RESEARCH ARTICLE

Early Prediction of Dental Caries using Hormonal Fingerprint in 6–12 Years Old Children: A Cross-sectional Study

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ABSTRACT

Background: The ratio between second and fourth digit lengths (2D:4D ratio) is termed as hormonal fingerprint. Second and fourth digit lengths ratio is used as a biological marker for predicting and diagnosis of many metabolic disorders mainly coronary heart disease and autism, whereas, in dentistry, this method is still in blooming stage. The aim of the study was to assess the relationship between the new biological marker–hormonal fingerprints in the early detection of caries in children.

Methodology: A total of 250 children were randomly selected from both sexes of the age group 6–16 years. Caries assessment was done using standard mouth mirrors and community periodontal index probes. Caries status (deft and DMFT) was recorded and subjects with a total DMFT/deft score of >5 were considered to have a high caries rate. The hormonal fingerprint was made by measuring the length ratio of the index and ring finger with the help of vernier caliper. The entire study population was divided into children with 2D:4D ratio less than 1 and ≥1 based on the calculations of 2D:4D.

Results: The results showed that 79.67% males and 29.92% females have 2D:4D ratio <1 and 70.07% females and 20.32% males have 2D:4D ≥1. There is negative correlation between caries incidence and 2D:4D ratio. Children with low 2D:4D ratio have high caries index (54.4%) and high 2D:4D ratio have low caries index (45.6%), which is statistically significant.

Conclusion: The study confirms a positive correlation between low 2D:4D ratio and high caries, which could be used as an early biological predictor of dental caries.

Keywords: Biological marker, Caries risk, Hormonal fingerprints, Second and fourth digit lengths ratio.

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INTRODUCTION

According to the Centers for Disease Control and Prevention, dental caries is possibly the maximum popular infectious illnesses of the oral cavity, most commonly affecting children. Unlike other issues, it is irreversible in nature and cannot be managed through pharmacological interventions and can result in pain, poor quality of life, and hindering the nutritional reputation and growth of the child. Studies have shown that tooth decays are five times greater common than bronchial asthma and seven instances extra not unusual than hay fever in children.

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 are 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 prices are at a higher chance of decay.

The high-quality correlation between high sugar intake and the caries risk has been documented in the literature; but current ideas like genetic flavor sensitivity and taste thresholds had been evolving to pick out the caries risk at an early level.

The early and correct detection and analysis of dental caries is a crucial thing for the general control of the dental patient. Many techniques are accessible to the clinician; but it is far imperative that strategies with appropriate tiers of sensitivity and specificity are used in conjunction to attain a valid diagnosis to inform the right and appropriate remedy for the affected person.

Presently, the so-called hormonal fingerprint additionally 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 than ladies.

The primary mechanism explaining this sexual distinction is that the development of digits and gonads take vicinity by using the not unusual genes homeobox A and 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.

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Hence, this organic marker also can be used to expect kid’s caries susceptibility through determining their nutritional possibilities, taste perception, and additionally the association among them. 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 cross-sectional study was conducted in children of both sexes, aged 6–12 years visiting the Department of Pedodontics and Preventive Dentistry, PMS College of Dentistry, Kerala, India. The sample length was fixed to 250 and calculated using the formulation:

\[ n = \left( \frac{Z_{\alpha/2} + Z_{\beta}}{2} \right)^2 \times 2 \times \sigma^2/d^2 \]

where \( Z_{\alpha/2} \) is the analytic value of the normal spread at \( \alpha/2 \) (e.g., for a confidence level of 95%, \( \alpha \) is 0.05 and the analytic value is 1.96), \( Z_{\beta} \) is the analytic value of the normal spread at \( \beta \) (e.g., for a power of 80%, \( \beta \) is 0.2 and the critical value is 0.84), \( \sigma^2 \) is the population variance, and \( d \) is the difference.

The duration of the present study was for 6 months. The parents of the children signed the informed consent form containing details about the study. The study was accepted by the Ethical Committee of the institution. Children with no systemic illness, healthy kids with no bodily or mental incapacity have been included in the study and children with injuries or deformities of the hands, kids with long-standing systemic illness who were on any medication within the past 2 months, children with physical or mental disability, and children whose parents refused to provide consent have been excluded from the study.

