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Original Article

Attention-Deficit Hyperactivity Disorder Symptoms in A Group of Children Receiving Orthodontic Treatment in Turkey

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ABSTRACT

Objective: Children with attention-deficit hyperactivity disorder (ADHD) are known to have several oral health problems, particularly traumatic dental injuries, decayed or filled teeth, and poor oral hygiene. The objective of the present study was to determine the ADHD symptoms in a group of patients with malocclusion and receiving orthodontic treatment.

Methods: A total of 88 subjects with a diagnosis of malocclusion between aged 8 and 17 years were included in the study. Socio-demographic characteristics, breastfeeding history, oral habits, and dental trauma history of the subjects were acquired by a detailed questionnaire. Subjects and their parents completed questionnaires addressing ADHD, other psychiatric problems, and dental health impact on the quality of life. During the orthodontic examination, the Index of Complexity, Outcome, and Need was applied to confirm the diagnosis of malocclusion.

Results: Parent-reported psychiatric complaint occurred in almost half of the patients (n=38, 43.2%); the most frequent psychiatric complaints were inattention (n=22, 25%), opposition (n=13, 14.8%), and hyperactivity (n=11, 12.5%). The estimated ADHD prevalence according to parent measure was 15.9% (n=14). Self-report measures revealed that 18.4% (n=16) had behavioral symptoms. The most affected quality of life domain was psychological discomfort.

Conclusion: The findings indicate that ADHD prevalence in children with malocclusion is high. The orthodontists should have a keen eye on behavioral problems.

Keywords: Attention-deficit hyperactivity disorder, malocclusion, behavior, orthodontics

INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by persistent inattention, impulsivity, and hyperactivity. It begins in childhood and interferes with significant functional and developmental impairment (1). It is considered as one of the most common chronic health conditions in school-aged children, with a worldwide prevalence of 5.3% (2). Despite being consistently diagnosed in childhood, it contributes to lifelong impairment in the quality of life, as cognitive and behavioral symptoms mostly persist into adulthood. ADHD etiology is considered multifactorial and heterogeneous, with an important contribution from genetic factors. It is a highly heritable disorder in the range of 60%–90%. Along with genetic risk factors, there are many environmental factors associated with ADHD symptoms, such as prenatal exposure to nicotine and alcohol, premature birth, and low birth weight, as well as low socioeconomic status (1, 3). Some studies demonstrate an association between ADHD and insufficient breastfeeding, whereas some dispute (4, 5).

Dental problems in children with ADHD have been widely investigated. Children with ADHD have more frequent dental visits than those without ADHD. Some studies have found higher Decayed Missed Filled Tooth (DMFT)

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scores, whereas some have found no significant differences (6-9). However, a recent meta-analysis revealed that children with ADHD had significantly more decayed surfaces in permanent teeth, higher plaque scores, and higher dental trauma risk (10).

It has been shown that children with ADHD have worse oral hygiene status and tooth pain and bruxism is more frequent (6, 7, 11, 12). Non-nutritive sucking habits, such as nail biting, lip biting, bottle-feeding, and pacifier use, were observed more frequently in children with ADHD than in those without ADHD (4, 11). The research consistently demonstrates that there is a significant link between traumatic dental injuries (TDIs) and ADHD (10, 13). In some studies, this difference was not evident (12, 14). However, this controversy may be explained by the fact that the ADHD groups of these studies were recruited from psychiatry departments as already having an ADHD diagnosis at the time of the study. All of the children in the ADHD group were under pharmacological treatment for ADHD in Chau et al. (10) study and under behavioral therapy or pharmacotherapy in Altun et al. (14) study. It is well-established that the appropriate treatment of ADHD may result in diminished symptoms and fewer injuries (3).

In a review analyzing the oral–pharyngeal conditions relating to ADHD, it was suggested that there might be a link between ADHD and malocclusion, which are both well-established risk factors for TDIs (15). Additionally, breastfeeding duration and non-nutritive oral habits are associated with both ADHD and malocclusion (16, 17). It has been shown that children with ADHD have a narrower dental arch and higher prevalence of posterior cross-bite than those without ADHD (18). A recent study comparing dental and skeletal age between children with ADHD regarding methylphenidate use found that methylphenidate did not cause a delay (19).

