Relationship between obesity and prevalence of dental anomalies: Does body mass index play a role?

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Abstract

Aim The aim of this study was to investigate the prevalence of dental anomalies in different body mass index (BMI) percentile child and adolescent subjects.

Materials and methods Panoramic radiographs of 186 subjects (68 males and 118 females) were evaluated. The subjects were divided into three groups according to BMI percentile: Normal-weight (93), overweight (40), and obese (43) subjects. Supernumerary tooth, tooth agenesis, dens invaginatus, dens evaginatus, tooth impaction, taurodontism, pulp stone, and root dilaceration were assessed.

Results Root dilaceration was found in 11.3% of the obese subjects and 17.5% of the overweight subjects. There was a statistically significant difference in the root dilaceration prevalence among the groups ($p=0.015$). However, other dental anomalies did not display statistically significant differences among the groups ($p>0.05$). While there was no statistically significant difference in the dental anomalies prevalence among different BMI percentile groups in males ($p>0.05$), a statistically significant difference in the root dilaceration prevalence was detected among different BMI percentile groups in females ($p=0.036$). The data were analysed using chi-square and Fisher's exact tests.

Conclusions The prevalence of root dilaceration was significantly greater in obese and overweight subjects than in normal-weight subjects.

KEYWORD Body mass index percentile, Dental anomalies, Obesity, Overweight, Panoramic radiograph.

Introduction

Disturbances during the tooth formation result in dental anomaly formation (Gupta et al., 2011). Dental anomalies result not only in aesthetic, but also in functional and occlusal problems. They may lead to malocclusion through irregularities in arch formation and also complicate the course of dental treatment. Thus, early diagnosis of dental abnormalities is crucial to prevent orthodontic and maxillofacial deformities (Ardakani et al., 2007). Radiographic evaluation is essential as well as clinical examination to make a correct diagnosis of these anomalies (Küchler et al., 2008). Disturbances during the initiation or proliferation stages of dental development result in tooth number anomalies, while disturbances during the morphodifferentiation stage of dental development result in tooth shape and size anomalies (Lehtonen et al., 2015). Developmental disturbances in the eruption pattern of the permanent dentition lead to impaction and ectopic eruption of teeth. Depending on the timing of these interruptions, deciduous or permanent teeth are affected (Bondemark et al., 2007).

The prevalence of dental anomalies was found to range between 5.46% and 74.7% (Uslu et al., 2009). The etiologic factors of developmental abnormalities can be genetic, environmental or a combination of both of these factors (Brook, 1984).

Dental anomalies of number comprise hypodontia (agenesis of 1 or more teeth except the third molars) and hyperdontia (an enhancement in the number of teeth, known as supernumerary teeth), while dental anomalies of size can be classified as microdontia (smaller teeth than normal) and macrodontia (larger teeth than normal). Anomalies of shape contain fusion, gemination, concrescence, talon cusp, root dilacerations, dens evaginatus, dens invaginatus and taurodontism. The invagination of the surface of a tooth crown or more rarely the root that is lined by enamel and dentin is defined as dens invaginatus (dens in dente), whereas dens evaginatus is described as an extra cusp or tubercle from the occlusal or lingual surface of an affected tooth [Neville et al., 1991]. Pulp stones are discrete calcifications occurring in the pulp; their etiological factors are not fully understood,

however, pulp degeneration, orthodontic tooth movement, genetic factors and circulatory defects in pulp are thought to be related to pulp stone formation [Goga et al., 2008]. Dilaceration is an abnormal deviation or bend in the root or crown of a tooth [Guttal et al., 2010] and taurodontism is a dental anomaly that is seen in the molar teeth as vertically elongated and consequently widened tooth body and pulp chamber with shortened roots and apical displacement of the bifurcation or trifurcation [Weckwerth et al., 2016]. Impaction, dilacerations and taurodontism can result in extraction of the effected teeth and consequently, malocclusion.

Overweight and obesity rates are increasing alarmingly among both children, adolescents and adults in the recent years. Obesity is referred to by the World Health Organisation (WHO) as abnormal or excessive fat accumulation that may impair health. The origins of obesity are both genetic and environmental. Obesity was found to be associated with multiple health conditions such as noninsulin dependent diabetes mellitus, cardiovascular disease, high blood pressure, hyperlipidaemia and obstructive sleep apnoea [Slyper, 1998]. Being overweight in childhood and adolescence is considered a risk for adult obesity and related health complications in adulthood.

