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ORIGINAL ARTICLE

Temporomandibular pain and depression in adolescents—a case–control study

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Abstract This study compared the depression status of adolescents with temporomandibular (TM) pain to those without, considering the influence of age, sex, and other pain conditions. From a general population sample of 455 adolescents, 29 cases (mean age, 15.3 years) with current TM pain were compared with 44 age-matched controls without such pain. Study participants were examined for general health status, additional pain sites (back, abdomen, and head) in the previous month, and depression, using a 15-item German-language depression questionnaire. Cases had a statistically significant higher average depression score than controls (14.2±7.1 vs. 9.7±6.3; *t* test, $p<0.01$), and they reported more often additional pain. The more pain sites were mentioned, the higher was the depression score [no pain, 4.0±2.8; four pains, 17.3±8.0; analysis of variance (ANOVA), $p<0.001$]. We conclude that TM pain assessment among adolescents should include a whole-body pain drawing as well as a screening questionnaire to identify pain-related depressive symptoms.

Keywords Orofacial pain · Temporomandibular disorders · Chronic pain · Depression · Case–control studies

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Introduction

Depression, "a common mental disorder that presents with depressed mood, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, low energy, and poor concentration", has recently been acknowledged as a major contributor to the global burden of disease [61].

On the other hand, pain—"an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" [33, 37]—is not only the main symptom of many chronic diseases (e.g., arthritis and back problems) [20] but has also been recognized "as a disease or disorder in its own right" [33]. A large population survey across 16 European countries involving 46,394 adults revealed an overall chronic pain prevalence of 19% [range, 11% (Spain) to 30% (Norway)] [39], while the Canadian Pain Survey (n= 2,000) disclosed that 33% of Canadians live with moderate to severe pain as an ongoing part of their lives [53].

Moreover, both chronic pain and depression may show considerable comorbidity [1, 4, 19, 21, 34, 36, 59], influencing each other adversely [25]. One of the first epidemiological studies that shed light on this issue was an investigation carried out by Von Korff et al. [59] in the Seattle (WA, USA) area. They considered five different pain complaints [back pain, headache, abdominal pain, chest pain, and temporomandibular (TM) pain]. The investigators found that pain patients (n=1016) scored substantially higher for depression than pain-free individuals. Furthermore, these findings were a first indication that depression was a relatively frequent finding in persistent pain states [8]. In Europe, one of five sufferers from chronic pain may be diagnosed with this pain-associated mood disorder [39].

Although the precise relationship between pain and depression is still under debate, there is sufficient evidence suggesting that depression is more frequently the consequence than the cause of persistent pain [10, 12][1].

Patients with chronic pain are known to be at risk to develop *major depression* [5]: In the study by Von Korff et al. [59], major depression was three to five times more prevalent in pain groups than in controls. This view has been corroborated in subsequent epidemiological investigations, for example, in a large population study that was carried out between 1997 and 1999 in 113 communities in Germany involving a random sample of 4,181 participants: The 12-month prevalence of major depression was 9.3% among individuals with abdominal and/or chest pain, 7.9% for arm or leg pain, 7.7% for neck/shoulder pain, 6.6% for head pain, and 6.2% for back pain (in the absence of a somatic disorder, respectively) [1]. Results from a general population sample in Canada involving 10,600 household residents who were diagnosed with chronic back pain suggest a linear positive association between major depression and self-reported pain severity [5]. This observation corroborates earlier findings from patients with TM pain, i.e., pain located in the masticatory muscles, the temporomandibular joints (TMJs), and associated structures [35].

While the prevalence of depression in patients with chronic pain is usually higher in the elderly than in younger individuals [55], an association between these two conditions may also be clinically relevant among adolescents suffering from TM pain. Besides toothache, this form of musculoskeletal pain, which tends to fluctuate over time [24, 29], is the most frequent pain condition in the orofacial region. In an epidemiological study carried out in 2000, which involved 28,899 Swedish adolescents aged 12 to 19 years, the overall point prevalence of self-reported TM pain was 4.2%. The prevalence increased with age, and it was higher in girls (6.0%) than in boys (2.7%) [41]. The overall annual incidence of TM pain from 2001 through 2003 was 2.9% (n=2,255; age, 13–19 years) [42].

