Association Between Temporomandibular Disorders Pain and Migraine: Results of the Health 2000 Survey

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Aims: To study the possible associations of various clinically assessed painful signs of temporomandibular disorders (TMD) with the presence of migraine using a large population-based dataset. **Methods:** The data were taken from the nationally representative Health 2000 Survey (BRIF8901). The sample consisted of 5,876 adults (age range 30 to 97 years, mean ± standard deviation 52.5 ± 14.8), 5,378 nonmigraineurs and 498 migraineurs. The study participants answered questions concerning migraine presence, migraine frequency, and migraine medication consumption during a home interview. They also underwent a clinical TMD examination. **Results:** Based on the multivariate regression models, painful muscular TMD, but not joint-related TMD, was associated with the presence of migraine (odds ratio [OR] = 1.58; 95% confidence interval [CI] = 1.23 to 2.04; $P < .01$). Migraine with TMD was associated with increased migraine frequency (daily or a few attacks within a week) (OR = 1.93; 95% CI = 1.27 to 2.93; $P < .01$) and higher migraine medication consumption (OR = 2.37; 95% CI = 1.43 to 3.92; $P < .01$). **Conclusion:** According to the results of this study, muscle-related TMD pain is associated with the presence of migraine. Additionally, migraine along with painful TMD signs is associated with increased migraine frequency and migraine medication consumption. *J Oral Facial Pain Headache 2019;33:399–407. doi: 10.11607/ofph.2213*

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Globally, migraine constitutes the second largest cause of years lost due to disability (YLD).[1] Unilateral, disabling pain of moderate to severe intensity is a common feature of migraine, experienced by more than 11% of the adult population globally,[2] with women showing double the prevalence of men (13.8% vs 6.9%, respectively). In a recent Global Burden of Disease (GBD) study in 2016, it was observed that low back pain and migraine were the leading causes of YLD, especially in high- and middle-income countries.[1]

Temporomandibular disorders (TMD) are common comorbidities of migraine.[3–5] As per the Research Diagnostic Criteria for TMD (RDC/TMD), painful signs of TMD include pain in the masticatory muscles and in the preauricular and temporomandibular joint (TMJ) areas.[6] Of musculoskeletal disorders, only low back pain is globally more prevalent than TMD.[7] The global prevalence of TMD ranges from 21.5% to 51.8%, with a female to male ratio of 2:1.[8] Interestingly, the prevalence of pain alone as a TMD symptom is quite low. For instance, a study using a nationally representative sample of the population in the United States reported only 17% of patients with isolated localized facial pain, incorporating both muscular (mTMD) and TMJ-related (jTMD) pain.[9]

Among adult Finns, 38% exhibit at least one sign of TMD.[10] Generally, painful signs of TMD are more prevalent in women than in men in the Finnish population (5.1% vs 2.4% for jTMD, and 18.9% vs 7.2% for mTMD, respectively).[11] Accordingly, TMD is a significant public health issue in Finland.

Abnormalities in the autonomic nervous system have been found in both TMD[12] and migraine.[13] These include increased heart rate and decreased baroreceptor activity in TMD[12] patients and increased cranial autonomic symptoms such as lacrimation,[13] facial/forehead sweating,

and/or conjunctival injection in migraine.[14,15] Pain in both conditions has been attributed to common dysfunctions of the central pain regulation mechanisms.[16,17]

Recent evidence[18–20] suggests that TMD, and particularly mTMD, are associated with migraine. However, those studies included relatively small numbers of subjects seeking TMD treatment[18,19] or retrospective data.[20] Therefore, additional evidence regarding the associations of different TMD findings with migraine, especially those related to painful signs, is important.

This study aimed to identify the possible associations of various clinically assessed painful signs of TMD—including mTMD, jTMD, and combined TMD (cTMD) pain—with the presence of migraine based on a large population-based dataset. Associations of comorbid migraine and TMD with migraine frequency and migraine medication consumption were also investigated.

