

Tension-Type Headache: A Life-Course Review

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Abstract

Background: Tension-type headache is the most prevalent primary headache type worldwide and is associated with a wide spectrum of disability. Although progress has been made in understanding the complex mechanisms that lead to the pathogenesis of tension-type headache, to date there are no clear-cut markers of what makes tension-type headache unique. Due to a relative lack of research (compared to migraine), the pathophysiology of tension-type headache is not well understood and there are gaps in the epidemiological data, particularly from Australasia.

Objective: To provide a structured narrative review of the prevalence and correlates of tension-type headache, with focus on a birth cohort of young adults from the Dunedin Multidisciplinary Health and Development Study (DMHDS) in New Zealand.

Method: A review of the literature was conducted to identify the epidemiological, diagnostic, methodological and pathophysiological factors that contribute to tension-type headache being a specific entity.

Results: Findings suggest that prevalence rates of TTH vary across global region, age, gender and method of assessment. A wide range of risk factors for TTH was identified, and recent advances in genetic and neurobiological research have increased understanding of the etiology of TTH. Few longitudinal studies have been conducted on TTH.

Conclusion: Further longitudinal epidemiological research is needed to help distinguish tension-type headache from migraine, particularly in young people. Identifying the specific markers of tension-type headache is a first step towards developing effective prevention and treatment strategies.

Key Words: Headache; Epidemiology; Longitudinal; Dunedin Study; Tension-type; Migraine

Conflict of Interest: There are no conflicts of interest associated with this study.

Abbreviations: CTTH: Chronic Tension Type Headache; DMHDS: Dunedin Multidisciplinary Health and Development Study; ETTH: Episodic Tension-Type Headache; ICHD: International Classification Of Headache Disorders; IHS: International Headache Society; NZ: New Zealand; TTH: Tension-Type Headache

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Introduction

Tension-type headache (TTH) is the most prevalent form of headache in all age groups across the globe [1-3]. TTH leads to considerable disability [4, 5] with up to 60% of individuals reporting decreased work effectiveness [6], increased absenteeism [7], and

reduced social engagement [6]. The limited research on TTH, compared to that for other types of headaches [8], means that few recent advances have been made in the treatment of TTH [9]. Despite the availability of diagnostic criteria for TTH [10, 11], there is difficulty in distinguishing tension-type headache from

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migraine due to overlapping features [12]. Evidence suggests that features common to both types of headaches include the presence of throbbing, unilateral pain [13, 14], muscle tension [15, 16] and aggravation by physical activity [17]. Further evidence suggests that stress, fatigue, alcohol and menstruation are common triggers for TTH and migraine [18]. TTH is the most costly type of headache for society, due to its greater prevalence [19]. As such, identifying the precursors and distinctive characteristics of TTH is a research priority.

The aim of this review is to identify factors that characterize TTH as a specific entity and to address a gap in epidemiological data from Australasia. Here we provide an overview of current research on TTH and highlight our findings with headache sufferers from the Dunedin Multidisciplinary Health and Development Study (DMHDS). The DMHDS is a prospective and representative cohort study that has collected information face-to-face about headache symptoms longitudinally from age 7 to age 38 years [20]. Given the lack of specific markers of TTH and the common transitions between TTH, migraine, and other headache subtypes, longitudinal prospective studies are required to address gaps in knowledge about the risk factors, specificity, incidence, and course of TTH in adults [5, 21, 22]. Our ongoing research is one of a limited number of longitudinal studies that can address these gaps in knowledge.

Headache classification

The classification of TTH is based on its phenotype as defined by the International Classification of Headache Disorders (ICHD). In extant research, TTH is classified according to the ICHD-II. The ICHD-II describes four categories for TTH: infrequent episodic; frequent episodic; chronic; and probable. The criteria further classify TTH based on the presence or absence of a coexisting disorder of the peri-cranial muscles.

Tension-type headache is typically characterized by bilateral pressing or tightening pain that occurs in the frontal or occipital areas, is of mild to moderate intensity, and is not exacerbated by physical activity [23]. There is no nausea or vomiting, but photophobia or phonophobia may be present. Probable TTH is defined as a headache fulfilling all but one of the diagnostic criteria. TTH is primarily diagnosed by the absence of features that characterize other primary headaches [21] and by the exclusion of other organic disorders [24]. On the basis that diagnosis of TTH is made by the absence of associated symptoms diagnostic of migraine, Monteith and Sprenger (2010) suggest that the sensitivity and specificity of classification for TTH could be contended [21]. An initiative to stimulate further research into the mechanisms and treatment of TTH prompted the release of a third edition *beta* version of the International Classification of Headache Disorders (ICHD-3 beta) in 2013 [25]. This version is purported to have made improvements over the ICHD-II, and the International Headache Society (IHS) contend that it would “be unhelpful to continue to use the previous ICHD-II for scientific work” (p.633; IHS 2013).

Current diagnostic ambiguity contributes to the significant number of people who are misdiagnosed or who are assigned a diagnosis of probable TTH, or who remain unclassifiable

[26]. Findings show that, after examination by a physician, 35.6% of patients remained unclassified [27], one-third of TTH patients were misdiagnosed with sinusitis, followed by other misdiagnoses such as hypertensive or cervicogenic headache, [28] and as few as 1.3% of patients obtained a correct diagnosis of TTH [28]. The lack of specific markers of tension-type headache presents a substantial challenge in differential diagnosis of IHS-defined TTH and migraine due to the overlap of symptoms and precipitants of each headache type [12, 29, 30]. Many patients with chronic tension type headache (CTTH) over-use medication [24, 31], making it difficult to distinguish CTTH from medication overuse headache [32]. Further, TTH and migraine have been shown to frequently coexist [33, 34]. For instance, findings from our longitudinal study show that around four percent of adults experience coexisting TTH and migraine [30].

