**RESEARCH ARTICLE**          **Open Access**

# THE CORRELATION BETWEEN BMI AND DENTAL CARIES / TOOTH ERUPTION AMONG 12 YEARS OLD SCHOOL CHILDREN IN BOTH PRIVATE AND GOVERNMENTAL IN ERBIL CITY

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**Abstract:** The use of fast food and soft drinks, coupled with a lack of physical activity and exercise, is causing a global increase in the number of overweight people. The study included 250 samples of 12-years-old children from 3 governmental primary schools and three private primary schools in Erbil City in Iraq. Data were compared between subjects with different variables using a statistical significance level of 0.05 and evaluated using Pearson Chi square or Fisher's exact tests. 24% of students were caries free, and the dental caries prevalence was 76%. Caries free were more common in boys 63% than girls 37%, with significant difference (P-value: 0.038), while caries more common in girls 53% than boys 47%, also 78% caries free were from private school students while 22% from governmental school with significance difference (P-value: 0.001). The caries presented in normal weighted students 77% while obese students only had about 4% with over weighted students having 19% with significance difference (P-value: 0.665). Fort canine eruption was more in boy students in governmental school 53%, while erupted canine was in girls 67% in private school. For normal weighted student's canine were erupted 76%, while it was 20% in over weighted students and 4% in obese students, with significant difference (P-value: 0.016). Dental caries was more prevalent among students. The dental caries was higher among governmental school students than private school. Girl students had more caries than boys. The normal weighted students experienced higher caries prevalence than overweight/obese students.

**Keywords:** *BMI; Dental Caries; Obesity; Overweight.*

## 1. Introduction

The use of fast food and soft drinks, coupled with a lack of physical activity and exercise, is causing a global increase in the number of overweight people. The excessive ingestion of carbohydrates is related with obesity. The excessive use of refined carbohydrates, particularly refined sugar, is associated with dental cavities, tooth eruption, and obesity [1]. The effects of obesity on the timing of adolescence imply that obesity stimulates growth. The timing and pattern of tooth eruption are crucial to oral health as a whole. Obesity and overgrowth are both characterized by a high proportion of body fat to adipose tissue, along with psychological, physiological, metabolic, anatomical, and social alterations [2].

As diet plays an important role in tooth eruption and development, it is crucial to determine whether BMI (body mass index) has influenced the chronology of tooth eruption pattern, as alterations in timing of tooth eruption can have a significant impact on oral health due to its potential to cause malocclusion, which can lead to poor oral hygiene and periodontal disease. In addition, the duration of tooth eruption in the oral cavity impacts its susceptibility to dental caries [3]. BMI is a metric that has been in use

since the middle of the 19th century. It is used to differentiate adults and adolescents with an atypical weight-to-height ratio. It is calculated by dividing weight by height and is always stated in kilograms per meter squared [4].

The World Health Organization (2003) referred to this rapid increase in body weight as a "global pandemic disorder. "Obesity is described as a condition in which energy intake exceeds energy expenditure, resulting in the accumulation of body fat. Environmental or genetic factors may have a role in the buildup of excess fat in the body.

The BMI curves produced by the Centers for Disease Control and Prevention (CDC) classify children into four categories: underweight, normal, overweight, and obese. Increases or decreases in child body fat might result in weight-related diseases and other health issues. The BMI can precisely calculate this increase or decrease in body weight. According to research, there is a direct relationship between BMI and dental hygiene. However, there is little evidence to suggest that BMI influences tooth eruption [5].

Understanding the relationship between growth and dental caries should facilitate cross-disciplinary and common methods among public health, dental, and medical professionals involved in the care of children. Despite numerous systematic reviews, the association between BMI and dental caries is still uncertain [6].

Teeth might be delayed in their eruption for a several causes. When the eruption route is hindered, the issue might be localized, or it can be more widespread when a systemic condition is involved. After emergence, teeth continue to erupt to compensate for masticatory wear and jaw expansion [7].