Materials and Methods

Data were taken from the nationwide Health 2000 Survey (BRIF8901) conducted in the years 2000 to 2001 by the National Institute for Health and Welfare (THL, formerly the National Public Health Institute of Finland [KTL]). Statistics Finland employed a two-stage, stratified, cluster-sampling technique for this study. The total sample size consisted of 8,028 adults aged 30 years or older living in mainland Finland. Data were collected through interviews, clinical health examinations, self-administered questionnaires, and laboratory analyses.[21]

Study Population

Of the total sample of 8,028 subjects, 6,278 underwent clinical oral and TMD examinations and answered questions related to headaches during the home-visit interview (Table 1). Five subjects were excluded due to incomplete data regarding headaches based on the home-visit interview. Subjects reporting headaches other than migraine (such as tension-type and cluster headaches) were also excluded from the analyses (n = 397). The final study population for analyses of the association between TMD findings and the prevalence of migraine was 5,876 subjects. A subset of migraineurs (n = 498) was taken from the study sample and grouped as migraineurs with and without TMD, then analyzed with regard to migraine frequency and medication consumption.

Assessment of Headaches

The subjects were defined as migraineurs based on prior diagnosis by a physician. During the home-visit interview (Table 1), subjects were asked if they had severe headache diagnosed by a physician (yes/no). Those who answered yes were further asked about the kind of headache (recurrent migraine or other) they were diagnosed with. The outcome variable, the presence of migraine, was dichotomous (yes vs no).

Migraine frequency and medication consumption were also defined based on the home-visit interview (Table 1). Answer options for migraine frequency were every day or almost every day, a few times a week, a few times a month, once a month, or less than once a month. For the statistical analyses, the first two options (every day or almost every day, and a few times a week) were combined into one category owing to the small number of subjects who selected those options. Migraine medication consumption was categorized as yes or no.

TMD Examination

Five experienced and calibrated dentists performed a standardized clinical oral examination, including a TMD examination. Examination of the masticatory muscles and the TMJs was partially based on the guidelines by Dworkin and LeResche (1992),[6] although these were not followed strictly. The clinical examination of the masticatory system included recording maximum mouth opening, TMJ sounds (clicking and crepitation), and palpation of the TMJ and two masticatory muscles (temporalis anterior and masseter superficialis). TMJ tenderness on palpation was assessed by applying a force of 5 N over the immovable condyle, while muscle tenderness was assessed with a force of 10 N. Calibration of the palpation force was achieved by exerting the forces on a measuring scale before the examinations. Joint and muscle pain on palpation were recorded if the subjects reported pain when asked or demonstrated a protective or palpebral reflex. The pain response in connection with each palpation was recorded as a dichotomous variable (yes/no). Muscle-related TMD pain (mTMD) was defined as pain during palpation in any of the masseter or temporalis muscles; joint-related TMD pain (jTMD) was defined as pain in the TMJs during the opening of the mouth; and combined TMD pain (cTMD) was marked as pain in the masticatory muscles and the TMJs during opening of the mouth. The percent agreement between the examiners and the reference examiner was 95% for mTMD (kappa value 0.47; 95% CI = 0.41–0.53) and 92% for jTMD (kappa value 0.26; 95% CI = 0.19–0.34).[10,11,21]

Other Variables

Age was used both as a categorical (comparisons between groups) and as a continuous (regression models) variable. The study population was grouped

Table 1 Questions About Headaches Included in the Interview

I would like to ask you in detail which of the following diseases a doctor has ever diagnosed you with and about the treatment and care you have received for them.
BA42. Severe headache?
1. Yes
2. No (proceed to section BA43 [refers to question other than headaches])
BA42A a. What kind of headache?
1. Recurrent migraine
2. Other headache
BA42B b. How often does the headache recur?
1. Every day or almost every day
2. A few times a week
3. A few times a month
4. Once a month
5. Less often (1 = yes; 2 = no)
BA42C c. Have you been hospitalized because of it? 1 2
BA42D d. Are you being treated by a doctor because of it? 1 2
BA42E e. Are you currently using medication because of it? 1 2 (if BA42e = 1, proceed to section BA42E_1)
BA42E_1. What medicine? _____<SII's medicines classification>
BA42E_2 e_2. _____
BA42E_3 e_3. _____
BA42F f. How many times have you seen a doctor because of it during the past 12 months? _____