The coexistence of TTH and migraine, together with the difficulty in clinical settings to differentiate TTH from migraine, have led some researchers to argue that TTH and migraine are not distinct clinical entities but represent opposite ends of a pain severity continuum (i.e., continuum-severity theory) [35, 36]. However, the vast majority of people with TTH never seek medical attention [23, 31]. Hence the apparent lack of distinction between TTH and migraine in clinical settings may reflect referral bias [37]. Population-based evidence of significant differences in epidemiological characteristics suggests that migraine and tension-type headaches are distinct entities [36, 38]. We found, for example, that migraine was related to familial factors, anxiety, and stress reactivity, whereas TTH was associated with neck or back injury in early childhood [30]. Other studies have found that the prevalence of migraine is higher in women than men yet for tension-type headaches women are only slightly more affected than men [37, 38]. The risk factors for TTH appear to be different from those for migraine. Poor self-rated health, little sleep and an inability to relax after work are predictive of TTH whereas high work load, familial disposition, lack of secondary education and frequent TTH are risk factors for migraine [39]. Whether TTH and migraine represent distinct or similar entities continues to be debated. Nonetheless, the aforementioned research suggests that distinguishing TTH from other types of headaches purely on the basis of symptoms is difficult.

Epidemiology

According to the epidemiological literature on TTH, there are wide variations in the estimated prevalence of TTH. Although discrepancies are likely due to many factors, to a reasonable extent methodological differences can account for variability in prevalence estimates [24]. There is evidence that population estimates of TTH prevalence differ for questionnaire- versus interview-based assessments [22, 40]. There are inconsistencies between individuals' self-report of factors that trigger, aggravate, and ameliorate their headache and interview-based or objective measures. This work suggests that although questionnaires provide useful information about individuals' perceptions about their headache, they are subject to recall bias, and thus may not adequately identify actual relationships between TTH and other factors [41]. Further, the majority of epidemiological studies on TTH are cross-sectional and do not provide information on what

happens to prevalence rates over time, or the order of onset with respect to comorbid disorders, or how chronicity may develop [5, 22].

For a majority of individuals, first onset of TTH is before age 20 [7, 23], with peak prevalence between the ages of 30 and 39 years [31]. Data from our study show that 34.5% of New Zealand (NZ) children between 7-13 years of age experience frequent headaches. Only 9% of these children grow up to have TTH in adulthood. 11.1% of 26-year old study members were classified as having TTH and this rate increased to 17.5% at age 32 years [42, 43]. Of those with TTH at age 32, 10.3% had infrequent episodic tension-type headache (ETTH), 87.2% had frequent ETTH, and 2.6% had chronic TTH [43]. The lifetime prevalence of TTH in the general population ranges between 30% and 78%²⁴ and there is a slight decrease with advancing age [1].

Prevalence of TTH varies by age, gender, geographical region [1, 40] as well as according to education level and employment status [43]. The prevalence of TTH in our NZ females is twice that of males, consistent with the female-to-male ratio reported in various studies (ranging from 1.16:1 to 3:1 [1]). There is also evidence that the prevalence of TTH increases with higher levels of education [3]. Individuals with TTH in our study were more likely to have obtained a bachelors or graduate-level degree compared to those without headache [44]. For chronic tension-type headache (CTTH), however, there may be an inverse relation between headache and education level [45]. Data from studies examining the relation between TTH and employment status are also equivocal. TTH has been reported to be associated with unemployment [46], whereas 32-year-old members of the DMHDS with TTH were significantly more likely to be employed than headache-free individuals. The roles of education and employment in the development of episodic and chronic tension-type headache clearly need further investigation.

Prevalence rates of TTH vary widely across global regions [40]. The global one-year prevalence of TTH has recently been estimated at 32 % (30% for episodic TTH, 2.4 % for chronic TTH) [40]. Episodic TTH rates range from 10.8% [47] to 37.3% [40] and chronic TTH rates range from 0.6 % to 3.3% [40]. The cross-study weighted aggregate rate of TTH is 13% [22], substantially higher than that for migraine with aura (4.4%) and chronic migraine (0.5%) [22]. The average one-year prevalence rate is greater in European countries (53%) followed by South America (31.5%), North America (30%), Asia (18.5%), the Middle East (10.3%), and Africa (7%) [40]. There is a gap in epidemiologic research on TTH from Australasia [40]. In our study, the one-year prevalence of TTH was 11.6% at age 38 years. Most studies [22], including ours, report a greater prevalence of TTH than migraine. Presented in **Table 1** is selected epidemiology of tension-type headaches in adults (**Table 1**).

