Prevalence amongst adolescents in Bergen, Western Norway of temporomandibular disorders according to the DC/TMD criteria and examination protocol

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Abstract

Objective. The aims of this study were to assess the prevalence of temporomandibular disorders (TMD) amongst adolescents and to contrast the prevalence of TMD according to the DC/TMD clinical examination protocol versus the prevalence of TMD pain according to two screening questions. Material and methods. Two hundred and ten adolescents living in the county of Bergen, Norway, were offered an additional examination for TMD in connection with their regular dental check-up appointment. Five dental clinics were selected with differing socio-economic patient populations, as reflected by stratification of average levels of DMFT, and an equal number of girls and boys were invited to participate. The participants answered two screening questions for TMD pain followed by a clinical examination according to the DC/TMD protocol by five calibrated examiners. Results. Acceptable calibration results were obtained. Approximately 80% of eligible participants consented to partake. According to the criteria of DC/TMD, the prevalence of TMD amongst the study participants was 11.9%, with a peak at 16 years of age. According to the self-reported screening questions for TMD pain, 7.2 % responded positively. Only 7 participants with a TMD diagnosis established according to the DC/TMD clinical examination protocol reported also TMD pain based on answering the two screening questions. Conclusion. The prevalence of TMD is higher for girls than for boys and the prevalence of TMD established according to the DC/TMD criteria was higher than the prevalence of TMD pain estimated by use of screening questions for self-reported pain.

Key words:

TMD, temporomandibular disorders, prevalence, adolescent, DC/TMD

Introduction

Temporomandibular disorders (TMD) is a general term for various clinical signs and symptoms involving the masticatory muscles, the temporomandibular joint (TMJ) and associated structures [1]. TMD may influence daily life negatively by limitation of regular functions of the masticatory system, or because of pain originating in the stomatognathic muscles or the temporomandibular joints or the temple areas. The pattern of pain generally varies over time, but some individuals may suffer from longstanding problems caused by the TMD pain irrespective of age [2]. Adolescents with self-reported TMD pain report a higher consumption of analgesics and absence from school due to general pain in comparison to peers matched for age and gender [3]. For some individuals, the TMD pain constitutes a substantial problem and can influence all aspects of their daily life [4]. It is important to identify the earliest manifestation of TMD in young individuals, and a correct diagnosis based on signs and symptoms of TMD should be considered as an important first step in monitoring these individuals, both in relation to the condition's etiology and for individualized preventive and therapeutic interventions.

Reported estimates of the prevalence of TMD amongst adolescents vary widely, ranging between 4% and 68% [5-7]. One of the likely reasons for the large variance is the diversity of diagnostic criteria and clinical examination protocols. Accordingly, the need for calibrated examiners that apply valid and reliable diagnostic methods for TMD has long been recognized and debated in the literature [8, 9]. For young individuals, it is of special interest to identify the earliest manifestation of TMD. One clinical examination protocol for TMD that has gained international acceptance is The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) [10], which has been widely used globally to estimate prevalences of TMD. During later years, some limitations with this protocol were identified, and a revised clinical examination protocol has recently been presented, titled The

Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) [11]. Some of the items that were questioned were the procedures for diagnosing myofascial pain as well as disc reduction with displacement, and the feasibility and practical application of selected palpation sites [12]. The DC/TMD clinical examination protocol appears to be valid for identifying the most common pain-related TMD diagnoses with a reported diagnostic sensitivity of ≥ 0.86 and specificity ≥ 0.98 [11].

