Body mass index in relation to dental maturation of 10 to 14 years old school children in Erbil city. A cross-sectional prospective study

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Background and Objectives: Estimation of dental age is based upon the rate of development and calcification of tooth buds and their progressive sequence of eruption in the oral cavity. The tooth calcification provides a valuable indicator of dental age and serves as an index of the maturation of the child. The aim of this study is to determine whether Body Mass Index (BMI) has association with dental maturation.

Materials and Methods: A cross sectional study design was applied for the present study, 383 school children were participated in this study which nominated from Erbil city. For the sample to be representative the city was divided in to six geographic areas according to the municipalities, the samples randomly selected school children of 10 to 14 years old from both genders. The height and the weight of each participant had been recorded in the college of dentistry / Hawler Medical University in order to calculate the body mass index of the following the guidelines of centers of disease control (CDC) , at the same time an orthopantomography radiograph had been used to investigate the stage of the dental maturation using the Demirjian method, finally, the relationship between BMI and dental maturation were investigated using chi square test with P value of ≤ 0.05 was considered significant difference.

Result: there was a statistically significant relationship between dental maturation and BMI. The majority (93.6%) of samples with under-mature dentition were under-weight at the same time. The vast majority (96%) of samples with mature dentition had normal BMI. In the same manner, majority (91.7%) of samples with over mature dentition were over-weight too. Chi square test was used to find out the association and P-value was 0.001

Conclusion: In conclusion, normal weight students have normal dental maturation,   underweight students have under dental maturation and overweight or obese students have over dental maturation.

Keywords: body mass index, Demirjian, Orthopantomography

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Introduction

The prevalence of overweight and obesity in most developed and developing countries has been markedly increasing.[1]

Body mass index (BMI) is the preferred method of expressing body fat percentile in epidemiologic studies; BMI deliberation is different for individuals that are under twenty years old. It is calculated the same as adults, but it is compared with typical values for other children of the same gender and age (BMI percentile), allowing comparing with children of the same age and gender.[2]

Tooth development and emergence timing are multifactorial. One factor with a significant effect on dental and skeletal development is a child's body mass index (BMI). Some authors advocate a positive relation between overweight, obese children and skeletal development.[3]

Estimation of dental age is based upon the rate of development and calcification of tooth buds and their progressive sequence of eruption in the oral cavity. The tooth

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calcification provides a valuable indicator of dental age and serves as an index of the maturation of the child. Dental tissue calcification, which is a continuous development process, should be considered a better measure of physiological maturity than dental emergence.[4]

Several methods have been developed in order to assess the dental age according to the degree of calcification observed on permanent teeth. One such widely used method is that given by Demirjian, Goldstein and Tanner based on a large number of children.[5]

The necessities for an orthodontic treatment accomplishment by development alteration can be outlined into four classifications: The planning of treatment, Case determination, the patient consistence, Appliance choice. Development incitement can be characterized into two different ways: 1-The development accomplishment of conclusive size bigger than the one that would have happened without treatment. 2-The event of more development amid a given time frame than that would have been normal without treatment.[6]

This study aimed to determine whether Body Mass Index (BMI) has association with dental maturation.

Subjects and Methods:

The present study has been carried out at college of dentistry/ Hawler Medical University, the ethical approval obtained from the College of Dentistry/ Hawler Medical University through a written letter and written consents has been taken from the subjects or their parents after thorough oral and written explanation.

A cross sectional study design was applied for the present study and it was conducted in Erbil city which is the capital of Kurdistan regional government - Iraq, the study was conducted during the period between November of 2018 to June of 2019.

Criteria for sample selection:

1. All the subjects were Iraqi ethnic resident in Erbil City in order to eliminate the effect of the racial factor on the developmental chronology of the permanent dentition.
2. Subjects with age range from 10 to 14 years.
3. Individual with no history of trauma to facial skeleton.

Within each orthopantomogram, the seven left mandibular permanent teeth must be present (the third molar is excluded, because the third molar is the most commonly missing tooth in human If only a single tooth was not present, its correspondent on the right side of the mandible must be present for substitution (Demirjian et al., 1973).

4. No proved serious illness and systemic diseases (developmental, hereditary, nutritional and endocrine disorders).

A consent form written in Kurdish language was given to the parents of each participating student to get their agreement for participation in this study, the form also was a guide to inform the parents about the purpose of the study and the study procedures that was conducted on each participant and reassure the parents that all of these data were collected would remain confidential and it was used only for research purposes, A case sheet for data collection and history taking was specially designed for this study.

