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Risk factors associated with incidence and persistence of frequent headaches

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Abstract

Objective. Headaches represent a significant public health problem, but the knowledge of factors specifically related to incidence and persistence of headaches is still limited. The aim of this study was to evaluate whether gender, self-reported bruxism and variations in the dental occlusion contribute to onset and persistence of frequent headaches. ***Materials and methods.*** The study population comprised 280 dental students, examined annually in a 2-year prospective study with a questionnaire and a clinical examination of the jaw function. In the analysis subjects were dichotomized into cases with frequent (once a week or more) or without frequent headaches (controls). The 2-year cumulative incidence was based on subjects without frequent headaches at baseline. Cases with 2-year persistent headaches reported such symptoms at all three examinations. Self-reported bruxism and factors in the dental occlusion at baseline were used as independent variables in logistic regression analyses. ***Results.*** The 2-year cumulative incidence of frequent headaches was 21%. Female gender (OR = 2.6; CI = 1.3–5.4), self-reported bruxism (OR = 2.3; CI = 1.2–4.4) and mandibular instability in intercuspal position (OR = 3.2; CI = 1.4–7.5) were associated with incidence of frequent headaches. Persistent headaches during the observation period were present in 12 individuals (4%) and significantly related to mandibular instability in intercuspal position (OR = 6.1; CI = 1.6–22.6). ***Conclusions.*** The results indicate that female gender, self-reported bruxism and mandibular instability in intercuspal position are of importance in the development of frequent headaches. In management of these patients a multidisciplinary approach including dentists may be important and, thus, advocated.

Key Words: *bruxism, dental occlusion, gender, prospective, risk*

Introduction

Headaches constitute a common and major public health problem, affecting almost half of the population worldwide. Headaches comprise one of the 10 most disabling conditions overall and one of the five most disabling for women [1]. Thus, a considerable proportion of the general population has headaches, which affects daily living and social life. Disabling headaches are consequently a fairly common cause for medical [2,3] and dental healthcare utilization [4]; they are also related to both use and over-use of over-the-counter drugs [5].

An association between headaches and temporomandibular disorders (TMD) has been observed in several cross-sectional studies [6,7]. Consequently, in a topical review, musculoskeletal structures involved in jaw function were suggested to be perpetuating or triggering factors of headaches [8]. In a prospective study, both trigeminal and spinal pain predicted the onset of frequent headaches [9].

Bruxism is defined as repetitive jaw-muscle activity characterized by clenching or grinding of the teeth and/or by bracing or thrusting of the mandible [10]. Its etiology is considered multifactorial and mainly regulated centrally [11,12]. Bruxism may cause tooth destruction, jaw pain, limitations of jaw movement, as well as headaches [13–15]. In addition to bruxism being considered as a risk factor for TMD [16–18], jaw clenching was reported to induce tension-type headaches in an experimental study [19]. In order to assess whether bruxism is a risk factor for headaches and craniofacial pain, longitudinal studies were recently advocated [20,21].

Although a relationship between factors in the dental occlusion and occurrence of headaches was

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suggested in a recent cross-sectional study [22], the role of variations in dental occlusion as a local biomechanical loading factor on the temporomandibular joint and jaw muscles remains a controversial topic [23,24].

Recognition and understanding of risk factors related to onset and course of frequent headaches are essential in prevention, management and risk assessment. Even though numerous studies have observed co-morbidities and possible associated factors with headaches, the majority of these studies have been cross-sectional. In order to identify risk factors for the onset of headaches, prospective cohort studies are warranted. The aim of the present study was to analyze if gender, self-reported bruxism and variations in the dental occlusion were associated with the cumulative incidence and persistence of frequent headaches over a 2-year period. The null-hypothesis was that these factors were not related to incidence or persistence of frequent headaches.

