

The effect of nutritional status on arch width and length of primary teeth among five years old kindergarten children

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ABSTRACT

Background: In human life, malnutrition may adversely affect various aspects of growth at different stages of life. Teeth are particularly sensitive to malnutrition. Malnutrition may affect odontometric measurement involving arch width and length of primary dentition. The aim of this study is to estimate the effect of nutrition on arch width and length dimension measurements among children aged 5 years old.

Material 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 (inter-canine distance and inter-molar distance) were utilized, representing arch measurements.

Results: As for primary dentitions, all means value of maxillary and mandible arch width and length were lower among malnourished group than well-nourished group with statistically highly significant except for both inter-canine distance of maxillary and mandibular, maxillary anterior arch length and mandibular molar vertical length.

Conclusion: Malnutrition effect on minimize the odontometric measurements (dental arch width, dental arch length) among children aged 5 years.

Key words: Dental arch width, dental arch length and children. (J Bagh Coll Dentistry 2015; 27(2):173-177).

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. Researchers demonstrated that Protein-energy malnutrition is associated with decrease jaw height ⁽⁷⁾, as well as the reduced of the maxilla and mandible widths are also adversely influenced by malnutrition ⁽⁸⁾.

In general, several anthropometric studies found a significant adverse effect of malnutrition on the growth and development of facial bones of children, as well on the development of skeletal muscles and organs ⁽⁷⁻⁹⁾. This study represents the pioneering aspect. Its 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 ⁽¹⁰⁾. 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, and the children should be free from: congenital abnormalities, congenital missing teeth, supernumerary or abnormal shape tooth and clinical signs of attrition and enamel defect.

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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), 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.

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.

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

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^(11,12). One capture is sufficient for dental arch measurements. 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. The next step of orientation would be restrained by balancing the movements in the three axes (x, y and z)(define above). For each arch, four image captures were taken to one cast occlusal surfaces orientations of whole arch. This photograph capture view of cast was produced as: Occlusal surfaces of whole arch view were standardized by overlapping of the two cross lines (lines A and B) (where line A should overlap along the median palatal raphe of cast (Median Palatal Line MPL) for the maxilla. In addition, the mirror image of MPL was transferred to the mandibular cast, and line B should overlap to transverse line that was tangent to the distal edge of the two second molars(namely right and left) for maxilla and mandible respectively).

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 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.

Dental arch width

- **Inter-canine distance (ICD):** The linear distance from the right to the left canine at the cusp tip^(13, 14).
- **Inter-molar distance at disto-buccal cusp tips (IMD at DBCT):** The linear distance between the disto-buccal cusp tip of the right and left second deciduous molar^(13,14).

Dental arch length

- **Canine vertical distance (C-VD):** The vertical distance from the incisal point to the inter-canine distance at the cusp tips^(14,15).
- **Molar –vertical distance at disto-buccal cusp tip (M-VD at DBCT):** The vertical distance from the incisal point perpendicular to the inter-molar distance at the disto-buccal cusp tip⁽¹⁴⁻¹⁶⁾.

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 represents the point through which optical axis of camera pass.

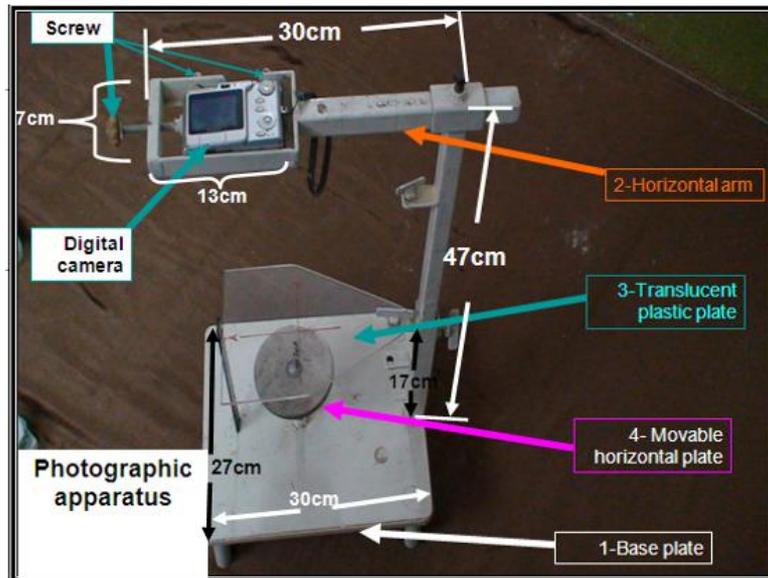


Fig. 1: Photographic Apparatus (Designed by Hasan in 2010⁽¹⁷⁾)

