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Original Research Article

Relationship between dermatoglyphics and early childhood caries in pre-school children in Coimbatore city: a cross-sectional study

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ABSTRACT

Background: Early childhood caries (ECC) is a prevalent public health issue affecting preschool children and impacting oral health, nutrition and overall well-being. As a multifactorial disease influenced by genetic, environmental and behavioral factors, ECC may be linked to dermatoglyphic patterns, which are genetically determined and remain unchanged throughout life. This study explores dermatoglyphics as a potential non-invasive biomarker for early risk assessment of ECC.
Methods: A school-based cross-sectional study was conducted among 250 preschool children (3–6 years) in Coimbatore city. Children with special health care needs, fingertip trauma or skin disorders were excluded. Oral examination was performed to screen for ECC. Fingerprints were recorded using blue duplicating ink and analyzed under ×2 magnification to identify loops, whorls and arches. Frequencies of each pattern were compared between ECC and caries-free groups.
Results: A significant association was found between dermatoglyphic patterns and ECC. Children with ECC showed a predominance of loop patterns, while caries-free children had more whorls on the left hand. Dermatoglyphics may serve as a simple, non-invasive tool for early identification of high-risk children, enabling timely preventive interventions.
Conclusions: The study found a significant association between dermatoglyphic patterns and early childhood caries (ECC). Loop patterns were more common in children with ECC, while caries-free children showed more whorl patterns on the left hand. These results suggest that dermatoglyphics can serve as a simple, non-invasive and cost-effective method to predict genetic susceptibility to ECC, enabling early identification and preventive care during a child's first dental visit.

Keywords: Caries risk assessment, Dermatoglyphics, Early childhood caries, Fingerprint patterns, Genetic marker, Non-invasive diagnosis, Preschool children

INTRODUCTION

Caries is a biofilm (plaque)-induced acid demineralization of enamel or dentin, mediated by saliva. The disease of ECC is the presence of 1 or more decayed (non-cavitated or cavitated lesions), missing (due to caries) or filled tooth surfaces in any primary tooth in a child 71 months of age or younger. In children younger than 3 years of age, any sign of smooth-surface caries is indicative of severe early childhood caries (S-ECC).

From ages 3 through 5, 1 or more cavitated, missing (due to caries) or filled smooth surfaces in primary maxillary anterior teeth or a decayed, missing or filled score of ≥4 (age 3), ≥5 (age 4) or ≥6 (age 5) surfaces constitutes S-ECC.[1] Dermatoglyphics is the scientific study of the unique, naturally occurring ridges that can be seen on the

fingers, palms of hands and soles of feet after birth. Dermatoglyphic patterns loops, whorls and arches form during the 6th to 7th week of intrauterine life, coinciding with the development of dental enamel. These patterns are genetically determined and stable throughout life, making them ideal for genetic and medical research.[2] Dental caries in the primary dentition is the 12th most prevalent disease worldwide, affecting nearly 560 million children. The incidence of early childhood caries (ECC) among children with deciduous teeth was 1.76 billion in 2016 and was reported to be one of the top ten conditions with the highest incidence in the Global Burden of Diseases, Injuries and Risk Factors Study 2016.[3] ECC remains a pressing global pediatric health issue with multifactorial etiology. Dermatoglyphics, particularly thumb print patterns, shows promise as an early, non-invasive biomarker for predicting susceptibility to ECC in preschool children.[4] Further large-scale, standardized research is necessary to validate these findings and integrate dermatoglyphic screening into public health strategies aimed at preventing early childhood dental caries.

ECC is a multifactorial infectious disease characterized by rapid decay of primary teeth, often beginning soon after tooth eruption and disproportionately affecting children in disadvantaged socioeconomic groups worldwide.[5] It causes pain, difficulty eating and speaking and can lead to broader developmental, nutritional and psychosocial consequences. Streptococcus mutans and related bacteria metabolize sugars to acids, demineralizing enamel and accelerated by frequent sugar intake and poor oral hygiene. Environmental factors such as low fluoride exposure, enamel defects and early bacterial transmission from mothers further increase risks.[6]

Though early childhood caries is not life threatening its impact on individuals and communities is significant; resulting in pain, mutilation of function, deleterious influence on the child's growth rate, body weight and ability to thrive, thus dropping the quality of life.[7] Although there are a variety of methods to identify ECC but there is no method to predict it.