Several studies in Scandinavia have been conducted with the aim to estimate the prevalence of TMD amongst adolescents, and possible impact on daily activities [2-4, 13]. The diagnostic methods and study designs have varied. In one cross-sectional study, approximately 29 thousand adolescents living in Östergötland County, Sweden answered two screening questions about any experiences of TMD pain [13]. The investigators described high reliability scores, which corroborated previous findings [14]. Furthermore, excellent diagnostic validation was reported following subsequent clinical examinations undertaken according to the RDC/TMD clinical examination protocol of sixty of the study participants versus sixty control subjects [15]. In another cross-sectional study, cohorts of 400 children and adolescents in Jönköping, Sweden, were examined clinically in 1983, 1993 and 2003 and classified according to The Clinical Dysfunction Index (Helkimo 1974) [16]. To the authors' knowledge, there are no studies that report the prevalence of TMD among adolescents in Norway. Neither do there exist other Scandinavian studies assessing the prevalence of TMD among adolescents according to clinical examinations and use of diagnostic criteria of the new DC/TMD protocol [11].

The main objective of this study was to assess the prevalence amongst adolescents aged from 12 up to 19 years located in in Bergen, Western Norway of TMD according to the DC/TMD clinical examination protocol. A secondary study objective was to contrast the prevalence of TMD according to the DC/TMD clinical examination protocol against the

prevalence of TMD pain identified by use of the two screening questions for TMD pain adopted by Nilsson et al [14] and by others [15].

Materials and methods

Sample

The Hordaland County Council, Western Norway offers free dental treatment to all children and adolescents up to 19 years through a public dental health service (PDHS). In the municipality of Bergen, the service include 13 dental clinics in which children and adolescents attend, and these maintain records of various dental parameters in their patient populations, including average decayed, missing and filled Teeth (DMFT) indices. DMFT is generally considered as a proxy for socio-economic status [17-19]. To reflect social gradients of the study sample, the 13 clinics were first ranked by average DMFT of their patient populations and alternate clinics from the top to the bottom of the ranking were invited to participate in the recruitment and clinical examination of adolescents, defined as individuals within the age of 12 up to 19 years. Four of the clinics were located in urban areas, whereas one clinic was situated in a rural area.

The total population size of 12 up to 19 years old in Bergen is 21 695 individuals according to Statistics Norway (Statistisk Sentralbyrå, SSB). The sample size calculation was based on a recent literature report [20]. We assumed a prevalence of 5% and used a precision of 3.5% for the 95% confidence interval, which gave a sample size of 149. Due to an anticipated drop-out (missing /cancelled appointments [21], the goal was to include 210 individuals in the study. Hence, the five clinics aimed to recruit approximately 40 study participants each, with the objective to obtain a convenience sample of 210, assumed to reflect the social gradients of adolescents managed by the PDHS in Bergen, Western Norway.

Study participants

All potential study participants received a written invitation to partake in the study, which detailed an additional TMD examination in connection with their regular dental check-up appointment conducted in their customary PDHS clinic. The invitation was sent in advance of the regular dental check-up appointment to those who were next in line for recall to the clinics according the digital journal system. An equal numbers of boys and girls in each age group received the information letter about the additional TMD examination.

The TMD examination

TMD was diagnosed by applying two different diagnostic tools. The study participants answered first two screening questions for TMD pain [13], which was followed by a clinical examination according to the DC/TMD protocol [11]. The two screening questions for TMD pain were: 1) Do you have pain in your temples, face, jaw joint and jaws once a week or more? and 2) Do you have pain when you open your mouth wide and chew once a week or more? If the patient answered yes to one or both of the questions, they were diagnosed as having TMD pain. The following DC/TMD clinical examination sessions lasted for approximately 20 minutes.

Calibration of clinical examiners

Prior to the initiation of the clinical examinations, the principal examiner (specialist candidate in pediatric dentistry) underwent calibration sessions together with an expert trained and educated in the use of the DC/TMD clinical examination protocol at The University of Aarhus, Denmark. Subsequent calibrations of four additional clinical examiners consisted of theory (5 hours) and clinical palpation exercises. The clinical calibrations were undertaken in several sessions, and included adult volunteers (mean age 22.6 years) as well as younger volunteers (mean age 16.5 years) examined in their respective local PDHS clinics.