Dental maturation assessment:

Dental maturation assessment was done by a method of dental maturation assessment developed by Demirjian [7], By this method, which utilizes orthopantomogram, certain scores were assigned to each of the seven left permanent mandibular teeth (excluding the third molar). Eight stages of development, from calcification of the tip of the cusp to the closure of the apex, are designed by letters A to H, corresponding to the eight stages as shown in Figure 1
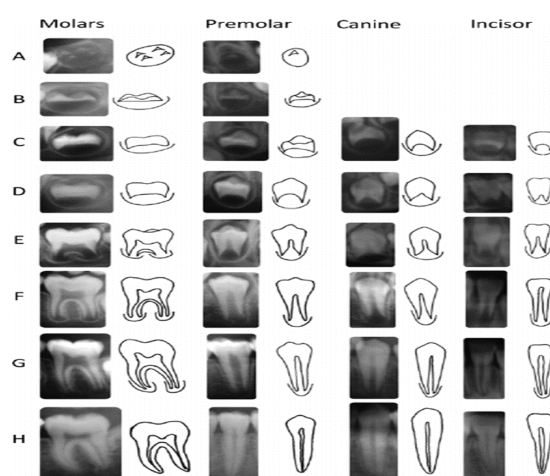

Figure 1: Radiographs representing the eight stages of mandibular teeth development

Body mass index:

The height and weight of each sample was used to calculate the body mass index, the body mass index for each student was calculated through a specific formula which is provided by the CDC body mass index guidelines and the formula that was used is like below:

Formula: weight / [height] 2

This formula was used on each student to calculate the BMI of each student, after obtaining the BMI of each student it was assessed using age- and sex-specific BMI percentile charts from the CDC figure 2, in which The CDC has specific guidelines for weight status according to the child's BMI percentile. A child with a BMI percentile less than 5 is considered underweight, a child with a percentile of 5 through 84 has a healthy weight, one with a percentile of 85 through 94 is overweight, and one at percentile 95 or greater is considered obese
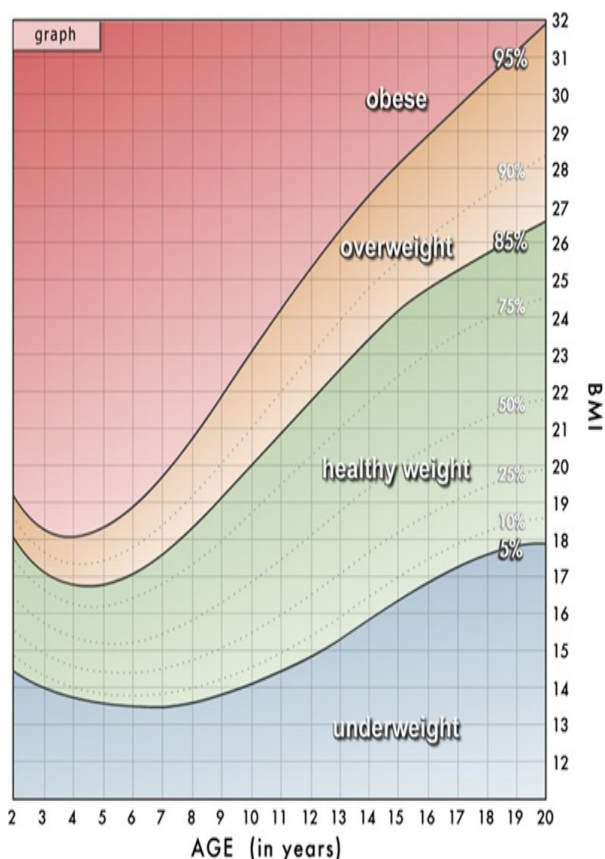

Figure 2.6: BMI chart.

Statistical analysis. All data of the samples were analyzed by the Statistical Package for the Social   Sciences (SPSS) version 24; the statistical analyses include the followings:
1. Descriptive statistics: including means, standard deviations and graphical presentations by charts and graphs.
2. Chi square test to show the association between BMI and dental maturation
3. Anova test to show the association between BMI, dental maturation and age.