Behavioral management and treatment compliance of children with ADHD have been shown to be challenging, and there is an increasing data in the research area about these difficulties and probable solutions to this problem, though we still do not know the ADHD prevalence in children with malocclusion (9, 11, 20, 21). Thus, the aim of the present study was to identify the ADHD symptoms and prevalence in children with malocclusion receiving orthodontic treatment and to investigate the probable association between ADHD and malocclusion.

METHODS

Subjects

This was a cross-sectional, descriptive design study conducted from April 2015 to August 2015. The study was approved by the local ethics committee (approval no.: 09.2015.112, 70737436-050.06.04). The authors informed all of the subjects about the details of the procedure. Written informed consent was obtained from one parent of each patient, and children's verbal consent was taken.

A convenience sampling method was used; a total of 100 consequent subjects who were newly referred to the orthodontics clinic for malocclusion and had an Index of Complexity, Outcome, and Need (ICON) score >43 during the diagnostic orthodontic examination were enrolled in the study. The ICON cut-off score was established because it is the cut-off value to decide the treatment need for malocclusion in Turkey (22). The age range of the participants was determined to be between 8 and 17 years according to the formal education period in Turkey and developing the ability of understanding the questionnaires. Children with an intellectual disability, a positive history of cleft lip/palate, or a seizure disorder were excluded from the study. Of the 100 subjects presented to the orthodontics clinic during the study period, 12 were included due to the lack of consent for the study. The participation percentage was 88%. Only the new referrals were included not to rely on retrospective data about malocclusion.

Data Collection

A qualified orthodontist examined all subjects. During the dental examination, orthodontists determined malocclusion classes according to Angle criteria, oral hygiene status, and TDI history. Oral hygiene was determined as bad, moderate, and good. The presence and the number of TDIs were noted. The authors collected socio-demographic information using a form designed for the study. The first author, a trained child and adolescent psychiatrist, conducted the scales during an interview format rather than a questionnaire format. The in-person interview has been found to provide more reliable data (23).

Measures

The authors filled out the socio-demographic form during an interview with the parents. It included the subjects' age, gender, and perceived socioeconomic status. This form also determined the subjects' breastfeeding history and current or previous psychiatric complaints. The parents completed the Swanson, Nolan, and Pelham (SNAP)-IV Rating Scale, the Strengths and Difficulties Questionnaire (SDQ), and the Oral Habits Questionnaire; the children completed the SDQ and the Oral Health Impact Profile (OHIP)-14.

The SNAP-IV Rating Scale, derived from the Diagnostic and Statistical Manual of Mental Disorders-IV criteria for ADHD, is a Likert questionnaire consisting of 18 items. Parents rate each item from 0 to 3 according to symptom frequency. The original version of the SNAP-IV has been used in clinical trials (The MTA Cooperative Group, 1999) and in community surveys to identify children with probable ADHD in other countries (24). The Turkish version has also been used in large-scale community studies to identify ADHD prevalence (25-27). The ADHD prevalences found in the studies using the SNAP-IV were similar with studies using structured diagnostic interviews (27). The parent form has profound psychometric features with coefficient alpha values of 0.94 for total score, 0.90 for inattention score, and 0.79 for hyperactivity score. The Turkish version of the questionnaire has been shown to be valid and reliable; and a per item score >1.2 is a positive determinant for ADHD clinical threshold (25).

The SDQ is a brief behavioral screening questionnaire that determines children's and adolescents' symptoms and positive attributes. It consists of 25 questions that belong to five sub-

scales: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior. All items can be scored from 0 to 2, and the sum of the first four scales generates a total difficulties score. The cut-off scores for the subscales were determined by the developers. The SDQ has an impact supplement that was not used in the present study. Five minutes is required to complete the form, and it has solid psychometric properties and can be used as a reliable guide for child psychiatric cases in population studies. The cross informant correlations were found to be higher than other relevant scales (28). There are child/adolescent, parent, and teacher versions. The validity and reliability study of the Turkish translation of the SDQ has been previously conducted (psychometric properties of the Turkish version of the SDQ). SDQ was found to be efficient to measure psychopathology in a nationwide study, which compared the SDQ with a structured diagnostic interview (24). Cronbach's alpha values those that estimate the internal consistency of the parent and child versions were 0.84 and 0.73, respectively. In the present study, the parent and child versions were used.