Published results of investigations about the putative association between orofacial pain and depression among adolescents are—at least in part—contradictory. For example, in a study involving 350 TM pain patients and 350 healthy age- and sex-matched individuals aged 12 to 19 years, female adolescents, particularly those aged 16 to 19 years, showed significantly higher depression scores than males and controls [40]. Conversely, in a case–control study involving 63 adolescent patients with TM pain and 64 healthy controls, List et al. [31] found significantly more distress, somatic complaints, and aggressive behavior in the pain group as compared to the controls; however, no differences were present for depression and anxiety. Similarly, Bonjardim et al. [2] reported that, in a sample of 217 Brazilian non-patient adolescents, depression was not associated with TM pain.

On the other hand, adolescents with TM pain often show additional pain sites outside the face [40], e.g., in the head, abdomen, or back [23, 28], which may have an influence on measured depression scores. However, this possible influence was not considered in the cited studies.

Thus, an analysis of the association between depression and orofacial pain among adolescents is hampered by various variables, including age, sex, and multiple pain sites/conditions, which may explain the inconsistencies among study results. The aim of this article is, therefore, to analyze the influence of depression status on TM pain in adolescents with special consideration of age, sex, and other pain conditions.

Materials and methods

Subjects

The study subjects were recruited from a random population sample of 1,190 children and adolescents 10–17 years of age living in the metropolitan area of Halle (Saale), Germany. This sample was drawn from a population of 24,129 registered schoolchildren using a two-stage cluster technique. First, a random selection of schools representing the three different German school types was made. Subsequently, school classes were randomly chosen. Of the 1,190 randomly selected children and adolescents, 1,011 (486 boys and 525 girls) agreed to take part in the study, which represents a response rate of 85% [23].

For the present analysis, we selected the data of a subsample of 455 subjects aged 14 to 17 years because, for the assessment of depression using our depression questionnaire (see below), the age of subjects must be older than 14 years [22]. From the subsample of 455 subjects, we selected 29 cases which fulfilled the following criteria:

- They had reported actual TM pain (i.e., pain in the masticatory muscles and/or TMJs) during the examination according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) [9].
- In addition, they had positively answered to the anamnestic question: “Do you have pain in the face, jaw, temple, in front of the ear or in the ear?” To ensure the diagnosis of TM pain as opposed to other pain sites, the subjects were asked for actual toothache and earache, respectively, and the examiners checked the pain localization.

[1] For Charles Darwin [6], this association was obvious. In his work, *The Expression of the Emotions in Man and Animals*, he wrote: “Pain, if severe, soon induces extreme depression or prostration;…”.

Forty-four age-matched TM pain-free adolescents from the same subsample served as controls.

All participants gave their consent. The study protocol was approved by both the school administration and the parents' council of the city of Halle (Saale, Germany), as well as by the Ethics Committee of the Martin Luther University Halle-Wittenberg.

Measurements and reliability

Before the RDC/TMD examination, all participants (i.e., cases and controls) completed a questionnaire that provided information about general health as well as the presence of three additional pain conditions (headache, abdominal pain, and back pain). The test–retest reliability (intraclass correlation coefficient=ICC) for the questions was acceptable to good with a median ICC of 0.63 (details in [23]).

The temporomandibular disorder (TMD) assessment was carried out by three calibrated dentists. In a multicenter study, the reliability of the clinical examination according to the RDC/TMD had previously been assessed [47]. The reliability of the assessment of TM pain (myofascial pain and arthralgia) had been fair to good (ICC 0.49–0.58).