Materials and methods

Study population

The study design was a case-control observational study within a 2-year prospective cohort. During a 7-year period from 1998–2005, all students attending the dentistry programme at Umeå University, Sweden, were invited to participate. All except one student gave their informed consent and in total 371 individuals accepted to participate. Mean age was 23 years (SD = 4.9; range = 18–48). In total, 280 dental students (98 men, 182 women) were examined annually (baseline, after 1 year and after 2 years) over a 2-year period. The dropouts had all interrupted their studies. Except for a greater proportion of men among the dropouts, the baseline data did not differ significantly from that of the remaining 280 participants [9]. The study was approved by the Regional Ethics Committee of Northern Sweden (Dnr 03-111) and all participants gave their informed consent to participate.

Questionnaire

Before the clinical examination, a questionnaire was filled out which included questions on the presence and frequency of headaches (temporal or forehead) and awareness of bruxism (tooth clenching and/or grinding). At baseline, the time frame of the questions addressed occurrence of symptoms during the previous month and at the follow-ups, occurrence of symptoms during the previous year. The frequency of headache was stated on a 5-grade scale (never; occasionally; once a week; several times a week; and daily). Reported symptoms were dichotomized into frequent (once a week or more) and none/non-frequent.

Clinical examination

Two experienced and calibrated TMD/orofacial pain specialists (AW and SM, both co-authors of the present paper) examined the jaw function and presence of variations in the dental occlusion as possible biomechanical factors. Each student was examined by the same examiner at baseline and at the follow-ups by use of a standardized protocol. The examiners were always blinded to the results from the questionnaires and the results from previous examinations. Briefly, the clinical examination of the dental occlusion included morphological and functional variation of the dental occlusion. In the analyses, the following occlusal factors were used as independent variables: sagittal occlusion (neutro-, mesio- or dist- occlusion), vertical overbite (normal, open/edge-to-edge or deep), overjet (<5 mm or ≥5 mm), transversal occlusion (normal or uni/bilateral crossbite), bilateral or unilateral contact pattern in the retruded position (RP), lateral slide (<1 mm or ≥1 mm) in centric, mandibular stability in the intercuspal position (ICP) and presence of mediotrusive side interferences (MI) during lateral excursion. Mandibular stability was registered if the molar teeth could keep a firm grip on a foil during moderate clenching. Mandibular instability in the ICP was accordingly registered if the molar teeth could not keep a firm grip on the foil, indicating infra-occlusion between the molar teeth in the upper and lower jaw and, thus, potential lever actions on the jaw system. Details of the clinical examination have been presented elsewhere [25].

Statistics

The data were analyzed using SPSS version 20.0 (SPSS, Inc., Chicago, IL). Only subjects who participated in all three examinations were included in the final analyses (n = 280). Controls were constituted among those who did not report frequent headaches at any of the three examinations. Incidence cases were based on subjects without frequent headaches at baseline. Cases with persistent headaches were those who reported frequent headaches at all three examinations. Associations between baseline factors (independent variables) and cases and controls (dependent variables) were assessed by odds ratios (OR) in binary logistic regression models. The independent variables were age, gender, self-reported bruxism and a number of dental occlusal factors. Independent variables significantly associated with a dependent variable in the univariate analyses were also assessed in multiple regression models. In these, age and gender were always included. Estimates of the OR for the baseline factors are presented, together with 95% confidence

Table I. Number of cases (+) and non-cases (–) for frequent headaches at the baseline (0), 1-year (1) and 2-year examinations (2) (n = 280).

	Year						
Headaches	0	1	2	Total n (%)	Men n (%)	Women n (%)	p-value[a]
No headaches	–	–	–	198 (71)	81 (83)	117 (64)	
2-yr incidence	–	–	+	23 (8)	3 (3)	20 (11)	
	–	+	–	15 (5)	6 (6)	9 (5)	0.007
	–	+	+	15 (5)	2 (2)	13 (7)	
Persistent	+	+	+	12 (4)	1 (1)	11 (6)	0.06
Non-persistent	+	–	–	11 (4)	4 (4)	7 (4)	
	+	+	–	3 (1)	1 (1)	2 (1)	NS
	+	–	+	3 (1)	0 (0)	3 (2)	
Total				280 (100)	98 (100)	182 (100)	

[a]p-values denote differences for respective groups compared to those without frequent headaches (No headaches).

interval (CI). Results were considered statistically significant if the CI did not include 1 (one). Changes in prevalence during the observation period were analyzed with the McNemar test. Differences in the distribution of the incidence and persistence of symptoms in relation to gender were analyzed with Chi-square test. $p < 0.05$ was considered statistically significant.