TTH as a dynamic condition

Research suggests that the one-year prevalence rate of TTH changes during adulthood and that TTH is a dynamic condition [48, 49]. For instance, rates of TTH increased from 79% to 87% over a 12-year period among young adults in Denmark [7]. Our prevalence rates have similarly fluctuated in adult participants as

they have aged: from 11.1% at age 26; 16% at age 32; and 11.6% at age 38. In young adulthood, individuals are in the process of establishing their careers, social networks, and health practices. It is possible that for some young adults, coping with these life transitions impacts physical and psychological processes that increase their susceptibility to TTH. This idea is supported by findings showing that compared to healthy controls, individuals with TTH display higher levels of perceived stress and deficient problem-solving skills [46, 50]. Although the observed variation between our prevalence rates and those of the Danish epidemiologic study by Lyngberg and colleagues (2005) [7] may to some extent reflect methodological differences, recent work suggests that prevalence rates of TTH are influenced by culture and degree of urbanization [40]. Future research could explore this notion.

Lyngberg and colleagues further reported that, of individuals diagnosed with episodic or chronic TTH, 45% went into remission, 39% had an unchanged frequency of episodic TTH, and 16% had either unchanged or newly diagnosed chronic TTH [7]. Similarly, a clinical 10-year follow-up study showed that 75% of individuals initially diagnosed with episodic tension-type headache continued to experience episodic TTH, and 25% of the study population progressed to chronic TTH. In those diagnosed with initial chronic tension-type headache, 31% remained chronic, 21% had developed medication overuse, and the remaining 48% had reverted to the episodic form [51]. In our study, 9.2% of study members experienced remission from age 26 to 38 years, 6% reported TTH at two of the three age group periods, and 2.7% had a late onset of TTH at age 38.

At the same time our findings suggest that, for many individuals, TTH is a persistent problem throughout young adulthood. Up to 40% of cohort participants diagnosed with TTH at age 26 were also diagnosed with TTH at age 32 and 43.5% of study members diagnosed with TTH at age 32 were also diagnosed with TTH at age 38 [43].

Precipitants and correlates of TTH

Researchers have identified multiple precipitants and correlates of TTH [48]. The most frequently reported precipitants of TTH are stress or mental tension [5], followed by sleep problems or fatigue [52]. There is also evidence that factors such as weather changes [18], menstruation [53], and inability to relax after work [5] are all associated with TTH.

Although many studies have found that TTH is related to stress, few studies have investigated subcomponents of stress or the timing with which the stress occurred. In our study, we found that overall levels of stress did not differ between adults with TTH and those who were headache-free. TTH sufferers did, however, report a high level of stress about bodily changes [54]. It is possible that the stress of a changing body during adolescence increases an individual's vulnerability to developing TTH. Individuals with TTH may also have different stress adaptive mechanisms involving both cardiovascular activation and the pain control system [55]. In response to ongoing cognitive stress, individuals with TTH maintained increased heart rate and blood pressure, whereas these decreased for migraineurs and controls.

Table 1 Selected epidemiology of tension-type headaches in adults.

Reference	Characteristic	Tension-type headache		
		ETTH	CTTH	TTH
	(Unspecified)			
	Prevalence:			
Sahler K (2012) [40]	Global	30.00%	2.40%	
	Europe	53.00%	2.30%	
	South America	31.50%	3.60%	
	North America	30.00%	2.20%	
	Asia	18.50%	2.40%	
Waldie et al., (2007) [43]	New Zealand	11.60%		
Sahler K (2012) [40]	Middle East	10.30%	3.50%	
	Africa	7.00%	1.10%	
	Female-to-male ratio			
Lynberg AC. et al., (2005) [7]				3:01
Rasmussen BK.et al., (1993) [18]				1:03
Schwartz BS. et al., (1997) [6]		1.16:1	2:01	
Waldie KE et al., (2002) [30]				2:01
	Education Level (high-university level/low- school level)			
Queiroz LP et al., (2009) [45]			Low	
Robbins MS et al., (2010) [8], Schwartz BS et al., (1997) [6]	High	Low		
Waldie KE et al., (2007) [43]		High		
Yu S et al., (2012) [47]				Low
	Employment (employed/unemployed)			
Yu S et al., (2012) [47]	Unemployed			
Waldie KE et al., (2002) [30]		Employed		
	Age of onset			
Lyngberg AC et al., (2005) [7]	<20 yrs			
Mueller L. et al., (2002) [23]				
	Persistent TTH			
Lyngberg AC et al., (2005) [7]	39.00%			
Moerk H, et al., (2000) [5]	75.00%			
Waldie KE et al., (2007) [43]	40-43.5%			
	Change in TTH			
Lyngberg AC et al., (2005) [7]	25years	79.00%		
	37 years	87.00%		
Waldie KE et al., (2008) [42]	7-13 years	34.50%		
	26 years	11.10%		
	32 years	17.50%		
	Remission of TTH			
Lyngberg AC et al., (2005) [7]	12 year period	45.00%		
Waldie KE et al., (2007) [43]	6 year period	9.00%		
	Coexist migraine			
Waldie KE et al., (2002) [30]	4%			
Rasmussen BK et al., (1992) [33]	83%			
Lyngberg AC et al., (2005) [38]	94%			

Note: ETTH episodic tension-type headache, CTTH chronic tension type-headache.

Moreover, stress-induced pain responses were abnormally large while pain recovery was delayed for individuals with TTH compared to controls. These findings complement other findings that pain sensitivity mediates the relationship between stress and headache intensity in individuals with CTTH [56].

Our findings also add to evidence that TTH is frequently co-morbid with anxiety and depression [57] and with reports of repressed anger and resentment [57-59]. We also found that adults with TTH were less antisocial in childhood and less aggressive during adolescence and early adulthood than individuals

Table 2 Selected factors associated with tension-type headaches in adults.

