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Manuscript title:

Can headache profile predict future disability: a cohort study.

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Abstract:

Objectives:

The aim of this study was to determine if headache profile can predict future disability in patients with TTH.

Methods

Eighty-three patients with TTH were recruited. To be included in the study participants needed to fulfill the International Headache Society classification's criteria for episodic or chronic TTH form and to be at least 18 years old. Baseline clinical outcomes (headache and neck-related disability, kinesiophobia, self-efficacy and anxiety) and physical outcomes (neck extensors muscles maximum voluntary contraction) were collected for all patients. A prospective data collection of headache characteristics (intensity and frequency) was conducted using daily SMS or e-mail over a 1-month period. Headache-related disability was assessed at the 3-month follow-up and was used as the disability criterion for TTH.

Results

Correlations showed that the number of years with headache ($r=.53$; $p<0.001$, self-reported neck pain intensity ($r=.29$; $p=0.025$), headache frequency ($r=.60$; $p<0.001$) and intensity ($r=.54$; $p<0.001$), anxiety ($r=.28$; $p=0.031$) as well as neck-related disability ($r=.63$; $p<0.001$) were correlated to headache-related disability assessed at 3 months. Multiple regression showed that these determinants can be used to predict headache disability ($R^2= 0.583$). Headache frequency ($\beta=0.284$) was the best individual predictor.

Discussion

Results showed that TTH frequency and intensity and the presence of concomitant infrequent migraine are predictors of future disability over a 3-month period. Further studies are needed to evaluate the contribution of other potential physical outcomes on headache-related disability.

Keys words: Tension-type headache; headache profile; neck pain; disability; strength

List of abbreviations

TTH: tension-type headache

IETTH: infrequent episodic tension-type headache

FETTH: frequent episodic tension-type headache

CTTH: chronic tension-type headache

IHS: International Headache Society

MVC: maximum voluntary contraction

HIT-6: 6-item headache impact test

NDI: neck disability index

VAS: visual analogue scale

Can headache profile predict future disability: a cohort study.

Introduction

Tension-type headache (TTH) is the most common type of headache [1] with a lifetime prevalence in the general population that ranges between 30% to 78% [2-4]. The average age of TTH onset is estimated between 25 and 30 years old with the peak prevalence for both sexes occurring between 30 to 39 years of age, followed by a decline with increasing age [1, 5]. Women are more affected than men with female:male ratios ranging from 1.3:1 to 5:4 [1, 5, 6].

According to the International Headache Society (IHS), tension-type headache is classified as a primary headache [3] and typically described by a bilateral, pressing, tightening and non-pulsating pain. In addition, intensity of TTH is considered to be mild to moderate without aggravation by routine physical activity such as climbing stairs or walking and is not associated with nausea or vomiting except for mild nausea that can be present in chronic TTH (CTTH) [5]. Furthermore, phonophobia or photophobia can occur during TTH episodes, but both symptoms should not be present at the same time [3, 5]. TTH can be divided into two categories: episodic or chronic form. The episodic form is further divided into two subcategories based on the frequency of episodes: infrequent episodic tension-type headache (IETTH) or frequent episodic tension-type headache (FETTH) [3]. IETTH is characterized by at least 10 episodes occurring less than one day per month (< 12 days per years), FETTH is characterized by 1 to 14 days per month for at least 3 consecutive months (> 12 and < 180 days per year) and CTTH consists of fifteen days or more with headaches per month (> 180 days per year) [1, 3]. In a Danish population-based study, the one-year prevalence of each category at 40 years old was 48.2%, 33.8% and 2.3%

respectively and the prevalence was higher in men for the infrequent episodic TTH than in women but frequent episodic and chronic TTH was more frequent in women than in men [7]. Tension-type headache and particularly CTTH are often associated with medical and psychiatric conditions. Indeed, TTH has previously been linked to common comorbidities such as temporomandibular disorders, depression, anxiety and panic disorders [5].

