The Effect of Nutritional Status on Mesiodistal and Bucco-Lingual (Palatal) Diameters of Primary Teeth among Five Years Old Kindergarten Children

Zaid Saadi Hasan Ahmed, B.D.S., M.Sc., Ph.D. [(1)]
Ban Sahib Diab, B.D.S., M.Sc., Ph.D. [(2)]

ABSTRACT

Background: Malnutrition in human life may adversely affect various aspects of growth at different stages of life. Teeth are particularly sensitive to malnutrition. Malnutrition may affect odontometric measurement involving tooth size dimensions. The aim of this study is to estimate the effect of nutrition on teeth size dimension measurements among children aged 5 years old.

Materials and methods: This study was conducted among malnourished group in comparison to well-nourished group matching with age and gender. The present study included 158 children aged 5 years (78 malnourished and 80 well-nourished). The assessment of nutritional status was done by using three nutritional indicators, namely Height-for-age, Weight-for-age and Weight-for-height. Odontometric measurements including two different orientations. For both upper and lower study models, photographs were taken using special photographic apparatus for each child, and the data were then analyzed using special computer software. For primary dentitions, two linear measurements (mesiodistal and bucco/lingual or palatal) were utilized, representing tooth diameters for each tooth.

Results: Among children aged 5 years, the findings revealed that all means of mesiodistal and bucco-lingual diameters values of maxillary and mandibular teeth were lower among malnourished than well-nourished groups with statistically significant, except for mesiodistal diameters of both canine and lateral incisor maxillary teeth, canine of mandibular teeth and for bucco-palatal diameters of central incisor of maxillary teeth, canine, lateral incisor and central incisor of mandibular teeth.

Conclusions: Malnutrition effect on minimize the odontometric measurements (mesio-distal and bucco-lingual diameters) among children aged 5 years.

Keyword: Mesiodistal diameter, bucco-lingual diameter, bucco-palatal diameter, primary teeth. (J Bagh Coll Dentistry 2016; 28(2):152-157).

INTRODUCTION

Nutrition is one of the essential needs of human beings and it provides human body with energy and essential nutrients necessary for adequate physical and social activities, and maintains or enhances its healthy state [(1)]. Malnutrition can be defined as a “pathological state resulting from absolute or relative deficiency or excess of one or more of the essential nutrients" [(2)]. Still malnutrition is one of the global highest priority health issues not only as its effects are so widespread and long lasting but also because it can be eradicated [(3,4)].

The dental plaster models of a patient's dentition are necessary in dental measurement [(5)]. Recently, dentistry looks to digital archive and tend to be paperless patient information systems. Especially when many methods have been used to determine and to analyze dental plaster casts [(6)].

This is one of the reasons to use photograph technique to measure dimension of dental cast in this study. Protein Energy Malnutrition might responsible for the decrease in tooth diameters [(7)].

This study represents the pioneering aspect. It's importance in terms of providing greater visibility to the harmful effects of malnutrition on oral pictures and change dental morphometric.

MATERIALS AND METHODS

The sample collection

The sample of this study involved two age groups 5 years with different nutritional status. Age was recorded according to the last birthday [(8)]. Out of 240 children who were initially examined, only 158 children (78 malnourished and 80 well-nourished) were candidates selected for the morphometric analysis in this study. The pupil should not suffer from any serious systemic disease or health problem as indicated by the schools’ records, all primary teeth were erupted with no permanent tooth, the children should be free from: congenital abnormalities, congenital missing teeth, supernumerary or abnormal shape tooth and clinical signs of attrition and enamel defect.

Instruments and supplies

Plane mouth dental mirror (No. 4), sickle shape explorer (No.00), bathroom scale for recording weight, The height of the individuals was measured by using the ordinary height measuring tape, electric vibrator (Quale Dental),

(1) Lecturer. Department of Pedodontic and Preventive Dentistry College of Dentistry, University of Baghdad
(2) Assist. Prof. Department of Pedodontic and Preventive Dentistry College of Dentistry, University of Baghdad

dental vernier (Dentaurum 0.05 mm (042-751) Germany, digital Camera (6 Mega pixels) Sony, photographic apparatus (Figure 1), software Auto Cad, 2006, product version Z.54.10.