Additionally, study participants were asked to complete a 15-item German-language depression questionnaire (*Allgemeine Depressionsskala—Kurzform*, ADS-K; General Depression Scale—Short) [22]. The reliability of the assessment of depressive symptoms using the ADS-K is reported in the manual [22]. Following the RDC/TMD protocol [9], patients were also asked to report about possible jaw-related disabilities.

Statistical analyses

First, we used means ($\bar{x}$) and standard deviations (SD) to describe the distribution of continuous variables (age and ADS-K score) in cases and controls. Chi-square test was chosen to compare the distribution of sex, the proportion of subjects with ADS-K scores greater than 16 (clinically relevant according to Hautzinger and Bailer [22]) on the 0–45 scale, and the presence of pain in the head, back, and/or abdomen. The Kolmogorov–Smirnov test was used to check whether the ADS-K score was normally distributed.

Second, we used ANOVA to evaluate the depression score in subjects reporting multiple pain locations (none up to four). In addition, we calculated correlation coefficients to show whether or not a correlation existed among the various pain complaints. A statistically significant positive correlation among the various pain complaints outside the face would result in the new variable "general pain", which combined the different pain conditions in one variable.

Third, we estimated the odds ratio (OR) and 95% confidence intervals (95% CI) for the risk of TM pain (as dependent variable) in relation to the depression score by multiple logistic regression analysis, adjusting for sex and general pain as confounders. Age was not included in the model because the sampling of control subjects was matched for age.

Results

The prevalence of actual TM pain in the subsample of 14- to 17-year-old individuals was 6.4% (29/455). Eighty percent of these subjects were females. Two of three cases (i.e., subjects with TM pain) reported an impaired general health ("fair" and "poor" (Table 1)), while one of five cases considered herself/himself as severely or very severely impaired due to TM pain. Among the cases, the five most frequently reported functional limitations (according to the RDC/TMD-related jaw disability checklist) were "yawning" (65%; n=19), "chewing" (55%, n=16), "eating hard foods" (52%, n=15), "cleaning teeth or face" (31%, n=9), and "swallowing" (31%, n=9).

The mean depression score of the selected subjects was 11.5 (±7.0). The depression score was normally distributed in the sample. Girls showed higher values than boys (12.9±7.4 vs. 8.5±5.1; t test, $p<0.05$). In comparison with the age-matched controls, adolescents with TM pain showed higher depression scores and reported more pain outside the face (Table 1). The more pain locations were reported, the higher was the depression score (Fig. 1): The average score increased continuously and nearly in a linear fashion, from 4.0±2.8 (no pain) to 17.3±8.0 (four pains, i.e., TM pain, back pain,

Table 1 Distribution of the variables in cases and controls (in percent)

	Cases with TM pain (N=29)	Controls without TM pain (N=44)	p value
Mean age (SD)	15.3 (±0.7)	15.3 (±1.2)	n.s.
Females	79% (n=23)	59% (n=26)	n.s.
General health "fair" or "poor"	69% (n=20)	39% (n=17)	0.011
Mean ADS-K (SD)	14.2 (±7.1)	9.7 (±6.3)	0.005
ADS-K score 17+	38% (n=11)	16% (n=7)	0.033
Pain outside the face			
Head	86% (n=25)	73% (n=32)	n.s.
Stomach	72% (n=21)	52% (n=23)	n.s.
Back	63% (n=18)	34% (n=15)	0.019
Pain medication once per week and more	38% (n=11)	25% (n=11)	0.036
Visit to the doctor twice per year or more	59% (n=17)	52% (n=23)	n.s.