To date, only a few studies have evaluated risk factors for the development of TTH or risk factors that leads to a transition from episodic to chronic forms [8-10]. In fact, environmental, genetic and peripheral factors such as tenderness in pericranial muscles, muscle strain, muscle blood flow and other central factors have all been hypothesized as possible contributors to the development of TTH [8]. Moreover, risk factors to transition from the episodic TTH form to the chronic TTH form are divided into two categories: non-modifiable risk factors and modifiable risk factors. On the one hand, non-modifiable risk factors include increasing age, female sex, being Caucasian, previous history of head trauma and low socioeconomic status [9]. On the other hand, modifiable risk factors include sleep disturbances, medication overuse, obesity and the presence of psychological comorbidities [9]. Depression and anxiety are common with TTH, especially in the chronic form [11]. However, there are only few studies with follow-ups that have been conducted in adults with tension-type headache. A study by Lyngberg and colleagues showed that, in adults randomly drawn from the general population, predictors of poor outcomes in patients with tension-type headache were having frequent episodic or chronic tension-type headache at baseline, having coexisting migraine, not being married and having sleep problems. In their study, no association was found with respect to age, gender or educational levels [12].

Frequency and intensity of tension-type headache are two factors frequently assessed in studies but are also used to define inclusion criteria for TTH participants (IETTH, FETTH or CTTH group). Moreover, Sauro et al. reported a positive correlation between intensity and headache-related disability as evaluated by the 6-item headache impact test (HIT-6) questionnaire but failed to identify any correlations between frequency and headache-related disability [13] in patients with headache including patients with TTH. In the general population, individuals with higher impact associated to TTH have a lower quality of life, are more frequently absent from work and have lower work performance [14]. A Danish population-based study reported that absence rates were higher in individuals with FTTH than in healthy subjects [15]. Headache-related disability assessed by the HIT-6 questionnaire appear to be an important aspect to monitor in TTH patients to evaluate changes over time and to guide futures clinical interventions. The aim of this study was to determine if headache profile can predict future disability in participants with tension-type headache.

Materials and Methods

Study design

This cohort study was conducted at the Laboratory of motor control and neuromechanics located at the University of Québec in Trois-Rivières. Recruitment, testing and follow-up were conducted from August 2016 to November 2017. This study falls within the continuity of a study with controls and TTH participants (Marchand et al. in press in BMJ).

Participants' selection

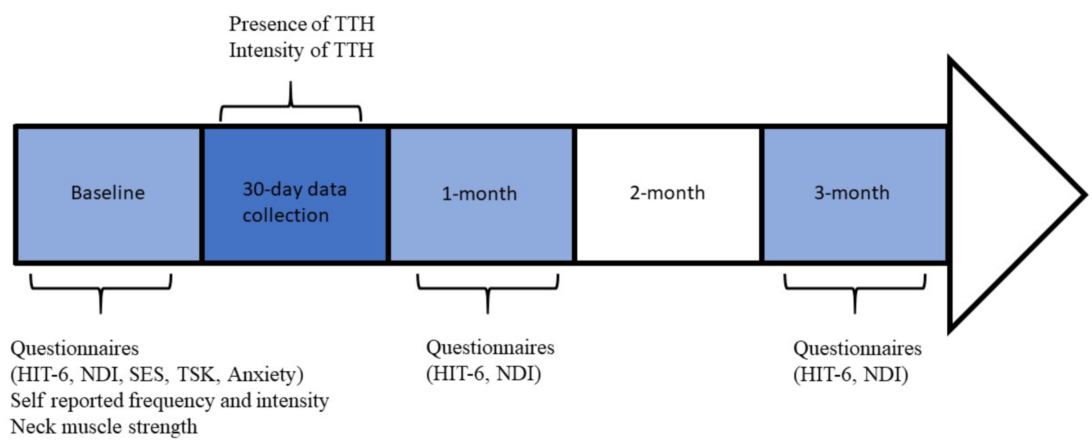
Eighty-three participants with tension-type headache were recruited via social media platforms and from the university community. To be included in the study, participants needed to fulfill the International Headache Society (IHS) classification criteria for IETTH, FETTH or CTTH (see table 1). Participants with concomitant headache and neck pain were included only if neck pain was not the dominant pain perceived. For participants experiencing other concomitant headache type, presentation and symptoms of TTH were discussed at baseline and only patients for which tension-type headache was the main headache type were included. Participants with concomitant migraine were included only if their episodes were infrequent. Distinction between headaches types were clearly highlighted at baseline as the goal of the study was to track only information related to TTH over the study period. However, participants were asked to report when they were affected by another headache type during the follow-up period. Exclusion criteria included having a recent history of cervical spine trauma, recent whiplash, neck fracture, surgery or malignant lesion, infection, medication overuse, having a diagnosis of fibromyalgia and having neurological deficits, spasmodic torticollis, presence of upper limb pain or lack of tension type headache episodes. Participants with neck, head or shoulder pain due to an injury were excluded from this study as well as participants with all forms of pain whose frequency and intensity could interfere with headaches. Participants were not allowed to participate if they were under a course of treatment for headache tension-type headache or for neck pain. Pregnant women were also excluded from the experimentation because of the prone position adopted during the neck extension task.