SII = Social Insurance Institution of Finland. Reference: Questionnaire from the Health 2000 (BRIF8901) survey, https://thl.fi/fi/web/thlfi-en/research-and-expertwork/projects-and-programmes/health-2000-2011/forms/health-2000-forms.

into three age categories: 30–44 years (youngest), 45–59 years (middle age), and 60 years or older (oldest).[22] Marital status, educational level, and income were ascertained at the home-visit interview and were added as confounding variables in the regression models. For the statistical analyses, marital status was categorized as follows: married or living together; divorced or widowed; or single. Educational level was categorized as follows: no vocational training; vocational qualification; professional education; or higher degrees (licentiate or doctorate). Finally, income was categorized as ≤ 60,000 €/year; 60–100,000 €/year; or > 100,000 €/year.

Data Analyses

The differences between migraineurs and nonmigraineurs in terms of gender, age, marital status, education, and income status were compared. In the case of a multinomial variable, dummy variables were created to compare each category to the rest of the categories (eg, those aged the youngest were compared to the middle-aged and oldest; the middle-aged were compared to the youngest and oldest; and the oldest were compared to the youngest and middle-aged, etc). Additionally, the prevalences of mTMD, jTMD, and cTMD were compared in different age categories of women and men (among age groups and between genders). The prevalences of mTMD, jTMD, and cTMD in different age categories of migraineurs and nonmigraineurs were also compared. Finally, the prevalences of migraine in different age categories of subjects with mTMD, jTMD, and cTMD and in subjects without TMD-related pain were compared. All these comparisons were conducted using a chi-square test.

Associations of mTMD (with pain on palpation in the masseter or temporalis muscles also as separate variables), jTMD, cTMD, gender, and age (continuous) with the presence of migraine (yes/no) were assessed using binary logistic regression. The associations between migraineurs with and without painful TMD signs and migraine medication consumption were also assessed using binary logistic regression. Last, the associations between migraine with TMD and without TMD and the frequency of migraine was assessed using ordinal logistic regression. Marital status, educational level, and income were added as confounding variables in all of the regression models. All of these analyses are depicted in Fig 1.

SPSS Statistics 25.0 (IBM) was used for the data analyses. The level of statistical significance was taken to be $P < .05$ in all analyses.

Ethical Issues

Ethical approval for the Health 2000 Survey was obtained from the Ethics Committee for Epidemiology and Public Health of the Hospital District of Helsinki and Uusimaa, Finland. The survey was taken voluntarily, and all subjects gave written informed consent prior to their participation in the survey. Additional information about the Health 2000 Survey is available in a report by Aromaa and Koskinen.[21]

Differences between migraineurs and nonmigraineurs	Gender Age Marital status Educational level Income
Differences between genders in different age categories	mTMD prevalence jTMD prevalence cTMD prevalence
Differences between migraineurs and nonmigraineurs in different age categories	mTMD prevalence jTMD prevalence cTMD prevalence
Differences in prevalence of migraine in different age categories	Subjects: With mTMD With jTMD With cTMD Without TMD
Binary logistic regression with the presence of migraine as dependent variable	Explanatory variables of: mTMD jTMD Gender Age
Binary logistic regression with migraine medication consumption as dependent variable	Explanatory variables: Migraine with painful signs of TMD Gender Age
Ordinal logistic regression with headache frequency as dependent variable	Explanatory variables: Migraine with painful signs of TMD Gender Age

Fig 1 Sequence of data analyses performed in the current study.