The foundation of considering dermatoglyphic pattern as genetic marker for dental caries is that the epithelium of finger buds as well as enamel which is the most vulnerable dental tissue to dental caries has an ectodermal origin and both develop at the same point in time of intra uterine life.[8] Thus with genetic susceptibility and added environmental factors the proneness for caries due to abnormality in the tooth structures may be reflected in the dermatoglyphics namely whorls, loops and arch patterns.[9]

This study aims to evaluate the relationship between thumb impression patterns and the presence of Early Childhood Caries (ECC), with the goal of determining whether dermatoglyphics can serve as a predictive tool for early identification of caries risk in preschool children.

METHODS

The study was a school based cross-sectional survey among 250 children aged 3 to 6 years among different primary schools in Coimbatore city during July 2025 to December 2025. Written informed consent was obtained from parents/guardian of each child before the participation. Children with Special Health Care Needs (SHCN), skin disorders affecting fingers, children with trauma to fingertips and those who were not willing to participate in the study were excluded from the study. Oral examination was performed using a mouth mirror and probe under illuminated light.

The study was conducted after receiving formal approval from the institutional review board of RVS Dental College and Hospital, Coimbatore. Before study commencement, written informed consent was obtained from all participants legal guardians following a comprehensive explanation of study procedures. The investigation strictly adhered to international ethical guidelines as outlined in the current revision (2013) of the World Medical Association's Declaration of Helsinki.

Dermatoglyphic pattern recording and interpretation

Children's hands were washed with soap and water to eradicate any dirt and oil from the ridged skin and air dried to improve the quality of finger prints. Blue duplicating ink was used to record finger prints (both right and left hand) of all the subjects. The digits were guided and pressed tightly against the white bond paper clipped on to a hard board.

Dermatoglyphic pattern interpretation

The thumb prints were assessed under a magnifying glass with ×2 power sequentially in both the hands. This study included qualitative analysis, i.e., the fingertip patterns (loops, whorls, arches). The frequency or manifestation of true patterns of loops, whorls and arches was counted. They were assessed for increase or decrease in mean frequencies.

Statistical method

The data obtained were entered into Microsoft Excel Software, exported to the Statistical Package for Social Sciences (SPSS) Version 27, IBM Statistics, Corp., Armonk, New York, USA.

RESULTS

The study population included 250 preschool children aged between 3 and 6 years. Among them, 23 children (9.2%) were 3 years old, 91 children (36.4%) were 4 years old, 99 children (39.6%) were 5 years old and 37

children (14.8%) were 6 years old. The mean age of the participants was 4.6±0.85 years. Of the total participants, 122 (48.8%) were males and 128 (51.2%) were females, showing nearly equal gender representation.

Early childhood caries prevalence

Among the study population, 101 children (40.4%) had ECC, while 149 children (59.6%) were caries-free. The overall prevalence of ECC is depicted in Figure 1.

Fingerprint patterns–right hand

The most common right-hand fingerprint pattern observed was the loop 133 (53.2%), followed by the whorl 79 (31.6%) and the arch 38 (15.2%). The distribution of fingerprint patterns is shown in Figure 2.

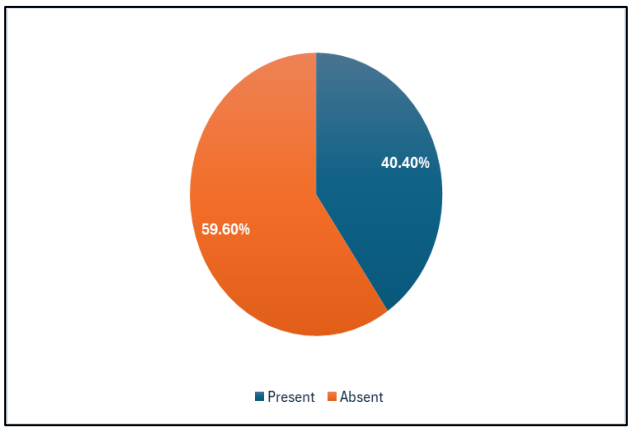

Figure 1: Prevalence of early childhood caries among the study population.

