Original Article

A study on nutritional status and tooth crown size among 6–9-year-old children: An observational cross-sectional study

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Abstract

Background: Numerous factors contribute to variation in tooth size. This is broadly described as genetic, epigenetic, and environmental factors. A strong genetic contribution has been shown, but environmental factors may also play a role. **Aim:** The aim of this study was to determine the relationship between nutritional status and tooth crown size. **Design:** An observational cross-sectional survey was conducted among 100 school-going children of 6–9 years. The value obtained was plotted on age- and gender-specific percentile curves chart given by the Centers for Disease Control and Prevention; individuals were categorized based on body mass index criteria. The participants were examined for the mesiodistal width of primary second molar and permanent first molar by three different observers using a Vernier Caliper. Data obtained were statistically analyzed. **Results:** A total of 45, 40, and 15 belonged to underweight, normal, and overweight category, respectively. The tooth size of primary molar between healthy, overweight, and underweight children was 9.87 ± 0.23, 9.47 ± 0.48, and 9.61 ± 0.7, respectively, and for permanent molar between healthy, overweight, and underweight children was 10.63 ± 0.2, 10.56 ± 0.5, and 10.57 ± 0.6, respectively. **Conclusion:** The correlation between tooth crown size with an exogenous chronic stressor, i.e., malnutrition, was found to be nonsignificant when compared with the healthy individuals. The findings indicate that nutritional status does not significantly influence the determination of tooth size in humans.

Key words: Body mass index, Centers for Disease Control and Prevention, malnutrition, nutritional status, tooth size

Introduction

Odontometrics is the biometric science that studies tooth size. It is used in anthropology, archeology, dentistry, and forensic dentistry.[1] Dental anthropology studies variation in the morphology and dimensions of the dentition of human populations over time and space, and

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their relationship with the adaptive processes and changes in feeding habits that led to the evolution of the human race and its dental system.[2,3] Numerous factors can contribute to variation in tooth size and these may be described broadly as genetic, epigenetic, and environmental influences.[4-6] A strong genetic contribution to variation in tooth size has been shown, but environmental factors such as nutrition may also play a role. It is reported in the literature, tooth may fail to develop to its maximum genetic size potential when there is interference from exogenous chronic stressor such as malnutrition.[7,8] Therefore, the study was aimed to determine the relationship between the nutritional status and tooth crown size among 6–9-year-old children.

Materials and Methods

The study was ethically conducted and approved by the Institutional Review Board and Ethics Committee. This observational cross-sectional survey was conducted among a group of 100 healthy school-going children, between 6 and 9 years of age and of both the genders. The inclusion criteria were: (1) children with parents consent and assent to participate in the study, (2) children of the age 6–9 years, (3) children with caries-free teeth, (4) children with the presence of primary second molars and fully erupted first permanent molar. Children with the following criteria were excluded from the study: (1) presence of tooth abnormalities, (2) presence of proximal fillings or prosthetic restorations, (3) teeth that had not emerged sufficiently to be able to measure, (4) children with long-standing systemic illness, (5) children with any physical or mental disability, (6) children from whom parental consent was rejected.

Study design

The study was conducted in a selected government school. Permission from the school authorities was obtained to conduct the study in their school. The study design, an observational cross-sectional study was explained to the parents. After obtaining parent's written consent in the local language, children were included through simple random sampling based on the inclusion criteria for the study. Demographics including age through date of birth, education through studying class, and nationality were obtained from the school records before anthropometric measurements and clinical examination. The total study period was 3 months.

A pilot study on twenty individuals was conducted. Based on the pilot study, correlation coefficient between nutritional status and tooth size was 0.4 with 1% level of significance and 90% power. The required minimum sample size was 85; we round it up as 100.

Calculation of body mass index

Height and weight measurements were recorded for all the children who participated in the study. The weight of each child on barefoot was measured to the nearest 0.1 kg using a portable glass electronic personal weighing scale (EB9003 L Ishimura Med Supplies, Matsudo, Japan) which was calibrated before use. Each child was instructed to stand with mass equally distributed between feet until the scale reading stabilized. The reading was then recorded. Height was measured to the nearest 0.1 cm using a stature meter attached to the wall. For the calculation of body mass index (BMI), the following formula was used:
BMI = Weight in kg/height in meter.[2]

The value obtained was then plotted on age- and gender-specific percentile curves given by the Centers for Disease Control and Prevention, and children were categorized into four groups based on their BMI percentiles as follows:

- Underweight group children with BMI for age <5th percentile
- Normal group children with BMI for age ≥5th percentile and less 85th percentile.
- Overweight children with BMI for age ≥85th percentile and <95th percentile.
- Obese group children with BMI ≥95th percentile.

