



# Association of Hormonal Fingerprints with DMFT, BMI and Hemoglobin in 4-12 Years Old Children of Raichur

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## Abstract

**Introduction:** Dental caries is hereditary and excessive caries run in households and are passed from mother to baby and run along generations. The early and correct detection and analysis of dental caries is a crucial thing for the general control of the dental patient. Presently, the so-called hormonal fingerprint additionally known as 2D:4D ratio has received a lot of research attention. The aim of the study is to evaluate the influence of digit ratio on the incidence of dental caries. **Material and Methods:** One hundred patients between 4 and 12 years participated in the study. Hormonal fingerprints (2D:4D ratio) was measured with the help of a digital vernier calliper. Caries incidence was recorded using the DMFT, Calculation of Body Mass Index and estimation of Hb levels was also done. **Results:** Out of 100 children 53 were males and 47 were females, in which 57% of males and 39% of females were with 2D:4D less than 1, 2% males and 17% females were having 2D:4D  $\geq$  1. Male population showed higher prevalence in the low 2D:4D ratio. Children with low 2D:4D ratio have excessive caries index, Low BMI values and Low Hb levels. **Conclusion:** The present study confirms the impact of hormones on Digit Ratio, BMI which in turn influence the caries index and could be used as an early predictor dental caries and Anaemia in children.

**Keywords:** Dental Caries, Detection, Males, Females, Children.

## Introduction

Hormonal fingerprint known as 2D:4D ratio has received a lot of research attention. It refers to the relative span of the fourth digit compared to the second digit and is pronounced to be strong, reproducible, and regular function for an individual. Research confirms that the 2D:4D ratio is sexually differentiated in human beings. Adult males tend to have decreased 2D:4D ratio than ladies. The primary mechanism explaining this sexual distinction is that the development of digits and gonads occur by the common genes Hox

A and Hox D. The other suggested method is that finger ratio, being a purpose of androgen sensitivity in preference to androgen awareness, is affected by exposure to androgens, and thus this digit ratio can be regarded as an easy measure for prenatal androgen exposure [1].

Biological markers are a measurable indicator of physiological state or condition. They are used to measure, evaluate, and examine the normal or pathologic processes. They are the tools that help in diagnosis, prevention, or retrogression of disease. Biomarkers can be pulse, blood pressure, or anything that gives a

correlation between biological process and a potential hazard, as given by the World Health Organization (WHO). One such biological marker is the hormonal fingerprint or digit ratio. Hormonal fingerprint or the digit ratio is the ratio of the second digit (2D) to the fourth digit (4D). The digits are measured from the midpoint of the fingers bottom crease (where the finger joins the hand) to its tip. 2D:4D ratio is the 2D divided by the 4D of the same hand. It is considered a substitute marker for prenatal androgen exposure, which is known to show sexual dimorphism. This ratio (2D:4D) is lower in males and higher in females. Individuals with a shorter index finger are testosterone derived and those having a longer index finger, estrogen derived [2].

Dental caries consequences from an overgrowth of precise organisms like Streptococcus mutans and Lactobacillus species, which are part of generally going on human oral flora. Dental caries is hereditary and excessive caries run in households and are passed from mother to baby and run along generations. The children of mothers with high caries are at a higher chance of decay [1].

The early and correct detection and analysis of dental caries is a crucial thing for the general control of the dental patient. Presently, the so-called hormonal fingerprint additionally known as 2D:4D ratio has received a lot of research attention [1]. In dental literature, there is a lack of research that focuses on the link among 2D:4D ratio and dental caries experience. The aim of the study is to spotlight the position of recent biologic marker, hormonal fingerprint inside the early detection of caries in children.

## Methodology

The present study was conducted in children of both sexes, aged 4–12 years visiting the Department of Pedodontics and Preventive Dentistry, Navodaya Dental College, Raichur, India. The sample size was fixed to 100. The study was conducted for a time period of six months. The Guardian/the Parents of the participants signed individual informed consent forms containing information about the aim of the study and the study procedures. The study was approved by the Ethical Committee of the Institution.

### Inclusion Criteria

1. Children of age group 4 to 12 years,
2. Children with no systemic illness,
3. Healthy normal children with no physical or mental disability.

### Exclusion Criteria

Children with injuries or deformities of the hands, children with long-standing systemic illness, children who were on any medication within the past two months, children with physical or mental disability, children whose parents did not give consent were excluded from the study.

