Original Research

Comparative evaluation of association of hormonal fingerprint and caries status in 6-14 year old children in Ahmedabad city-A cross-sectional study

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ABSTRACT:
Background: The ratio between second and fourth digit lengths is termed as hormonal fingerprint. It is widely used as a marker in medical scenarios but not many records are available in dentistry. This ratio has a role to play in prenatal sex-hormone action on the body, brain behavior along with taste perception thus influencing the dietary preferences of contributing to dental caries. **Materials and Methodology:** 250 healthy children (aged 6- 14 years) who visited our Department of Pediatric and Preventive Dentistry, Ahmedabad Dental College and Hospital were included in the study. Type 3 dental examination was conducted to ascertain caries status using the deft/DMFT index and subjects with a score >5 were considered as high caries group. The length of the index and ring finger was measured with the help of a digital vernier caliper and divided to obtain the ratio. The entire study population was divided into 2 groups as children with a digit ratio <1 and ≥1. **Results:** The results showed that 71.5% males had ratio <1 and 72.5% females had ratio ≥1 which displays sexual dimorphism. There is a negative correlation between caries status and digit ratio. Children with low digit ratio have high caries status (81.5%) and high digit ratio have low caries status (79.2%), which is statistically significant. **Conclusion:** The study confirms a negative correlation between digit ratio and caries status which could be used as a potential biomarker to predict caries susceptibility.

INTRODUCTION

The most commonly occurring oral disease that is prevalent across all age groups is dental caries. It is the destruction of dental hard tissues by acidic by-products from bacterial fermentation of dietary carbohydrates, mainly sucrose.[1] Dental caries occurs due to overgrowth of organisms like Streptococcus mutans and Lactobacillus species, which are part of normal human oral flora. Dental caries has a multifactorial etiology and eventually leads to pain, discomfort, loss of tooth in children if left untreated.

The early detection and analysis of dental caries is crucial for maintaining oral health. Although many techniques are available, it is imperative that newer strategies are explored to predict risk of dental caries. Biological markers are a measurable indicator of physiological state or condition. They are used to measure, evaluate and examine the normal or pathologic processes.[2] They are the tools that aid 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).[3] One such biological marker is the hormonal fingerprint or digit ratio.

The ratio between second and fourth digit length is termed as hormonal fingerprint (2D:4D). It is believed to reflect exposure to sex hormones during fetal development. It is pronounced to be strong, reproducible and regular function for an individual.[4]

The 2D:4D ratio shows sexual dimorphism as it is lower in males and higher in females.[5]The primary mechanism explaining this sexual distinction is that the development of digits and gonads take place under the influence of Hox-genes namely 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.[6] According to the literature, fetus during intrauterine life is exposed to prenatal androgens and it is their concentration of exposure which dictates their taste perception, thereby affecting their oral health.[7]

In dental literature, there is a lack of research that emphasizes the link among 2D:4D ratio and dental caries experience. Therefore, this research seeks to delve into the relatively unexplored realm of "hormonal fingerprints" and their potential connection to dental caries which could offer valuable insights into developing preventive strategies for dental caries.

METHODOLOGY

The present cross-sectional study was conducted in children of both sexes, aged 6–14 years visiting the Department of Pediatric and Preventive Dentistry, Ahmedabad Dental College and Hospital, Gujarat, India.

The sample size was fixed to 250 and calculated using the formulation:

$$n=(Z_{\alpha/2} + Z_{\beta})^2 \times 2 \times \sigma^2/d^2$$

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

The duration of the present study was 3 months. The ethical approval was obtained from the ethical committee of the institution. Healthy kids with no systemic illness were included in the study and children with injuries or deformities of the hands, kids with long-standing systemic illness or disability were excluded from the study.

CLINICAL EXAMINATION

A Type 3 dental examination was performed on the children by a single trained examiner. Caries status index were recorded using deft/DMFT index and participants with a DMFT/deft score of greater than or equal to 5 were taken into consideration as high caries group while a deft/DMFT score below 5 was grouped as low caries group.[8]

CALCULATION OF 2D:4D RATIO

The index finger (2D) and ring finger (4D) of the right hand was measured from the midpoint of the basal crease till the tip of the digit on the palm side using a digital vernier caliper (Fig 1).

Figure 1: Measurement of the length of the index finger using digital vernier caliper

Some reports state that the hormonal fingerprints of the right hand are more sensitive and differentiated to prenatal testosterone exposure, while others found average ratios across both.[9] The digit ratio was obtained by dividing these values. The entire population was divided into two categories as Group A having the ratio less than 1 and Group B having ratio more than or equal to 1. These groups were further subdivided into low caries groups and high caries groups. All the recorded data had been

tabulated and subjected to statistical evaluation and SPSS 20.0, IBM, Chicago software was used for analyzing the data.

RESULTS
Of the 250 participants, 126 (50.4%) were males while 124 (49.6%) were females. Among females, 37 (28.5%) had ratio less than 1 (<1) while 87 (72.5%) had ratio more than or equal to 1 (>/= 1). Among the males, 93 (71.5%) had ratio <1 while 33 (27.5%) had ratio >/=1. This established sexual dimorphism with the majority of males having ratio <1 and a p-value of <0.001 which was statistically significant (Table 1 and Figure 2).