Results:
A total of 383 students enrolled in this study. The sample was chosen from the different schools in the six municipalities inside Erbil city. On average more than 60 students were selected in each municipality. And the contribution of each municipality was ranging from 15.9 – 17.8% of the total sample size

Sample distribution:

In the selected classes, all students from the age group of 10 – 14 years old were included. The mean age ± S.D of children were 11.89±1.3 years. Their average height ± S.D were 1.42±0.09 meters. The mean weight ± S.D of participants were 38.09 ± 10.38 kilograms table 1.

Table 1: Range, Minimum, Maximum, Mean and S.D of age, height and weight of participants.

Varia-bles	Range	Mini-mum	Maxi-mum	Mean	Std. Deviation
Age	4	10	14	11.89	1.30
Height	0.46	1.26	1.72	1.42	0.09
Weight	62	21	83	38.09	10.38

about more than half of the students (51.2%) were male, while females contributed to the rest of 48.8% of the sample size. 45.7% of the students were over-weight, followed by 33.9% normal, 19.1% under-weight then only 1.3% obese school aged children. 47% of the cases had over mature teeth, while 32.6% of them had mature and 20.4% under mature teeth (Table 2).

Table 2: Gender, BMI and dental maturation of the studied sample

Variables	Categories	Number	percent
Gender	Female	187	48.8
	Male	196	51.2
BMI	Under weight	73	19.1
	Normal	130	33.9
	Over weight	175	45.7
	Obese	5	1.3
Dental maturation	Under mature	78	20.4
	Mature	125	32.6
	Over mature	180	47
Total	All categories	383	100

Relationships between body mass index and dental maturation:

According to results of Table 3, there was a statistically significant relationship between dental maturation and BMI of students. The majority (93.6%) of children with under-mature teeth were under-weight at the same time.

The vast majority (96%) of students with mature teeth had normal BMI. In the same manner, majority (91.7%) of students with over mature teeth were over-weight too. Chi square test was used to find out the association and P-value was 0.001.

Table 3: Association between dental maturation and BMI (p 0.001)

Dental maturation		BMI				Total
		Under weight	Normal	Over weight	Obese	
Under mature		73	0	5	0	78
		93.6%	0%	6.4%	0%	100%
Mature		0	120	5	0	125
		0%	96%	4%	0%	100%
Over mature		0	10	165	5	180
		0%	5.6%	91.7%	2.8%	100%
Total		73	130	175	5	383
		19.1%	33.9%	45.7%	1.3%	100%

Discussion

Determination of dental age is important to know the overall maturation of various tissue systems, and it is used in dentistry to formulate treatment plan and acts as an additional source of information in the field of orthopedics, forensics, hematology, pediatrics, and anthropology as well.[8]

Dental age is one of the factors taken into consideration when formulating treatment plans for preventive orthodontic treatment such as space maintainers, serial extractions, and growth modulation through myofunctional growth appliances having particular relevance to the timing of the treatment.[9]

The timing of intervention while carrying out dental treatments such as growth modulating therapies or serial extractions requires recalculation to consider not only gender and race but also BMI of the patient, The

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Demirjian method was the most reliable among the different age estimation methods in a study conducted by Hagg and Matsson in 1985 because of high accuracy and precision, especially in the younger age group [10].

In this study, when correlation of calculated dental age and BMI in different subgroups of children was made, it was inferred that overall there was a statistically significant correlation between calculated dental age and BMI.

Half of the students were over-weight, followed by normal, then under-weight and obese school aged children. Half of the cases had over mature teeth, while less than the half of them had mature and only quarter of the samples had under mature teeth.

There was a significant positive association between the BMI and the dental maturation this indicates that the overweight or obese children had over mature teeth and the underweight children had under mature teeth which was in accordance with the findings of the present study, these findings support in parts those of Hilgers et al who reported an acceleration of dental development in the overweight and obese children though this acceleration was observed in both boys and girls.[11] Shantanulal et al. also reported that diabetic patients in the two higher percentiles of BMI experience faster dental development.[12]

In another similar study showed that the boys with delayed growth and maturation showed a delayed dental maturation as well, Such a relationship has not been mentioned in the girls.[13] This result is along with the result of our study which identifies the effect of increased BMI on the children in preadolescence years. Ultimately, this could be a guide to the relationship between gender, maturation, and dental development that requires more investigations for clarification, results of this study indicate that when planning interventional dental treatments in the overweight and obese preadolescent boys, the possibility of accelerated dental development should be considered

Conclusions

In conclusion, normal weight students have normal dental maturation, underweight students have under dental maturation and overweight or obese students have over dental maturation.

Conflicts of interst
The authors report no conflicts of interest.

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