Table 2 Description of the Study Participants, n (%)

	Migraineurs (n = 498)	Nonmigraineurs (n = 5,378)	*P* value
Gender			
Men	110 (22.1)	2,605 (48.4)	< .01
Women	388 (77.9)	2,773 (51.6)	< .01
Total (M/W)	110/388	2,605/2,773	< .01
Age categories			
30–44 y	185 (37.1)	1,829 (34.0)	.16
45–59 y	184 (36.9)	1,886 (35.1)	.40
≥ 60 y	129 (25.9)	1,663 (30.9)	.02
Total	498 (100.0)	5,378 (100.0)	.06
Marital status*			
Married or living together	345 (69.3)	3,765 (70.0)	.73
Divorced or widowed	106 (21.3)	1,010 (18.8)	.17
Single	47 (9.4)	602 (11.2)	.23
Total	498 (100.0)	5,377 (100.0)	.25
Educational level*			
No vocational training	100 (20.1)	1,319 (24.5)	.03
Vocational qualification	232 (46.6)	2,491 (46.3)	.90
Professional education	129 (25.9)	1,140 (21.2)	.02
Higher degree	37 (7.4)	426 (7.9)	.69
Total	498 (100.0)	5,376 (100.0)	.04
Income*			
≤ 60,000 €/y	443 (91.3)	4,765 (91.1)	.68
60–100,000 €/y	39 (8.0)	400 (7.6)	.51
> 100,000 €/y	3 (1.2)	65 (0.6)	.88
Total	485 (100.0)	5,230 (100.0)	.46

*Differences in the total number of migraineurs and nonmigraineurs according to marital status, educational level, and income are due to the lack of data on these variables in some of the subjects.

Results

Characteristics of migraineurs (n = 498) and nonmigraineurs (n = 5,378) are presented in Table 2.

Prevalence of TMD and Migraine

In both genders, mTMD was more prevalent in the older age groups, with the highest mTMD prevalence being in the oldest age category ($P < .01$ for all) (Fig 2). The prevalence of jTMD was lowest in the oldest age category in both genders ($P > .05$ for women, $P < .05$ for men) (Fig 2). The presence of cTMD was highest in the oldest age category of women and in the middle age category of men ($P < .05$) (Fig 2). The highest prevalence of migraine among women was reported in the youngest age group and among men in the middle age group, whereas the lowest prevalence was found in the oldest age group in both genders ($P < .05$ for all) (Fig 2).

The prevalences of both mTMD and migraine were higher in women than in men in all age categories ($P < .01$ for all). Women also reported higher prevalences of cTMD than men in all age categories, but the difference was statistically significant only in the middle and oldest age categories ($P = .217$, $P < .05$, and $P < .01$ for younger, middle, and oldest age categories, respectively). The prevalence of jTMD was not different between any age category for either men or women (P values of 1.00, .39, .06 for younger, middle, and oldest age categories, respectively).

TMD Findings in Migraineurs and Nonmigraineurs

In all age categories, the prevalence of mTMD was higher among migraineurs compared to nonmigraineurs ($P < .05$ for youngest and oldest age categories, $P < .01$ for middle age category). The prevalence of jTMD and cTMD did not differ between the two groups ($P = .71$ and $P = .39$, respectively) (Fig 3).