Clinical examination

The participants were examined for the mesiodistal crown size of primary second molar and permanent first molar by three different observers using a Vernier Caliper.

Statistical analysis

All the data obtained from anthropometric measurements and clinical examination were tabulated. Data were expressed in mean, standard deviation (SD). Comparison of three groups was done by ANOVA test. A two-tailed $P < 0.05$ was considered statistically significant. Data were analyzed by SPSS version 16.0. SPSS Version 16.0 (By Flip Phillips, Macworld).

Results

Demographic characteristics of the study participants

Table 1 shows the demographic characteristics of the study participants. Of total 100 participants, 65 were male and 35 were female. Considering the nutritional status of the participants, 40 were healthy weight, 15 were overweight, and the remaining 45 were with underweight status. Gender distribution and nutritional status of children

Table 1: Demographic characteristics of the study participants (*n*=100)

Variables	Subgroups	*n* (%)
Gender	Male	65 (65)
	Female	35 (35)
Nutritional status	Healthy weight	40 (40)
	Overweight	15 (15)
	Underweight	45 (45)

in various BMI for age categories are represented in Figures 1 and 2.

Tooth crown size and body mass index

Table 2 shows the comparison of the mean (SD) of tooth size of primary second molar and permanent first molar among participants of different nutritional status using one-way ANOVA test. There was no significant difference observed between the groups in relation to the tooth size ($P > 0.05$). This statistical comparison is represented in Figure 3.

Discussion

Earlier studies have investigated the effects of environmental influences on the development of dental structures. Literature shows, the environmental improvements (better nourishment) have led to the greater size of skeleton-dental structures as the population had come closer to express their genetic growth potential.[9-11] On the other hand, teeth had failed to develop to their maximum genetic size potential when there was interference from exogenous chronic stressors such as malnutrition or disease.[12] The present study was carried out to examine the relationship between the nutritional status and the tooth crown size of both primary as well as the permanent dentition.

Primary teeth formation starts from the first trimester and continues until about 3 years of age. Hence, primary teeth represent as a record of prenatal development. They express genetic traits and also reflect the environmental effects including maternal health, childhood disease, and nutrition.[8] Eruption of the primary teeth completes around 2½ years age and their replacement begins around 6 years, being completed by around 12 years of age.[13,14] Thus, the assessment was carried out in children of 6–9 years age to investigate the influence of nutritional status on tooth size of both primary and permanent teeth.

In children, the use of BMI as a screening tool to identify malnutrition has been validated by the recent analysis.[15] The reliability of BMI to predict nutritional status has also been evaluated; it is found to be more sensitive and accurate than conventional anthropometric indexes.[16] Therefore, in the present study, the Centers for Disease Control and Prevention BMI for age growth charts for boys and girls was used to calculate and interpret BMI. The individuals were categorized based on the nutritional status.

Mesiodistal crown diameter has shown to provide significant information on human evolution and biological problems as well as in forensic and clinical dentistry. Anthropologists use mesiodistal diameter to draw the evolution of tooth size which provides a perception of the connection between populations and environmental adaptation. Morrees *et al*.[17] have described the technique

Table 2: Comparison of the mean±standard deviation of tooth size of primary second molar and permanent first molar among participants of different nutritional status using one-way ANOVA test

Nutritional status	Mean±SD	
	Primary second molar	Permanent first molar
Healthy weight	9.87±0.23	10.63±0.2
Overweight	9.47±0.48	10.56±0.5
Underweight	9.61±0.7	10.57±0.6
F	2.68	0.09
P	0.07	0.90

*$P<0.05$ - Significant, **$P<0.001$ - Highly significant. SD: Standard deviation