Reference	Tension-type headache
	TTH (Unspecified)
Lyngberg AC et al., (2005) [7]	Poor health, lack of sleep, inability to relax
Rasmussen BK et al., (1993) [18], Jensen R et al., (2010) [32], Scher AI et al., (1998) [46]	Stress, mental tension, fatigue, psychological problems
Couch JR. et al., (2007) [68], Côté P et al., (2000) [70], Waldie KE et al., (2002) [30]	Neck, back or head injury
Russell MB et al., (2006) [64], Ostergaard S et al., (1997) [65]	Genetic predisposition
Eskin, M. et al., (2013) [94]	Problem solving, stress, depression
Baskin SM et al., (2006) [57]	Anxiety, depression,
Adler CS et al., (1987) [58]	Repressed anger, resentment
Waldie KE et al., (2002) [60]	Lower aggression, less antisocial
Waldie KE. (2001) [54]	Stress about bodily changes
Aaseth K et al., (2010) [73], Bell BD et al., (1999) [81]	Changes in brain structure

without headache [60]. This complements recent evidence that individuals with TTH have difficulty with outward expression of anger; inward anger is thought to increase the intensity level of headache through somatization [61]. Our findings using the SF-36 Health Survey [62] also showed that adults with TTH report significantly less vitality, poorer social functioning, and poorer physical and emotional health in everyday roles than individuals without headache [30]. Presented in **Table 2** are selected factors associated with tension-type headaches in adults.

While the biological mechanisms that predict progression from episodic TTH to chronic TTH have yet to be clarified, the epidemiologic literature has identified both depression and anxiety, and medication overuse, as primary factors that increase the risk of headache progression [1]. Taken together, the research discussed above suggests that more precise classification of TTH may require a more refined analysis of known precipitants and determinants.

Genetics and neurobiology

Genetic factors are most certainly involved in TTH pathogenesis [63], with a higher genetic influence for frequent ETTH than infrequent ETTH [64]. The population relative risk in relatives of individuals with chronic TTH was increased threefold compared with normal controls [65].

The exact neurological mechanisms of TTH are unknown. Although TTH was previously considered to be primarily psychogenic, recent evidence strongly indicates a neurobiological basis [66]. A distillate of recent research suggests that peripheral pain mechanisms are of importance in episodic TTH, whereas chronic TTH is related to sensitization of pain pathways in the central nervous system resulting from prolonged nociceptive stimuli from pericranial myofascial tissues [25, 67].

Several studies demonstrate a relationship between neck or head injury and headache [68-70]. Findings from this work suggest that the relationship between injury and headache is not strongly related to the temporal proximity of the injury. Instead, individuals with lifetime injuries to the head or neck had increased risk of headaches, even if the injuries were remote to the onset of headache. In our research, nearly one quarter of young adults with TTH suffered from a childhood neck or back

injury [30]. It is plausible that a neck or back injury can lead to an increased vulnerability in the skeletal and pericranial muscles that increases susceptibility to TTH. This idea is supported by evidence that disturbances of the muscles of the upper cervical spine and neck-shoulder region play a role in the pathogenesis of tension-type headache [71, 72]. Research suggests that myogenic referred pain caused by active myofascial trigger points in the head, neck, and shoulder muscles might contribute to patterns of head pain in individuals with TTH [24].

Recent findings from epidemiological research examining the association of chronic headache and chronic rhinosinusitis in middle aged adults revealed that CTTH is significantly associated with chronic rhinosinusitis [73]. Indeed, individuals with chronic rhinosinusitis had a ninefold increased risk of having chronic headache compared with the general population.

Some researchers have proposed that sympathetic hyperactivity is the mechanism by which psychological factors such as stress triggers the development of TTH. There is evidence that muscle nociceptors can be stimulated by endogenous neurotransmitters and/or hormones such as serotonin, norepinephrine, and bradykinin [74]. This raises the possibility that activation of the sympathetic nervous system and hypothalamic-pituitary-adrenal axis in response to stress may be important in TTH pathogenesis. Sympathetic hyperactivity has been implicated in other pain disorders such as fibromyalgia [61], and a number of studies have demonstrated differences in short-term nervous system response between TTH patients and controls in response to stress [75-77].

If prolonged hyperactivity of the sympathetic nervous system in response to psychological stressors contributes to the abnormal pain processing observed in TTH, this may be accompanied by long-term changes in cardiovascular function and haemodynamics. Findings from other work suggest that nitric oxide-related central sensitization may be an important mediator in pain mechanisms of TTH [78, 79].

There is evidence that chronic TTH is associated with changes in brain structure. Research using magnetic resonance imaging (MRI) voxel-based morphometry showed that patients with CTTH have significant gray matter decreases in areas of the brain involved in nociceptive transmission [73]. The gray matter reduction correlated with lifetime duration of headache. There is

also evidence of white matter abnormalities in elderly patients with TTH (34% of the sample compared with 7% of headache-free controls) [80, 81]. Further, recent research shows that CTTH is associated with impaired motor learning [82]. CTTH patients had a deficit in use-dependent neuroplasticity within networks responsible for task performance [82].

In sum, advances in genetic and neurobiological research have increased our understanding of the complex mechanisms that may lead to TTH. As the preceding discussion illustrates, there is strong evidence for a genetic predisposition for frequent ETTH and chronic TTH. Moreover, sensitization of pain pathways in the central nervous system, and disturbances to the cervical spine or musculature from prior injury, are positively associated with TTH. Research has progressed our current understanding regarding the means through which psychological factors lead to TTH, suggesting sympathetic hyperactivity as a possible mechanism. Further, some studies indicate that CTTH is associated with structural and functional changes in the brain. By utilizing these findings, future interventions may provide better treatment outcomes for people with TTH.

