An Exploratory Study to Determine the Relationship between Cervical Dysfunction and Perimenstrual Migraines

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ABSTRACT

Purpose: To determine whether an association between cervical dysfunction and perimenstrual migraines exists. **Methods:** Forty perimenstrual migraine sufferers and 46 controls were compared. Information on the participants' ages and perceptions of neck pain and stiffness were solicited. The blinded physical examination of the cervical area consisted of postural, range of motion, muscle strength, muscle length, trigger point, neural mobility, and segmental cervical joint movement assessment. **Results:** The migraine group had increased perception of neck pain and stiffness ($p < 0.001$); reduced bilateral rotation ($p = 0.013$); decreased muscle length in both trapezii, left sternocleidomastoid, and right occipitals ($p = 0.045$); more pain on muscle stretch in both levator scapulae, both trapezii, left sternocleidomastoid, and both occipitals ($p = 0.013$); increased trigger points bilaterally in the left trapezius ($p = 0.021$), right trapezius ($p = 0.023$), left sternocleidomastoid ($p = 0.004$), and right sternocleidomastoid ($p = 0.021$); reduced neural mobility with bilateral elbow lag ($p = 0.043$); greater C4–C6 pain ($p = 0.045$); and increased cervical stiffness in C5–C7 ($p = 0.023$). There were no differences in posture and muscle strength. Decreased muscle length increased the risk of perimenstrual migraines 2.4–6.7 fold, reduced neural mobility 5.8–10.7 fold, and increased C7 stiffness 17.0 fold. **Conclusion:** The results suggest that an association between cervical dysfunction and perimenstrual headaches should be further explored.

Key Words: cervical pain; headache; menstruation; migraine disorders.

RÉSUMÉ

Objectif : Cette étude visait à déterminer s'il y a un lien entre la dysfonction cervicale et les migraines périmenstruelles. **Méthodes :** On a comparé 40 femmes souffrant de migraines périmenstruelles à 46 témoins. On a réuni de l'information sur l'âge des participantes et les perceptions de la douleur et de la raideur dans le cou. L'examen médical à l'insu de la région cervicale a consisté à évaluer la posture, l'amplitude du mouvement, la force musculaire, la longueur des muscles, le point de déclenchement, la mobilité neurale et le mouvement de l'articulation cervicale segmentaire. **Résultats :** Les patientes souffrant de migraines avaient une perception accrue de la douleur et de la raideur dans le cou ($p < 0,001$), une rotation bilatérale réduite ($p = 0,013$); elles présentaient une diminution de la longueur musculaire au niveau des deux trapèzes, du sternocléidomastoïdien gauche et des occipitaux droits ($p = 0,045$); ressentaient plus de douleur à l'étirement musculaire au niveau des deux muscles élévateurs de la scapula, des deux trapèzes, du sternocléidomastoïdien gauche et des deux occipitaux ($p = 0,013$); une élévation des points de déclenchement des deux côtés dans le trapèze gauche ($p = 0,021$), le trapèze droit ($p = 0,023$), le sternocléidomastoïdien gauche ($p = 0,004$) et le sternocléidomastoïdien droit ($p = 0,021$); une réduction de la mobilité neurale avec latence du coude des deux côtés ($p = 0,043$); douleur plus grande au niveau C4–C6 ($p = 0,045$) et une raideur accrue de la colonne cervicale au niveau C5–C7 ($p = 0,023$). Il n'y avait pas de différences aux niveaux de la posture et de la force musculaire. La diminution de la longueur des muscles accroissait le risque de migraine périmenstruelle d'un facteur de 2,4 à 6,7; réduisait la mobilité neurale d'un facteur de 5,8–10,7; augmentait la raideur au niveau C7 d'un facteur de 17,0. **Conclusion :** Les résultats indiquent qu'il faudrait étudier plus à fond l'existence d'un lien entre le dysfonctionnement cervical et les maux de tête périmenstruels.

The International Headache Society (IHS) defines migraine as “a common disabling primary headache disorder” with severe, throbbing, long-lasting headaches usually accompanied by autonomic symptoms such as photophobia, phonophobia and/or nausea.^{1(p.644–5)},² Migraines are divided into two main subtypes: “with”

and “without aura.” Migraine “without aura” is the more common subtype, with more frequent disabling attacks.¹ The hormonal changes associated with the menstrual cycle have a direct effect on migraines;³ Russel et al. (1995)⁴ and Cupini et al. (1995)⁵ report a direct relationship between menstruation and migraine “without aura.”