Prevalence of Migraine in Relation to Painful Signs of TMD

The prevalence of migraine was higher in subjects with mTMD in all age categories compared to

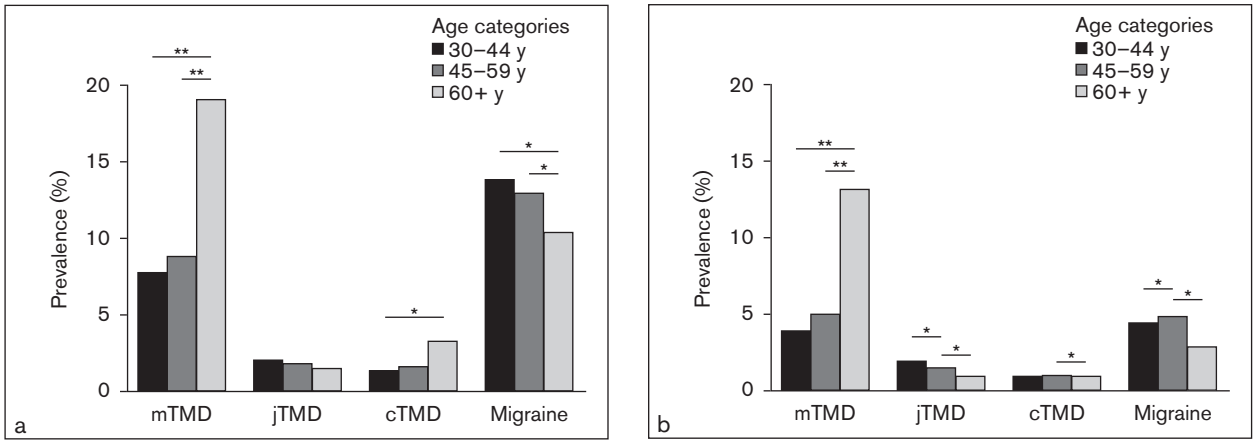

Fig 2 Prevalence of muscular (mTMD), joint-related (jTMD), and combined (cTMD) TMD pain and migraine in different age categories in **(a)** women (n = 3,161) and **(b)** men (n = 2,715). *P < .05. **P < .01.

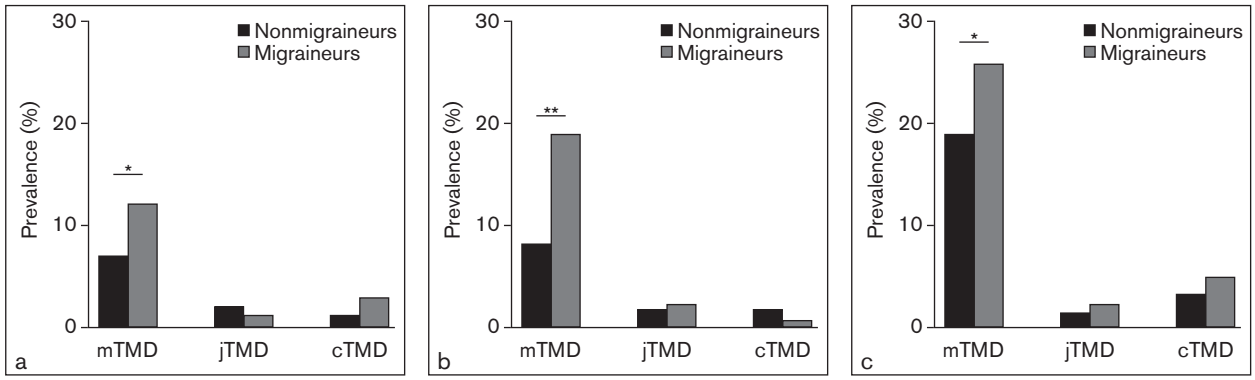

Fig 3 Prevalence of muscular (mTMD), joint-related (jTMD), and combined (cTMD) TMD pain in different age categories in migraineurs (n = 498) and nonmigraineurs (n = 5,378). **(a)** 30–44 years. **(b)** 45–59 years. **(c)** 60+ years. *P < .05. **P < .01.

subjects without TMD (P < .05). The prevalence of migraine did not differ between the subjects with jTMD and those without TMD in any of the age categories (P > .05). The prevalence of migraine in subjects with cTMD was higher compared to subjects without TMD only in the youngest age category (P < .05) (Fig 4).