Treatment

There have been few recent advances in treatment options for TTH. The treatment of tension-type headaches can be divided into pharmacologic and non-pharmacologic therapies [32, 83]. For a majority of individuals with TTH, the mainstays in pharmacotherapy are simple analgesics and nonsteroidal inflammatory drugs (NSAIDs) [32]. In our cohort, over half of adults with TTH were taking at least one form of prescription medication during the past 12 months compared to 35% of controls. In addition, 45% were taking analgesic medications during the past 12 months (most were simple analgesics) compared to 25.6% of controls. Although simple analgesics and NSAIDs have proved effective in the treatment of acute TTH, their efficacy decreases with increasing frequency and chronicity of TTH [83].

In individuals with very frequent episodic TTH and those with chronic TTH prophylactic, pharmacotherapy in the form of antidepressants is widely used [32]. The tricyclic antidepressant amitriptyline is the recommended drug of first choice as it has been shown to have a significant and clinically relevant effect in the prevention of CTTH [84, 85]. Other evidence suggests that the noradrenergic and specific serotonergic antidepressant mirtazapine [86], and the serotonin and noradrenaline reuptake inhibitor venlafaxine [87] may have comparable efficacy in the treatment of CTTH to that of amitriptyline and may be better tolerated. The effectiveness of other pharmacotherapies tested for TTH has been variable. For instance, findings on the effectiveness of muscle relaxants appear equivocal [88, 89]. Research suggests that botulinum toxin is ineffective or potentially harmful, thus is not recommended as treatment for CTTH [90]. Overall, research suggests that current pharmacotherapy options are far from optimal. Future pharmacotherapies that appear promising in the treatment of CTTH include third-generation antidepressants, nitric oxide inhibitors, Na⁺ and/or Ca²⁺, channel modulators, and anticonvulsants [32].

Non-pharmacologic management of TTH encompasses a wide variety of physical and psychological therapies. There is evidence for the utility of therapies such as electromyography biofeedback alone or in combination with relaxation [91] and physiotherapy [92], and increasing evidence that cognitive-behavioral therapy may be effective in TTH [93]. However, for many therapies (e.g., acupuncture, emotional freedom therapy) there is currently no robust scientific evidence for efficacy [9]. There is some evidence that the combination of non-pharmacologic and pharmacologic therapies may be effective in the treatment of TTH [17]. Given that the underlying pathophysiology of TTH is complex, future studies focusing on the interaction of multi-modal treatments are warranted [94].

Summary and Conclusions

TTH is the most prevalent primary headache type worldwide and is associated with significant disability. The prevalence of TTH differs by geographical region, with the prevalence of TTH in NZ comparable to that of Asia and the Middle East. Further, the prevalence of TTH in young NZ adults is dynamic, with peak prevalence at age 32 years. For a large proportion of sufferers, however, TTH is a persistent problem.

Although current diagnosis is primarily clinical and based on negative associations and by exclusion, a majority of individuals with TTH do not seek medical attention. Thus, identifying the factors that characterize TTH as a specific entity has proven difficult. Findings from our study suggest that TTH and migraine are associated with different developmental characteristics. NZ adults that have suffered a neck or back injury, and those who are educated and employed are more likely to have TTH. Stress about bodily changes in adolescence is also a significant precipitant of TTH. Neurobiological studies suggest that TTH is associated with sympathetic hyperactivity and structural changes in the brain.

Further research is needed to reliably determine what is so special about tension-type headache. Research using the updated beta version of the ICHD may shed new light on clinical features that better characterize TTH. Moreover, a classification system developed from studies that further examine the epidemiology, neurobiology, and genetics of TTH is required.

This review also highlights the need for further longitudinal research. Prospective studies that elucidate the multiple correlates of TTH across the lifespan can provide clues regarding etiologic mechanisms and factors that characterize TTH as a specific entity.