Table 1: International Headache Society (IHS) classification criteria for IETTH, FETTH or CTTH

<table>
<tr><th>Infrequent episodic tension-type headache</th><th>Frequent episodic tension-type headache</th><th>Chronic tension-type headache</th></tr>
<tr><td>A. At least 10 episodes of headache occurring on <1 day/month on average (<12 days/year) and fulfilling criteria B-D</td><td>A. At least 10 episodes of headache occurring on 1-14 days per month on average for >3 months (≥12 and <180 days per year) and fulfilling criteria B-D</td><td>A. Headache occurring on ≥15 days per month on average for >3 months (≥180 days per year) and fulfilling criteria B-D</td></tr>
<tr><td>B. Lasting from 30 minutes to 7 days</td><td>B. Lasting from 30 min to 7 days</td><td>B. Lasting hours to days, or unremitting</td></tr>
<tr><td colspan="3">C. At least two of the following four characteristics:
1. bilateral location
2. pressing or tightening (non-pulsating) quality
3. mild or moderate intensity
4. not aggravated by routine physical activity such as walking or climbing stairs</td></tr>
<tr><td>D. Both of the following:
1. no nausea or vomiting
2. no more than one of photophobia or phonophobia</td><td>D. Both of the following:
1. no nausea or vomiting
2. no more than one of photophobia or phonophobia</td><td>D. Both of the following:
1. no more than one of photophobia, phonophobia or mild nausea
2. neither moderate or severe nausea nor vomiting</td></tr>
</table>

This study was approved by the University's Research Ethic Committee for human subjects (CER-16-225-07.15). All participants provided informed written consent prior to their participation in the study.

Procedures



<u>Figure 1 : Timeline of clinical and physical outcomes</u>

The first session began with a brief history taking to obtain demographic data as well as information regarding typical episodes of TTH and neck pain over the last month. Headache and neck pain maximum and mean intensities were measured using a 10 cm visual analogue scale (VAS). Participants were inquired about frequency of headache and neck pain episodes over the past month. All clinical and physical outcomes were obtained at baseline. In addition, headache frequency and intensity were monitored daily for 30 days and two self-reported questionnaires (6-item Headache Impact Test and Neck disability

Index) were completed electronically using an online survey at the 1- and 3-month follow-ups (see figure 1).

Clinical Outcomes

6-item Headache Impact Test

The validated French version of HIT-6 questionnaire was used to assess disability related to headaches [16]. The HIT-6 is a 6-item, retrospective and self-reported questionnaire. This questionnaire addresses several quality of life components of such as pain, cognitive functioning, role functioning, vitality, social functioning and psychological distress [13, 17]. Participants were asked to complete the questionnaire based on the past four weeks [13]. The total score obtained was calculated by adding scores from each question for a maximum of 78 points [13]. Higher scores reveal greater headache-related disability.

Neck Disability Index (NDI)

The validated French version of NDI was used to evaluate disability related to neck pain [18]. This is a 10-item questionnaire related to cervical pain and the impact on everyday life as, for example, pain intensity, headache, concentration, reading, driving and work [19]. The total score obtained was calculated by adding scores from each question for a maximum of 50 points and higher scores reveal greater neck-related disability [18].