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Contributors: All authors designed the study; collected, analyzed, and interpreted the data; drafted or critically revised the article; and approved the final draft.

Competing interests: None declared.

Acknowledgements: The authors acknowledge the contribution to this publication of their research assistant, Janine Webber, PT (MSc Physiotherapy), who undertook all the physical assessments.

Physiotherapy Canada 2015; 67(1);30–38; doi:10.3138/ptc.2012-47

Of the 9 million women worldwide who suffer from migraines, 60% experience migraines during or around menses.⁶ Perimenstrual migraines are problematic as they last significantly longer, are more disabling, and are more difficult to treat pharmacologically than non-menstrual migraines.^{3,7,8}

The definition of a menstrual period is two or more consecutive days of bleeding.¹ The IHS classifies menstrual migraine attacks as those that occur anytime from 2 days before onset to the last day of menses; the peak time for migraine attacks is between 2 days pre-menses and the first 2 days of the cycle.^{3,9} These findings support evidence that menstrual migraine occurs during the largest fluctuation in estrogen levels, which may alter plasma prostaglandin levels, and that increased concentrations of prostaglandins are found during menstrual migraine attacks.^{8,9} Prostaglandins increase neurogenic inflammation and sensitize nociceptors, lowering their threshold. This inflammation may be a causative factor for headaches. Another function of prostaglandins that may be affected during a migraine is the modulation of the descending noradrenergic pain control pathways.⁸

In addition to headache, 82% of women who have migraines also experience posterior ipsilateral neck stiffness or pain, which may be a premonitory symptom occurring a few hours before other migraine symptoms.^{10,11} Cervical dysfunction has been reported in patients with migraine, with neck pain being a common and prominent migraine symptom.¹² When compared to controls, migraineurs have more tender and tight craniocervical musculature, greater forward head posture, and decreased cervical mobility.¹² Migraines seem to be accompanied by cervical dysfunction caused by muscle tenderness, mechanical abnormalities, postural changes, and neural modifications.¹²

It seems, then, that migraines may be referred from the neck. The anatomic pathway for pain referral from the neck to the head is the convergence of the afferent (sensory) trigeminal nerves and afferent fibres from the upper cervical nerves in the trigeminocervical nucleus^{13,14} in the grey matter of the upper cervical dorsal horn. Although the pathogenesis of migraine does not lie primarily in musculoskeletal dysfunction, concomitant cervical dysfunction may further sensitize the trigeminocervical nucleus.¹⁵ Estrogen, the proven precipitator of perimenstrual migraines, also increases the receptor field size of the trigeminal mechanoreceptors.⁸

The clinical features of cervicogenic headache—a headache arising from musculoskeletal disorders of the upper cervical spine—might coexist with migraine.^{12,16} The following elements are included when assessing a patient for cervical spine dysfunction: posture, neck range of motion, and cervical segmental range of motion.¹⁷ Muscular components are assessed through strength tests for cervical movements and length tests for upper trapezius, levator scapulae, scalene, and suboccipital muscles.

Neural tension tests are performed to assess mechanosensitivity of neural structures.¹⁸ Cervical muscle trigger points contribute to the activation of the trigeminovascular system, which is involved in the pathogenesis of migraine, and therefore require appropriate assessment.^{14,19,20}

As the literature suggests that cervical dysfunction accompanying migraines is caused by muscle tenderness, mechanical abnormalities, postural changes, and neural modifications,¹² it would be useful to demonstrate a relationship between these factors and perimenstrual migraines. If such a relationship is established, researchers can then consider further investigation into the appropriate physiotherapeutic management.

Our exploratory study therefore aimed to determine if there is an association between cervical dysfunction and perimenstrual migraines. Our specific objectives were to establish whether the following variables are associated with perimenstrual migraines:

- perceived neck pain and stiffness
- poor posture
- decreased range of cervical movements
- decreased strength of cervical muscles
- reduced cervical muscle length and/or pain on muscle stretch
- presence of trigger points
- reduced neural mobility
- pain and/or stiffness with cervical segmental movements.