Table 1: Distribution of 2D:4D ratio based on gender

SEX	2D:4D < 1	2D:4D >/=1	Total	Chi-square	p-value
Male	93 (71.5%)	33 (27.5%)	126	48.41	<0.001
Female	37 (28.5%)	87 (72.5%)	124		
Total	130 (52%)	120 (48%)	250		

2D:4D= ratio of index finger and ring finger, <1 means less than 1, >/=1 means greater than or equal to 1. The digit ratio was found to be less than 1 in 71.5% of males while ratio >/=1 was found in 72.5% of females.

**Figure 2: Distribution of digit ratio based on Gender**
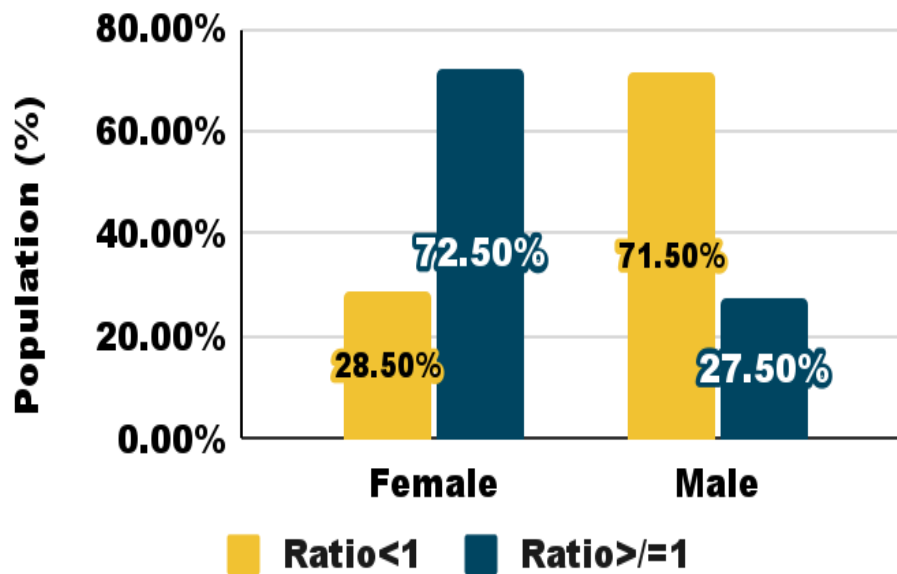
Among the 250 participants, 119 (47.6%) belonged to the low caries group while 131 (52.4%) belonged to the high caries group. There was a statistically significant pattern that was observed between the caries status and the digit ratio as in the Low caries group, 95 (79.2%) children had ratio >/=1 while in the high caries group 106 (81.5%) children had ratio <1 (Table 2 and Figure 3) with a p-value <0.001.

Table 2: Distribution of 2D:4D ratio based on caries status

Caries Risk	2D:4D Ratio <1	2D:4D Ratio>/=1	Total	Percentage	Chi-square	p-value
Low Caries Group	24 (18.5%)	95 (79.2%)	119	47.6%	92.193	<0.001
High Caries group	106(81.5%)	25 (20.8%)	131	52.4%		

2D:4D= ratio of index finger and ring finger, <1= less than 1, >/=1 means greater than or equal to 1. 79.2% of subjects with low caries had ratio >/=1 while 81.5% subjects with high caries had ratio <1.

**Figure 3: Distribution of digit ratio based on Caries status**
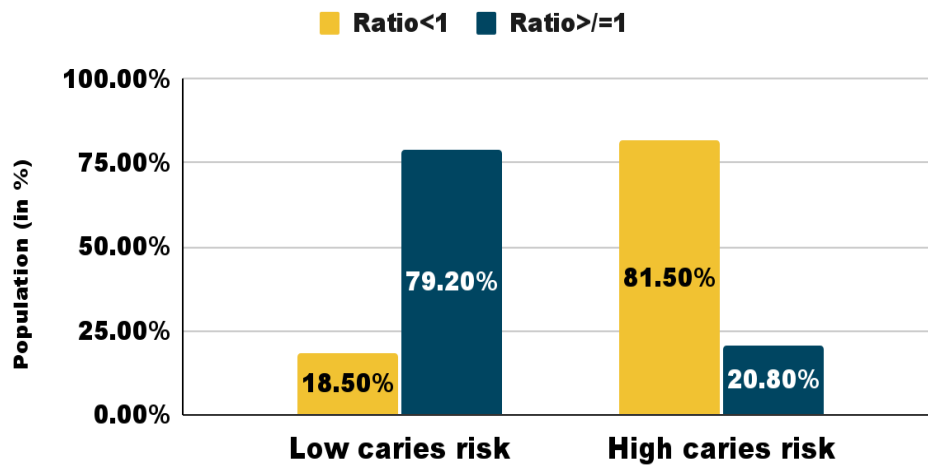
The Pearson's correlation between the parameters 2D:4D ratio and caries status shows a negative correlation and is significant with a p-value of 0.019. Children with low 2D:4D ratio have high caries status (81.5%) and high 2D:4D ratio have low caries index (79.2%), which is statistically significant with a p-value of 0.019 (Table 3 and Figure 4).

