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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 2, February 2026

https://eurekaoa.com/index.php/5

SALIVARY PHYSICOCHEMICAL AND BIOELEMENTAL PROFILES IN CHILDREN WITH EARLY CHILDHOOD CARIES

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Abstract

Background. Saliva plays a key role in maintaining oral homeostasis and protecting dental hard tissues. Alterations in its physicochemical properties and bioelemental composition may increase susceptibility to early childhood caries (ECC).

Objective. To investigate salivary physicochemical characteristics and bioelemental profiles in children with ECC and to assess their association with caries severity and feeding practices.

Materials and Methods. A total of 173 children aged 6 months to 6 years with ECC were enrolled. Salivary flow rate, viscosity, density, pH, water content, and dry residue were assessed. Concentrations of calcium, phosphorus, sodium, potassium, and fluoride were determined. Participants were stratified by age and feeding type. Statistical analysis was performed using SPSS software ($p<0.05$).

Results. Children with ECC, particularly those artificially fed, demonstrated reduced salivary pH, increased viscosity, and significantly lower concentrations of calcium, phosphorus, and fluoride. These changes correlated with higher dmft values and caries prevalence.

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Conclusion. Salivary physicochemical and bioelemental parameters are informative biomarkers of caries risk in early childhood and should be incorporated into individualized preventive strategies.

Keywords: Saliva, bioelements, early childhood caries, salivary pH, calcium, fluoride.

Introduction

Early childhood caries (ECC) is one of the most common chronic diseases in pediatric populations and represents a major public health challenge. The disease develops as a result of a complex interaction between dietary factors, oral microbiota, host susceptibility, and salivary protective mechanisms.

Saliva is a multifunctional biological fluid essential for maintaining oral health. Its buffering capacity, mineralizing potential, and antimicrobial activity contribute to enamel resistance against demineralization. In young children, these protective mechanisms are still developing, making them particularly vulnerable to disturbances in salivary homeostasis.

Previous studies have demonstrated that reduced salivary flow rate, acidic pH, and decreased concentrations of calcium, phosphate, and fluoride are associated with increased caries activity. However, data on the combined analysis of physicochemical and bioelemental salivary parameters in children of early age remain limited.

Feeding practices during infancy may influence salivary composition by affecting metabolic activity, mineral intake, and microbial colonization. Understanding how these factors interact is crucial for early identification of children at high risk for ECC.

The present study aims to provide a comprehensive assessment of salivary physicochemical and bioelemental profiles in children with ECC and to evaluate their association with caries severity.

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Materials and Methods

Study Design

A clinical and laboratory cross-sectional study was conducted.

Study Population

The study included 173 children aged 6 months to 6 years diagnosed with ECC. Written informed consent was obtained from parents or legal guardians. The study protocol complied with ethical standards of biomedical research.

Grouping Criteria

Participants were stratified according to:

- age (6 months–2 years; 2–4 years; 4–6 years);
- feeding practice (breastfeeding, mixed feeding, artificial feeding).

Saliva Collection

Mixed unstimulated saliva was collected in the morning (7:00–9:00 a.m.) under fasting conditions, prior to tooth brushing or feeding. Saliva was collected for 10 minutes using passive drooling.

Physicochemical Analysis

The following parameters were assessed:

- salivary flow rate (mL/min);
- viscosity;
- relative density;
- pH level;
- water content and dry residue.

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Bioelemental Analysis

Salivary concentrations of calcium (Ca), phosphorus (P), sodium (Na), potassium (K), and fluoride (F) were determined using standardized biochemical methods.

Statistical Analysis

Data were expressed as mean ± standard error. Comparisons between groups were performed using Student's t-test. Correlations between salivary parameters and caries indices were analyzed. Statistical significance was set at $p<0.05$.

Results

The mean salivary flow rate across the study population was 0.57±0.06 mL/min. Children with higher caries intensity demonstrated a tendency toward reduced salivary secretion, particularly in the artificially fed group.

Salivary pH values were significantly lower in children with severe ECC (mean pH 6.52±0.20), indicating a shift toward an acidic oral environment. Increased viscosity and relative density were also observed, suggesting impaired salivary clearance.

Bioelemental analysis revealed reduced concentrations of calcium (47.23±2.38 µg/mL), phosphorus (138.25±4.22 µg/mL), and fluoride (0.98±0.04 µg/mL) in children with ECC. These reductions were most pronounced in artificially fed children and were strongly associated with higher dmft values ($p<0.05$).

A positive correlation was identified between the Ca/P ratio and caries resistance, whereas lower fluoride levels were associated with increased caries prevalence.

Discussion

The results of this study demonstrate that ECC is associated with significant alterations in salivary physicochemical and bioelemental parameters. Acidic pH, increased viscosity, and reduced mineral content create favorable conditions for enamel demineralization and cariogenic microbial activity.

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Calcium and phosphorus are critical for maintaining enamel integrity through remineralization processes. Their decreased concentrations in saliva compromise enamel resistance, particularly in primary teeth, which are inherently less mineralized than permanent teeth.

Fluoride deficiency further exacerbates the risk of ECC by reducing enamel resistance to acid attacks. The pronounced changes observed in artificially fed children may reflect differences in mineral intake and salivary stimulation compared to breastfed children.

These findings support the concept of saliva as a diagnostic medium for early identification of caries risk and highlight the importance of monitoring salivary parameters in preventive pediatric dentistry.

Limitations

This study did not evaluate dietary sugar intake, socioeconomic status, or fluoride exposure from external sources, which may influence salivary composition and caries development. Longitudinal studies are needed to confirm causal relationships.

Conclusion

Children with early childhood caries exhibit significant disturbances in salivary physicochemical properties and bioelemental composition. Reduced salivary pH, increased viscosity, and decreased concentrations of calcium, phosphorus, and fluoride are associated with increased caries severity. Salivary analysis represents a valuable tool for caries risk assessment and the development of personalized preventive strategies in early childhood.

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