The BMI categories for children and adults are distinct. Children's body composition fluctuates with age and varies between boys and girls. Therefore, BMI values in children and adolescents must be compared to those of children of the same age and gender. The BMI can be obtained by measuring child's height and weight with their shoes and heavy clothes off, and then calculate BMI with this formula:

Formula: weight (kg) / [height (m)] 2 [8].

underweight (BMI ≤5th percentile)

normal weight (BMI >5thand <85th percentile)

at risk of overweight (BMI ≥85th and <95th percentile)

overweight (BMI ≥95thpercentile).

This study's objective was to examine the association between childhood obesity with tooth eruption and dental caries in both private and public schools in Erbil, adjusting for age and gender. Once by age and then by gender, the average number of erupted permanent teeth in obese and non-obese individuals was compared and the prevalence of dental caries.

## 2. Materials and Method

From February 2022 to July 2022, the study was conducted, including diagnosis, sample collecting, data analysis, and article writing. The Ministry of Education has granted permission to diagnose the students (No. 17116, dated 27-9-2021) (as shown in Appendix I). Before beginning the study, the objectives of the research were described to each school administrator and signed parental consent was sought for their child's participation. This study included 250 students (128 were boys and 122 were

girls), all the students were 12 years old from two governmental primary schools and two private primary schools in Erbil City in Iraq. The selections were done among both genders.

During the interviewing, the researchers used both English and Kurdish language. The answers were written in English only on the case sheet. The questions were filled by researchers. Before the examination of children, the procedure were explained to them, then the height and weight were measured for each child, after that examination of the teeth. The examined children were seated at their classroom. The examiner stood in front of student's chair for diagnosis with the use of artificial light.

The survey was done by simple diagnose that dental mirror and probe has been used and survey case sheet used in this research, which contains: General information such as name, age and gender, School type, Weight scale (Tianshan brand penguin electronic scale, China), Height, BMI measurement, dental caries scale and Tooth number scale (as shown in Appendix II).

All 12-year-old students from governmental and privet schools were invited to participate. Students with systemic disease were excluded from the study, also students over or less than 12 years were excluded from the study.

Version 26 of Statistical Package for the Social Sciences is utilized for data entry and analysis (SPSS Inc., IBM Company, Chicago, Illinois, USA). Inferential data were compared between subjects with different variables using a statistical significance level of 0.05 and evaluated using Pearson Chi square or Fisher's exact tests, if required.

## 3. Result

128 of the sample were boys 51% and 122 were girls 49% with an age 12 years. This sample was taken from both private and governmental schools (130 from private and 120 from governmental schools), the distribution of students according to gender and school types are summarized in Table 1.

Table 1: comparison between both genders

| Gender | No. | %100 | School type | No. | %100 |
|---|---|---|---|---|---|
| Boy | 128 | 51.2 | Private | 130 | 48 |
| Girl | 122 | 48.8 | Governmental | 120 | 52 |
| Total | 250 | 100 | Total | 250 | 100 |

The result showed that 24% (60) of students were caries free, and the dental caries prevalence was 76% (190) in the sample of students, as shown in the Table 2.

Table 2: The frequency changes between both genders

| Frequency | Percent % |
|---|---|
| 60 | 24 |
| 190 | 76 |
| 250 | 100 |

It had been observed from the result that caries free were more common in boys 63% (38) than girls 37% (22), with significant difference (p-value: 0.038), while for the caries, it was more common in girls 53% (100) than boys 47% (90), as it was shown in table 3.

Table 3: The association between dental caries and gender

| Gender | Dental Caries | | |
|---|---|---|---|
| | Caries free | Caries | Total |
| Boy | 38 | 90 | 128 |
| | 63.3% * | 47.4% | 51.2% |
| Girl | 22 | 100 | 122 |
| | 36.7% | 52.6% | 48.8% |
| Total | 100.0% | 100.0% | 100.0% |

* p- value: 0.038

For the caries free 78% of them were from private school students while only 22% of governmental school students with significance difference (p-value: 0.001), on the other hand the result observed that caries are more common in governmental school students 56% comparing with private school students 44% as shown in table 4.