Clinical examination

All the clinical examinations were conducted from November 2014 to May 2015. In four of the PDHS clinics, the local dentists performed the examinations, while the principal author examined the study participants in the fifth clinic.

The clinical examinations in compliance with the DC/TMD clinical examination protocol involve ten different examination items; location of pain, incisal relationship, jaw opening pattern, opening movements in millimeters, lateral and protrusive movements in millimeters, temporomandibular joint (TMJ) noises during opening/closing/lateral/protrusive movements, joint locking and muscle and TMJ pain upon calibrated palpation. Muscle palpation sites include the masseter, temporalis and supplemental muscles such as the lateral pterygoid area and the posterior and submandibular muscles. All registrations were done separately for the left and right side of the face [11].

The examiners used a pressure measuring instrument regularly to facilitate proper palpation force, and to assure high inter- and intra-examiner reliability. Two pressure measuring instrument instruments (Dentrade, Köln, Germany) measuring 0.5 kg and 1.0 kg were used to produce the proper force in a steady manner before every examination of muscle groups and TMJ. Additionally, the rulers for measuring millimeters were properly prepared, by cutting the end so that the edge was even with the “0” mark and by reducing the width to create space for the lip. In this study, palpation was performed for 2 seconds, which restricted the diagnoses for referred pain according the DC/TMD clinical examination protocol [11].

The DC/TMD Symptom Questionnaire

The DC/TMD Symptom Questionnaire consists of a minimum of 5 and maximum of 14 questions, focusing on pain in the jaw, temples, and ears or in front of the ears. Also items about headache, joint noises and locking of the jaw were included. The time frame that was

applied according to the DC/TMD Symptom Questionnaire was consistently “the last 30 days”, in line with the time frame used in the clinical examination [11]. The clinical examiner assisted the study participants if they had problems of understanding the item content.

Diagnosis of TMD

The TMD diagnosis was established based on the DC/TMD diagnostic decision tree**,** using both the completed clinical examination form as well as Symptom Questionnaire. The diagnostic decision tree in DC/TMD, which contains 11 different diagnosis options within three different categories, was applied [11]. This implied that one patient could have multiple diagnoses, and categories such as pain-related TMD in combination with headache, and intra-articular joint disorders in combination with degenerative joint disorders were used. All participants diagnosed with TMD were offered treatment or a referral to a specialist when needed.

Ethical considerations

This cross-sectional study was approved by The Regional Committee for Medical Research Ethics (REK-number 2012/542). A written consent was obtained from the study participant when being 16 years and older, or from both the study participant and a parent when below 16 years.

Statistics

Inter-examiner agreements amongst the five clinical examiners of the clinical measurements (mm) were assessed by applying Bland Altman plots. The alternatives for registration of pain upon palpation as well as for joint sounds were “yes” or “no”, and the inter-examiner agreements were calculated in percentages.

Possible differences between study participant subgroups were tested by use of Chi-square statistics. The level of statistical significance was set at 5%. All statistical tests were computed by use of a commercial statistical software package (SPSS version 22, IBM).

Results

Out of the 210 eligible dental patients, 23 failed to show up for their appointment and a further twenty declined to partake, resulting in study sample consisting of 167 adolescents (79.5%) aged from 12 up to 19 years (Figure 1). Fifty-one percent of the study participants were girls (n=86).

Calibration and reliability of clinical examiners

The limits of agreement were within 3 mm in maximum mouth opening without assistance, and 2.5 millimeters for maximum mouth opening with assistance. The measurement of pain during free mouth opening showed wider limits of agreement, i.e., 4-5 millimeters (Figure 2). The inter-examiner agreement in registering pain upon palpation (Yes/No) in the masseter and temporalis muscle was 87.9 % of all registrations. For TMJ sounds (Yes/No) the agreement was 86.5 %.