There has been a growing interest in the association between childhood obesity and dentistry. Different studies showed an association between childhood and adolescence overweight and obesity and caries in the primary and permanent dentition [Werner et al., 2012]. Obese adolescents have early craniofacial growth, that can lead to alterations in their orthodontic treatment timing [Öhrn et al., 2002]. Overweight and obese children were shown to have accelerated dental development that may also affect their orthodontic and paediatric treatment planning that is highly affected by timing [Hilgers et al., 2006].

To date, the prevalence of dental abnormalities in different populations, anomalies and syndromes were investigated multiple times. To our knowledge, there are no studies in the literature to analyse the prevalence of dental anomalies in obese patients. Therefore, the aim of the present study was to analyse the effect of childhood and adolescent obesity on dental anomalies.

Materials and methods

Panoramic radiographs of obese, overweight, and normal-weight subjects referred to Ordu University for dental treatment were included. The protocol for this radiographic research study was approved and reviewed by the local clinical research ethics committee of the Ordu University (2018/35). The sample size was calculated based on a power analysis software using G*Power Software version 3.1.9.2 (University of Düsseldorf, Germany) for dental anomaly at alpha error probability of 0.05 and a power of 95%. The power analysis showed that 40 subjects were required for each group. The sample size in this study was 186 patients (68 male and 118 female). The inclusion criteria were: (1) height and weight recorded within 2 weeks of panoramic radiographs; (2) pretreatment panoramic radiographs taken within 1 month with adequate diagnostic quality; (3) subjects aged between 9–17 years old; (4) a full complement of teeth excluding the third molars. Exclusion criteria were: (1) any important medical history (genetic alterations and/or syndromes) that would affect physical growth and development; (2) history of orthodontic treatment or dental extraction; (3) patient having cleft lip and palate.

Groups	Gender		Total
	Female	Male	
Normal-weight	66	27	93
Overweight	28	12	40
Obese	24	29	43
Total	118	68	186

TABLE 1 Distribution of the total sample according to body mass index percentile and gender.

The body mass index (BMI) of each patient was calculated from the child's height and weight. The BMI score, age, and gender were used to assess the BMI percentile value for each patient with gender- and age-specific growth charts from the Centers for Disease Control (CDC). CDC describes BMI categories as follows: underweight, BMI less than fifth percentile; normal (average), fifth percentile to less than 85th percentile; overweight, 85th percentile to less than 95th percentile; and obese, 95th percentile or greater (CDC., 2011). Patients were divided into three different BMI percentile groups as normal-weight (93 patients), overweight (40 patients) and obese (53 patients). Distribution of the total sample according to body mass index percentile and gender was shown in Table 1.

Panoramic radiographs for each patient were assessed by one investigator to determine dental anomalies, independently from the patients' BMI score, under optimum lighting conditions, good screen brightness and high resolution to detect the dental anomalies. Twenty panoramic radiographs were selected randomly and re-evaluated four weeks later. The reliability between the two evaluation times was 0.915 according to the Kappa statistics.

	Supernumerary	Tooth agenesis	Dens invaginatus	Dens evaginatus	Tooth impaction	Taurodontism	Pulp stone	Root dilaceration
Normal	2 (2.2%)	5 (5.4%)	3 (3.2%)	3 (3.2%)	18 (19.4%)	5 (5.4%)	6 (6.5%)	3 (3.2%)
Overweight	2 (5.0%)	5 (12.5%)	1 (2.5%)	2 (5.0%)	3 (7.5%)	1 (2.5%)	3 (7.5%)	7 (17.5%)
Obese	1 (1.9%)	5 (9.4%)	3 (5.7%)	1 (1.9%)	5 (9.4%)	2 (3.8%)	2 (3.8%)	6 (11.3%)
P value	.608a	.336a	.780a	.748a	.103b	.897a	.779a	.015a

a Results of Fisher's exact test; b Results of chi-square test.

TABLE 2 Prevalence of dental anomalies according to body mass index percentile groups.

	Supernumerary	Tooth Agenesis	Dens Invaginatus	Dens Evaginatus	Tooth Impaction	Taurodontism	Pulp Stone	Root Dilaceration
Normal-weight	2 (3.0%)	2 (3.0%)	1 (1.5%)	3 (4.5%)	15 (22.7%)	2 (3.0%)	5 (7.6%)	2 (3.0%)
Overweight	1 (3.6%)	4 (14.3%)	0 (0.0%)	2 (7.1%)	3 (10.7%)	1 (3.6%)	2 (7.1%)	4 (14.3%)
Obese	0 (0.0%)	3 (12.5%)	1 (4.2%)	0 (0%)	2 (8.3%)	2 (8.3%)	1 (4.2%)	4 (16.7%)
P[a] value	1.000	.062	.422	.598	.211	.400	1.000	.036

[a] *Results of Fisher's exact test.*

TABLE 3 Prevalence of dental anomalies according to body mass index percentile groups in females.