OHIP-14 is a self-rated questionnaire that measures the perceived impact of oral health on the quality of life using 14 questions pertaining to seven subscales: functional limitation; physical pain; psychological discomfort; physical, psychological, and social dimensions of disability; and handicap dimension. Higher scores represent higher severity of the problem and lower quality of life. Each item is answered from 0 to 5 according to the frequency of the problem. The Turkish adaptation of the OHIP-14 has been conducted and found to be valid and reliable (29).

The Oral Habits Questionnaire developed for an earlier study (4) consists of items pertaining to the breastfeeding period; bottle-feeding experiences; non-nutritive sucking habits, such as thumb sucking or pacifier use; and parafunctional oral habits, such as nail biting and mouth breathing.

Statistical Analysis

Statistical Package for the Social Sciences software version 21.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Statistical analysis was conducted to compare the groups according to gender and ADHD diagnosis. Categorical variables were expressed as frequency and percentage, and continuous variables were expressed as mean and standard deviation for the evaluation of the descriptive data. Independent sample t-test, Mann–Whitney U test, Spearman test, and Pearson correlation test were used according to the nature of the data. A probability level of $p \leq 0.05$ was regarded as statistically significant.

Data from 12 subjects who did not complete the questionnaires were excluded in the analyses.

RESULTS

The analyses were conducted on 88 subjects; the study group consisted of 47 (53.4%) female and 41 (46.6%) male individuals. The average age of the study group was 12.9±2.5 years. Perceived socioeconomic status was low in 18 (20.5%) subjects, medium in 58 (65.9%) subjects, and high in 12 (13.6%) subjects. Of the 88 subjects, 25% (n=22) had Class I malocclusion, 47.7% (n=42) had Class II malocclusion, and 27.3% (n=24) had Class III malocclusion according to Angle's classification. Thirty-five (39.8%) subjects had good oral hygiene, 36 (40.9%) subjects had moderate oral hygiene, and 17 (19.3%) subjects had bad oral hygiene. A positive TDI history was seen in 14 (16.1%) subjects; 2 subjects had more than one TDI.

Psychiatric complaint, as identified with the clinical intake form, occurred in 43.2% (n=38) of the subjects; 23.8% (n=21) subjects had more than one complaint. The most frequent complaints were inattention (n=22, 25%), oppositional behavior (n=13, 14.8%), and hyperactivity (n=11, 12.5%). Nine (10.2%) subjects had a prior psychiatric diagnosis, and 12 (13.6%) subjects had a prior psychiatric referral.

The mean SNAP-IV scores of the subjects are presented in Table 1. Fourteen (15.9%) subjects had a SNAP-IV per item score >1.2, which is the clinical threshold for ADHD. The distribution of probable ADHD, as identified with the SNAP-IV, according to gender was 7 (14.9%) girls and 7 (17.1%) boys.

According to the self-rated version of the SDQ, 18.4% (n=16) of the subjects scored higher than the cut-off value (abnormal) for total difficulty score. The percentages of subjects identified as abnormal in the hyperactivity/attention problems, conduct problems, emotional problems, and peer relationship problems subscales were 17.2% (n=15), 17.2% (n=15), 13.6% (n=12), and 23% (n=20), respectively. For the prosocial behavior subscale, 9.2% (n=8) of the subjects scored lower than the cut-off value.

According to the parent version of the SDQ, 25.3% (n=21) of the subjects were identified as abnormal in the total difficulty score. The percentages of the subjects identified as abnormal for the hyperactivity/inattention problems, conduct problems, emotional problems, and peer relationship problems subscales were 14.5% (n=12), 20.5% (n=17), 31.3% (n=26), and 53% (n=43), respectively. For the prosocial behavior subscale, 9.6% (n=8) of the subjects scored abnormal according to the parent reports.

Total scores from the OHIP-14 ranged from 0 to 36 with a mean of 8.62±6.92. Subscale mean scores were 0.68±0.99 for functional limitation, 1.61±1.86 for physical pain, 2.30±1.79 for psychological discomfort, 0.78±1.20 for physical disability, 1.52±1.57 for psychological disability, 1.14±1.60 for social disability, and 0.56±1.15 for handicap. The association between OHIP scores and ADHD is presented in Table 2.