Results

The distribution of frequent headaches during the 2-year study period is presented in Table I. The majority (71%) did not report frequent headaches at any time during the observation period. Considerable fluctuation in occurrence of frequent headaches was noted (Figure 1).

Two-year cumulative incidence of headaches and associated factors

The incidence analysis was based on 251 study participants without frequent headaches at baseline. The onset of frequent headaches was 12% during the first observation year and 11% during the second. The 2-year cumulative incidence of frequent headaches was 21% (Figure 1). The prevalence of frequent headaches increased significantly during the first observation year (p = 0.016). Onset of headaches during the 2-year study period were significantly more often observed among women (OR = 2.6, CI = 1.3–5.4), among those who reported awareness of bruxism (OR = 2.3, CI = 1.2–4.4) and among those with registered mandibular instability in the intercuspal position (OR = 3.2, CI = 1.4–7.5) at baseline (Table II). Also, in the multiple regression analysis the same baseline variables were significantly related to the 2-year cumulative incidence of frequent headaches.

Two-year persistent headaches and associated factors

Twelve subjects (4%; one man and 11 women) reported persistent headaches throughout the 2-year observation period. In the analysis, mandibular instability in intercuspal position was the only factor associated with persistent headaches (OR = 6.1, CI = 1.6–22.6) (Table II).

Discussion

This 2-year prospective study showed that female gender, self-reported bruxism and mandibular instability in intercuspal position predicted the onset of frequent headaches. Mandibular instability in intercuspal position was the only examined factor that predicted persistent frequent headaches during the observation period.

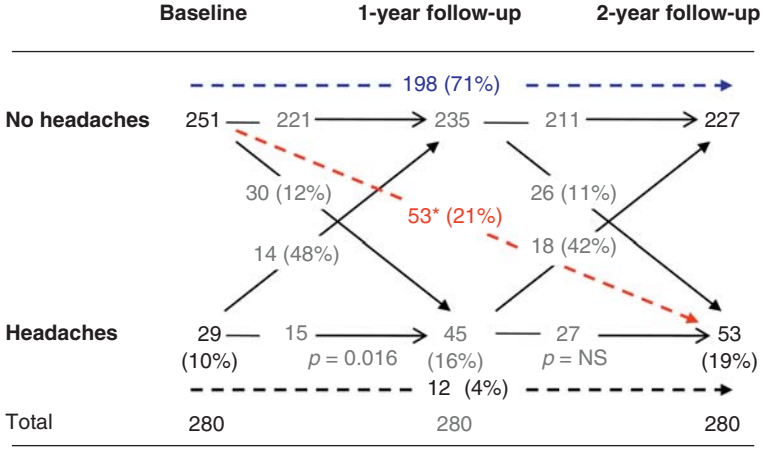

Figure 1. The 2-year course, cumulative incidence and persistence of frequent headaches among 280 dental students. *2-year cumulative incidence.

Table II. Logistic regression analysis of baseline factors as independent variables and 2-year cumulative incidence and 2-year persistent headaches as dependent variables (crude data). Odds ratio (OR) and 95% confidence interval (CI).