Table 4: Relationship of caries and school type:

| School type | Dental Caries | | |
|---|---|---|---|
| | caries free | Caries | Total |
| Governmental | 13 | 107 | 120 |
| | 21.7% | 56.3% | 48.0% |
| Private | 47 | 83 | 130 |
| | 78.3% * | 43.7% | 52.0% |
| Total | 60 | 190 | 250 |
| | 100.0% | 100.0% | 100.0% |

* p- value: 0.001

The result demonstrated that most caries presented in normal weighted students 77.4% (147) while obese students only had about 3.7% (7) with over weighted students having 18.9% (36) with no significance difference (p-value: 0.065) as demonstrated in table 5.

Table 5: Caries and BMI classes:

| BMI classes | Dental Caries | | |
|---|---|---|---|
| | caries free | Caries | Total |
| Normal weight | 49 | 147 | 196 |
| | 81.7% | 77.4% | 78.4% |
| Over weight | 10 | 36 | 46 |
| | 16.7% | 18.9% | 18.4% |
| Obese | 1 | 7 | 8 |
| | 1.7% | 3.7% | 3.2% |
| Total | 60 | 190 | 250 |
| | 100.0% | 100.0% | 100.0% |

The result showed that about 78.4% (196) of the sample of students had normal weight, while on the other hand only about 3.2 % (8) were obese and about 18.4% (46) were overweight as seen in table 6.

Table 6: Sample weight distribution

| BMI class | Total |
|---|---|
| normal weight | 196 |
| | 78.4% |
| over weight | 46 |
| | 18.4% |
| obese | 8 |
| | 3.2% |
| Total | 250 |
| | 100.0% |

The result reveals that canine eruption was more in boy students who was in governmental school 53.1% (120), while unerupted canine was in girls 66.7% (16) who were in private school as it shown in table 7.

Table 7: Compare canine eruption among boy and girl in government and private school

| Gender and school | | Eruption of canines | | |
|---|---|---|---|---|
| | | No | Yes | Total |
| Gender | Boy | 8 | 120 | 128 |
| | | 33.3% | 53.1% | 51.2% |
| | Girl | 16 | 106 | 122 |
| | | 66.7% | 46.9% | 48.8% |
| Total | | 24 | 226 | 250 |
| | | 100.0% | 100.0% | 100.0% |
| School type | Governmental | 0 | 120 | 120 |
| | | 0.0% | 53.1% | 48.0% |
| | Private | 24 | 106 | 130 |
| | | 100.0% | 46.9% | 52.0% |
| Total | | 24 | 226 | 250 |
| | | 100.0% | 100.0% | 100.0% |

For canine eruption normal weighted students canine were erupted 76.1% (172), while it was 20.4% (46) in over weighted students and 3.5% (8) in obese students, with significant difference (p-value: 0.016), while unerupted canine were present only in normal weight students 100% (24) as presented in table 8.

Table 8: Association between BMI and canine eruption

| BMI classes | Eruption of canines | | |
|---|---|---|---|
| | No | Yes | Total |
| Normal weight | 24 | 172 | 196 |
| | 100.0% | 76.1% | 78.4% |
| Over weight | 0 | 46 | 46 |
| | 0.0% | 20.4% | 18.4% |
| Obese | 0 | 8 | 8 |
| | 0.0% | 3.5% | 3.2% |
| Total | 24 | 226 | 250 |
| | 100.0% | 100.0% | 100.0% |

## 4. Discussion

This research was planned to explore the relationship of BMI with dental caries and teeth eruption among child in Erbil- city, the sample consisted from 250 children.

The result showed that 76% of students had dental caries at the age of 12 in both governmental and private school, which was similar to that founded by Shingare et al. [9] (73%), while the result was higher than that found by [10; 11; 12; 13] (62%, 54%, 46%, 45%) respectively.

In current study the prevalence of dental caries was higher in girls 52.6% than boys 47.6%, a study by [14] supported that girls had more caries prevalence 43% while in other studies by Moses, et al. [15] and Goenka P, et al. [13] found boys had more caries prevalence than girls. This difference in caries prevalence between boys and girls may be due to early eruption of teeth in girls, more sweet and food intake and lack of physical activity than boys.