Table 1. Parent SNAP-IV per item scores of the subjects (n=88)

	Girls (n=47) Mean±SD	Boys (n=41) Mean±SD	p
Inattention	0.67±0.49	0.62±0.47	0.370
Hyperactivity	0.76±0.54	0.85±0.64	0.528
Total	0.72±0.46	0.73±0.46	0.698

SNAP-IV: Swanson, Nolan, and Pelham-IV Rating Scale

Table 2. The relationship between OHIP scores and ADHD

	ADHD (n=14) r	Non-ADHD (n=71) r	p
OHIP-functional limitation	53.50	40.93	0.044*
OHIP-physical pain	37.86	44.01	0.373
OHIP-psychological discomfort	40.82	43.43	0.713
OHIP-physical disability	49.00	41.82	0.258
OHIP-psychological disability	39.75	43.64	0.574
OHIP-social disability	47.43	42.13	0.424
OHIP-handicap	44.71	42.66	0.726
OHIP total	46.04	42.40	0.614

*p<0.05, Mann–Whitney U test

Table 3. Correlation between ADHD and dental trauma among genders

		TDI presence		No. of TDIs	
		Girl	Boy	Girl	Boy
SNAP-IV					
Parent	r	0.192	0.011	0.204	0.011
	p	0.205	0.949	0.179	0.949
SDQ					
Parent	r	0.512	–0.016	0.516	–0.016
	p	0.001**	0.927	0.001**	0.927
Self-rated	r	0.355	0.015	0.378	0.015
	p	0.014*	0.927	0.009*	0.927

r: Correlation coefficient.
*p<0.05.
**p<0.01.

Of the 88 subjects, 92% (n=81) were breastfed; mean breastfeeding duration was 12.09±8.91 months. Bottle-feeding ratio was 70.5% (n=62); mean bottle-feeding duration was 14.41±13.38 months. Pacifier use history was present in 50% (n=44) of the subjects; mean pacifier use duration was 12.52±9.14 months. As identified with the Oral Habits Questionnaire, 12.5% (n=11) of the subjects had thumb sucking, 34.1% (n=30) had nail biting, 23.9% (n=21) had lip biting, 19.3% (n=17) had pencil biting, 25% (n=22) had bruxism, and 54.5% (n=48) had mouth breathing in the past or present that lasted >6 months. There was a relationship between probable ADHD, as identified with the SNAP-IV, and thumb sucking (p=0.013), nail biting (p=0.014), and pencil biting (p=0.001) habits, as identified with the Oral Habits Questionnaire. Durations of breastfeeding, bottle-feeding, and pacifier use were not significantly related with probable ADHD, as identified with the SNAP-IV (p=0.454, p=0.775, and p=0.408, respectively). According to the SDQ parent and self-report scores, dental trauma history frequency was positively correlated with ADHD symptom scores in girls but not in boys. That correlation was not evident in parent SNAP-IV (Table 3).

DISCUSSION

In our study, we recruited subjects according to treatment need using an ICON cut-off score of 43. The mean age of the subjects was 12.9±2.5 years, and the female-to-male ratio was 1:14; these numbers are consistent with data from epidemiological studies of malocclusion. In one of those studies, the age range of peak orthodontic treatment need was 13–14 years, and in the other, the age range of orthodontic patients receiving clinical care was 13.4±2.3 years (30). Therefore, we assume that our subjects represent the population characteristics of patients with malocclusion.

Among the 88 subjects, 43.2% (n=38) had at least one psychiatric complaint, as identified with the clinical intake form, and only 13.6% (n=12) had a previous psychiatry referral. The ratio of subjects who had a prior psychiatric referral in the group who had psychiatric complaints was 26.3%. The referral rate of children with at least one psychiatric complaint is one-fourth, which represents the service gap in mental health service and liaison between dentistry and psychiatry.

The prevalence of children who were ever breastfed was 92% in our study group. Compared with the national estimated rate of breastfeeding of 96%, this is a relatively low rate (Turkish Statistical Institute, Turkish Health Survey, 2012). Bottle-feeding prevalence in our study group was 70.5%, which was substantially higher than the national prevalence of 41% (Turkish Statistical Institute, Turkish Health Survey, 2012).

A positive TDI history was present in 16.1% (n=14) of the subjects. In the literature, there is no consistent prevalence for TDI, but according to the World Health Organization report, TDI prevalence in industrialized countries is 4%–33% (31). We found an association between ADHD, as identified with the SNAP-IV, and TDI, which is in agreement with recent studies of the relationship between ADHD and TDI (10, 12, 13, 32). The association of TDI and ADHD was significant in girls but not in boys; there are no data showing female gender as a risk factor for TDI in ADHD. However, there is a study regarding female gender as a greater risk factor for unintentional injuries in children with ADHD (33).