	Supernumerary	Tooth Agenesis	Dens Invaginatus	Dens Evaginatus	Tooth Impaction	Taurodontism	Pulp Stone	Root Dilaceration
Normal-weight	0 (0.0%)	3 (11.1%)	2 (7.4%)	0 (0.0%)	3 (11.1%)	3 (11.1%)	1 (3.7%)	1 (3.7%)
Overweight	1 (8.3%)	1 (8.3%)	1 (8.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (8.3%)	3 (25%)
Obese	1 (3.4%)	2 (6.9%)	2 (6.9%)	1 (3.4%)	3 (10.3%)	0 (0.0%)	1 (3.4%)	2 (6.9%)
P[a] value	.324	.859	1.000	1.000	.729	.137	.578	.138

[a] *Results of Fisher's exact test.*

TABLE 4 Prevalence of dental anomalies according to body mass index percentile groups in males.

Patients' panoramic radiographs were analysed to determine to following anomalies: supernumerary tooth, tooth agenesis, dens invaginatus, dens evaginatus, tooth impaction, taurodontism, pulp stone, and root dilaceration.

Statistical Analysis

All statistical analyses were done by using SPSS (SPSS for Windows version 20.0; SPSS Inc, Chicago, IL) program. Dental anomalies according to the gender and BMI percentile were analyzed using the chi-square and Fischer-Exact tests. P <0.05 values were considered as statistically significant.

Results

Prevalence of the investigated dental anomalies and p values according to body mass index percentile groups are given in Table 2. There were no statistically significant differences among normal-weight, overweight and obese patients in terms of supernumerary tooth, tooth agenesis, dens invaginatus, dens evaginatus, tooth impaction, taurodontism and pulp stones. Root dilaceration was the only significantly different dental anomaly between the groups ($p<0.05$). Overweight and obese subjects had statistically significantly more dilacerated root numbers than normal subjects.

Table 3 displays the prevalence of dental anomalies according to body mass index percentile groups in females, while the prevalence of dental anomalies according to body mass index percentile groups in males are shown in Table 4. In female normal-weight, overweight and obese patients, no statistically significant differences were found for dental anomalies other than root dilaceration. Root dilaceration numbers were significantly higher in overweight and obese than in normal females ($p<0.05$). None of the analysed dental anomalies were significantly different between body mass index percentile groups in males.

The overall assessment showed that root dilaceration was the most common dental anomaly in overweight and obese children and adolescents, followed in descending order by tooth agenesis, tooth impaction, pulp stone, dens invaginatus and taurodontism, dens evaginatus, supernumerary teeth (last 3 anomalies were equal in number).

Discussion

The present study evaluated the prevalence of different dental anomalies in a relatively large sample of overweight and obese patients. Numerous studies investigated the prevalence of dental anomalies in different sample groups. However, no studies analysed dental anomalies of overweight and obese children and adolescents.

The difference in the prevalence rates of the dental anomalies may be based on different ethnic groups, environment, nutrition and method of diagnosis. The specification of dental anomalies may be genetic and could be related to specific syndromes. Knowledge of the prevalence rates of dental anomalies in different patient groups is substantial to be prepared for the complications related to these anomalies.

Dental anomalies may lead to esthetic and functional problems of the dentition, orthodontic malocclusions, and complexity in dental treatment. Thus, understanding of the developmental dental abnormalities would be indispensable. To avoid the various complications of dental anomalies and build a proper treatment plan, early identification is of great importance. The treatment of the dental anomalies varies based on the anomaly type, occlusion, periodontal health and age of the patient. With a multidisciplinary treatment approach, an aesthetic and functional occlusion can be achieved.

Hyperdontia or supernumerary teeth prevalence was found to vary between 0.1% and 3.8% in the literature [Guttal et al., 2010]. In their study of 2599 radiographs, Esenlik et al. [2009] reported that the prevalence of supernumerary teeth was 2.7% in the Turkish patients, while Laganà et al. [2017] recorded a prevalence rate of 0.9% in 5005 Italian

subjects. Gabris et al. [2001] showed that the frequency of supernumerary teeth was 1.92% in their study which detected the panoramic radiographs of 1875 children and adolescents aged between 6 and 18 years. In accordance with the literature, the prevalence of supernumerary teeth of the normal subjects was 2.25% in the present study, while the numbers of supernumerary teeth in each group did not vary greatly with the prevalence rates of 5% and 1.9% for overweight and obese subjects. Ardakani et al. [2007] reported a prevalence rate of 3.5% for supernumerary teeth, with a higher incidence in males than females. Contrary to their results, the number of supernumerary teeth in females was higher than males in our study. This could be attributed to different sample population and size.