Self-reported TMD pain

Twelve study participants answered yes to at least one of the two screening questions for TMD pain, indicating a prevalence of 7.2 %. Five study participants (5/167, 3.0 %) answered “yes” to question one, while five (5/167, 3.0 %) answered “yes” to question two, and two (2/167, 1.2 %) answered “yes” to both questions. The prevalence for TMD pain was higher for girls (11.6 % vs 2.5 %), but did not reach a statistically significant difference (Figure 3).

Clinical examination according to the DC/TMD protocol

Twenty study participants were identified with a TMD diagnosis, suggesting a prevalence of 11.9 %. The prevalence was higher for the girls compared to the boys (19. 8%, n=17/86 *vs* 3.7%, n=3/81, p<0,002). The age group showing the highest prevalence of TMD (28.0%, n=7/25) was at 16 years (Figure 3).

The most common TMD diagnosis was disc displacement with reduction, with a prevalence of 5.4% (9/167), followed by myalgia, 3.0 % (5/167) (Figure 4). Three participants (1. 8%) had more than one TMD diagnosis. The combination of myalgia and arthralgia occurred in 2 participants (1.2 %) and a combination of arthralgia and headache in 1 participant (0.6 %). Disc displacement with intermittent locking occurred in 1 participant (0.6%).

Out of the 20 participants diagnosed with TMD, twelve (60.0%) reported pain from the jaw, temple, or ear alternatively in front of the ear during the last 30 days. Of those, 10 participants (8 girls) reported worsening of the intensity of pain during activities like chewing, opening the mouth, chewing and talking. Nine out of the 20 participants (45.0%) with a DC/TMD diagnosis reported temple headache in the DC/TMD symptom questionnaire. Amongst the participants with no DC/TMD diagnosis, 29 out of 147 participants (19.7%) reported headache within the last 30 days in the DC/TMD questionnaire. None of the study participants complained of any adverse effects after the clinical examination according to the DC/TMD protocol.

Self-reported TMD pain versus clinical examination

Five study participants whom responded positively to the two screening questions for TMD pain did not qualify for a diagnosis according to DC/TMD clinical examination protocol. Four of these had responded in the DC/TMD symptom questionnaire that they suffered from headache.

Discussion

This is the first study in Norway that report TMD findings based on the use of the new DC/TMD clinical examination protocol [11]. Moreover, this is the first study that has attempted to establish the prevalence of TMD as well as TMD pain amongst adolescents in Norway.

The PDHS in Norway offers free dental care from birth until the year of reaching 19 years of age and practically all children make use of the service, independent of socioeconomic backgrounds. The present study sample should therefore represent different socio-economic patient backgrounds, particularly by sampling the clinics with differences in the clinics' DMFT-indices. The recruitments for study participation followed also the recall lists for regular dental appointments. Moreover, the response rate of approximately 80% was deemed satisfactory for being a cross-sectional clinical study [22]. Hence, the TMD data collected in the current study is considered as likely representative for adolescents living in the Bergen municipality.

Calibration over multiple sessions has been shown to improve the reliability of clinical examinations for TMD [23], and this was endeavored by the adoption of various calibration exercises. Acceptable calibration results were obtained for vertical range of motion of the mandible in the maximum- and maximum-assisted mouth opening, while wider limits of agreement were seen when asking for unassisted opening without pain. The observation corroborate previous findings [23], and is likely a consequence of difficulties for the patient to know exactly at what level of mouth opening the pain onset will occur.

The prevalence of TMD according the DC/TMD clinical examination protocol was 11.9%, with a significantly higher prevalence for girls than for boys, as expected and in accordance with literature [13, 24, 25]. Also for those who reported a worsening of pain

during activities (chewing, talking, opening the mouth), girls constituted the vast majority. The finding that TMD has a greater impact in girls was also in accordance with the findings of Nilsson [3]. It has been suggested that self-reported TMD symptoms in girls is likely related to pubertal development [26]. Not all of the study participants diagnosed with TMD according to DC/TMD, experienced pain due to their condition. Especially for those with disc displacement with reduction, pain was not a common problem. It is important to be aware of the fact, since pain often is the main cause when seeking help with TMD problems [3].