Kinesiophobia, anxiety and self-efficacy

At baseline, participants were asked to complete three other questionnaires related to kinesiophobia, anxiety and self-efficacy. Kinesiophobia was assessed using the validated

French version of the Tampa Scale of Kinesiophobia (TSK) a 17-items questionnaire which allow to quantify fear of movement with higher score reflecting an increased level of kinesiophobia [20]. To assess anxiety, the validated French-Canadian version of the state trait anxiety inventory (STAI-Y) was used [21]. This 20-item questionnaire allows to evaluate anxiety as a personality trait and anxiety as an emotional state related to a particular situation [21]. Finally, self-efficacy was assessed by the validated French general self-efficacy scale (GSE) which allows the evaluation of individuals perception to meet the needs of tasks in different contexts [22, 23].

30-day data collection

On a daily basis, participants were asked for 30 days about the presence and intensity of headaches within the last 24 hours. If any, they were invited to identify the type of headache they had (TTH or migraine for participants known to have concomitant types of headache). Based on participants' preferences, they were contacted by e-mails (5) or text messages (43) and some people (11) preferred to complete a headache diary.

Physical Outcomes

Maximum voluntary contraction (MVC) of neck-extensor muscles was tested in a prone position on a table with the participant's head and the neck past the edge of the table. To ensure minimal recruitment of thoracic and scapular muscles, the cervico-thoracic junction was stabilized with a strap (see figure 2). To evaluate the strength of the neck extensor muscles, another strap was disposed over the protuberancia occipitalis and was anchored to the floor. The head strap was adjusted to ensure that participants' head was stabilized in neutral horizontal position throughout testing. Participants were then asked to perform three neck extensors MCV while keeping the neutral horizontal position of the neck and the head. To perform the neck extensors MVC, participants were asked to progressively increase muscle contraction until maximum, hold the maximum for 3 to 5 seconds and then release. Maximum voluntary contractions were recorded using a force gauge (Model IPM250; Futek Advanced Sensor Technology Inc, Irvine, CA, USA). The first trial was performed to familiarized participants with the isometric extension contraction and a further two trials were conducted after the familiarization task. Each trial was followed by a period of rest of one minute.

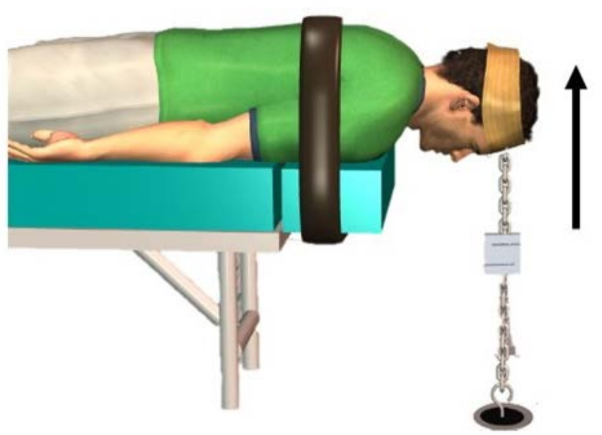


Figure 2: Participants position during the evaluation of neck extensor maximal isometric strength

Data and statistical analyses

Statistical analyses were performed using STATISTICA statistical package version 10 (Statsoft, Tulsa, OK), and the level of significance was set at $p<.05$. Because of the asymmetrical data distribution (skewness) of several variables, data were normalized whenever it was deemed necessary using log-transformation. Self-reported headache frequency and intensity were compared to the data obtained from the 30-day daily monitoring using dependent t-tests to assess participants' ability to estimate their headache characteristics. Repeated ANOVA were performed for HIT-6 and NDI questionnaires to assess the evolution of participants' headache and neck-related disabilities and Tukey post-hoc tests were performed to identify significant differences between baseline, the 1-month and the 3-month follow-up for HIT-6 and NDI. Correlations between headache frequency, headache intensity, neck pain frequency, neck pain intensity, kinesiophobia, anxiety, self-efficacy, neck-related disability and headache-related disability at the 3-month follow-up were evaluated using the Pearson's correlation coefficient. Multiple regressions analysis were conducted using the highest correlations value between all determinants and HIT-6 questionnaire at the 3-month follow-up to test if any variables predicted future headache-related disability over a 3-month period. Significant correlated determinants were added into the stepwise regression model and determinants that significantly contributed to headache-related disability over a 3-month period were identify.