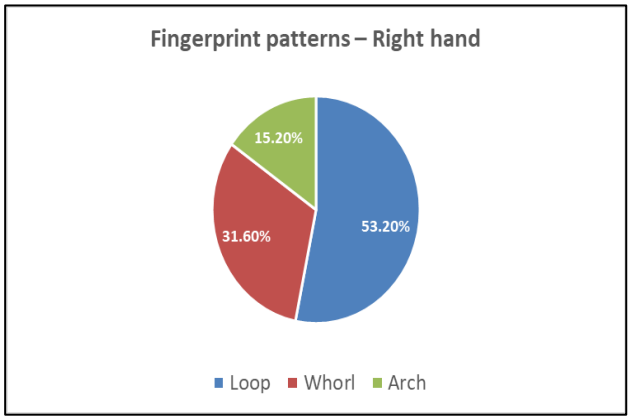

Figure 2: Distribution of right-hand fingerprint patterns.

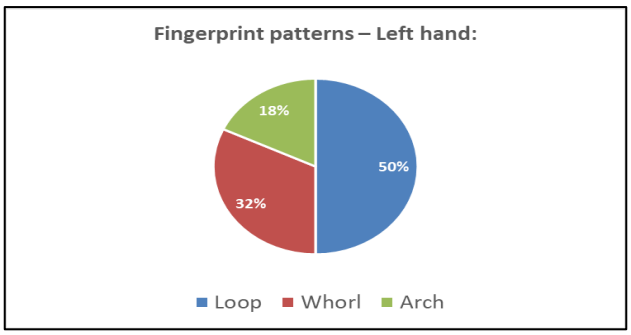

Figure 3: Distribution of left-hand fingerprint patterns.

Fingerprint patterns–left hand

Similarly, on the left hand, loop patterns were predominant 125 (50%), followed by whorls 80 (32%) and arches 45 (18%). The distribution of fingerprint patterns is shown in Figure 3 (left hand).

Association between early childhood caries and gender

Although a higher proportion of females (57.4%) presented with ECC compared to males (42.6%), the difference was not statistically significant (p=0.068). The statistical association between ECC and gender was analyzed using the Chi-square test and is summarized in Table 1.

Association between early childhood caries and right fingerprint pattern

Children with ECC most frequently exhibited the loop pattern (64.4%), followed by whorl (22.8%) and arch (12.9%). In contrast, among caries-free children, the loop pattern accounted for 45.6%, whorl 37.6% and arch 16.8%. The association between right-hand fingerprint pattern and ECC was found to be statistically significant (p=0.013) using the Chi-square test and is summarized in Table 2.

Association between early childhood caries and right fingerprint pattern

Children with ECC most frequently exhibited the loop pattern (64.4%), followed by whorl (22.8%) and arch (12.9%). In contrast, among caries-free children, the loop pattern accounted for 45.6%, whorl 37.6% and arch 16.8%. The association between right-hand fingerprint pattern and ECC was found to be statistically significant (p=0.013) using the Chi-square test and is summarized in Table 2.

Table 1: Association between early childhood caries and gender.

ECC	Male	Female	P value
Absent	79 (53%)	70 (47%)	0.068
Present	43 (42.6%)	58 (57.4%)	

Table 2: Association between early childhood caries and right-hand fingerprint patterns.

ECC	Loop	Whorl	Arch	Total	P value
Absent	68 (45.6%)	56 (37.6%)	25 (16.8%)	149 (100%)	0.013
Present	65 (64.4%)	23 (22.8%)	13 (12.9%)	101 (100%)	

Table 3: Association between early childhood caries and left-hand fingerprint patterns.

ECC	Loop	Whorl	Arch	Total	P value
Absent	59 (39.6%)	62 (41.6%)	28 (18.8%)	149 (100%)	<0.01
Present	66 (65.3%)	18 (17.8%)	17 (16.8%)	101 (100%)	

DISCUSSION

Significant interest in the study of epidermal ridges has emerged over the past several decades, particularly after it was observed that many patients with chromosomal abnormalities exhibited distinct ridge pattern variations.[10,11] Dermatoglyphic patterns are considered valuable for genetic studies because, unlike traits such as stature, intelligence or body weight, they are minimally influenced by age or postnatal environmental factors.[12] Moreover, dermatoglyphics remain stable throughout life, allowing reliable comparisons across individuals of different ages. Both tooth enamel and the epithelium of finger buds share an ectodermal origin and develop simultaneously during intrauterine life.[12,13] This shared developmental timeline forms the basis for considering dermatoglyphic patterns as potential genetic markers for predicting susceptibility to dental caries.