RESULTS

The maxillary and mandibular dental arch width for malnourished group and well-nourished among children aged 5 years are shown in **Table (1)**. Concerning inter - canine distance, the mean value of maxillary inter - canine distance was found to be lower among malnourished group ($29.133 \pm 0.178 \pm 1.572$ mm) than well-nourished ($29.517 \pm 0.171 \pm 1.530$ mm), with no significant difference ($P > 0.05$). In mandible, the mean value of inter - canine distance was found to be lower among malnourished group ($24.819 \pm 0.187 \pm 1.652$ mm) than well-nourished ($24.951 \pm 0.176 \pm 1.570$ mm), with no significant difference ($P > 0.05$). Concerning inter-molar distance, the mean value of maxillary Inter-molar distance was found to be highly significant lower among malnourished group ($41.840 \pm 0.177 \pm 1.562$ mm) than well-nourished group ($43.162 \pm 0.170 \pm 1.520$ mm) ($P < 0.01$). In mandible, the mean value of inter-molar distance was found to be highly significant lower among malnourished group ($38.356 \pm 0.296 \pm 2.616$ mm) than well-nourished group ($39.397 \pm 0.266 \pm 2.378$ mm) ($P < 0.01$).

The maxillary and mandibular dental arch length for malnourished group and well-nourished among children aged 5 years are shown in **Table (2)**. Concerning anterior arch length, the mean value of maxillary anterior arch length was found to be lower among malnourished group ($8.145 \pm 0.113 \pm 0.994$ mm) than well-nourished group ($8.165 \pm 0.138 \pm 1.235$ mm), with no statistically significant difference ($P < 0.05$). Concerning mandible, the mean value of anterior arch length was found to be highly significant lower among malnourished group ($5.595 \pm 0.087 \pm 0.766$ mm) than well-nourished group ($5.878 \pm 0.080 \pm 0.719$ mm) ($P < 0.01$). Concerning molar vertical length, the mean value of maxillary molar vertical length was found to be highly significant lower among malnourished group ($24.729 \pm 0.163 \pm 1.442$ mm) than well-nourished group ($25.912 \pm 0.176 \pm 1.573$ mm) ($P < 0.01$). In mandible, the mean value of molar vertical length was reported highly significant lower among malnourished group ($21.103 \pm 0.127 \pm 1.119$ mm) than well-nourished group ($22.400 \pm 0.119 \pm 1.063$ mm) ($P < 0.01$).

Table 1: Maxillary and mandibular dental arch width (mm) for malnourished and well-nourished groups among children aged 5 years.

| | | Malnourished | | | Well-nourished | | | Statistical differences | |
|----------|-----------------------|--------------|--------|-------|----------------|--------|-------|-------------------------|---------|
| | | No. | Mean | ±SD | No. | Mean | ±SD | Z -value | P-value |
| Maxilla | Inter-canine distance | 78 | 29.133 | 1.572 | 80 | 29.517 | 1.53 | -1.923 | 0.054 |
| | Inter- molar distance | 78 | 41.84 | 1.562 | 80 | 43.162 | 1.52 | -4.824** | 0.000 |
| Mandible | Inter-canine distance | 78 | 24.819 | 1.652 | 80 | 24.951 | 1.57 | -0.697 | 0.486 |
| | Inter- molar distance | 78 | 38.356 | 2.616 | 80 | 39.397 | 2.378 | -2.935** | 0.003 |

** P<0.01

Table 2: Maxillary and mandibular dental arch length (mm) for malnourished and well-nourished groups among children aged 5 years.