Table 3: Correlation between caries status and 2D:4D ratio

Parameters being correlated	Total	Correlation (r)	p-value
Caries status with 2D:4D ratio	250	-0.149	0.019

The correlation between digit ratio and caries status is a negative correlation.

Figure 4 Correlation graph between digit ratio and Caries status shows negative correlation
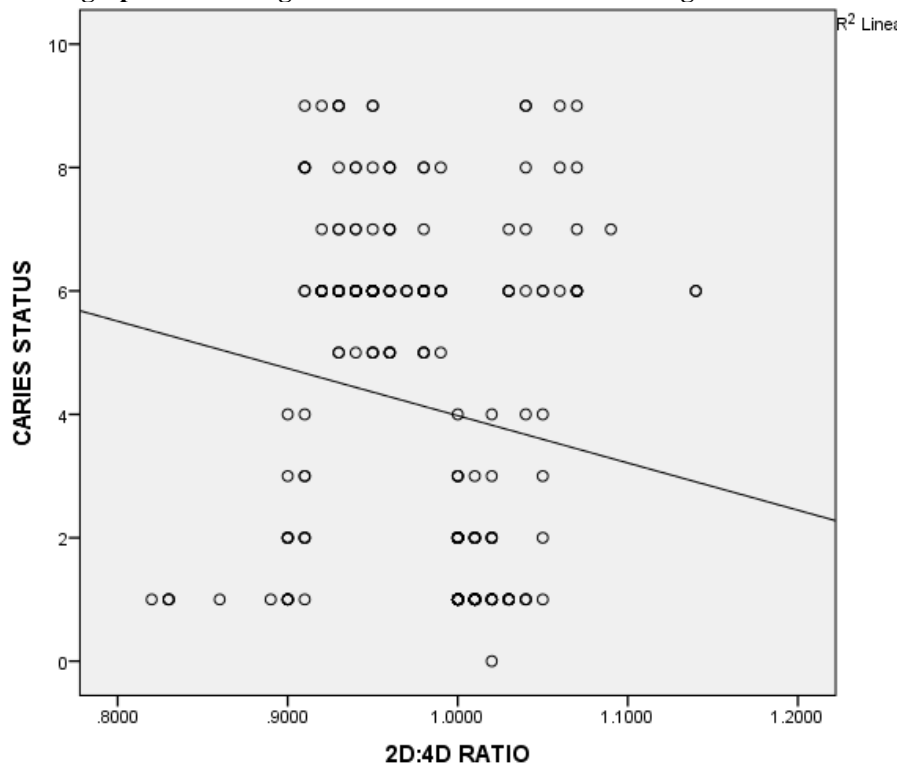
DISCUSSION

Hormonal fingerprints represent a unique hormonal profile within an individual influenced by endocrine system dynamics and genetic predispositions. This article aims to synthesize existing knowledge regarding the impact of hormonal variations on oral

health, focusing particularly on their potential role in dental caries.The study was done to elucidate the intricate relationship between genetic composition and its role in the occurrence of dental caries.

The present study showed that 71.5% males and 28.5% females have 2D:4D ratio <1 and 72.5% females and 27.5% males have 2D:4D ≥1 which is in accordance with studies done by Manning et al.[10] and Kangassaloet al.[11]

The low 2D:4D ratio in males shows that men may have been exposed to higher degrees of prenatal androgens (testosterone) than women. Similarly, the females have minor exposure to testosterone, therefore, they are more likely to possess a high digit ratio. The digit ratio has been observed as a reliable marker for prenatal testosterone which causes prolongation of fourth digit relative to the second digit.[12]

The present study showed that the children with low 2D:4D ratio had high caries rate, which is in accordance with Vermaet al.[13], 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.

Issraniet al.[14] stressed that hormonal fingerprints could be potential biomarkers in early diagnosis, prognosis and intervention for various dental diseases which is also evident from our study as children with low caries status(79.2%) showed high digit ratio.

Lakshmi et al.[15] 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, nontasters, sweet likers and high caries index which is in conformity of our study that elucidates a negative correlation between caries status and digit ratio.

CONCLUSION

The present study confirms the high incidence of dental caries in children having low digit ratio. The concept of a "hormonal fingerprint" holds intriguing potential in understanding the interplay between genetic dynamics and oral health. Hormonal fingerprints are contemporary organic markers, which may be used as an effective tool for predicting caries susceptibility in neonates. It is an easily performable chair-side procedure and can pave the way for implementation of new preventive measures for dental caries. However, the sample size is too small to be conclusive and further research with a larger sample size is required to establish concrete and reliable results. Further research and exploration in this field are vital to unlock the full potential of hormonal fingerprints in advancing dental care and promoting overall well-being.

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