**Clinical Examination**

Children had been made to sit down on the dental chair and examination was performed below light connected to the dental chair. Two trained and calibrated examiners performed comprehensive clinical exam. Caries index (dft and DMFT) were recorded and participants with a complete DMFT/deft score of >5 were taken into consideration to have high caries rate.

Caries were recorded if a lesion is present in occlusal surface with undermined enamel or smooth surface which may be arrested or active caries. The occlusal characteristics along with molar relation, anterior and posterior crossbite, open bite, deep bite, and lower anterior crowding were additionally recorded.

**Calculation of 2D:4D Ratio**

The length of the index (2D) and ring (4D) fingers had been measured for all the children from the ventral proximal crease of the digit to the end (Figs 1 and 2). In case there were multiple creases at the bottom of the digit, dimensions were taken from the maximum proximal of these creases with the help of vernier 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 of both the palms separately. The whole participants were divided into children with 2D:4D ratio less than 1 and ≥1 based on the calculations of 2D:4D.

All the statistics had been tabulated and subjected to statistical evaluation and SPSS software was used for analyzing the data.
Lakshmi et al. evaluated the association between genetic taste sensitivity, dietary alternatives, and salivary flow rate in 6–14 year-old children for identification of individuals at better danger of developing dental caries and found a positive relation between low digit ratio (2D:4D ratio), nontasters, sweet likers, and high caries index.

**Conclusions**

The present study confirms the high incidence of dental caries in children having low 2D:4D ratio. Hormonal fingerprints are recent organic markers, which may be used as a device for predicting caries susceptibility in neonates. It is a simple, noninvasive chair-side procedure and can implement new preventive measures for dental caries. It can open doors for ruling out other risk factors in dentistry through estimation of hormonal fingerprints. However, the sample size is too small to be conclusive and further research with bigger sample size is required to establish concrete and reliable results.

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The present study was conducted in a group of 250 children to identify the relationship among caries risk and 2D:4D ratio. In the present study, the male mean 2D:4D ratio was lower than the females, which is in accordance with Manning et al. and Kangassalo et al.

The low 2D:4D ratio in males shows that man may additionally have experienced higher degrees of prenatal testosterone and lower tiers of prenatal estrogen than women. The 2D:4D ratio has been observed as a reliable marker for prenatal testosterone which causes prolongation of fourth digit relative to the second digit.

The sexual dimorphism in digit ratio was defined by Lutchmaya et al., who studied the relationships among 2D:4D ratios and fetal testosterone (FT) and fetal estrogen (FE) from amniotic fluid in a sample of 33 children. They stated significant poor relationship between right 2D:4D ratio and FT/FE ratio – independent of sex – such that low 2D:4D becomes associated with higher levels of FT relative to FE, and excessive 2D:4D correlated with low FT relative to FE.

The present study showed that the children with low 2D:4D ratio have excessive caries index, which is in accordance with Verma et al., who also showed a favorable 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.

**Table 1:** Distribution of males and females in 2D:4D < 1 or ≥ 1

| Sex     | 2D:4D < 1 | 2D:4D ≥ 1 | Total | Mean  | SD   |
|---------|-----------|-----------|-------|-------|------|
| Male    | 98 (79.67%) | 25 (20.32%) | 123   | 3.41  | 2.62 |
| Female  | 38 (29.92%) | 89 (70.07%)  | 127   | 2.75  | 2.00 |
| Total   | 136 (54.40%) | 114 (45.60%) | 250   |       |      |

**Table 2:** Distribution of 2D:4D ratio of study subjects based on caries experience

| Caries risk category | Low 2D:4D ratio | High 2D:4D ratio | Total | Percentage | p-value |
|----------------------|----------------|----------------|-------|------------|---------|
| High caries risk     | 110            | 26             | 136   | 54.4%      | <0.01   |
| Low caries risk      | 24             | 90             | 114   | 45.6%      |         |

Caries risk categorized as DMFT <5 (low risk) and DMFT >5 (high risk)
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