SD standard deviation, *n* number of subjects

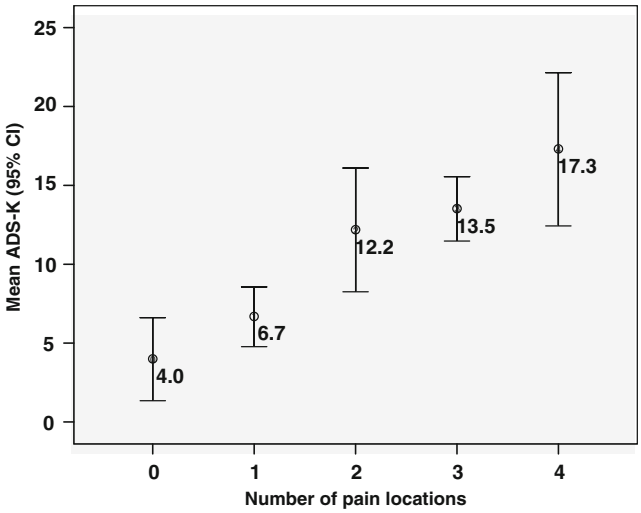

Fig. 1 Depression scores (ADS-K) and 95% confidence intervals (95% CI) against the number of pain locations

abdominal pain, and headache; ANOVA, $p<0.001$). The pain complaints were all positively correlated, although the correlation was statistically significant in only three of six cases (Table 2). The consumption of pain medication was higher among cases as compared to controls, while there was no statistical difference between the two groups with regard to the number of visits at a physician's office.

In the multivariable model (Table 3), the odds for reporting TM pain increased by about 9% per unit on the 0–45 ADS-K scale after controlling for the effects of sex and additional pain, i.e., headache and/or abdominal and/or back pain (logistic regression analysis: OR=1.09; 95% CI, 1.01–1.19, $p<0.05$).

Table 3 Estimation of the odds ratio (OR) and upper and lower 95% confidence intervals (95% CI) for the risk of temporomandibular pain in relation to the depression score

	OR	95% CI	*p* value
Unit of ADS-K score	1.09	1.01, 1.19	0.043
Sex	0.53	0.17, 1.67	0.282
General pain	1.14	0.19, 7.00	0.883

Discussion

The orofacial region is known not only for its dense innervation and its prominent representation within the somatosensory cortex but also for its deep psychological meaning [48]. Löe [32] emphasized that persistent orofacial pain may be a threat to that region, leading to serious consequences to the sufferer because "it is very possible that it is the combination of physical pain and the loss of self-image and control over oral functions that make the life of the chronic orofacial pain patient so miserable." Hence, it is not surprising that depressive symptoms are a frequent finding among adults suffering from orofacial pain [7, 11, 26, 38, 45, 50, 63]. Our data expand this knowledge by showing not only that pain-associated depression is prevalent among adolescents diagnosed with TM pain but that there is a linear relationship between pain and depressive symptoms in this age group.

The number of cases in the present study was rather small. However, we evaluated the point prevalence of TM pain, which is considerably smaller than a period prevalence of, say, one or more months as assessed in other studies. The advantage of using the point prevalence is that a possible association between two events is less likely a chance finding when both events are temporally connected. For two reasons, we are confident to have chosen a representative sample: (1) The prevalence found in our study was similar to that reported by authors from investigations among adolescents in Scandinavia [30, 41, 60] and the USA [27]; (2) the same relates to the sex distribution: As in other studies (cf., [3, 29, 41, 54, 60]), girls were more affected by TM pain than boys. Based on a

Table 2 Correlations among pain sites

		TM pain	Headache	Stomach pain	Back pain
TM pain	*R*	1			
	p				
	N	73			
Headache	*R*	0.159	1		
	p	0.178			
	N	73	73		
Stomach pain	*R*	0.201	0.382	1	
	p	0.088	0.001		
	N	73	73	73	
Back pain	*R*	0.275	0.215	0.231	1
	p	0.019	0.068	0.049	
	N	73	73	73	73

R coefficient of correlation, *p* *p* value, *N* number of subjects, *TM pain* temporomandibular pain

large sample in the Seattle area, LeResche et al. [27] identified female gender as a predictor of developing clinically significant TM pain at the age of 14 (odds ratio, 2.0; 95% CI, 1.2–3.3).