Binary Logistic Regression

Female sex, presence of mTMD, and lower age were found to predict the presence of migraine. Women showed three times higher probability of having migraine compared to men (P < .01). An association between mTMD and the presence of migraine was observed (P < .01). This association was also observed with pain in the masseter (P < .05) and temporalis muscles (P < .01). However, neither jTMD (P = .95) nor cTMD (P = .44) were associated with migraine. Age was inversely associated with the presence of migraine (P < .01) (Table 3).

Another binary logistic regression model estimated the associations of migraine with TMD, migraine without TMD, gender, and age (continuous variable) as independent variables, with migraine medication consumption as a dependent variable. Migraine medication consumption was higher in migraineurs with TMD than in those without TMD (P < .01) (Table 3).

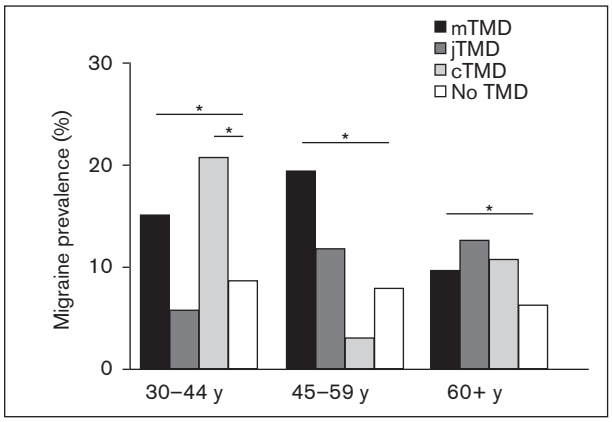

Fig 4 Prevalence of migraine in different age categories of subjects with mTMD (n = 91/582), jTMD (n = 9/86), and cTMD (n = 12/100) and in subjects without TMD-related pain (n = 386/4,610). *P < .05 between subjects without TMD and those with mTMD, jTMD, or cTMD.

Table 3 Predictors of Presence of Migraine in All Studied Subjects (n = 5,714) and Consumption of Headache Medication and Higher Headache Frequency in Migraineurs (n= 480)

Factor	OR	95% CI	*P* value
Presence of migraine (n = 5,714)			
mTMD	1.58	1.23 to 2.04	< .01
Gender (female)	3.23	2.58 to 4.04	< .01
Age	0.98	0.97 to 0.99	< .01
Consumption of headache medication (n = 480)			
Migraine with TMD	2.37	1.43 to 3.92	.01
Age	0.96	0.94 to 0.98	.01
Higher headache frequency (n = 480)			
Migraine with TMD	1.93	1.27 to 2.93	< .01
Age	0.97	0.95 to 0.99	< .01

All regression models were adjusted for marital status, educational level, and income. OR = odds ratio; CI = confidence interval.

Ordinal Regression

Migraineurs with TMD had more frequent headaches than those without TMD. However, these differences were not statistically significant. The prevalences were 13.5% vs 8.4% ($P = .14$) in the category of daily or a few times a week; 27.0% vs 18.3% ($P = .60$) in the category of a few times a month; 15.3% vs 19.9% ($P = .33$) in the category of once a month; and 44.1% vs 53.4% ($P = .10$) in the category of less than once a month. Additional painful signs of TMD as a comorbidity of migraine were associated with higher migraine frequency ($P < .01$). Age was also inversely associated with the frequency of migraine ($P < .01$) (Table 3).

Discussion

In the present study, it was found that painful signs of TMD, specifically those related to mTMD but not those related to jTMD, were associated with the presence of migraine. Moreover, a higher migraine frequency was observed in migraine patients suffering from at least one painful sign of TMD. It was also found that migraine medication consumption was higher in subjects who, in addition to migraine, had painful signs of TMD.