Hypodontia or agenesis is known as the most common dental anomaly. Excluding the third molars, agenesis prevalence in permanent dentition was found between the range of 0.15 and 16.2% [Rakhshan, 2015]. Küchler et al. [2008] analysed 1167 panoramic radiographs and indicated a frequency of 4.8% for agenesis. Dang et al. [2017] reported a prevalence of 4.28% for agenesis in an Australian population, while Goya et al. [2008] reported a prevalence of 9.4% in Japanese patients. In their studies, Fekonja [2017] and Laganà et al. [2017] found similar results for hypodontia with prevalence rates of 7.2% and 7.1%. Our results showed prevalence rates of 5.4%, 12.5% and 9.4% in normal-weight, overweight and obese subjects, respectively. Although overweight and obese patients had more tooth agenesis rates than normal-weight subjects, the difference was not significant. Brook [1984] showed that hypodontia is more common in women than in men. In accordance with their results, higher numbers of tooth agenesis was observed in females in the present study.

Hamasha and Alomari [2004] found a prevalence rate of 0.65% for dens invaginatus in Jordanian adults, while Ardakani et al. [2007] found a prevalence of 0.8% in a patient group in Iran. The results of our groups showed relatively higher rates with obese patients displaying the highest rate (5.7%), but with no statistical significance.

Cho et al. [2006] reported a prevalence of 6.3% for dens evaginatus. The present sample demonstrated the highest prevalence rate of dens evaginatus in overweight subjects (5%), but the difference was not significant either.

Excluding the third molars, Dang et al. [2017] showed that the prevalence of impaction was 0.6% in Australian patients, whereas Gupta et al. [2011] indicated a frequency of impaction of 3.74% in an Indian population. Ardakani et al. [2007] showed that the prevalence rate for impaction was 8.3% in their study. In the present study, third molars were also not included while analysing impaction. Our results indicated a relatively higher prevalence in normal-weight subjects (19.4%) than in overweight and obese subjects (7.5% and 9.4%), which was not significant.

Ardakani et al. [2007] and Darwazeh et al. [1998] found similar prevalence rates for taurodontism with 7.5% and 8%, respectively. The sample of this study showed relatively lower rates compared with their results with most taurodont teeth in normal-weight subjects compared to overweight and obese ones, however these rates are not statistically significant.

The prevalence of pulp stones was 10.1% in an Australian population [Ranjitkar et al., 2002]. Chandler et al. [2003] found a 4% rate for pulp stone prevalence. In the groups of our study the prevalence of pulp stone was compatible with these studies, without any statistically significant difference in the rates of 6.5%, 7.5% and 3.8% for normal-weight, overweight and obese subjects respectively.

Root deviations equal to or greater than 20° to the long axis of the tooth are defined as root dilacerations. In the literature root dilacerations have been associated with trauma to the deciduous teeth or an idiopathic developmental disturbance [Maragakis, 1995]. The prevalence of dilacerations were found to be 15% in the Iranian population [Ardakani et al., 2007] and 3.78% in Jordan subjects [Hamasha et al., 2002] in different studies. Our results showed a similar rate to previous studies in the normal-weight subjects (3.2%). The number of root dilacerations in overweight and obese subject was significantly higher in overweight and obese subjects, with prevalence rates of 17.5% and 11.3%, respectively. This finding may be associated with the enhanced bite forces of overweight and obese patients, applying possibly traumatic forces to the dentition. Another possibility could be the effect of higher bone mineral density and bone mineral content in overweight and obese subjects [Kemp et al., 2016], which may lead to root dilacerations during tooth development in the maxillary and the mandibular bones.

In this study, the use of panoramic radiographs may have caused detection of fewer numbers of dilacerations due to the fact that dilacerations not only occur in mesio-distal direction, but also in bucco-lingual direction and detection of bucco-lingual dilacerations is not possible using panoramic radiographs.

The limitation of present study is the use of two-dimensional panoramic radiographs. The future studies may be planned on three-dimensional cone beam tomography images in different ethnic groups.

Conclusion

The present study has investigated the prevalence of eight dental anomalies in overweight and obese adolescents who were all examined using panoramic radiographs. Root dilaceration was found to be significantly higher in overweight and obese patients, compared to normal-weight subjects.

Both surgical extractions, orthodontic and endodontic treatments of dilacerated tooth are complicated. Paediatric dentists and orthodontists should be aware of the increased prevalence rates of root dilacerations in overweight and obese subjects during dental treatments.

Conflicts of interest

The authors declare that they have no conflict of interest.

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