### Calculation of 2d:4d Ratio

The length of the Index (2D) and Ring (4D) fingers were measured for all the children from the ventral proximal crease of the digit to the tip. In the case there were multiple creases at the base of the digit, measurement taken from the most proximal of these creases with the help of digital Vernier’s caliper. The digit ratio is obtained by dividing these values and calculating the mean of the multiple

measurements for both hands and divided for the calculation of 2D:4D ratio. The entire study population was divided into children with 2D:4D ratio less than 1 and  $\geq 1$  based on the calculations of 2D:4D.

**Clinical Examination:** Caries status (deft and DMFT) was recorded based on WHO standard criteria mentioned in the WHO oral health proforma, 1997. Two trained and calibrated examiners performed comprehensive clinical examination with the assistance of one recorder. The values of one investigator were cross examined by another investigator. Children were made to sit on the dental chair and examination was conducted under light attached to the dental chair. Sterile mouth mirrors, Community Periodontal Index (CPI) ballpoint probes were taken. Caries was recorded as present when a lesion in a pit and a fissure or on a smooth surface had cavity with undermined enamel or smooth surface which may be arrested or active lesion. Recordings of the data were noted by a trained assistant.

### DMFT Scoring

- Low (1 - 1.5)
- Medium (1.5 - 2.0)
- High (> 2.0)

**Calculation of Body Mass Index:** Height and weight were measured for all those who are enrolled in the study. The weight of each child was measured in standing posture with equal distribution of mass between feet, to the nearest 0.1 kg using a Krups Imperial analogue weighing scale which was calibrated before use. Each child was instructed to stand still, with mass equally distributed between feet, until the scale reading stabilized. The reading was then recorded. Height was measured to the nearest 0.1cm using a stature meter attached to the wall in the department. For the calculation of BMI, the following formula was used.

$$BMI = \text{Weight in kg} / \text{height in m}^2$$

From the values obtained children were categorized as,

- Underweight = <18.5
- Normal weight = 18–24
- Overweight = 25–30

### Hemoglobin Levels Estimation

Blood samples were obtained on the day of study by examiner. Hemoglobin level was measured chair side by Sahli’s Method.

All the data were tabulated and subjected to statistical analysis. Chi-square test, t-test and Anova test were used for analysing the data using SPSS software.

## Results

The entire study population was divided into children with 2D:4D ratio less than 1 and  $\geq 1$  based on the calculations of 2D:4D. Out of 100 children 53 were males and 47 were females, in which 57% of males and 39% of females were with 2D:4D less than 1, 2% males and 17% females were having 2D:4D  $\geq 1$ . Male population showed higher prevalence in the low 2D:4D ratio [Table 1].

**Table 1: Distribution of 2D:4D ratio <1 or >1 according to gender among the study population**

Digit Ratio	Males	Females	Total	Chi-square	P- Value
Low <1	52 (57%)	39 (43%)	91	6.967	0.008
High $\geq 1$	1 (11%)	8 (89%)	9		
Total	53	47	100		

Out of 91 subjects with low 2D:4D ratio, i.e., <1, 50 (53%) subjects had a high DMFT score, 20 (23%) had medium, and 22 (24%) subjects had a low DMFT score. Out of 9 subjects with high 2D:4D ratio, i.e., >1, 7 (78%) had high DMFT score, 1 (11%) subject had medium DMFT score, and 2 (11%) subjects had a low DMFT score

[Table 2]. A Chi-square test was performed to assess the association between digit ratio and DMFT, yielding a Chi-square value of 8.092 and a P-value of 0.007, indicating statistically significant association.

**Table 2: Comparison of 2D:4D ratio <1 or >1 with DMF among the study population**

DMF	Low <1	High ≥1	Total	Chi-square	p-value
Low (1 - 1.5)	22 (24%)	1 (11%)	23	8.092	0.007
Medium (1.5 - 2.0)	20 (23%)	1 (11%)	22		
High (≥ 2.0)	48 (53%)	7 (78%)	55		
Total	91	9	100		

Out of 91 subjects with low 2D:4D ratio, 52 (58%) were found to be underweight, 25 (27%) were found to have normal weight and 14 (15%) were found to have Overweight. Out of 9 subjects with high 2D:4D ratio, 7 (78%) were found to be underweight, 1 (11%) were

found to have normal weight and 1 (11%) were found to be underweight [Table 3]. A Chi-square test yielded a value of 0.003 with a P-value of 0.032, indicating significant association between digit ratio and DMFT score.