Results

Eighty-three participants were included at baseline. Twelve participants were lost at the 1-month follow-up and 8 others were lost at the 3-month follow-up because participants did not return the questionnaires (see figure 3). Before excluding a participant, a reminder was sent on 3 different occasions to any participant who did not return their questionnaires. A total of 59 participants were included in the analysis. Three participants had concomitant infrequent migraine.

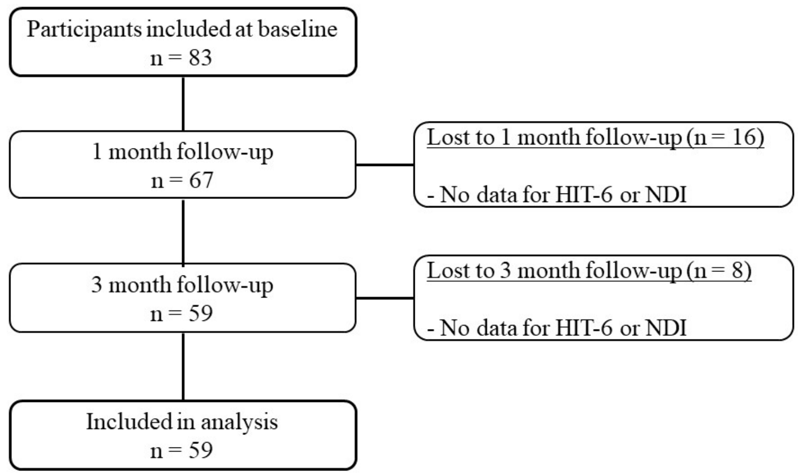


Figure 3: Flowchart of TTH participants enrollment and reasons for exclusion of the analysis

Baseline demographics

Means scores and standard deviations were calculated for all clinical and physical baseline outcomes (see table 2). Participants presented with low fear of movement (27.80±5.86) and anxiety (35.64±9.47) mean scores and a high self-efficacy mean score (35.42±3.24). The mean score for headache-related disability indicated moderate headache impact (score ≥50 points for the HIT-6 questionnaire).

Table 2: Participant's baseline results for clinical and physical outcomes

	Variables	*Mean*	*SD*
Demographics	Age (years)	27.88	9.41
	F:M	40:19	N/A
	Weight (kg)	67.72	14.12
	Height (m)	1.67	0.09
	BMI (kg/m^2)	24.18	4.10
	Years with headache	6.22	6.55
	Kinesiophobia (17-68)	27.80	5.86
	Self-efficacy scale (10-40)	35.42	3.24
	Anxiety (20-80)	35.64	9.47
Headache	Self-reported frequency of headache (previous month)	6.58	8.06
	Self-reported mean intensity of headache (/10)	3.93	1.77
	HIT-6 (36-78)	51.17	9.31
Neck pain	Self-reported frequency of neck pain (previous month)	5.97	8.15
	Self-reported mean intensity of neck pain (/10)	2.58	1.89
	NDI (/50)	5.52	4.99
Strength	MVC (N)	97.57	34.86

SD= standard deviation, F= female, M= male, BMI= body mass index, HIT-6= 6-item headache impact test, NDI= neck disability index, MVC= maximum voluntary contraction.

Table 3 : Participant's results regarding frequency and intensity of headache for the 30-day data collection

Variables	***Mean***	***SD***
Frequency of headache (/30 days)	7.75	6.84
Intensity (/10)	2.97	1.51

Frequency and intensity of headache

T-test for dependent samples comparing self-reported frequency (mean= 6.58; SD = 8.06) and frequency assess at 30 days (7.75; SD= 6.69) revealed no significant difference between self-reported headache frequency and 30 days data collection ($p = 0.107$). However, there was a significant difference ($p < 0.001$) between self-reported headache intensity (mean = 3.93; SD = 1.77) and headache intensity obtain from the 30-day data collection (mean = 2.97; SD = 1.51) (see table 2 for self-reported data and table 3 for 30-day data collection).

HIT-6 and NDI score evolution

The ANOVA indicated a significant effect of time on headache-related disability ($F(2, 116)=4.53$, $p=0.013$) and a significant effect of time on neck-related disability (F(2, 116)=4.89, p=0.009). Tukey post-hoc test showed a significant decrease in headache-related disability between baseline and the 1-month follow-up (p=0.036) and between baseline and the 3-month follow-up (p=0.021) (see figure 4) and showed a significant diminution in neck-related disability between baseline and the 3-month follow-up (p=0.007) (see figure 5).