| | | Malnourished | | | Well-nourished | | | Statistical differences | |
|----------|-----------------------|--------------|--------|-------|----------------|--------|-------|-------------------------|---------|
| | | No. | Mean | ±SD | No. | Mean | ±SD | Z -value | P-value |
| Maxilla | Anterior Arch Length | 78 | 8.145 | 0.994 | 80 | 8.165 | 1.235 | -0.485 | 0.628 |
| | Molar Vertical Length | 78 | 24.729 | 1.442 | 80 | 25.912 | 1.573 | -4.399** | 0.000 |
| Mandible | Anterior Arch Length | 78 | 5.595 | 0.766 | 80 | 5.878 | 0.719 | -2.601** | 0.009 |
| | Molar Vertical Length | 78 | 21.103 | 1.119 | 80 | 22.4 | 1.063 | -49.576 | 0.000 |

** P<0.01

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^(18,19). 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^(14,20,21). 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 by the age of three, and the entire arch and occlusion are relatively stable for the next two years until the eruption of permanent dentition. Instead, the collected data were intended to be used for planning and evaluation of nutritional and odontometric measurements for the present group and the follower population in addition to standardize the measurement for nutrition status through oral picture conditions. 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. WHO⁽²²⁾ 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.

As for the arch width and length measurements 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 arch dimensions; and the varying definitions of well-nourished group, as the previous studies might have included the different degrees of malnutrition. Protein Energy Malnutrition may be reflected on retardation of the development and growth rate of the hard tissues⁽²³⁾. It affects directly by decreasing bone width as well as delaying the appearance of ossification centers⁽²⁴⁻²⁶⁾. The results of present study showed lower mean values of dental arches width and length for maxillary and mandibular dental arches among malnourished group as compared to well-nourished in both genders. This coincides with the finding by Gonçalves *et al*⁽²⁷⁾ who found that the trabecular structure of the alveolar bone among well-nourished group was found to be thicker than in malnourished group, and well-nourished group appeared to have predominant Type I collagen fibers.

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الخلاصة

الخلفية: في حياة الانسان سوء التغذية قد يؤثر عكسياً على مختلف اوجه النمو وكذلك مشاكل في مختلف المراحل في الحياة . الاسنان بالخصوص حساسة الى سوء التغذية . سوء التغذية قد يؤثر على قراءات التي تشمل حجم السن وابعاد الفكين . هدف الدراسة أجريت لتحديد التغذية على حجم السن للاطفال بعمر 5 سنوات. هذه الدراسة اجريت لمجموعة سيني التغذية بالمقارنة مع جيدي التغذية مع مطابقة العمر والجنس. المواد والطريقة: هذه الدراسة شملت مجموعة من سيني التغذية واخرى من جيدي التغذية متماثلة بالعمر والجنس 158 طفل بعمر 5 سنوات (78 سيني التغذية و 80 جيدي التغذية). تقييم الحالة الغذائية أنجز من خلال استعمال ثلاثة معايير تغذية : الطول بالنسبة للعمر والوزن بالنسبة للعمر والوزن بالنسبة. دراسة القياسات القمية تم لبعدين قياس. الصور لنموذج الفك العلوي والسفلي تم اخذها لكل شخص من خلال استعمال جهاز فوتوغرافي خاص ومن ثم تم تحليل القرانه من خلال برنامج سوفت وير خاص بالحاسبة. لكل من الاسنان اللبنية تم استعمال قرانتين لبعده الفك العرضي والطولي. النتائج: اظهرت النتائج للاطفال بعمر 5 سنوات ان القيم الوسطية للفك العلوي والسفلي لبعده الفك العرضي والطولي اقل في مجموعة سيني التغذية عنه في مجموعة جيدي التغذية وبوجود فرق معنوي عالي فيما عدا البعد الفك العلوي والسفلي العرضي (بين الانياب) وبعد الفك الطولي العلوي الخاص بالاناب وبعد الفك السفلي بين الثنية. الاستنتاج: سوء التغذية يؤثر تقليل الفك العرضي والطولي للاطفال بعمر 5 سنوات.