**Table 3: Comparison of 2D:4D ratio <1 or >1 with BMI among the study population**

BMI	Low <1	High ≥1	Total	Chi-square	p-value
Underweight (<18.5)	52 (58%)	7 (78%)	59	6.873	0.032
Normal weight (18.5–24.9)	25 (27%)	1 (11%)	26		
Overweight (25–29.9)	14 (15%)	1 (11%)	15		
Total	91	9	100		

The table 4 presents the comparison of hemoglobin (Hb) levels between individuals with low (<1) and high (>1) digit ratios. The mean Hb level for the low digit ratio group was 11.2, with a standard deviation of 0.0593 and a standard error mean of 0.0081. In contrast, the high digit ratio group had a higher mean Hb level of 13.3, with a

standard deviation of 0.0655 and a standard error mean of 0.0096. A t-test was performed, yielding a value of 100.448 with a P-value <0.001, indicating a statistically significant difference in hemoglobin levels between the two groups [Table 4].

**Table 4: Comparison of 2D:4D ratio <1 or >1 with Hb among the study population**

Digit Ratio	Hb Mean	Std. Deviation	Std. Error Mean	" t " test	P Value
<1	11.2	0.0593	0.0081	100.448	<0.001
≥1	13.3	0.0655	0.0096		

**Discussion**

The present study was conducted in a group of 100 children to identify the relationship among 2D:4D ratio with caries risk, BMI and Hb. 2D:4D ratio is sexually dimorphic. Our findings suggest that 2D:4D ratio was lower in males than females, which was in accordance with Priyanka *et al.* [3], Beegum *et al.* [11]. It was revealed that 2D:4D ratios and sex had a statistically significant and positive relationship, with male mean 2D:4D being lower than female mean 2D:4D ratio. This shows that men’s prenatal testosterone levels were greater and their prenatal estrogen levels were lower than women’s. The 2D:4D ratio, which causes the 4th digit to be longer than the 2nd, has been proven to be a viable marker for prenatal testosterone. The 2D:4D ratio has been found to be a reliable indicator of prenatal testosterone levels, which causes the 4th digit to be longer than the 2nd. Our data suggest that males have a lower 2D:4D ratio than females, which is consistent with the findings of Garg *et al.* [4].

When the caries was observed according to sex, males had higher caries experience compared with females. These findings were in accordance with Verma *et al.* [5]. The present study showed that the children with low 2D:4D ratio have excessive caries index, which is in accordance with Issrani *et al.* [6], who also showed a favourable correlation between low 2D:4D ratio, i.e., excessive prenatal androgen values and high caries index. They concluded that the hormones have an impact on taste perception and nutritional preferences, which in turn influence their caries index.

Lower 2D:4D ratio was associated with less BMI and higher dental caries was associated according to the current study. According to Priyanka *et al.* [3], the higher caries incidence was associated with low BMI values and stated that dental caries and BMI are related in a nonlinear fashion with more dental caries occurring in individuals with either lower BMI.

In the present study, comparing digit ratio with hemoglobin levels and dental caries, suggests that a lower digit ratio is generally associated with a higher risk of dental caries, while low hemoglobin levels can also be linked to increased caries experience, potentially due to malnutrition impacting oral health [7]. However, the relationship between these factors is complex and requires further research to fully understand the mechanisms involved.

Implementation of preventive measures, need for education for the correct maintenance of oral health, and preventive and continuous dental care are vital to the decline of caries prevalence. It is a simple, non-invasive chair-side procedure and can implement new preventive measures for dental caries [1]. Further research to inspect the impact of 2D:4D on caries with larger sample size is required to ascertain the relationship of hormonal fingerprints with DMFT, BMI and Hb.

**Conclusion**

The hormonal finger prints are new biological markers which can be used as forecasters for the incidence of Caries, as low 2D:4D ratio associated with high Caries, Lower BMI and Hb values. The present

study confirms the impact of hormones on Digit Ratio, BMI which in turn influence the caries index and could be used as an early predictor dental caries.

## Declarations

## Data Availability

Available on corresponding author upon a responsible request.

## Funding Support

None

## Conflicts of Interest

Author declares there no conflict interest.

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