The specific measurements for these objectives are described in the Methods section.

METHODS

Sample

Our study compared a group of women with perimenstrual migraines to a group without migraines. Potential perimenstrual participants were recruited from the staff of a regional hospital in Johannesburg, South Africa.

Women were included in the study if they were between 21 and 45 years old, had regularly menstruated every 21 to 35 days for the previous 6 months, and were perimenstrual; had experienced at least five perimenstrual migraines “without aura” in the past 12 months; and were not pregnant or trying to become pregnant.

Potential participants were excluded if they had used birth control pills, patches, or injections in the previous 6 months; had a history of any medical problem that can affect migraines (e.g., lupus erythematosus); had been pregnant or lactating within the past year; had a history of breast, ovarian or, endometrial cancer; had a history of whiplash injury, cervical fracture, or dislocation; or had irregular menses (i.e., not occurring every 21–35 days). We did not exclude women with neck pain from the study because of the high prevalence of neck pain in the normal population.^{21,22}

Table 1 Pilot Study Results (Intrarater)

Measurement	Component	No. of tests done	Inconsistencies, no. (%)	% accuracy
Muscle length tests		60 (12/person $\times$ 5)	13 (21)	78
Neural mobility	Category of lag	10 (2/person $\times$ 5)	1 (10)	90
	Positive of the test	10 (2/person $\times$ 5)	0 (0)	100
Trigger points	Active/latent present	50 (10 $\times$ 5)	10 (20)	80
	Side of most	25 (5 $\times$ 5)	4 (16)	84
PAIVMS	Restriction level	30 (6/person $\times$ 5)	1 (3.33)	96

PAIVMS = passive accessory intervertebral movements.

We anticipated that between six and eight factors would be associated with perimenstrual migraines: (1) perceived neck pain and stiffness, (2) poor posture, (3) reduced cervical mobility, (4) decreased muscle strength, (5) muscle length restriction and pain on muscle stretch, (6) presence of trigger points, (7) decreased neural mobility, (8) pain and/or stiffness on segmental cervical assessment. Because of the exploratory nature of the study, we used Nunnally's "rule of thumb" (1978) of 10 subjects per factor.²³ The alpha level was set at $p < 0.05$. The final sample size consisted of 40 participants in the migraine group and 46 in the control group.

Ethical approval was granted by the Human Research Ethics Committee, University of the Witwatersrand, Johannesburg, South Africa. Permission was granted by the Helen Joseph Hospital, where the study was conducted. After receiving an information sheet that detailed the study and providing written informed consent, participants completed a questionnaire to determine age, menstrual history, and presence or absence of current neck pain and stiffness. Each participant was then assigned to the migraine group or to the control group. Participants predicted the date of their next menstruation and were given a date between 2 days before menstruation to 3 days into menstruation for the assessment.

Procedure

Prior to the study, we undertook a familiarization process to ensure that the research assistant performing the assessments (a physiotherapist with 7 years of experience in musculoskeletal practice) was accurate in performing and assessing the various components of the physical examination. The assessment order and procedures were refined to be as efficient, objective, and uniform as possible, and an experienced academic neuromuscular physiotherapist with 15 years of experience checked each procedure with the research assistant until she was satisfied that the procedures were being carried out accurately. The assessments were performed on a healthy volunteer to ensure that both physiotherapists obtained the same results on the assessments. In addition, the research assistant's intrarater reliability during the objective assessment was checked, incorporating the changes and advice of the more experienced physiotherapist.

Following this process, the research assistant assessed five participants on muscle length, neural mobility, trigger points, and passive accessory intervertebral movements, then reassessed them a week later. The two assessments were compared by the first author (SH), and they showed good reliability, ranging between 78% for the muscle length tests to 96% for the passive accessory intervertebral movements (see Table 1). The research assistant then proceeded with the assessments for the study.

Before each participant entered the examination room, she was told by the first author that the research assistant did not and could not know whether or not she suffered from any type of headache. Participants were asked not to comment during the assessment, especially if a test provoked their headache pain, until the final part of the assessment when they were asked specifically to comment on any pain evoked during muscle length tests, trigger point identification, and cervical mobilization. At the end of the assessment, once the research assistant had left the examination room, the first author asked participants whether or not they had a headache post-assessment and if any of the tests had provoked any familiar symptoms of their perimenstrual migraine pain.