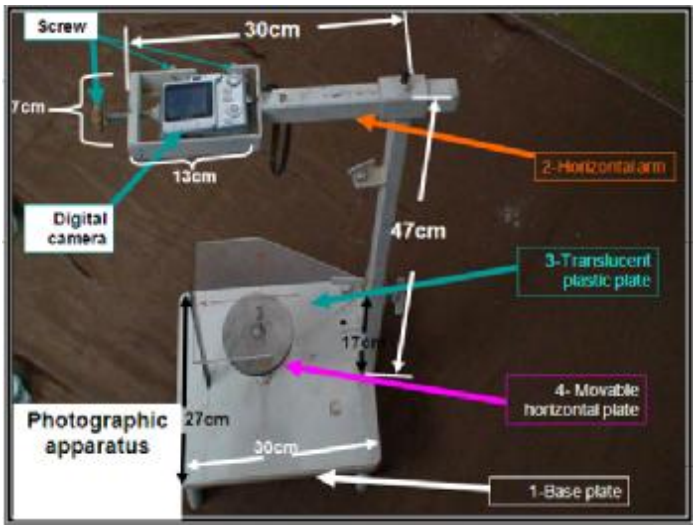

Fig. 1: Photographic Apparatus [13]

Classification of nutritional status of children aged 5 years

Three indicators of the subjects' nutritional status were used to assess the nutritional status of each person in this study and they involve: Height for age (H.F.A), Weight for age (W.F.A) and Weight for height (W.F.H). Based on each nutritional status indicator, the cut off point used Z-Score below -2 SD and between median to +1 to classify malnutrition and well-nourished conditions respectively. And the person was classified as either malnourished or well-nourished depending on these three indicators. Each Z-score was considered in terms of standard deviation.

$$\text{The Z score} = \frac{\text{Individual value — median of reference population}}{\text{Standard deviation of the reference population}}$$

Morphometric measurements

§ **Photographic technique and Cast orientation**

The three-dimension analysis of crown orientation was achieved by considering the three rotational axes of pitch, roll and yaw [9,10] . The three rotational axes introduced into the systematic description of dentofacial traits significantly improved the precision to descript tooth orientation which included crown angulation and inclination. The crown orientations represent the reference to classify each dental arch into three segments according the occlusal views (one anterior, right posterior and left posterior) to measure mesiodistal and bucco-lingual diameters of the tooth crown. Tooth diameters measurements permit by capturing with photographic technique depending on these three views for each arch.

Before image acquisition, the cast should be oriented until incisal surfaces or occlusal surfaces of specific dental segment are orthogonal to the optical axis of the camera for each captures. This procedure was performed by putting the dental cast in surveyor base, and the cusp tips of specific segment teeth were reflected by the highest points. Cast orientation was done through the rotation through which the four sides of the tooth should be well defined. The next step of orientation would be restrained by balancing the movements in the three axes (x, y and z) (define above). The incisal or occlusal view of crowns for each segment was standardized by visually maximizing the visibility of the crown's sides (buccal, lingual, mesial, and distal) in away that it could measure tooth bucco-lingual and mesio-distal diameters (note: it is necessary to use the same orientation system for each dental typology). For each arch, four image captures were taken to three different cast orientations involving: anterior incisal segment, right and left posterior occlusal segments and occlusal surfaces of whole arch. These three photograph capture views of cast were produced as:

a) The posterior occlusal segment (right or/and left) views were standardized depending on overlap **line A** that represented the occlusal line of four posterior teeth and the index point* that should be located between first and second molar for primary dentition.
b) The anterior incisal segment view was standardized according to overlap **line B** which represented the occlusal line of six anterior teeth and the index point ***** that should be located between right and left central

incisor for primary dentition (Line B is a line that present on translucent horizontal plate).

A reference metric system: prepare a metric scale in position parallel to and at the same level of the incisal and /or occlusal surface of cast (for each capture). By means of this metric scale, the calibration of each image dimension could be prepared. It was used to give a real metric value of the cast measurement by obtaining hypothetical factory and multiplying it with an initial measurement value of the photograph cast.