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References

- 1 Crystal SC, Robbins MS (2010) Epidemiology of tension-type headache. *Curr Pain Headache Rep* 14: 449-454.
- 2 Jensen R, Symon D (2005) Epidemiology of tension-type headaches. In: Olesen J, Goadsby PJ, Ramadan N, et al. *The Headaches*, 3rd edn. Philadelphia: Lippincott Williams & Wilkins 621-624.
- 3 Schwartz BS, Stewart WF, Simon D, Lipton RB (1998) Epidemiology of tension-type headache. *JAMA* 279: 381-383.
- 4 Jensen R, Stovner LJ (2008) Epidemiology and comorbidity of headache. *Lancet Neurol* 7: 354-361.
- 5 Bendtsen L, Jensen R (2006) Tension-type headache: the most common, but also the most neglected, headache disorder. *Curr Opin Neurol* 19: 305-309.
- 6 Schwartz BS, Stewart WF, Lipton RB (1997) Lost workdays and decreased work effectiveness associated with headache in the workplace. *J Occup Environ Med* 39: 320-327.
- 7 Lyngberg AC, Rasmussen BK, Jørgensen T, Jensen R (2005) Secular changes in health care utilization and work absence for migraine and tension-type headache: a population based study. *Eur J Epidemiol* 20: 1007-1014.
- 8 Robbins MS, Lipton RB (2010) The epidemiology of primary headache disorders. *Semin Neurol* 30: 107-119.
- 9 Bendtsen L, Fumal A, Schoenen J (2010) Tension-type headache: mechanisms. *Handb Clin Neurol* 97: 359-366.
- 10 [No authors listed] (1988) Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. Headache Classification Committee of the International Headache Society. *Cephalalgia* 8 Suppl 1: 1-96.
- 11 Headache Classification Subcommittee of the International Headache Society (2004) *The International Classification of Headache Disorders: 2nd edition*. *Cephalalgia* 24 Suppl 1: 9-160.
- 12 Kaniecki RG (2002) Migraine and tension-type headache: an assessment of challenges in diagnosis. *Neurology* 58: S15-20.
- 13 Turkdogan D, Cagirici S, Soylemez D, Sur H, Bilge C, et al. (2006) Characteristic and overlapping features of migraine and tension-type headache. *Headache* 46: 461-468.
- 14 Gobel H, Heinze A, Heinze-Kuhn K (2006) Phenotypes of chronic tension type headache. In: Olesen J, *Classification and diagnosis of headache disorders*. Oxford University Press, New Delhi.
- 15 Anderson CD, Franks RD (1981) Migraine and tension headache: Is there a physiological difference? *Headache* 21: 63-71.
- 16 van Boxtel A, Goudswaard P, Janssen K (1983) Absolute and proportional resting EMG levels in muscle contraction and migraine headache patients. *Headache* 23: 215-222.
- 17 Iversen HK, Langemark M, Andersson PG, Hansen PE, Olesen J (1990) Clinical characteristics of migraine and episodic tension-type headache in relation to old and new diagnostic criteria. *Headache* 30: 514-519.
- 18 Rasmussen BK (1993) Migraine and tension-type headache in a general population: Precipitating factors, female hormones, sleep pattern and relation to lifestyle. *Pain* 53: 65-72.
- 19 Stovner LJ, Hagen K, Jensen R, Katsarava Z, Lipton R, et al. (2007) The global burden of headache: a documentation of headache prevalence and disability worldwide. *Cephalalgia* 27: 193-210.
- 20 Silva PA, Stanton WR (1996) From child to adult: The Dunedin Multidisciplinary Health and Development Study. Auckland: Oxford University Press, New Zealand.
- 21 Monteith TS, Sprenger T (2010) Tension type headache in adolescence and childhood: Where are we now? *Curr Pain Headache Rep* 14: 424-430.
- 22 Ferrante T, Manzoni GC, Russo M, Camarda C, Taga A, et al. (2013) Prevalence of tension-type headache in adult general population: The PACE study and review of the literature. *Neurol Sci* 34 Suppl 1: S137-138.
- 23 Mueller L (2002) Tension-type, the forgotten headache. How to recognize this common but undertreated condition. *Postgrad Med* 111: 25-26, 31-32, 37-38 passim.
- 24 Fumal A, Schoenen J (2008) Tension-type headache: current research and clinical management. *Lancet Neurol* 7: 70-83.
- 25 Headache Classification Committee of the International Headache Society (IHS) (2013) *The International Classification of Headache Disorders, 3rd edition (beta version)*. *Cephalalgia* 33: 629-808.
- 26 Rossi LN, Vajani S, Cortinovis I, Spreafico F, Menegazzo L (2008) Analysis of the International Classification of Headache Disorders for diagnosis of migraine and tension-type headache in children. *Dev Med Child Neurol* 50: 305-310.
- 27 Li X, Zhou J, Tan G, Wang Y, Ran L, et al. (2012) Clinical characteristics of tension-type headache in the neurological clinic of a university hospital in China. *Neurological Sciences* 33: 283-287.
- 28 Ertas M, Baykan B, Orhan EK, Zarifoglu M, Karli N, et al. (2012) One-year prevalence and the impact of migraine and tension-type headache in Turkey: a nationwide home-based study in adults. *J Headache Pain* 13: 147-157.
- 29 Kaynak Key FN, Donmez S, Tuzun U (2004) Epidemiological and clinical characteristics with psychosocial aspects of tension-type headache in Turkish college students. *Cephalalgia* 24: 669-674.
- 30 Waldie KE, Poulton R (2002) The burden of illness associated with headache disorders among young adults in a representative cohort study. *Headache* 42: 612-619.
- 31 Chowdhury D (2012) Tension type headache. *Ann Indian Acad Neurol* 15: S83-88.
- 32 Jensen R, Torelli P (2010) Treatment of tension-type headache. *Handb Clin Neurol* 97: 377-386.
- 33 Rasmussen BK, Jensen R, Schroll M, Olesen J (1992) Interrelations between migraine and tension-type headache in the general population. *Arch Neurol* 49: 914-918.
- 34 Goadsby PJ, Boes C (2002) Chronic daily headache. *Journal of Neurology Neurosurgery and Psychiatry* 72: 2-5.
- 35 Vargas BB (2008) Tension-type headache and migraine: two points on a continuum? *Curr Pain Headache Rep* 12: 433-436.
- 36 Leston JA (1996) Migraine and tension-type headache are not separate disorders. *Cephalalgia* 16: 220-222.
- 37 Rasmussen BK, Jensen R, Schroll M, Olesen J (1991) Epidemiology of headache in a general population—a prevalence study. *J Clin Epidemiol* 44: 1147-1157.
- 38 Lyngberg AC, Rasmussen BK, Jørgensen T, Jensen R (2005) Has the prevalence of migraine and tension-type headache changed over a 12-year period? A Danish population survey. *Eur J Epidemiol* 20: 243-249.