The peak of TMD amongst the 16 year old study participants was interesting in the context that the majority of Norwegian adolescents at that age change from compulsory secondary school to high school. Greater expectations from both the students themselves and their environment on their achievements with the school work can be stressful and perhaps might be a factor in onset of TMD. A Swedish study from 2008 on mental health amongst adolescents from 16 to 18 years old found that a large proportion, especially girls, associated self-perceived stress with high pressure and demands from school, and also that perceived stress correlated strongly with health complaints like tiredness, headache, musculoskeletal pain and sleeping difficulties. [27]. A comparable study has recently been completed in Norway in 16 and 17- years old and corroborates the Swedish study in that high levels of perceived stress and musculoskeletal pain seem to prevail [28]. The highest levels of stress and pain values were reported in the group with head pain. Bodily pain elsewhere than in the orofacial region in adolescents is associated with TMD pain [24], and the probability of facial pain increases with the number of other pain conditions [25].

The prevalence of TMD pain according to the two screening questions for TMD pain, was 7.2%, higher percentage than reported by Nilsson et al. in 2000 [13]. This can be explained by the fact that. time has passed since the Swedish study took place, and that this increase might reflect general changes in the society. For instance, a wider use of electronic

devices and social media, has taken place during these years. Electronic devices like smartphones and PCs are used for extensive time periods every day, both in school and during leisure time [29]. It has been hypothesized that there is an association between excessive use (> 4 hours a day) of electronic devices and the presence of headache and insomnia [29, 30]. The use of electronic devices for many hours leaves fewer hours for physical activity, and is believed to be associated with recurrent musculoskeletal pain in adolescents [31].

It is logical that the two diagnostic tools differ with regard to identifying individuals likely to have TMD. The two screening questions for TMD pain may prompt the reporting of various forms of headaches that are likely unrelated to TMD. Moreover, since there is no limitation to a time limit for the two screening questions there is no way of distinguishing between chronic and acute pains. In contrast, the DC/TMD clinical examination protocol is limited to examination of structures within the stomatognathic domain and experienced symptoms registered only within the last 30 days [11]. Lastly, the spectrum of TMD diagnoses include also asymptomatic conditions such as disc displacements, which the pain screening question will likely fail to identify.

Only 7 participants were diagnosed with TMD according to the DC/TMD clinical examination protocol, and with TMD pain according to the two screening questions. Knowing that the most frequent diagnosis according to the DC/TMD clinical examination protocol was disc displacement with reduction and that this condition often is pain free, this may be a reason why several participants did not get a TMD diagnosis according to two screening questions for TMD pain.

Four out of the five participants that reported pain according to the two screening questions for TMD pain were not diagnosed with TMD according to the DC/TMD criteria and examination protocol. However, they had marked for headache in the temple areas in the

DC/TMD symptom questionnaire. The positive response to the two screening questions for TMD pain might be actually due to tension headaches [14]. Common for these study participants was that they reported that the headache had been there for a long period, varying for 1-6 years. Tension headaches are relatively common amongst adolescents [29] and in the current cross-sectional study, self- reported headache was more than twice as frequent in the TMD group established according to the DC/TMD clinical examination protocol in comparison to those without a TMD diagnosis. Our findings thus corroborate the observations that TMD and tension headache often are coexisting conditions [32] and that headache seem to precede TMD pain in adolescents [33].

Limitations of the study

A larger sample size would have strengthened the reliability of the current study results. However, conducting clinical examinations according to the DC/TMD protocol is time-consuming, and it was not possible to achieve a larger sample size within the existing logistical and financial limits.

Conclusions

Female gender is a risk factor for TMD. The prevalence of TMD established according to the DC/TMD criteria was higher than the prevalence of TMD pain estimated by use of screening questions for self-reported pain. This is of clinical relevance for specialists working in this field.

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Declaration of interests:

The authors report no conflicts of interests. The authors alone are responsible for the content and writing of the paper.

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