Final real (Actual) value = hypothetical factor X initial measurement value

§ **Taking dental cast captures**

After identifying landmark and orientation of each dental cast, the dental cast was placed on the portable part [(5)] of surveyor and oriented in an ideal way (Cusps heights were not used to orient the cast segment). Before taking a picture (in order to calibrate the image through suitable software), it is necessary to set a reference millimetric scale in correspondence to the occlusal surface of the tooth.

§ **Measurement of dental cast**

Measurements were made directly on upper and lower dental casts by photographic technique through photographic apparatus which provides a constant distance between digital camera and occlusal teeth surfaces through the plastic plate for standardization. Each set of dental casts were measured to the nearest 0.001 mm. Mesiodistal width is measured between two anatomical contact points (the greatest width from the anatomic mesial contact point to the distal one). Bucco-lingual measurement is the maximum diameter of the crown and perpendicular to the mesiodistal diameter [(11,12)] .

All data analyses were performed using the SPSS statistical software programme (version 10 for Windows, SPSS). The confidence level was accepted at the level of 5%.

***Index point** is that point formed by crossing of two line (A,B), and it mark on the translucent horizontal plate to standardized the cast segment for capture, as it represent the point through which optical axis of camera pass.

RESULTS

For primary dentition, an initial analysis was made where tooth diameters (mesiodistal and/or bucco-lingual diameter) were calculated for right and left sides separately. Result found no significant difference between mean tooth diameter of right and left sides for all tooth categories (P>0.05). All subsequent statistical analysis were carried out on pooled data of right and left side measurements. **Table (1)** illustrates the measurement of mesiodistal diameters of maxillary teeth in malnourished group and well-nourished among children aged 5 years. Concerning the maxillary teeth, data reported that the mean values of second, first molars and central incisor diameters among malnourished group were highly significantly lower than well-nourished group (P< 0.01). Result observed that the mean values for both canine and lateral incisor diameters among malnourished group were lower than well-nourished, with no significant difference (P> 0.05).

Table (2) illustrates the measurement of mesiodistal diameters of mandibular teeth in malnourished group and well-nourished of children aged 5 years. Concerning the mandibular teeth, result found that the mean values of second, first molars, lateral incisor and central incisor diameters among malnourished group were highly significantly lower than well-nourished group (P< 0.01). While the mean values for canine diameter among malnourished group were significantly lower than well-nourished, with significant difference (P< 0.05).

Table (3) illustrates the measurement of bucco-palatal diameters of maxillary teeth in malnourished group and well-nourished among children aged 5 years. Concerning maxillary teeth, data showed that the mean values for maxillary second and first molars diameters among malnourished group were highly significantly lower than well-nourished group (P< 0.01). Result observed that the mean values of canine lateral and incisor diameters among malnourished group were significant lower than well-nourished (P< 0.05). Result reported that the mean values for central incisor diameter among malnourished group were lower than well-nourished, with no significant difference (P [>0.05).

The measurement of bucco-lingual diameters of mandibular teeth in malnourished group and well-nourished among children aged 5 years are shown in **Table (4).** Concerning the mandibular teeth, data showed that the mean value for second and first molars diameters among malnourished group were highly significantly lower than well-nourished group (P< 0.01). Result observed that the mean values for canine, lateral incisor and central incisor diameters among malnourished group were lower than well-nourished, with no significant difference (P>0.05).

Table 1: Measurement of mesiodistal diameters (mm) of maxillary teeth in malnourished and well-nourished group among children aged 5 years by gender.

Tooth	Malnourished			Well-nourished			Statistical differences	
	No.	Mean	±SD	No.	Mean	±SD	Z -value	P-value
Right maxillary second molar	78	8.347	0.539	80	8.623	0.53	-3.483**	0
Right maxillary first molar	78	6.704	0.289	80	6.959	0.274	-5.085**	0
Right maxillary canine	78	6.359	0.59	80	6.436	0.443	-0.756	0.449
Right maxillary lateral incisor	78	5	0.364	80	5.108	0.339	-1.852	0.064
Right maxillary central incisor	78	5.953	0.379	80	6.149	0.335	-3.099**	0.002
Left maxillary second molar	78	8.385	0.536	80	8.657	0.531	-3.429**	0.001
Left maxillary first molar	78	6.667	0.29	80	6.922	0.274	-5.172**	0
Left maxillary canine	78	6.324	0.59	80	6.401	0.443	-0.716	0.474
Left maxillary lateral incisor	78	5.036	0.367	80	5.145	0.342	-1.782	0.075
Left maxillary central incisor	78	5.918	0.378	80	6.113	0.336	-3.093**	0.002

Table 2: Measurement of mesiodistal diameters (mm) of mandibular teeth in malnourished and well-nourished group among children aged 5 years by gender.