Baseline factors	2-year cumulative incidence of headaches OR (95% CI)	2-year persistent headaches OR (95% CI)
Controls, *n*	198	198
Cases, *n*	53	12
Gender		
Men	1.0	1.0
Women	*2.6 (1.3–5.4)*	7.6 (0.96–60.1)
Clenching		
No	1.0	1.0
Yes	*1.9 (1.03–3.5)*	1.5 (0.4–4.3)
Grinding		
No	1.0	1.0
Yes	*2.6 (1.4–5.0)*	2.0 (0.6–6.9)
Bruxism		
No	1.0	1.0
Yes	*2.3 (1.2–4.4)*	1.3 (0.4–4.2)
Morphological occlusion		
Normal occlusion	1.0	1.0
Any deviation	0.6 (0.3–1.1)	0.5 (0.1–2.0)
Mandibular stability in ICP[a]		
Stable	1.0	1.0
Instability	*3.2 (1.4–7.5)*	*6.1 (1.6–22.6)*
Mediotrusive side interferences		
No	1.0	1.0
Yes	1.1 (0.6–2.0)	0.7 (0.2–2.6)

Significant variables in italic text.
[a]Mandibular stability in the intercuspal position (ICP) was registered if the molar teeth, on the right and left sides, could keep a firm grip on a foil during moderate clenching. Mandibular instability in ICP was accordingly registered if the teeth could not keep a firm grip on the foil.

Although many studies have reported relationships between female gender, awareness of bruxism and headaches, the vast majority of these studies have been cross-sectional. Thus, there is a need for prospective studies in order to identify pre-disposing and risk factors [20,21]. One benefit of a prospective study design is that it reduces the risk of observing relationships between conditions occurring by chance and, thereby, it provides a basis of more robust knowledge of possible cause and effect in relation to a disease. On the other hand, large prospective population-based observational studies are time-consuming and costly, and drop-outs may jeopardize the interpretation. In the present study all subjects were observed under fairly similar conditions and reasonably common daily social environments as a consequence of following a syllabus and the related workload. The participants were dental students and the base survey was conducted ~1 month after their entrance to the education. It may be questioned if they as dental students might be more observant on oral habits such as presence of bruxism compared to the general population. However, since the baseline data were collected close to the start of their dental education the possible effect from the syllabus on the students' awareness and subsequently their answers to the questionnaire is expected to be marginal. The ability to draw conclusions from studies of putative risk factors is not exclusively related to the sample's representatives of larger populations. A characteristic that emerge as a risk factor provides a 'proof of principle' that the characteristic can influence the condition in focus [26].

The outcome variable used in the present study was occurrence of headaches once a week or more. This time frame for occurrence of symptoms was earlier shown to improve the reliability [27]. No attempt was made in our study to classify the headache or to estimate intensity or impact on quality-of-life, which could have further improved the study. Incidence cases were identified among those who reported a headache frequency of once a week or more during the past year and no headache at base-line. Cases with onset of frequent headache were fairly equally distributed over the observation period. The results of the study emphasizes a fluctuating pattern of headache frequency, with onset, remission as well as longer duration of symptoms within the study population. A diagnostic approach of reported headaches was avoided due to difficulties to correctly classify headaches with the aid of a questionnaire, the focus was instead on reported headache frequency and its temporal occurrence over a 2-year period. The results should, thus, be read and interpreted from that perspective.

There are few data available on the incidence of frequently occurring headaches [28], since the majority of studies have been cross-sectional. It is difficult to make direct comparisons of prevalence figures due to variations in methods such as study design, time frame of question (i.e. any headache during the whole life time span vs daily severe headaches) and specific diagnostic criteria. Longitudinal study designs are necessary when incidence and the natural course of a disease are in focus, in order to make it possible to elucidate the temporal sequence of events. The 2-year cumulative incidence of frequent headaches was relatively high and a fluctuating pattern of the presence of headaches was confirmed. A similar fluctuating pattern, but with a lower annual incidence rate (5%), was previously reported among adolescents [29]. The term 'incidence' used here is equivalent with onset of new cases during the observation period, but it cannot be excluded that some of the subjects

without headaches at the start of this study previously have had such symptoms.

Tension-type headaches are considered to affect more than 2/3 of the population at some stage in their lives [30] and are more common among women than men [1,2,22,28]. This is in line with the present findings that females had a 3-fold risk of onset of frequent headaches compared to men. Furthermore, a majority of subjects with persistent headaches were women. The total number of individuals with long-standing headaches was low and the lack of a significant gender difference was probably due to an under-powered analysis.