In current study, dental caries was more common in the governmental school children (56.3%), in comparison with private school children (43.7), similar finding was observed by other studies in which showed less caries prevalence in private school (21.6%, 47%, 31.1%) than governmental (37.2%, 53%, 28.6%) [16; 17; 18]. In contrast other studies showed a higher prevalence of caries in private school compared with governmental which were found by [19; 20] (28.6%, 71.4% and 61.4%-21%) respectively. The significance difference found between private and governmental school in caries prevalence may be due to the better standard of living, more educated families and the recent visit to dentist.

The current study demonstrated that dental caries where highest in normal weighted students 77.4% while it was 18.9% and 3.7% in over weighted and obese students respectively, similar findings were found by Bhayat, A. [10]; Younus S, et al. [21]; Shi R, [22] with normal weighted student had more prevalence of dental caries than the others (57%, 88%, 58%) respectively. Other studies claimed that dental caries prevalence were higher in obese/ over weighted students (90.2%, 27%), (80%, 24%), respectively while it was (62%, 22%) in normal weighted students [23].

The relationship between BMI and dental caries is controversial, some studies reported that BMI has no any relationship with caries while others suggest that as BMI increases the dental caries increases. In the present study it was found out that the DMFt mean (3.47), other study which was done by Al-Ansari A, et al. [24] had similar mean (3.55), while it was much lesser in other studies [25; 26] which was (0.51, 1.9) respectively.

The tooth eruption of students (anterior and posterior) were calculated in relation with BMI, the result reveals that canine eruption was more, in normal weighted students, while it was less in over-weighted and obese students, and also it was more in boy students who was in governmental school, while unerupted canine was more in girls who were in private school, which was similar to a study by Bagwadi, et al. [27].  A study done by Raghavan et al. [28] showed that girls had more tooth erupted than boy, while other studies showed that tooth eruption were more in overweight than in normal weighted students [29; 21]. On the other hand, a study done by Sivapathasundharam, et al. [30] claimed that there was no significant relation between tooth eruption and gender of the student. Many factors had an effect on the teeth eruption for that more detailed study will be needed.

From the result of this study it was concluded that the dental caries was higher among governmental school students than private school. Girl students had more caries than boys. The normal weighted students experienced higher caries prevalence than overweight/obese students. On comparing the eruption of permanent teeth in both gender, boys showed overall earlier eruption than girls.

Furthermore, students who were over weighted/obese showed delay in eruption of permanent teeth than those who had normal weight.

## 5. Acknowledgment

## 6. Authors' Contributions

"We confirm that the manuscript has been read and approved by all named authors. We also confirm that each author has the same contribution to the paper. We further confirm that the order of authors listed in the manuscript has been approved by all authors."

## 7. Conflict of Interest

The authors declare that there is no conflict of interest for this paper.

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*Appendix*

**I.**



حكومة إقليم كوردستان- العراق
رئاسة مجلس الوزراء
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پ . پەروەردەى ناوەندى هەولێر
بەشى پلاندانان

ژمارە :
رێکەوت:

بۆ / گشت قوتابخانەکانى بنەرەتى لە سنورى پەروەردەکەمان

بابەت / ئاسانکارى

ئاماژە بە نوسراوى بەرێوەبەرايەتى گشتى پەروەردەيى هەولێر / بەرێوەبەرايەتى پلانى
پەروەردەيى / هۆبەى پلاندانان / ژمارە ( ٢١٠٤٨ ) لە ( ٢٠٢١/٩/٢٣ ) وە ئاماژە بە نوسراوى زانکۆى
نێودەوڵەتى تيشک / ژمارە ( ١٢٧١ ) لە ( ٢٠٢١/٩/٢١ ) ئاسانکارى بکەن بۆ ئەو قوتابيانەى لە خوارەوە
ناويان هاتووە کە قوتابى قۆناغى ( پێنجەمى ) فاکەڵتى پزيشکى دەدانين بە مەبەستى تەواو
کردنى پرۆژەى دەرچوونيان لە زانکۆ بەمەرجێک کاريگەرى نەبيت لەسەر ژينگەى قوتابخانە و
راگرتنى پرۆسەى خوێندن وە پايەندى رێنمايى و رێککارى خۆپارێزى کۆرۆنا بن .

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٢ — زەينەب عبدالسلام صابر.
٣ — هاژە محمود عزيز .

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*II.*