The same assessment order, instructions, and encouragement were followed with all participants. The assessments of participants with migraines and those without were conducted in a random order to ensure that the assessor was blinded. The left side was always tested first, and all questions were standardized. Standard clinical tests were used for all of the outcome measures described below.

Measurements

Observation of posture

Participants were positioned in front of a plumb line, which was parallel to a posture grid board with the vertical tangent running through the apex of the thoracic spine. The distance between the plumb line and the mid-cervical spine of a normal head-neck posture is 6 cm; a farther distance is classified as a forward head-neck posture.²⁴ This distance was measured using a ruler in cms.^{24,25} Lateral flexion and rotation of the head was then observed and the two shoulder heights compared¹⁷ (see Figure 1 online). In a 2011 study, Silva and colleagues

found intrarater measurements of forward head posture (ICC = 0.82–0.91) and lateral flexion (ICC = 0.63–0.83) to be reliable.²⁶

Cervical range of movement

To measure cervical range of motion (ROM), we used an optic visor headband with an attached inclinometer (Inclinometer OptiVisor, Donegan Optical Company, USA) that could be adjusted for sagittal, frontal, and horizontal planes of movement.²⁷ To measure flexion, extension, and lateral flexion, participants sat upright in a chair, maintaining contact between their thoracic spine and the chair back²⁸ with feet flat on the floor and arms relaxed by their sides. The first author assisted in ensuring precision of the planes of the instrument and also checked that the research assistant stopped the lateral cervical flexion before scapular elevation occurred. Cervical rotation was measured in supine with the head over the edge of the bed, lightly supported by the research assistant to prevent the bed from restricting the ROM. Participants were encouraged to perform all the movements as far as possible, but were stopped when trick movements, such as scapular elevation, began.²⁷ ROM was recorded in degrees (see Figures 2–4 online). According to previous studies, all cervical movement measurements show fair to high intrarater reliability (ICC = 0.70–0.99).^{28,29}

Cervical muscle strength tests

Strength testing of the cervical muscles was performed using a hand-held dynamometer (Micro Fet Hoggan Health Industries, Draper, Utah, USA).³⁰ To test flexion strength, the participant lay in crook-lying position with arms folded over her chest and straps placed loosely over her shoulders to minimize trunk movement³¹ and was instructed to tuck in her chin before performing the cervical strength tests.³² Extension strength was tested with participants lying prone. For the lateral flexion and rotation tests, the participant was seated comfortably in a chair with her back against the back rest while the research assistant stabilized her trunk to avoid compensatory movements.³³ To measure rotation, the dynamometer was placed just above the ear's external auditory meatus to align with the rotational centre of the cervical spine, which runs through the dens.³² Isometric testing was done at half the available range.^{33,34} The participant pushed maximally against the dynamometer with resistance applied to maintain a constant head position. The measurements were repeated three times to allow the participant to adjust to the movements and to obtain an accurate average strength.³⁵ The contractions were held for 5 seconds each, with a 10-second break between attempts and a 45-second break between movements.³⁶ All participants were given the same verbal encouragement during the tests.³⁴ Strength was recorded in Newtons (see Figures 5–8 online). The interrater reliability of the hand-held dynamometer for patients with and without neck

pain has been shown to be moderate (ICC = 0.45–0.93).^{37,38}

Muscle length

Muscle length was measured using standard length tests, with standardized starting positions, methods of fixation, and movements.³⁹ The amount of resistance during and at the end of the stretch, the amount of reduced range, and displacement of the shoulder and neck were assessed. Participants were asked to relax completely and to allow for a slow, smooth, passive stretch.⁴⁰

