

## ORIGINAL RESEARCH

# Correlation between head circumference and mesio-distal width of the maxillary central incisor: a cross sectional study among three different population groups

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**Abstract**

The size and shape of a tooth vary between individuals of different ethnic groups and genders because of the influence of different genetic factors. The information regarding the different anatomical factors using maxillary anterior teeth is very scanty. Thus to give more clarity, a study was planned to assess the correlation between head circumference and tooth-mesiodistal width among children of different ethnic origins. The study was carried out on 210 children aged 7 to 12 years in schools at Abha, Saudi Arabia. The mesiodistal (MD) width of the central incisor was measured using a digital vernier caliper. A Meter tape ruler was used to measure the Head/Cephalic dimensions. The data obtained were subjected to statistical analysis using IBM SPSS 20.0, and the results were analyzed. It was found that mean MD tooth width and head circumference were maximum in Saudi children, followed by South Asian and Arab/African, with an insignificant statistical difference ( $p$ -value  $> 0.05$ ). Correlation between MD dimensions of maxillary central incisor with head circumference was statistically significant ( $p$ -value  $< 0.05$ ) among Saudi and South Asian populations, whereas statistically insignificant ( $p$ -value  $> 0.05$ ) difference between Saudi and Arab/African populations. It was concluded that there exist the ethnic differences between tooth-mesiodistal width and head circumference dimensions of children. A positive correlation between head circumference and mesiodistal width of the central incisor was determined.

**Keywords**

Head circumference; Maxillary central incisor; Mesio-distal width

## 1. Introduction

The study of dimensions and features of teeth, like size and shape, is called Dental morphometrics. It is the field of analysis and research. Assessing various features of the form of a tooth is an essential part of clinical studies. They are also used for forensic odontology by identifying a person for medico-legal issues [1]. The development of a tooth begins in the intra-uterine life of an individual, and various hereditary factors determine tooth size [2]. Mesiodistal diameter of a tooth is defined as the horizontal distance between the two parallel lines drawn tangential to the most distal and mesial points on the tooth crown, parallel to the occlusal plane [3].

Various studies have advocated that the size and shape of a tooth vary between individuals of different ethnic groups and genders because of the influence of different genetic factors [4]. Thus, this variation of mesiodistal dimensions among different human populations plays a crucial role in clinical applications, biological issues, study of human evolution, and

in cases of forensic investigations [5]. Assessment of the dental features, called odontometrics, based on a comparison of tooth dimensions, is also helpful for forensic purposes by identifying the gender of the individual [6].

Clinically, in pediatric dentistry, the mesiodistal dimensions of teeth determine the arch alignment, thus influencing malocclusion in children and adolescents. Facial appearance is of great value as it determines an individual's self-image. Nowadays, children and adolescents are even conscious about their appearance [7]. Thus, in pediatric esthetic dentistry, one of the most important tasks is producing a pleasant dimension while replacing or restoring these teeth. It is essential to assess the size and shape of a tooth and its proportions while treating patients to attain optimal results [8]. In cosmetic rehabilitation, anterior maxillary teeth play an important role as their facial aspects are mainly visible while smiling.

Teeth selection is of chief significance for successfully managing missing teeth in children and adolescents. A patient who needs to get his missing maxillary anterior teeth replaced

want the replaced tooth to be as natural as possible [9]. The selection of artificial teeth is a critical step. For selecting the teeth, pre-extraction records are valuable and reliable guides in getting a successful rehabilitation for a patient. The absence of pre-extraction records, like radiographs, diagnostic casts, and photographs, makes anterior tooth selection difficult [10].

The studies revealed that various anatomical measurements like head diameter; inter-commissural and bizygomatic width; interpupillary, innercanthal, and inter-alar distances help in the selection of maxillary anterior teeth, successfully [11–14]. The information concerning the different anatomical factors used to select maxillary anterior teeth is very scanty. Thus to give more clarity, a study was planned to assess the correlation between head circumference and mesiodistal width among children of different ethnic origins.

## 2. Materials and method

This cross-sectional study was conducted in the Department of Pedodontics by assessing the record of dentate children aged between 7 to 12 years of age. The study was carried out on 210 children in schools in Abha, Saudi Arabia. Both genders were divided into three categories depending upon ethnic background: Saudis, South-Asian and Arab/African.