The primary finding of this study was a statistically significant association of mTMD with the presence of migraine. Although some of the recent studies have reported an association between masticatory muscle pain and migraine, these studies lack the general representativeness of the population.[18–20,23] A review study by Furquim et al (2015)[17] has suggested that jTMD is a rather localized phenomenon compared to mTMD, which may be combined with some more general functional changes. The association of mTMD with migraine may be due to some common neurophysiologic mechanisms such as central sensitization[24] or abnormal autonomic cardiovascular regulation, as shown to be the case in migraineurs in a recent study.[25] In fact, central neuronal hyperexcitability has been implicated in migraine and TMD based on alterations in glutamatergic and N-methyl-D-aspartate receptors.[26] Evidence has also linked both migraine and mTMD to one of the central sensitivity syndromes due to impairment of the central nociceptive pathway.[24] Migraine seems to be associated with the sensitization of the trigeminal nociceptive system, which is also reflected in other craniofacial structures, such as the masticatory muscles.[27] In spite of the major advancements in studies concerning the pathophysiology of both migraine and mTMD, the mechanisms underlying the two conditions are still not fully understood.

Several studies, although with conflicting results, have reported an association between musculoskeletal dysfunctions (evidenced as muscular pain) and migraine. Many of them have reported an association of muscle pain with primary headaches, including migraine.[28–38] Apart from masticatory myalgia, migraine (during a nonheadache period) has also been reported to be associated with greater cranial and upper cervical muscle activity,[39] manifested, for example, as neck pain.[40–42]

Another feature common to both mTMD and migraine is their high prevalence in women.[43] The peak in the prevalence of migraine during the reproductive years has been attributed to the modulation by estrogen through various mechanisms.[44] It has been reported that the prevalence of mTMD is highest in older women.[45] This higher mTMD prevalence may be attributed to the more general musculoskeletal dysfunctions observed in elderly women.[46] This prevalence pattern was observed in the current study, too.

The high prevalence of mTMD and migraine in women can be attributed to the role of both biologic and psychologic factors. Female sex hormones have been connected to lowered pain thresholds, as women report significantly higher pain intensity in both migraine and mTMD—for example, before and during menstrual cycles.[44,47] Emerging data also suggest the role of this sex-related difference is due to gender-specific inflammatory pathways and genetic variants, such as the presence of estrogen receptors.[26]

Concerning psychologic factors, it has been reported that mTMD patients[48,49] and migraine sufferers[50,51] experience more anxiety, depression, and emotional distress, giving a behavioral dimension to the etiology of both conditions. Women with chronic health issues tend to suffer more from psychologic problems, such as depression, when compared to men.[52] This finding extends to the explanation of the psychologic dimension of chronic and painful conditions such as mTMD and migraine.

In the present study, higher mTMD prevalence was observed in older subjects, particularly in women. Concomitantly, jTMD prevalence did not show any significant increase in prevalence related to older age. The higher mTMD prevalence in older subjects can be attributed to an increased disability of the musculoskeletal system with aging.[46] Additionally, it has also been reported that women experience more musculoskeletal dysfunctions compared to men.[53] There are fewer studies reporting the prevalence of jTMD signs and symptoms in the elderly in comparison to young adults. Carlsson et al (2014) reported a lower prevalence of jTMD in older adults.[54] Their results also indicate that the gender differences in the prevalence of jTMD remain statistically nonsignificant at older ages. These findings are in line with the results of the current study. Namely, lower jTMD was observed in older age groups, and no significant differences were found in jTMD prevalence between genders in any of the three age groups in the current study. In addition, the prevalence of cTMD did not differ between genders significantly owing to the fact that the intersection of mTMD and jTMD subjects resulted in a small number. This small number was due to the significantly lower prevalence of jTMD in the study population compared to mTMD.