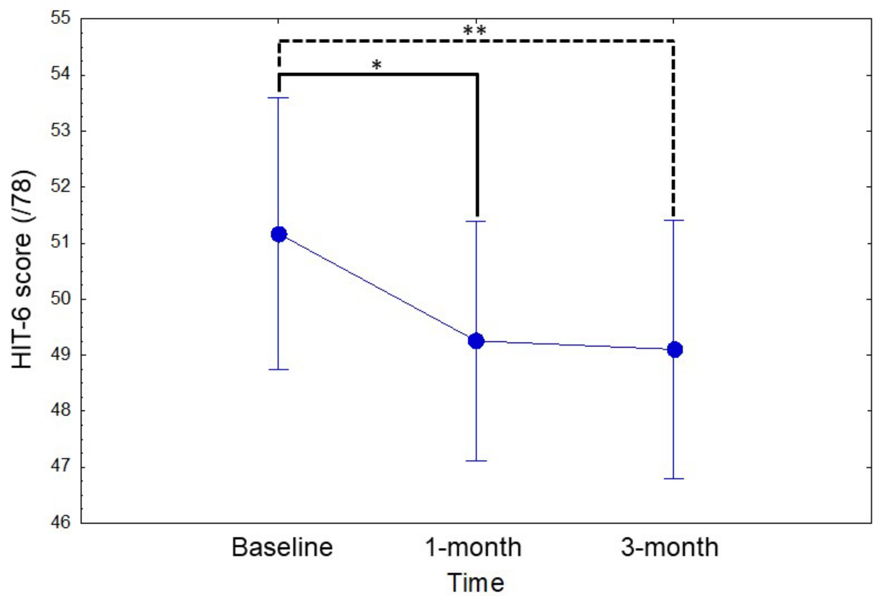


Figure 4: HIT-6 score evolution from baseline to the 3-month follow-up in TTH participants.

* : p= 0.025, ** : p= 0.017

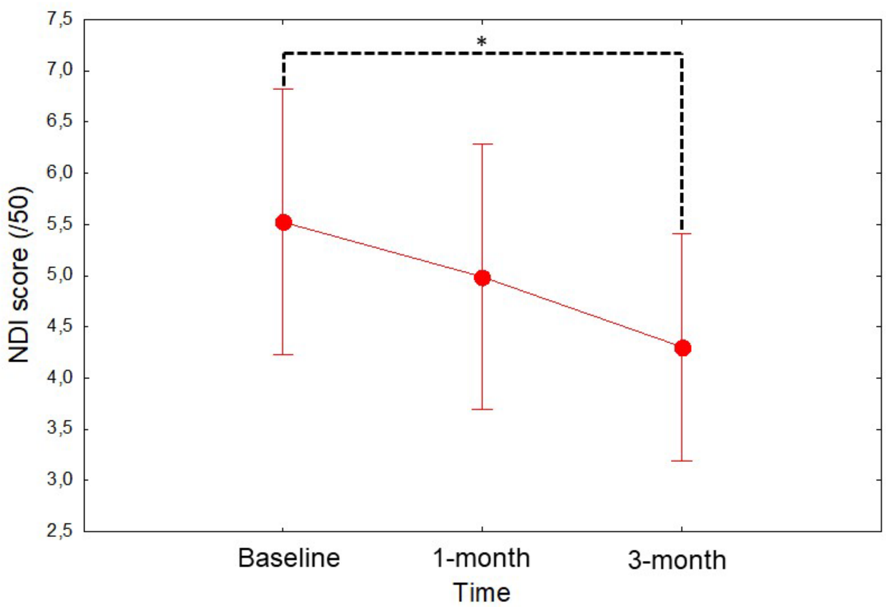


Figure 5 : NDI score evolution from baseline to the 3-month follow-up in TTH participants.