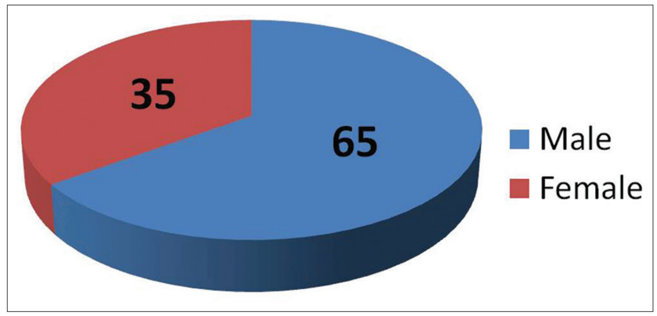

Figure 1: Sex distribution among the study participants

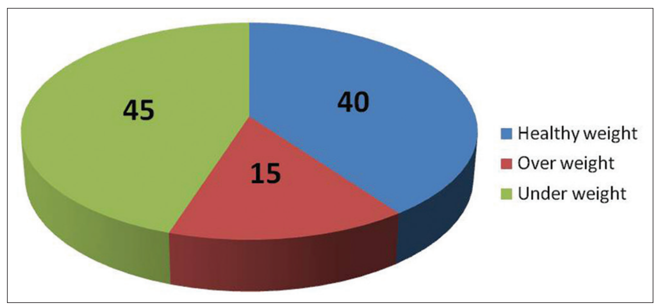

Figure 2: Nutritional status distribution based on body mass index criteria

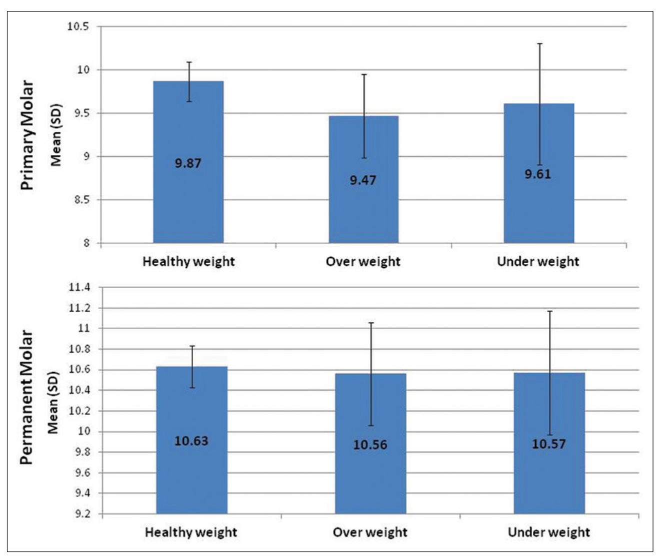

Figure 3: Comparison of the tooth size among participants of different nutritional status

of measuring the greatest distance between the mesial and distal points of contact, keeping the axis of the caliper parallel to the occlusal and buccal surfaces. This method was used whenever the teeth were in a normal position within the arch. When this was not the case, the measurement was performed between the points at which contact would normally be established. Austro *et al*.[18] have used this technique to measure the mesiodistal dimension of tooth directly in the mouth of the individuals. In the present study, mesiodistal measurements were obtained by intraoral examination of the teeth.

Determination of tooth size in humans as reported is through the polygenic genetic factors,[19-21] meaning that several genes subject to environmental influences, but the dental size inheritance is still an unknown process. The environmental influences included are the socioeconomic conditions, ethnicity, nutrition, childhood health, and maternal aspects, such as gestational conditions and systemic factors.[22] In the present study, the influence of environmental factor, i.e., malnutrition over the tooth crown size, was compared with the tooth size of healthy individuals. The results have shown no significant change in the tooth crown size among the malnourished individuals.

According to the present study, tooth size determination is not significantly influenced by the environmental factor, i.e., nutrition. This was a cross-sectional study limited to a specific school of a particular region. Further studies can be conducted at different places with a larger sample size to better explore and correlate the nutritional status and its expression in the determination of tooth size in humans.

Conclusion

The correlation between tooth crown size with an exogenous chronic stressor, i.e., malnutrition, was found to be nonsignificant when compared with the healthy individuals. The findings indicate that the nutritional status does not significantly influence the determination of tooth size in humans.

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Conflicts of interest
There are no conflicts of interest.

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