- 39 Lyngberg AC, Rasmussen BK, Jorgensen T, Jensen R (2005) Prognosis of migraine and tension-type headache: A population-based follow-up study. *Neurology* 65: 580-585.
- 40 Sahler K (2012) Epidemiology and cultural differences in tension-type headache. *Curr Pain Headache Rep* 16: 525-532.
- 41 Merikangas KR (2013) Contributions of epidemiology to our understanding of migraine. *Headache* 53: 230-246.
- 42 Waldie KE, McGee R, Reeder AI, Poulton R (2008) Associations between frequent headaches, persistent smoking, and attempts to quit. *Headache* 48: 545-552.
- 43 Waldie KE, Welch D (2007) Cognitive function in tension-type headache. *Curr Pain Headache Rep* 11: 454-460.
- 44 Freitag F (2013) Managing and treating tension-type headache. *Med Clin North Am* 97: 281-292.
- 45 Queiroz LP, Peres MF, Piovesan EJ, Kowacs F, Ciciarelli MC, et al. (2009) A nationwide population-based study of tension-type headache in Brazil. *Headache* 49: 71-78.
- 46 Scher AI, Stewart WF, Liberman J, Lipton RB (1998) Prevalence of frequent headache in a population sample. *Headache* 38: 497-506.
- 47 Yu S, Liu R, Zhao G, Yang X, Qiao X, et al. (2012) The prevalence and burden of primary headaches in China: a population-based door-to-door survey. *Headache* 52: 582-591.
- 48 Heckman BD, Holroyd KA (2006) Tension-type headache and psychiatric comorbidity. *Curr Pain Headache Rep* 10: 439-447.
- 49 Merikangas KR, Cui L, Richardson AK, Isler H, Khoromi S, et al. (2011) Magnitude, impact, and stability of primary headache subtypes: 30 year prospective Swiss cohort study. *BMJ* 343: d5076.
- 50 Katsarava Z, Dzagnidze A, Kukava M, Mirvelashvili E, Djibuti M, et al. (2009) Primary headache disorders in the Republic of Georgia: prevalence and risk factors. *Neurology* 73: 1796-1803.
- 51 Moerk H, Jensen R (2000) Prognosis of tension-type headache: A 10-year follow-up study of patients with frequent tension-type headache. *Cephalalgia* 20: 434.
- 52 Wober C, Wober-Bingol C (2010) Triggers of migraine and tension-type headache. *Handb Clin Neurol* 97: 161-172.
- 53 Karh N, Baykan B, ErtaS M, Zarifoglu M, Siva A, et al. (2012) Impact of sex hormonal changes on tension-type headache and migraine: A cross-sectional population-based survey in 2,600 women. *J Headache Pain* 13: 557-565.
- 54 Waldie KE (2001) Childhood headache, stress in adolescence, and primary headache in young adulthood: A longitudinal cohort study. *Headache* 41: 1-10.
- 55 Leistad RB, Sand T, Nilsen KB, Westgaard RH, Stovner LJ (2007) Cardiovascular responses to cognitive stress in patients with migraine and tension-type headache. *BMC Neurol* 7: 23.
- 56 Cathcart S, Bhullar N, Immink M, Della Vedova C, Hayball J (2012) Pain sensitivity mediates the relationship between stress and headache intensity in chronic tension-type headache. *Pain Res Manag* 17: 377-380.
- 57 Baskin SM, Lipchik GL, Smitherman TA (2006) Mood and anxiety disorders in chronic headache. *Headache* 46 Suppl 3: S76-87.
- 58 Adler CS, Adler SM (1987) Clinical and psychosomatic aspects of tension headache. In: Adler CS, Adler SM, Packard RCPsychiatric Aspects of Headache. Baltimore: Williams & Wilkins 111-123.
- 59 Hatch JP, Schoenfeld LS, Boutros NN, Seleshi E, Moore PJ, et al. (1991) Anger and hostility in tension-type headache. *Headache* 31: 302-304.
- 60 Waldie KE, Poulton R (2002) Physical and psychological correlates of primary headache in young adulthood: A 26-year longitudinal study. *Journal of Neurology, Neurosurgery & Psychiatry* 72: 86-92.
- 61 Oz O, Erdem M, Yucel M (2011) Evaluation of anger, anger expression style and mood profile in tension-type headache. *Noropsikiyatri Arsivi/Archives of Neuropsychiatry* 48: 171-174.
- 62 Newnham EA, Harwood KE, Page AC (2007) Evaluating the clinical significance of responses by psychiatric inpatients to the mental health subscales of the SF-36. *J Affect Disord* 98: 91-97.
- 63 Van Den Maagdenberg AM, Terwindt GM, Haan J, Frants RR, Ferrari MD (2010) Genetics of headaches. *Handb Clin Neurol* 97: 85-97.
- 64 Russell MB, Saltyte-Benth J, Levi N (2006) Are infrequent episodic, frequent episodic and chronic tension-type headache inherited? A population-based study of 11 199 twin pairs. *J Headache Pain* 7: 119-126.
- 65 Ostergaard S, Russell MB, Bendtsen L, Olesen J (1997) Comparison of first degree relatives and spouses of people with chronic tension headache. *BMJ* 314: 1092-1093.
- 66 Ashina M (2004) Neurobiology of chronic tension-type headache. *Cephalalgia* 24: 161-172.
- 67 Bendtsen L (2000) Central sensitization in tension-type headache--possible pathophysiological mechanisms. *Cephalalgia* 20: 486-508.
- 68 Couch JR, Lipton RB, Stewart WF, Scher AI (2007) Head or neck injury increases the risk of chronic daily headache: A population-based study. *Neurology* 69: 1169-1177.
- 69 Scher AI, Midgette LA, Lipton RB (2008) Risk factors for headache chronification. *Headache* 48: 16-25.
- 70 Côtéa P, Cassidy D, Carroll, L (2000) Is a lifetime history of neck injury in a traffic collision associated with prevalent neck pain, headache and depressive symptomatology? *Accident Analysis & Prevention* 32: 151-159
- 71 Sohn J-H, Choi H-C, Jun A-Y (2013) Differential patterns of muscle modification in women with episodic and chronic tension-type headache revealed using surface electromyographic analysis. *Journal of Electromyography and Kinesiology* 23: 110-117.
- 72 Shimizu T, Suzuki N (2010) Biological sciences related to headache. *Handb Clin Neurol* 97: 35-45.
- 73 Aaseth K, Grande RB, Kvaerner K, Lundqvist C, Russell MB (2010) Chronic rhinosinusitis gives a ninefold increased risk of chronic headache. The Akershus study of chronic headache. *Cephalalgia* 30: 152-160.
- 74 Jørum E, Årstad K, Schmidt R, Namer B, Carr RW, et al. (2007) Catecholamine-induced excitation of nociceptors in sympathetically maintained pain. *Pain* 127: 296-301.
- 75 Leistad RB, Stovner LJ, White LR, Nilsen KB, Westgaard RH, et al. (2007) Noradrenaline and cortisol changes in response to low-grade cognitive stress differ in migraine and tension-type headache. *J Headache Pain* 8: 157-166.
- 76 Ozkul Y, Ay H (2007) Habituation of sympathetic skin response in migraine and tension type headache. *Auton Neurosci* 134: 81-84.
- 77 De Benedittis G, Lorenzetti A (1992) The role of stressful life events in the persistence of primary headache: major events vs. daily hassles. *Pain* 51: 35-42.