Muscle-length testing of the upper trapezius was performed with the participant lying in supine. The neck was laterally flexed passively to the contralateral side, with slight flexion added to stretch the cervical insertion;^{40,41} the research assistant added contralateral shoulder depression at the end of the movement.⁴⁰ For levator scapulae, the participant lay in supine, and the research assistant flexed, laterally flexed, and rotated the neck away from the side being tested.⁴¹ Shoulder depression was added at the end of the movement.⁴⁰ Sternocleidomastoid muscle length was tested with a chin tuck, neck lateral flexion away from and rotation toward the tested side.⁴⁰ The clavicular fibres of pectoralis major were tested in 90° of shoulder abduction, with the research assistant stabilizing the trunk. The sternocostal fibres were tested through full shoulder flexion.⁴⁰ The anterior scalenes were tested using extension, contralateral lateral flexion, and rotation toward the tested side. The deep occipital muscle length was tested with the participant's head supported against the abdomen of the research assistant to allow the participant to fully relax her head. The head was then passively flexed and the muscles palpated for tightness (see Figures 9–15 online).

The first author (SH) asked the participants if they experienced any pain during these tests; the answers were recorded as painful, no pain, or pulling. The length test results were recorded as normal movement, slight restriction, or restricted. According to Sharhidi and colleagues (2010), intrarater reliability of muscle-length tests in people with neck pain is fair (ICC = 0.19–0.82), and for those without neck pain, it is moderate (ICC = 0.40–0.93).³⁸

Trigger point assessment

Trigger points were assessed in the upper trapezius, levator scapula, scalene, suboccipital, and sternocleidomastoid muscles by manual palpation of the muscles by the research assistant using either a pincer grip, flat palpation, or both. Participants lay in supine for assessment of the trapezius, scalene, suboccipital, and sternocleidomastoid muscles, which were assessed bilaterally and compared for tight bands and trigger points. The levator scapulae muscles were assessed with the participant lying prone, with the arms relaxed and hanging over the plinth to ensure relaxation of the trapezius.

The first author (SH) recorded the presence of tight bands and trigger points. Once a potential trigger point was identified, the participants were asked if there was pain, if the pain travelled, and to where the pain travelled. An active trigger point causes spontaneous referred pain in addition to local pain and can cause restricted range of motion. Latent trigger points are locally painful and do not have a referral pattern on palpation but can cause restricted range and fatigue in the muscle.^{42–44} The presence of trigger points was recorded as no tenderness, latent, or active (see Figures 16–20 online). In Lucas and colleagues' (2009) systematic review, interrater reliability for identification of tenderness and a tight band, reproduction of the pain, and referred pain and therefore identification of the trigger point showed moderate reliability for tenderness ($k = 0.22–1.0$), for tight band ($k = 0.57–1.0$), and for local twitch response ($k = 0.05–0.57$).^{45–47}

Neural mobility test

Neurodynamic tests are used to ascertain the amount of neural mobility of the brachial plexus and its cervical roots and may therefore help identify the contribution of neural tension to headache symptoms.^{40,48}

For the neuromobility tests, participants lay in supine with the side to be tested on the edge of the bed and were asked to report the first symptom of pain or discomfort and the location. The test began with shoulder girdle depression and proceeded through shoulder abduction to 90°, shoulder lateral flexion, forearm supination, wrist and finger extension, and elbow extension.⁴⁹ The test was stopped at the first report of neural type pain in the C5 and C6 nerve roots. If the test was stopped during elbow extension, the amount of elbow extension lag (degrees off full elbow extension) was visually estimated. The test was positive if the last movement was released and the pain was relieved. If no neural tension was felt in the C5 and C6 nerve roots by the end of full elbow extension, then the sensitizing manoeuvre of contralateral lateral flexion was performed (Figure 21 online). According to Schmit and colleagues (2009), these tests show moderate reliability ($k = 0.45$).⁵⁰

Cervical segment testing

Segmental dysfunction is implicated in the initiation and perpetuation of myofascial pain.¹⁷ Decreased joint ROM can lead to shortening and tightening of the muscle, which causes trigger point formation. Information on the passive intervertebral movement of the spine relies on palpation and subjectively perceived movement at joints that have very little excursion;⁵¹ to improve reliability and accuracy in this part of the assessment, participants were asked if there was any pain on the passive accessory intervertebral movements at each level.⁵²

For the cervical segment testing, the participant lay in prone position on a plinth, with her cervical spine flexed, her head in the nose hole, and a pillow under her chest

to ensure that her head was relaxed. The research assistant first palpated the spine to identify the cervical levels and explained the visual analogue scale (VAS) pain rating scale to the participants.