In the present study self-reported tooth clenching and/or grinding were related to the onset of frequent headaches. The role of bruxism as an initiating risk factor for headache has been questioned [31], but associations may vary depending on the definition of bruxism and whether this activity is daytime or nighttime. In the present study no distinction was made between daily or nocturnal parafunctional activities. The validity of the students self-reported clenching and/or grinding was not evaluated. Their answers should, thus, be understood as a self-reported condition and interpreted with due caution. Overloading of jaw muscles and muscle hyperactivity during sleep are two conditions that may share common risk factors and co-morbidities and it seems reasonable to assume that these conditions may contribute to headaches [21,32].

The significance of dental occlusion as a contributing factor to the development of headaches is a subject of controversy. This debate is probably related to differences in study designs and variability in outcome measures as well as differences in the definition of the condition in focus. Variations in dental occlusion have not emerged as significant factors in cross-sectional analysis [23–25,33,34] and in this area there is also a lack of longitudinal studies. There is a potential risk that a too simplistic view of biomechanical factors, as contributing factors in the development of musculoskeletal disorders, may be disadvantageous for the individual patient. Infra-occlusion between molar teeth, causing mandibular instability and a lever action of the temporomandibular joint following clenching, may traumatize the tissues involved and induce pain. Mandibular instability has previously been linked to signs and symptoms of TMD [18,25,33]. In the present study population, a registered mandibular instability in intercuspal position was fairly common (11%) and disclosed as a risk factor, not only for the incidence, but also for the persistence of headaches. We, therefore, propose that mandibular instability caused by infra-occlusion or general hypermobility should be further investigated.

In accordance with the bio-psycho-social model, headaches can have several causes. Based on available research, headaches are affected by psycho-social factors such as gender, social role expectations, stress and coping styles [35]. In addition, epidemiological studies have shown a co-morbidity to mood disturbances in several head pain disorders [36], as well as a higher risk of onset of headaches for chronically depressed [37]. The incidence of headaches [9], as well as facial pain [38], seem to be predicted by the presence of other pain conditions. With regard to pain in the orofacial region, an association between the severity of TMD and the frequency of temple headaches has been suggested [39]. Headaches, thus, seem to be related to TMD and an increased frequency of headaches linked to TMD pain characteristics as well as to spread of pain [39,40].

Taken together, all these possible factors, together with the aforementioned bruxism and local biomechanical factors such as occlusion and mandibular instability, may all contribute in the development and perpetuation of headaches. These findings probably reflect common patho-physiological mechanisms and individual vulnerability to musculoskeletal pain. Peripheral and central sensitization mechanisms leading to altered pain thresholds and cortical awareness may be involved. From this perspective, the prevention of progress of pain and headaches should be a priority and a multidisciplinary approach with collaboration between medical and dental care may be beneficial for patients (Figure 2). Further knowledge of possible risk factors related to development of headaches is important. With reference to a bio-psycho-social perspective, we recommend that the relative importance of oral behavior patterns (i.e. tooth grinding and/or tooth clenching), biomechanical conditions (i.e. mandibular instability), spinal pain conditions and psychosocial factors should be addressed in future studies and assessed in multivariate regression models in men and

Figure 2. Possible contributing factors to frequent headaches and healthcare level.

women, respectively, to evaluate the significance of individual factors for incidence as well as duration of headaches.

Conclusion

Female gender and self-reported bruxism were associated with the onset of frequent headaches during a 2-year study period. Mandibular instability in intercuspal position was identified as a local biomechanical factor affecting both incidence and persistence of frequent headaches. These factors, together with presence of other pain conditions, should thus be paid attention to, since they seem to be of importance in the development of frequent headaches. The findings contribute to the understanding of cause and effect and can provide a basis for further studies related to incidence and persistence of frequent headaches. Based on the results we advocate that, when assessing frequently occurring headaches, dental expertise can be of assistance and benefit for the patients.

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