The examiner was calibrated in the department of Pediatric Dentistry. An irreversible hydrocolloid impression of the maxillary arch was made, and a diagnostic cast was prepared using dental stone. The tooth measurements were performed directly on the study models of subjects using digital Vernier Calliper (#700-123-10, Andover, Hampshire, Mitutoyo (UK) Ltd.), to obtain the values with accuracy of up to 0.01 mm. Mesiodistal (MD) crown width has been defined as the greatest distance between the contact points of the approximal surfaces of the dental crown, with the calipers parallel to the occlusal and buccal surfaces. So, the Vernier caliper was placed parallel to the occlusal surface, by the buccal face, perpendicular to the long axis of the crown, measuring the tooth's (Maxillary right central-incisor) largest mesiodistal distance. Each tooth was measured twice at a week's interval and the mean value of the two measurements was used.

Head circumference was measured using an inflexible paper meter-tape from just above the eyebrows outwards to the most posterior occipital protuberance. The intra-examiner reliability was assessed for tooth-measurement and head-circumference measurements and was found to be strong with kappa coefficient of 0.81 and 0.83 respectively.

The data obtained were subjected to statistical analysis using IBM SPSS (Statistical Package for Social Sciences) 20.0 (Chicago, IL, US) and the results were analyzed. The confidence interval was 95% and level of significance was set at 5%.

## 3. Results

The study consisted of 210 study subjects, out of which 70 each were from Saudi, South Asian, and Arab/African nationalities. It was observed that in all the groups, female predominance was found with an insignificant ( $p$ -value  $> 0.05$ ) difference among all three groups (Table 1). Maximum children with

Saudi and Arab/African nationalities were aged 7–8 years, whereas the maximum (51.4%) were 9–10 years of age in the case of the South-Asian group, with a statistically significant ( $p$ -value  $< 0.05$ ) difference between all the groups (Table 2). We observed that among the South Asian group, the maximum number of subjects was Indian, and in the Arab/African group, the maximum were Sudanese (Table 3).

In all study subjects, the Mesiodistal dimension was measured for the maxillary right central incisor along with the circumference of the head. It was found that mean MD tooth width and head circumference were maximum in Saudi subjects, followed by South-Asian and Arab/African, with a statistically insignificant difference ( $p$ -value  $> 0.05$ ) on the intergroup comparison (Table 4). Correlation between MD dimensions of the maxillary central incisor with head circumference was done using Pearson correlation. It was observed that a statistically significant ( $p$ -value  $< 0.05$ ) difference was observed among Saudi and South Asian populations, whereas a statistically insignificant ( $p$ -value  $> 0.05$ ) difference was observed when compared to Arab/African population (Table 5).

## 4. Discussion

Appropriate tooth dimensions are functionally and aesthetically pleasing, an essential step for the aesthetic rehabilitation of teeth in children and adolescents. Various studies have suggested different anthropometric landmarks for selecting a tooth or its dimensions without pre-extraction records. It has been detailed that these landmarks show variations among different races and ethnic groups [15].

Based on odontometric findings, the tooth size can be determined based on the gender and age of patients. Most of the studies in this area do not include Saudi, Arab and Asian populations. So we assessed the correlation of MD tooth (maxillary central incisor) width with head circumference among these three ethnic groups. In the present study, we found that mean MD central incisor tooth-width and head circumference were maximum in Saudis, followed by South Asian and Arab/African subjects, with a statistically insignificant difference ( $p$ -value  $> 0.05$ ) on the intergroup comparison. Correlation between MD dimensions of maxillary central incisor with head circumference was done and found to be statistically significant ( $p$ -value  $< 0.05$ ) among Saudi and South Asian populations, whereas a statistically insignificant ( $p$ -value  $> 0.05$ ) difference was observed when compared to the Arab/African population.

Kumar M *et al.* [16] found a significant association between the body's height and length, width, and head circumference. Ilayperuma [17] reported an association between cranial dimensions and stature and found it statistically significant ( $p < 0.05$ ). Deogade SC *et al.* [18] found a significant difference among gender in body height, length and head width.

A strong correlation between the head circumference and the mesiodistal width of the maxillary central incisor among Saudi and South Asian populations advocates that it can be a valuable and potential tool for the reconstruction of the face and rehabilitation of esthetics in pediatric dentistry.