To assess the comparative mobility of the cervical levels, the research assistant performed two to three Maitland Grade III passive accessory intervertebral movements on the spinous processes using the tips of the thumbs. A Grade III allowed the full ROM to be assessed.⁵³ While the research assistant assessed the movement for any restriction and rated the amount of stiffness (1 = severe restriction, 2 = moderate restriction, 3 = minimal restriction, 4 = normal), the participant was asked to rate her pain at each level using the VAS; this rating was recorded in mms (see Figure 22 online). A study by Hanten and colleagues (2002) found that intrarater reliability for manual mobility testing of the upper cervical spine was acceptably high (Spearman's $r = 0.943$, $k = 0.208–1.000$).⁵²

Statistical analysis

The categorical data obtained from the perceived pain and stiffness reports and from the muscle length, trigger point, neural mobility, and segmental cervical assessments were expressed as frequencies and percentages and were compared between the two groups using Fisher's exact test. The continuous data from the ROM, strength, and VAS tests were expressed as means and standard deviations; the data between the two groups were compared using the Welch t -test, and results were confirmed using the Wilcoxon rank sum test (Mann–Whitney U-test). These inferential tests highlighted the factors that differed significantly between the two groups. Once these discrete significant factors ($p \leq 0.05$) were identified, they were entered together into a logistic regression to determine the odds ratios and their 95% CIs.

RESULTS

Our sample consisted of 86 participants (40 in the migraine group and 46 in the control group).

Ages of participants

Table 2 illustrates the significant differences in age between the migraine and control groups. While there were more participants with migraine in the second youngest category (26–33 years), the age range was small, which suggests that age did not significantly affect physical outcomes.

Presence of pain and neck stiffness

Significantly more participants in the migraine group than in the control group reported neck stiffness (78% vs. 28%, $p < 0.001$) and neck pain (68% vs. 13%, $p < 0.001$).

Posture observation

There were no significant between-groups differences in the distance between the plumb line and the mid-cervical spine.

Table 2 Age of Participants ($n = 86$; control $n = 46$, migraine $n = 40$)

Age category, y	No. (%) of participants		<i>p</i> -value
	Control	Migraine	
18–25	40 (86.96)	25 (62.5)	0.02*
26–33	4 (8.7)	10 (25)	
34–41	2 (4.35)	2 (5)	
42–49	0	3 (7.5)	

*Indicates statistically significant difference.

Range of movement tests

Bilateral rotation was significantly reduced in the migraine group: mean right rotation was 82.88° (SD 12.60°) in the migraine group versus 88° (SD 9.70°) in the control group ($p = 0.042$), and mean left rotation was 87.53° (SD 11.29°) versus 93.52° (SD 10.52°), respectively ($p = 0.013$).

Strength tests

There were no significant differences in the strength of the cervical flexors, extensors, lateral flexors, or rotators between the migraine group and the control group.

Muscle length tests and pain on muscle stretch

The migraine group had greater muscle length restriction in the right trapezius, left sternocleidomastoid, and right occipitals ($p = 0.045$) and more pain on muscle stretch in the right and left levator scapulae, right and left trapezius, left sternocleidomastoid, and right and left occipitals ($p = 0.013$).

Trigger points

In the migraine group, 80% and 78% of participants had active trigger points compared to 54% and 46% of the control group for the right ($p = 0.023$) and left ($p = 0.021$) trapezius muscles, respectively. For the right sternocleidomastoid, 73% of the migraine group had active trigger points compared to 52% of controls ($p = 0.024$); for the left sternocleidomastoid, 55% of the migraine group had active trigger points versus 28% of controls ($p = 0.004$).

Neural mobility

The migraine group included a significantly higher percentage of participants who showed reduced neural mobility before the full neural tension position was obtained (right—33% vs. 13%; $p = 0.021$; left—18% vs. 2%, $p = 0.043$).

Segmental cervical movements

There was greater C4–C6 pain reported on the VAS ($p = 0.045$) in the migraine group than in the control group, as well as increased cervical stiffness in C5 and C7 ($p = 0.023$).