- 78 Ashina M, Bendtsen L, Jensen R, Olesen J (2000) Nitric oxide-induced headache in patients with chronic tension-type headache. *Brain* 123 : 1830-1837.
- 79 Olesen J (2008) The role of nitric oxide (NO) in migraine, tension-type headache and cluster headache. *Pharmacol Ther* 120: 157-171.
- 80 Schmidt-Wilcke T, Leinisch E, Straube A, Kampfe N, Draganski B, et al. (2005) Gray matter decrease in patients with chronic tension type headache. *Neurology* 65: 1483-1486.
- 81 Bell BD, Primeau M, Sweet JJ, Lofland KR (1999) Neuropsychological functioning in migraine headache, nonheadache chronic pain, and mild traumatic brain injury patients. *Arch Clin Neuropsychol* 14: 389-399.
- 82 Vallence AM, Smith A, Tabor A, Rolan PE, Ridding MC (2013) Chronic tension-type headache is associated with impaired motor learning. *Cephalalgia* 33: 1048-1054.
- 83 Bendtsen L, Jensen R (2011) Treating tension-type headache - an expert opinion. *Expert Opin Pharmacother* 12: 1099-1109.
- 84 Bendtsen L, Jensen R, Olesen J (1996) Decreased pain detection and tolerance thresholds in chronic tension-type headache. *Arch Neurol* 53: 373-376.
- 85 Holroyd KA, O'Donnell FJ, Stensland M (2001) Management of chronic tension-type headache with tricyclic antidepressant medication, stress management therapy, and their combination: A randomized controlled trial. *JAMA* 285: 2208-2215
- 86 Bendtsen L, Jensen R (2004) Mirtazapine is effective in the prophylactic treatment of chronic tension-type headache. *Neurology* 62: 1706-1711.
- 87 Zisis NP, Harmoussi S, Vlaikidis N, Mitsikostas D, Thomaidis T, et al. (2007) A randomized, double-blind, placebo-controlled study of venlafaxine XR in out-patients with tension-type headache. *Cephalalgia* 27: 315-324.
- 88 Fogelholm R, Murros K (1992) Tizanidine in chronic tension-type headache: A placebo controlled double-blind cross-over study. *Headache* 32: 509-513.
- 89 Murros K, Kataja M, Hedman C, Havanka H, Sako E, et al. (2000) Modified-release formulation of tizanidine in chronic tension-type headache. *Headache* 40: 633-637.
- 90 Krishnan A, Silver N (2009) Headache (chronic tension type).
- 91 Nestoriuc Y, Rief W, Martin A (2008) Meta-analysis of biofeedback for tension-type headache: efficacy, specificity, and treatment moderators. *J Consult Clin Psychol* 76: 379-396.
- 92 Torelli P, Jensen R, Olesen J (2004) Physiotherapy for tension-type headache: a controlled study. *Cephalalgia* 24: 29-36.
- 93 Holroyd KA, Penzien DB (1986) Client variables and the behavioral treatment of recurrent tension headache: a meta-analytic review. *J Behav Med* 9: 515-536.
- 94 Eskin M, Akyol A, Çelik EY, Gültekin BK (2013) Social problem-solving, perceived stress, depression and life-satisfaction in patients suffering from tension type and migraine headaches. *Scandinavian journal of psychology* 54: 337-343.