilitation.

5. Conclusion

A study exhibited that the cervical range of motion has a significant association with headache-related disability in subjects with cervicogenic headache. At baseline, the participants had severe restriction in the cervical range of motion, and high headache disability, neck disability, pain intensity, and low quality of life. During the six-month follow-up, cervical flexion, extension, and bilateral rotation improved significantly. Moreover, Headache Disability Index (HDI), Neck Disability Index (NDI), and Visual Analogue Scale (VAS) scores significantly decreased, as did the SF-36 quality-of-life outcomes. Findings from the Pearson correlation analyses revealed consistently moderate to strong negative correlations between cervical range of motion (ROM) and headache disability over time. Greater cervical mobility was related to lesser disability. The analysis of multiple regressions also showed that increasing cervical ROM predicts decreasing headache disability over time. Based on the results, it can be concluded that cervical mobility is a clinically relevant correlate of headache-related disability and may also be a therapeutic target. So, the restoration of cervical function should be given due consideration as an important aspect of physiotherapy assessment, rehabilitation planning, and long-term management of patients with cervicogenic headache.

6. Declarations

Ethics Approval and Consent to Participate

The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrolment.

Consent for Publication

Written consent for publication of clinical photographs was obtained from all participants.

Availability of Data and Materials

The datasets used and analysed during the current study are available from the corresponding author upon reasonable request.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions
All authors contributed to the study conception, design, data collection, analysis, interpretation of results, and manuscript preparation. All authors read and approved the final manuscript.

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