Another interesting finding was the high prevalence of migraine in middle-aged men (group of 45–59 years old). Although this has not been studied extensively, results from a nationally representative study from the United States report that the highest migraine prevalence has two peaks in men, the highest in young adulthood and the second highest in middle age, which may be related to a drop in testosterone level at that age.[55]

It was also observed that migraine frequency was higher when any painful sign of TMD was present together with migraine. Previously, Franco et al (2010)[56] and Florencio et al (2017)[57] stated that higher primary headache frequency, especially that of migraine, is related to the severity of TMD. However, the latter of these studies had a relatively small sample size consisting only of women, while the former took the sample from a tertiary university-based hospital. Accordingly, studies examining the relationships between migraine and TMD based on any representative population-based study sample have, so far, been missing.

According to the present results, higher migraine medication consumption was reported in migraineurs with simultaneously occurring painful signs of TMD compared to migraineurs without such a condition. Concurrently, Tomaz-Morais et al (2015) reported that headache medication overuse was significantly associated with the presence of TMD in their study of 42 subjects.[58] A possible explanation for the higher headache medication consumption may be a general tendency toward analgesic overuse by women experiencing various orofacial pain conditions.[59] Since female migraineurs are more likely also to have TMD, analgesic overuse could be present in a majority of patients suffering from TMD and migraine concomitantly.

The strength of the current study is the population-based, representative, and large sample size obtained from a survey providing a comprehensive combination of a health interview and health examination. The nationally representative study sample is also a strength, considering the generalizability of the results.

The small number of subjects with jTMD and cTMD (Fig 2) may have had an effect on the statistical analyses with regard to the statistical nonsignificance of the results. However, with both genders and all three age groups, the combined results of the present study definitely indicate that mTMD is statistically significantly associated with migraine, whereas jTMD is not.

Additionally, the current study reports a slightly lower prevalence of migraine compared to the migraine prevalence reported for Europe.[2] A plausible explanation for this could be the fact that a sizable population in the age range of 12 to 29 years experiences migraine,[60] and that age group was not included in the current study sample. Thus, the higher age range in the current study may explain the lower migraine prevalence.

There are limitations to the current study. The primary limitation is the cross-sectional design, as no causal effects can be concluded based on the findings. Further studies with longitudinal data are therefore needed to explore the causality in this association. The presence of migraine recorded only on the basis of a prior diagnosis by a physician can also be considered as a limitation, since no information was available on the diagnostic criteria used. Another limitation is the fact that the diagnosis of the presence of jTMD was based solely on palpation. Due to the close proximity of the masticatory musculature to the TMJ area, this way of examination may carry with it a risk of false positive findings in terms of jTMD diagnoses.[61,62] The risk of this spurious diagnosis significantly increases in the presence of myogenous TMD (mTMD), which markedly reduces the pressure pain threshold of the masticatory muscles.[63] Lastly, the categorical assessment of headache medication, which does not distinguish between acute and prophylactic treatment, is a limitation that has to be mentioned. One must be very cautious when drawing parallels to medication overuse, which is defined based on the days on which acute medication is taken.

Regarding statistical methods, the lack of Bonferroni corrections may also be considered as a limitation. However, the number of comparisons was reasonable, and the present study is explorative in nature, not experimental. No causal inferences have been made based on the results, and the need for further studies to validate the findings of this study is acknowledged. Therefore, regarding the present study, the risk of having false positive (statistically significant) findings can be considered to be less important than the risk of losing statistical power, which is evident with the Bonferroni corrections. In addition, the implementation of the Bonferroni corrections, especially in epidemiologic studies, has been challenged.[64,65]

Conclusions

The findings of the current study indicate that muscular TMD pain is associated with migraine. Conversely, such an association was not found between joint-related TMD pain and migraine. Additionally, comorbidity of migraine with TMD was associated with both higher migraine frequency and medication consumption. The existence of an association between painful signs of TMD and migraine may be a foundation for future studies of the pathophysiologic mechanisms of the two conditions. New knowledge and deeper understanding of the existing mechanisms can lead to better prevention and treatment of both these debilitating disorders. Last, the incorporation of a multidisciplinary approach in the treatment of migraine, along with its comorbidities such as TMD, will definitely help in its treatment.

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