**TABLE 1. Distribution of study subjects in all three groups according to gender.**

Gender	Saudi		South Asian		Arab/African	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Female	55	78.6	50	71.4	51	72.9
Male	15	21.4	20	28.6	19	27.1
Total	70	100.0	70	100.0	70	100.0
Chi-square	1.118					
<i>p</i> -value	0.057*					

\**p*-value > 0.05 is insignificant.

**TABLE 2. Distribution of study subjects in all three groups according to age groups.**

Age groups (yr)	Saudi		South Asian		Arab/African	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
7–8	35	50	26	37.14286	37	52.85714
9–10	21	30	36	51.42857	26	37.14286
11–12	14	20	8	11.42857	7	10
Total	70	100	70	100	70	100
Mean age	9.0000	1.62409	8.8000	1.35775	8.5857	1.31318
Chi-square	2.109					
<i>p</i> -value	0.002*					

\**p*-value < 0.05 is significant.

**TABLE 3. Distribution of study subjects in all three groups according to nationality.**

Nationality	Frequency	Percentage
Saudi	70	100
South Asian		
Bangladeshi	7	10.0
Indian	51	72.86
Pakistani	12	17.1
Arab/African		
Egyptian	17	24.3
Jordanian	1	1.4
Moroccans	1	1.4
Palestinian	6	8.6
Sudanese	23	32.9
Syrian	6	8.6
Yemeni	16	22.9

**TABLE 4. Mean dimensions in all three groups and intergroup comparison using ANOVA statistical test for both the parameters.**

Parameters	Saudi		South Asian		Arab/African		F-test	<i>p</i> -value*
MD tooth width	6.9443	1.70664	6.8884	1.69485	6.8819	1.40311	5.009	0.098
Head circumference	51.7529	1.95735	51.9457	1.61359	51.6100	6.49468	11.516	1.010

\**p*-value > 0.05 is insignificant. MD: mesiodistal.

**TABLE 5. Correlation between MD dimensions of maxillary central incisor with head circumference using Pearson correlation.**

Statistical Analysis	Saudi	South Asian	Arab/African
Pearson correlation coefficient	0.184	0.272	-0.040
<i>p</i> -value	0.028*	0.023*	0.743
N	70	70	70

\**p*-value < 0.05 is significant.

## 5. Limitations

The study has a few limitations; firstly, study was conducted on a limited sample size, so further studies should be conducted taking more study subjects. Secondly, we assessed results by taking only three ethnic groups; thus, results cannot be generalized for other population groups.

## 6. Conclusions

Our study determined a positive correlation between head circumference and mesiodistal width of the central incisor. We also observed the ethnic differences between MD and head circumference dimensions. This indicates that head circumference can be used as a tool while restoring the missing tooth or rehabilitating the teeth to their original dimensions.

## AVAILABILITY OF DATA AND MATERIALS

The data are contained within this article.

## AUTHOR CONTRIBUTIONS

HMA—Literature review, data acquisition, approval of final version of manuscript; RAT—Study concept, study design, critical evaluation, approval of final version of manuscript; TSA—Result-interpretation, manuscript editing, approval of final version of manuscript; SAS—Drafting of manuscript, data acquisition, final approval of manuscript; RMA—Data acquisition, statistical analysis, final approval of manuscript; ZMA—Literature review, statistical analysis, final approval of manuscript; MZ—Critical evaluation, Result interpretation, final approval of manuscript; SMY—Statistical analysis, revision of manuscript, final approval of manuscript.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the institutional ethical committee review board, King Khalid University College of Dentistry, Abha, KSA (IRB/ETH/2022-23/006). Parents'/guardians' consent was obtained prior to the start of study.

## ACKNOWLEDGMENT

Authors would like to express their humble gratitude to King Khalid University for their constant support to accomplish this research.

## FUNDING

This research received no external funding.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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**How to cite this article:** Hanan Mashhour Alqahtani, Rafi Ahmad Togoo, Tasneem SakinatulAin, Alhnouf Saeed Alshahrani, Rawan Mohammed Asiri, Zuhair Motlak Alkahtani, *et al.* Correlation between head circumference and mesio-distal width of the maxillary central incisor: a cross sectional study among three different population groups. *Journal of Clinical Pediatric Dentistry*. 2023. doi: 10.22514/jocpd.2023.044.