On the OHIP-14, the psychological discomfort subscale had the highest score, indicating that the psychological impairment had the most severe impact on life quality. Supporting our finding, another study also found emotional well-being and social well-being to be the lowest domains in the oral health quality of life assessment (34). In a study investigating patient expectations from orthodontic treatment, general health, oral functionality, aesthetic appearance, and social functionality were the prominent items (35). It is understood that mental health is a matter of clinical importance in patients with malocclusion, and clinicians should maintain vigilance for psychological–psychiatric symptoms. As understood from the above list of psychiatric complaints, ADHD symptoms appear to constitute a substantial part of the symptom spectrum.

High rates of peer problems reflected on the SDQ may be explained by the social problems mentioned herein and the findings that patients with malocclusion are more frequently the victims of bullying (34, 35). Peer relationship problem rate in parent SDQs was 53%, which shows that those problems were well observed by the caregivers. ADHD prevalences were 17.2% and

14.3% in self-rated and parent forms, respectively. Epidemiological studies from our country and worldwide show that the ADHD prevalence ranges from 5% to 8% (2, 25, 36).

Many studies have investigated ADHD in dental diseases but not malocclusion. To our knowledge, this is the first study investigating ADHD symptoms and prevalence in children with malocclusion. The worldwide prevalence of ADHD among children is estimated to be 5.29% (2). In our sample, the ADHD prevalence, as identified with the SNAP-IV-Parent Scale, in patients with malocclusion was 15.9%. An epidemiological study with a very similar population recruiting 3110 children and their parents used the same instrument and obtained the ADHD prevalence as 9.6%. This finding reveals that ADHD prevalence is high in children with malocclusion. This finding is consistent with the findings of a previous study comparing the dental health status of psychiatric patients and healthy controls. In the present study, it was found that along with higher DMFT scores and increased prevalences of caries and TDI, orthodontic treatment need was also more frequent in patients with ADHD than in healthy controls and other psychiatric disorders (29).

The high prevalences of probable ADHD, as identified with the SNAP-IV and SDQ scores, found in the present study support the hypothesis that there could be an association between malocclusion and ADHD. Moreover, significant associations between several variables provide further support for the model proposed in 2013 (15). The association between malocclusion and ADHD should be investigated through a developmental perspective as both systems are developed from ectodermal tissues during embryogenesis.

Management of children with ADHD during orthodontic treatment, organization of visit frequency and duration, and further compliance at home has been known to be challenging, and there have been studies addressing techniques to solve these problems (11, 20, 21). Dentists should be able to recognize the early signs of ADHD and emotional and social problems to provide therapeutic and preventive mental health services. Mental health professionals should also be aware of the significance and importance of the link described in the present study.

Our study has limitations. The findings of the present study should be interpreted in light of some limitations. The first is the small sample size of the study that limits the power of the data. The second concern is the broad age range of the subjects as the presentation of ADHD may differ according to age and a broad age range might cause heterogeneity of symptoms. Since the study was limited to a clinical sample from a single center, it was not possible to generalize these findings for the population. Another limitation is that the results regarding ADHD symptoms came from self-report measures and not diagnostic interviews. However, all of the measures were valid and reliable in Turkish, and the SNAP-IV has been used in several large population studies to determine ADHD symptoms, and the SDQ has been equivalent to diagnostic interviews (24-27). Additionally, the scales were administered as in-person interviews by the first author who is a trained child psychiatrist. Another limitation regarding data collection is that the breastfeeding duration was collected through maternal recall, which may raise concerns about the accuracy of the data. However, the long-term maternal recall of breastfeeding duration was found to be quite accurate (37). Further population-based studies with large sample sizes and a narrow age need to be conducted to validate our findings.

CONCLUSION

Within the limitations of the present study, we conclude that ADHD symptoms may be seen to be high in children receiving orthodontic treatment and orthodontists should have a keen eye on psychiatric symptoms, especially ADHD symptoms.

Ethics Committee Approval: Ethics committee approval was received for this study from the Clinical Researches Ethics Committee of Marmara University (approval no.: 09.2015.112, 70737436-050.06.04).

Informed Consent: Written informed consent was obtained from one parent of each patient, and children's verbal consent was taken.

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