* : p=0.007

Table 4: Correlations between determinants and headache-related disability

	Variables	***HIT-6 (3-month)***	
		Correlation coefficient (r)	**p**
Baseline	MVC of neck extensors	-0.16	0.236
	Years with headache	0.53	<0.001
	Self-reported headache frequency	0.52	<0.001

	Self-reported headache intensity	0.61	<0.001
	Self-reported neck pain frequency	0.21	0.115
	Self reported neck pain intensity	0.29	0.025
	Kinesiophobia	-0.009	0.945
	Anxiety	0.28	0.031
	Self-efficacy	-0.10	0.437
	HIT-6	0.72	<0.001
	NDI	0.64	<0.001
30 days data collection	Headache frequency	0.60	<0.001
	Headache intensity	0.54	<0.001
1 month Follow-up	HIT-6	0.86	<0.001
	NDI	0.65	<0.001

MVC = Maximal Voluntary Contraction, HIT-6 = 6-item Headache Impact Test, NDI = Neck Disability Index

Table 5: Predictors of headache-related disability

	Variables	***β value***	***p***

Years with headaches	0.087	0.460
Self-reported neck pain intensity	-0.073	0.508
Headache frequency in 30 days	0.284	0.032
Headache intensity in 30 days	0.253	0.024
Anxiety	0.100	0.304
NDI (baseline)	0.245	0.112
Presence of concomitant migraine	0.206	0.044
	Multiple regression: R^2 = 0.583	

Predictors of headache-related disability at 3 months

High correlations were found between self-reported headache frequency, self-reported headache intensity and HIT-6 score at the 3-month follow-up. However, self-reported headache frequency and intensity were excluded from the multiple regression because frequency and intensity were also prospectively collected for 30 days and were considered more specific than self-reported data estimated at baseline considering the past month. Self-reported neck pain frequency, kinesiophobia and self-efficacy were also excluded because they did not correlate with HIT-6 at 3 months nor with any other outcome measures (see table 5). Number of years with TTH ($r=.53$; $p<0.001$), self-reported neck pain intensity ($r=.29$; $p=0.025$), headache frequency ($r=.60$; $p<0.001$), headache intensity ($r=.54$; $p<0.001$), anxiety ($r=.28$;$p=0.031$) as well as neck-related disability at baseline ($r=.64$; $p<0.001$) were included in the multiple regression model because of their high correlation with the HIT-6 score at 3 months. Presence of concomitant infrequent migraine was added as a covariable to the multiple regression model given that migraine is known to be a predictor of poor outcome in TTH [12]. Number of years with TTH, self-reported neck pain intensity, anxiety and neck-related disability at baseline were highly correlated with headache-related disability at 3-month. However, in the stepwise regression model, none of them remained significantly associated with headache-related disability at 3-month (p values = 0.460, 0.508, 0.304 and 0.112 respectively). Results showed that headache frequency, headache intensity and the presence of concomitant infrequent migraine were good predictors of headache-related disability at 3 months. All together, predictors were able to predict 58.3 % of the headache-related disability variance. Results of the regression model are presented in table 5.

Discussion

The purpose of this study was to determine if headache profile can predict future disability in participants with TTH. Participants' mean age was 27.88±9.41 years which is consistent with the age group with the highest TTH prevalence in the literature (25-30 years old). The results showed that 30 days mean headache frequency and intensity as well as self-reported mean intensity of neck pain, years with TTH, neck-related disability and presence of concomitant infrequent migraine can predict future disability in patients with TTH.

Headaches characteristics

With regards to participants' headache characteristics, the results showed a high correlation between the number of years with TTH and headache-related disability and between number of TTH episodes in a month and headache-related disability as well as a moderate correlation between TTH intensity and headache-related disability. Mild to moderate pain intensity represents the clinical criteria required in the diagnosis of TTH and based on the present results moderate intensity had a higher impact on headache-related disability. In this study, multiple regressions showed that intensity is an important predictor of future disability, but headache frequency was the most important predictive factor of headache-related disability. These results are in accordance with a previous study which showed that frequent headache categories (FETTH and CTTH) are associated with higher headache-related impact than the infrequent headache category [24]. Kim et al. (2015) also reported an increased burden of headache-related disability associated to the chronic form compared to infrequent and frequent episodic forms [25]. TTH patients seem to be more affected by the number of headache episodes than by their intensity. Suffering from TTH on a regular basis seems to influence psychological well being. In fact, frequent headache and disability seem to impair quality of life [26, 27]. Headache intensity contributes to occasional disability in a month or in a year while a higher number of headaches in a month can contribute to higher disability. A previous study showed the impact of ETTH and CTTH and their contribution to absenteeism and presenteeism in TTH patients [28].