Early Childhood Caries (ECC) remains a major public health concern affecting infants and preschool children worldwide, in both developing and industrialized nations.[11] The etiology of ECC is multifactorial, involving a combination of environmental, behavioral, microbial and genetic influences.[12] The relative contribution of each factor may vary significantly among individuals, emphasizing the importance of understanding both intrinsic and extrinsic determinants of caries risk.[13]

In the present work, we studied dermatoglyphic patterns to assess their usefulness as a simple, non-invasive and cost-effective tool for predicting the genetic susceptibility of children to dental caries and specifically to ECC. This approach has potential application in community-based and field studies, allowing early identification of children at higher risk and implementation of preventive strategies before the onset of the disease. The study included collection and analyses of 250 finger prints of 250 children, of which in right hand, children with ECC most frequently exhibited the loop pattern (64.4%), followed by whorl (22.8%) and arch (12.9%). But, among caries-free children, the loop pattern accounted for 45.6%, whorl 37.6% and arch 16.8%. On the left hand, children with ECC predominantly showed the loop pattern (65.3%), compared to whorl (17.8%) and arch (16.8%). Our findings were consistent with the previous studies regarding frequency of dermatoglyphic patterns in a population.[14,15] These aforementioned studies also reported that caries free children expressed more amount of loop patterns followed by whorls and arches. Whereas, on the left hand, among caries-free children, whorl patterns were more common (41.6%) than loop (39.6%) or arch (18.8%). Our results were in similar to study conducted by Abhilash PR et al, in 2012 that concluded that the dental caries susceptibility of an individual increases with an increase in the incidence of whorl pattern (83% correlation) and decreases with incidence of loop patterns.[16] But, results were in contrast to the previous studies done in an Indian population where the whorls pattern was found to be higher in individuals with high caries experience and in 2014 ,VP Thakkar et al, in their study stated results showing a statistically significant frequency of whorls in the index finger in children with a dental caries experience of more than 3.[17-19]

Kaur et al investigated the association between dermatoglyphic patterns and dental caries risk in children aged 6–12 years. They observed that the study group had a lower frequency of loop patterns, whereas the control group showed a higher frequency of loops on palmar digits a finding that contrasts with the results of our study.[20] Deepti et al, conducted a study to evaluate the role of dermatoglyphics in dental caries and reported a higher frequency of loops on the right-hand digits 3 and 5 (middle and little fingers) in caries-positive participants a finding consistent with the results of our study.[21] Reddy et al, assessed the correlation between dermatoglyphic patterns and caries experience in special children aged 6-16 years and found a higher frequency of whorls in the caries group compared to the caries-free group a finding that does not align with our results.[9] Similar observations were also reported by Sanghani et al.[22]

This study demonstrated a clear correlation between dermatoglyphic patterns in children with ECC and those who were caries-free. Therefore, recording dermatoglyphic patterns at an early age such as during a child's first dental visit could serve as a valuable tool for identifying whether the child falls into a high-risk or low-risk group. This, in turn, may help in formulating precise preventive and treatment strategies.

The present study was limited by its relatively small sample size and single-center design, which may affect the generalizability of the results.[23] Only qualitative assessment of dermatoglyphic patterns was performed; quantitative analysis (such as ridge counts and pattern intensity index) could provide more detailed insights. Moreover, other potential confounding factors such as dietary habits, fluoride exposure and socioeconomic status were not extensively evaluated, which might have influenced caries prevalence.[24]

CONCLUSION

The present study establishes a significant association between dermatoglyphic patterns and the occurrence of ECC. A predominance of loop patterns was observed among children with ECC, whereas caries-free children showed a relatively higher frequency of whorl patterns on the left hand. These findings support the hypothesis that dermatoglyphic patterns can serve as a simple, non-invasive and cost-effective screening tool to predict genetic susceptibility to ECC. Recording dermatoglyphic patterns at an early age such as during the first dental visit could allow clinicians to identify children at higher risk and implement timely preventive and therapeutic strategies to reduce caries incidence.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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