Significant factors identified

The significant factors shown above were included in the logistic regression, and the odds ratios were calculated (see Table 3). All the factors included in Table 3

Table 3 Odds Ratios of the Associated Factors ($n = 86$; control $n = 46$, migraine $n = 40$)

Associated factor	OR	95% CI	<i>p</i> -value
Neck stiffness	8.74	2.82–27.15	<0.001
Neck pain	13.85	3.72–51.52	<0.001
Muscle length tests			
Levator scapula (R) pain	7.46	1.94–28.79	0.001
Levator scapula (L) pain	6.81	1.74–26.67	0.006
Trapezius (R) length	4.88	1.47–16.20	0.004
Trapezius (R) pain	6.07	1.73–21.32	0.006
Trapezius (L) pain	6.00	1.48–24.33	0.007
Occip (R) length	6.72	1.58–28.62	0.006
Occip (R) pain	2.85	0.61–13.4	0.005
Occip (L) length	2.38	0.80–7.02	0.08
Occip(L) pain	4.24	0.94–19.10	0.004
Neural mobility test			
Elbow ext lag (R)	5.88	1.39–24.87	0.02
Elbow ext lag (L)	10.67	1.06–107.37	0.04
Trigger points			
Trapezius R	2.13	0.45–10.03	0.04
Trapezius L	6.64	1.18–37.48	0.009
SCM R	2.42	0.91–6.41	0.16
SCM L	2.29	0.88–5.95	0.006
PAVIMS			
C5 stiffness	4.25	1.22–14.82	0.02
C7 stiffness	17.00	0.91–316.02	0.02

OR = odds ratio; R = right; L = left; ext = extension; SCM = sternocleidomastoid; PAVIMS = passive accessory vertebral movements.

have high odds ratios and may play a contributing role in perimenstrual migraines.

DISCUSSION

The aim of this exploratory study was to determine if there is an association between cervical dysfunction and perimenstrual migraines. The specific objectives were to establish whether or not perceived neck pain and stiffness, poor posture, reduced range of cervical movements, reduced strength of cervical muscles, reduced cervical muscle length/pain on muscle stretch, presence of trigger points, reduced neural mobility, and pain and/or stiffness on cervical segmental movements are associated with perimenstrual migraines. The tests used were well known clinical tests; as described, we took considerable care to ensure their accuracy and reliability. Our findings as described below suggest that there may well be an association between cervical dysfunction and perimenstrual migraines.

Participants in the migraine group recorded significantly more perceived neck pain and neck stiffness than participants in the control group. They also reported feeling discomfort in the cervical spine, which could possibly be either a contributing factor to their migraine pain or a perpetuating symptom of their migraine. Those who reported neck pain were 13.9 times as likely to experience perimenstrual migraines as those who did not; those who reported stiffness were 8.7 times as likely to

experience premenstrual migraines. According to previous research, the majority of women who experience migraines also experience neck pain and stiffness and consider neck pain to be a trigger for their migraines.^{10,11}

The pain reported by the migraine group during both the muscle length tests and passive accessory intervertebral movements was significantly higher than that reported by the control group. The migraine group reported significantly more pain during muscle length testing of the bilateral levator scapulae and left trapezius, but testing did not find significantly reduced length relative to the control group. Similarly, testing of accessory intervertebral movements produced considerable pain for cervical levels C4 through C6; significant stiffness, rather than pain, was reported in cervical levels C5 and C7. Pain on stretching of the right levator scapula, left levator scapula, and right trapezius increased the odds of migraines by 7.46, 6.81, and 6.07, respectively.

A possible reason for this increased pain response in subjects with migraine is peripheral and central nerve sensitization. Persistent afferent discharge from dysfunctional cervical structures can sensitize the trigeminocervical nucleus by causing changes in the second order nociceptive neurons in the trigeminocervical nucleus.⁵⁴ The effects of this sensitization are a lowered firing threshold (the trigeminal nucleus fires in response to smaller noxious stimuli and to innocuous stimuli), increased responsiveness to noxious stimuli (i.e., stronger response with increased firing rate causing hyperalgesia), and an increase in spontaneous firing. Clinical manifestations of peripheral and central nerve sensitization include increased tenderness to manual palpation as well as a reduced pressure pain threshold.⁵⁵

Increased prostaglandin release from the endometrium may occur during menstruation, which initiates neurogenic inflammation, the cause of peripheral nociceptor sensitization.⁸ Prostaglandins also affect the central nervous system and modulate the descending pain-control noradrenergic systems. Furthermore, menstruation-related hormonal changes can alter endogenous pain modulation; the late luteal phase is reported to be associated with increased negative affect and hyperalgesia.¹³ These possible peripheral and central changes indicate that perimenstrual migraines may be classified as a chronic pain condition requiring a multidisciplinary approach to treatment.