Tooth	Malnourished			Well-nourished			Statistical differences	
	No.	Mean	±SD	No.	Mean	±SD	Z -value	P-value
Right mandibular second molar	78	8.757	0.423	80	9.439	0.434	-7.908**	0
Right mandibular first molar	78	7.469	0.342	80	7.713	0.311	-4.511**	0
Right mandibular canine	78	5.616	0.373	80	5.74	0.34	-2.109*	0.035
Right mandibular lateral incisor	78	4.818	0.323	80	4.983	0.3	-3.653**	0
Right mandibular central incisor	78	4.296	0.284	80	4.445	0.316	-3.888**	0
Left mandibular second molar	78	8.792	0.426	80	9.474	0.435	-7.912**	0
Left mandibular first molar	78	7.433	0.339	80	7.678	0.31	-4.366**	0
Left mandibular canine	78	5.581	0.369	80	5.707	0.332	-2.221*	0.026
Left mandibular lateral incisor	78	4.854	0.323	80	5.019	0.301	-3.660**	0
Left mandibular central incisor	78	4.289	0.285	80	4.408	0.312	-3.123**	0.002

Table 3: Measurement of bucco-palatal diameters (mm) of maxillary teeth in malnourished and well-nourished group among children aged 5 years by gender

Tooth	Malnourished			Well-nourished			Statistical differences	
	No.	Mean	±SD	No.	Mean	±SD	Z -value	P-value
Right maxillary second molar	78	9.752	0.482	80	10.011	0.48	-3.187**	0.001
Right maxillary first molar	78	8.348	0.394	80	8.993	0.483	-7.731**	0
Right maxillary canine	78	6.283	0.406	80	6.432	0.365	-2.315*	0.021
Right maxillary lateral incisor	78	5.25	0.388	80	5.403	0.364	-2.454*	0.014
Right maxillary central incisor	78	5.469	0.431	80	5.617	0.452	-1.911	0.056
Left maxillary second molar	78	9.788	0.482	80	10.046	0.485	-3.187**	0.001
Left maxillary first molar	78	8.314	0.396	80	8.958	0.477	-7.731**	0
Left maxillary canine	78	6.318	0.411	80	6.467	0.367	-2.335*	0.02
Left maxillary lateral incisor	78	5.217	0.39	80	5.37	0.367	-2.445*	0.014
Left maxillary central incisor	78	5.431	0.434	80	5.581	0.452	-1.901	0.057

DISCUSSION

This study was conducted to assess the effects of malnutrition, on the oral health condition which include odontometric measurements and to compare these with the control group with similar characteristics to the study group except for the factor under investigation: therefore, the control group in the present study included well-nourished subjects who possess as much similarity as possible in terms of age, gender, social structure and geographic position. The 5 years index age was selected in the present study: this age is considered a critical human life stage which has recorded the past and present history of malnutrition and oral health conditions [14,15].

Moreover, the study was conducted among children aged 5 years to represent the primary dentition stage, as teeth are considered to be full-size and within the appropriate normal time of complete eruption of all primary teeth [16-18].

Table 4: Measurement of bucco-lingual diameters (mm) of mandibular teeth in malnourished and well-nourished group among children aged 5 years by gender.