Although the correlation between the various pain sites is not very strong ($r<0.4$), the trend is obvious that a higher prevalence of one pain may be associated with a higher prevalence of any other pain. Since depression, however, is not associated with a specific pain location, e.g., masticatory muscles or TMJs [46, 63], different forms of facial pain (e.g., myofascial pain of the masticatory muscles and TMJ arthralgia) cannot be distinguished on the basis of depression scores [35]. In contrast, the number of pain sites has been shown to be a major contributor to decreased physical and mental general functioning among adults [1]. In fact, the combined findings from cross-cultural population surveys carried out in 17 countries worldwide (n=85,088 adults) suggest a linear relationship between the number of pain conditions and mood disorders [19]. In our sample of adolescents, we found that additional pain sites increased the likelihood of higher depression scores. Moreover, 70% of the cases were characterized by a self-report of impaired general health. These results reflect the clinical observation that many (adult) patients with persistent TM pain report multiple, often unspecific bodily complaints [13, 58]. Such additional pain-associated symptoms have been interpreted as signs of chronicity (i.e., an enhanced general feeling of being ill) and of the bodily expression of depressive preoccupation [43]. In their epidemiological investigation, LeResche et al. [27] found that negative somatic and psychological symptoms, including somatization (OR=1.8, CI=1.1–2.8), as well as the number of pain complaints outside the facial region (OR=3.2, CI=1.7–6.1) at the age of 11 years were risk factors for developing clinically significant TM pain by the age of 14. These findings justify the recommendation that assessment of adolescents (and adults) with TM pain should include a screening for pain-related depressive symptoms as well as whole-body pain drawings to identify pain sites beyond the face. The importance of a whole-body pain drawing arises for at least two reasons [57]: On the one hand, verbal reports have—in contrast to pain drawings—a low sensitivity: Within a dental setting, patients are likely to limit their verbal pain descriptions to the orofacial region because they do not expect that additional pain locations (which they would mark on a drawing) may be of interest for the dentist. By using a pain drawing, however, these "lost" pain sites can be easily detected. On the other hand, pain drawings have a high specificity: Patients are unlikely to mention pain sites that have *not* been indicated on their drawing.

In their textbook from 1968, Schwartz and Chayes [48] wisely called for "a sensitive and individualized approach to the management of facial pain." Managing pain patients in the presence of clinically relevant depression is an even greater therapeutic challenge [18]. In fact, since depression has been identified as a predictor of poor therapeutic outcome [17], reduction of depressive symptoms may be a precondition for the effective reduction of pain [51]. The same holds true for the therapy of depression in the presence of pain because high baseline pain (and pain-related interference with daily activities) is a risk factor for a negative response to depression therapy [25]. Moreover, the combination of both pain and depression is likely to be associated with greater disability than either condition alone [5], which is supported by similar observations among TM pain patients [56].

Recently, it was reported that, in patients with painful and disabling work-related musculoskeletal problems and concurrent depressive symptoms, the likelihood of a therapy-related reduction in both pain and depressive symptoms decreases with increasing chronicity of the pain condition [51]. Hence, timely recognition of these conditions and initiation of therapeutic measures is crucial in pain patients to prevent symptom persistence/chronicity [15, 44, 62] and to reduce the risk of (major) depression [7]. Of course, this is also the case for patients suffering from TMDs [14, 16], irrespective of age. Promising therapeutic strategies are available: Gatchel et al. [14], for example, have shown that an early biopsychosocial intervention for patients with depression and acute TMDs is an effective management strategy to decrease pain. It is important to note, however, that chronic pain comorbid with depression warrants specific therapeutic interventions for both conditions. Considering the suffering of the patient and the significant socioeconomic burden of both pain [49] and depression [15], it is important to realize that "neglect of one may imperil effective amelioration of the other" [25]. It is essential that this knowledge be transferred to students and general practice dentists who are managing adolescent and adult patients with TM pain (cf. [52]).

Conflict of interest The authors declare that they have no conflict of interest.

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