Reduced cervical rotation may occur when chronic avoidance of movement leads to joint stiffness and reduced ROM. Because neck movements usually worsen migraine pain, people with migraine may show a degree of kinesiophobic behaviour; participants in the migraine group may have voluntarily restricted full movement through the cervical range as a pain avoidance technique.⁵⁶ This behaviour may also be reinforced as a learned protective pattern of movement.

More participants in the migraine group had reduced

neural mobility, and this increased the odds of perimenstrual migraines between 5.8 and 10.7 times. De las Peñas and colleagues (2009) found generalized mechanical pain hypersensitivity in bilateral peripheral nerve trunks in a unilateral migraine sample;⁵⁷ this hypersensitivity may again reflect a state of hyperexcitability of the central nervous system, whereby innocuous stimuli synapse onto and activate cells that usually receive only noxious stimuli.

The odds of migraine occurring is between 2.1 to 6.6 fold as high in women with trigger points in the upper trapezius and sternocleidomastoid muscles. Pain from these two muscles is referred into the temporal areas and behind the eye—the headache referral areas. In addition, these two muscles are within the receptive field of the trigeminocervical nucleus and if dysfunctional, may contribute to the activation of the trigeminocervical nucleus.^{54,55} Nociceptive inputs from the trigger points may produce a continuous afferent barrage onto the trigeminocervical nucleus, thereby sensitizing it.⁴³

Our study found significantly increased cervical stiffness in the lower cervical levels (C5–C7) in the migraine group, and stiffness in C7 increased the odds of migraine by 17.0. These levels fall outside of the trigeminocervical nucleus receptive field and therefore are not included in the model of cervical facilitation of migraine pain.^{54,55} A possible reason for our findings is that anteroposterior stiffness may be linked to neural tension, but we could not find any support for this possibility in the literature. The upper-limb neural tension test used to test neural mobility primarily strains the C5, C6, and C7 nerve roots. A maladaptive cervical stiffness may have developed in the migraine group to decrease the strain on these nerve roots. Alternatively, articular stiffness may have contributed to the neural tension of these nerve roots. Stiffness at certain levels of the spine places more strain on the level above and below as they compensate for the lost motion.

CONCLUSION

Our study describes the cervical dysfunction factors associated with perimenstrual migraines, which may help to narrow down the list of potential predisposing or intensifying factors. These associated factors are perceptions of neck stiffness and pain; reduced cervical rotation; reduced muscle length of trapezius, sternocleidomastoid, and suboccipital muscles; increased pain response on muscle stretch of levator scapulae, trapezius, sternocleidomastoid, and suboccipital muscles; moderate neural tension in the upper limbs; trigger points in upper trapezius and sternocleidomastoid muscles; increased pain response to passive accessory intervertebral movements; and stiffness of C5 and C7.

These findings suggest that patients presenting with perimenstrual migraines may benefit from assessment and management by a physiotherapist. If the specified

dysfunctional areas are treated and corrected using physiotherapeutic techniques, there could be a decrease in the severity and possibly the frequency of these migraines.

Despite the obvious limitation of the subjective nature of the assessment techniques used in this study, we believe the results can be used in future confirmatory studies and in studies testing appropriate interventions for perimenstrual migraines.

KEY MESSAGES

What is already known on this topic

Sixty percent of the 9 million women worldwide suffering from migraines, experience migraines during or around menses. Perimenstrual migraines are longer, more disabling, and more difficult to treat pharmacologically than non-menstrual migraines. Women who have migraines also experience posterior ipsilateral neck stiffness or pain, and cervical dysfunction has been reported in patients with migraine.

What this study adds

Cervical dysfunction should always be considered when assessing patients with perimenstrual migraines, and consideration should be given to developing appropriate physiotherapeutic management regimes for these patients.

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