Neck pain and neck extensor muscle strength

In the current study, neck pain and neck extensor muscle MVC were assessed because neck pain has been traditionally linked with tension type headache [29, 30] and neck pain has been shown to be more prevalent in TTH patients than in individuals with no TTH [31]. Neck pain has previously been associated with decreased neck muscle strength [32, 33]. The present study did not reveal any correlation between neck extensor muscle strength and headache-related disability. In addition, neck muscle strength was not retained among predictive factors of future headache-related disability. However, results showed that concomitant neck pain was present in TTH patients with a self-reported mean of 5.97 days (SD = 8.15) which is consistent with the literature [31]. Results also showed that neck pain intensity was correlated with a higher score in HIT-6 at the 3-month follow-up (r=0.29) and that it can be considered as a predictive determinant of future disability. Ashina et al. (2015) found a correlation between neck pain frequency and the frequency of TTH and suggested a possible shared pathophysiological mechanism between neck pain and primary headache including tension-type headache [31]. Regarding neck extensor muscle strength, previous studies showed a decrease in neck extensor muscle force production in TTH patients compared to healthy controls [33, 34]. However, our results showed that MVC is not a physical determinant of future disability as evaluated by the HIT-6 questionnaire.

HIT-6 and NDI

Findings of the present study indicated statistically significant decreases in headache-related disability and neck-related disability over the 3-month follow-up period but these differences were not clinically significant. To be considered clinically significant, the minimally clinical important change in TTH related disability should reach 8 points on the HIT-6 score [17]. The results of the present study showed a decrease of only 2.07 points on the HIT-6 mean score between baseline and the 3-month follow-up. Regarding the neck disability, a difference of 3.5 points on the NDI scale represents the minimally clinical important change [35] and the present results indicated a decrease of 1.21 points between the baseline and 3-month scores therefore not reaching the threshold for neck-related disability minimally clinical important change. The decrease for HIT-6 and NDI scores found in the present study can be explained by the natural fluctuation of tension-type headache over time. Indeed, prognostic factors of TTH recovery are less severe headache, mild headache-related disability, not using medication, absence of anxiety, sleep problem, depression or other pain [36].

Kinesiophobia, anxiety and self-efficacy

The results showed low levels of kinesiophobia and high self-efficacy scores and these scores were not correlated to any of the clinical or physical outcomes. The current results showed that anxiety was correlated with headache-related disability. Anxiety has been extensively explored in TTH and some studies found that anxiety seemed to be more dependent on the TTH frequency [37, 38] which means that CTTH patients would be more anxious than ETTH patients. Results of the present study are consistent with theses previous findings.

Limitations

This study is not without limitations. Indeed, baseline neck pain frequency and intensity were self-reported by participants based on episodes over the past month, which could have been influenced by recollection bias. Although the comparison between retrospective and prospective self-reported data showed that participants were able to correctly estimate headache frequency, they overestimated headache intensity which could also have been overestimated in self-reported neck pain intensity. In addition, in the present study, TTH participants results were analyzed without considering TTH categories (infrequent episodic, frequent episodic and chronic), and it should be kept in mind that results could differ between the episodic forms and the chronic form. Another limitation is our small number of participants, meaning that the results should be interpreted with caution.

Results of the present study showed that TTH frequency and intensity, and the presence of concomitant infrequent migraine are predictors of future disability over a 3-month period. Results also showed that neck extensor muscles strength was not correlated with headache-related disability or with any other clinical outcomes and was not a good predictor of future disability. Further studies are needed to evaluate the predictive value of other physical outcomes on headache-related disability. Tension-type headache constitutes a major public health problem and a better understanding of clinical and physical factors is needed. Health professionals should consider clinical outcomes to evaluate and elaborate future treatment strategies for patients with TTH.

Declarations:

Ethics approval and consent to participate: This study has been approved by the ethic committee of human subjects of the Université du Québec à Trois-Rivières (CER-16-225-07.15).

Availability of data and material : The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests : None to declare.

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