Tooth	Malnourished			Well-nourished			Statistical differences	
	No.	Mean	±SD	No.	Mean	±SD	Z -value	P-value
Right mandibular second molar	78	9.036	0.427	80	9.439	0.436	-5.199**	0
Right mandibular first molar	78	7.313	0.755	80	7.86	0.675	-4.152**	0
Right mandibular canine	78	6.035	0.353	80	6.122	0.355	-1.442	0.149
Right mandibular lateral incisor	78	5.067	0.39	80	5.171	0.384	-1.647	0.1
Right mandibular central incisor	78	4.694	0.395	80	4.781	0.405	-1.4	0.162
Left mandibular second molar	78	9.073	0.431	80	9.477	0.437	-5.182**	0
Left mandibular first molar	78	7.278	0.757	80	7.822	0.676	-4.123**	0
Left mandibular canine	78	6.072	0.357	80	6.159	0.355	-1.478	0.139
Left mandibular lateral incisor	78	5.031	0.389	80	5.134	0.386	-1.619	0.105
Left mandibular central incisor	78	4.659	0.396	80	4.745	0.41	-1.191	0.234

In addition, the 5 age group can represent a proper time for prediction of arch dimension and they are also considered as a static stage. Moreover, the complete eruption of primary dentition was accomplished by the age of three. Protein energy malnutrition was assessed in the present study by using the anthropometric measurement (height, weight) through Z- score standard deviation value system which expresses the anthropometric value as a score below or above the reference mean: their major advantage for the population is based on that group of scores which can be subject to statistic. The present study used three indicators (height for age, weight for age and weight for height) to classify purely malnourished from well-nourished children aged 5 years. Furthermore, these measuring tools are simple and robust, and can be set up in any environment with non-invasive procedure [19]. WHO (1995) recommended using a -2SD cut off point which represents purely statistical separation of malnourished from well-nourished; therefore, the present study used this particular cut off point for the three nutritional health indicator (height for age, height for weight and weight for age). Traditional casts were eliminated with the use of computer-aided diagnosis, particularly due to problems of storage in terms of space and cost, in addition to the risks of damage because of the brittle nature of dental cast. Therefore digital photography was used in this study.

In the current study, it is obvious that the statistical analysis of tooth mean values of mesiodistal and bucco-lingual diameters in the upper and lower jaws revealed the absence of significant asymmetry between right and left sides for primary dentition. These findings indicated that the measurements for the right or left sides represent the mesio-distal and bucco-lingual tooth diameters for this particular sample. This finding agreed with the usual practice that teeth on one side of the jaw, or the average of the two could be used for analyzing the teeth diameters [20]. This symmetrical may be attributed to the presence of similar genetic and environmental factors affecting the tooth size of teeth on the right and left sides. This particular finding is supported by other studies [19, 20]. Similar finding was also reported in several Iraqi studies [16-18, 21-26].

As for the mesio-distal and bucco-lingual diameters of the primary teeth among well-nourished, it is difficult to compare the data of present study with other studies. This may be due to differences in: the criteria of the sample selection and size; the methods used to determine tooth diameters; and the varying definitions of well-nourished group, as the previous studies might have included the different degrees of malnutrition. In general, there appears to be a clear relationship between a child's crown diameters and the mother's health during pregnancy, implying that their heritability included shared environmental as well as genetic factors. Some researchers reported that children submitted to a protein deficient diet during gestation and lactation might have their affect on dental development affected, whereas children with low birth weight condition have been observed to have small tooth size in deciduous dentition [27, 28].

Reduction of tooth size is thought to result from a decrease in the volume of dentin rather than a reduction enamel thickness [29]. Thus, it is conceivable that the influence of Protein Energy Malnutrition on tooth germs is different in the development period from that in a slightly later period. These explain the smaller mesiodistal and bucco-lingual diameters of deciduous teeth among malnourished as compared to well-nourished groups in the present study. Although tooth crown morphology of deciduous dentition is determined predominantly in prenatal period. Some researchers observed that the pre-natal disturbances could lead to alteration of deciduous

teeth morphology [30]. In case of improper weaning and during period precede tooth development, Protein Energy Malnutrition might disrupt environmental homeostasis during the advance stage of tooth formation and maturation, and the odontoblastic layer in this condition might be responsible for the apparent decrease in the diameter and density of the Collegen fibrils of the intertubular dentin [7] .This proves the smaller mesiodistal and bucco-lingual tooth diameters among malnourished group in compare to well-nourished group for the dentition.

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