The multifactorial determinism of severe early childhood caries: socio-behavioral, preventive and genetic influences

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The term severe early childhood caries (S-ECC) refers to what was previously known as “baby bottle caries” and represents a chronic pathology of the primary dentition with a strong impact on the health of the child and on public health in general. The severity and incidence of S-ECC are not determined exclusively by direct etiological factors (such as cariogenic bacteria and sugar intake), but are significantly influenced by multifactorial risk factors, such as socio-behavioral, preventive and genetic. By identifying and managing these factors, the risk of occurrence and severity of S-ECC can be reduced.

The high prevalence of children with S-ECC and the increased values of caries experience indices found in these children indicate the need for a concentrated effort to reduce the incidence and severity of the disease. Thus, it becomes necessary to implement programs to prevent this condition that include both local oral hygiene and prophylaxis measures, as well as general advice to parents regarding the effect of carbohydrates in the etiopathogenesis of dental caries.

Study 1: Assessment of the incidence of S-ECC in a group of preschool children and the association between the severity of lesions and certain socio-behavioral determinants.

This study was conducted over a period of 4 months and is based on clinical-statistical research materialized through questionnaires addressed to parents and oral clinical examinations, with the aim of determining the incidence of S-ECC in a group of preschool children from Mureș County and to analyze the association between the severity of carious lesions and socio-behavioral risk factors. The study included 303 children, aged between 3 and 5 years. A self-designed questionnaire, based on questions validated by the literature, was completed by their parents and caregivers. Through oral clinical examinations, the dmft index was calculated according to the 2016 AAPD criteria. The data were then statistically analyzed using the GraphPad Prism software version 10.2.3 for Windows. The incidence of S-ECC in this group of preschoolers from Mureș County, included in our study, was 31.80%, and represents a high value compared to the results of other studies conducted in Romania. Social and behavioral factors are of major importance in terms of the onset and progression of S-ECC. Exclusive bottle feeding of children in the first years of life is positively associated with the development of the severe early childhood caries pattern, especially in combination with poor dental hygiene. Sugar and the high frequency of sweet snacks between meals are etiological factors strongly associated with the existence of carious processes in temporary teeth. Irregular frequency of oral hygiene and infrequent check-ups with the dentist have a negative impact on the progression of S-ECC.

Study 2: The role of fluoride-containing protective factors in the onset and progression of S-ECC.

This prospective randomized clinical study was conducted over a 6-month period and included 53 patients, aged 3 to 5 years. The aim of the study was to evaluate in vivo the efficacy of fluoride varnishes in remineralizing and/or arresting the progression of incipient carious lesions characteristic of S-ECC. Following clinical examination, incipient lesions were identified and their size was determined using the photographic method and Photopea software (Lasso tool). Patients were then divided into three study groups: G1 –

patients who were not treated with fluoridation methods due to parental refusal; G2 – patients who received local fluoridation but no hygiene and dietary counseling; G3 – patients who received both fluoridation and counseling. At the first and second re-evaluations (after 3 and 6 months), the fluoridation steps were repeated for groups G2 and G3 and the measurement of the size of the white spot lesions was repeated for all patients. The data obtained from the three evaluation times were statistically analyzed using the GraphPad Prism software version 10.2.3 for Windows. A significant reduction in the size of the incipient lesions was observed in group G2, but especially G3, while in group G1, without fluoride intervention, an increase in the size of the white spot lesions was noted.

Study 3: The role gene polymorphisms involved in the regulation of oxidative stress (*SOD2*, *GPX1*) on the onset and progression of severe early childhood caries (S-ECC).

The third study was an observational case-control study, the aim of which was to investigate the single nucleotide polymorphisms of the *SOD2* and *GPX1* genes, involved in the regulation of oxidative stress, and to analyze the association between allelic variants of the *SOD2* (rs4880) and *GPX1* (rs1050450) polymorphisms and the predisposition to S-ECC, in a Romanian population. The study was conducted over a period of 4 months and included 110 patients, aged between 3 and 5 years, divided into two groups: the study group (59 patients diagnosed with S-ECC) and the control group (51 patients without caries). Oral epithelial cells were collected from patients in both groups and then subjected to DNA isolation and genotyping steps using the PureLink Genomic DNA kit. DNA quantification was performed using an Eppendorf BioSpectrometer. TaqMan probes and 7500 Fast Dx Real-Time PCR were used for genotyping. The results of our study concluded that the AG and GG variant genotypes of the rs4880 polymorphism of the *SOD2* gene predispose patients to the development of carious lesions and influence the severity of caries in preschool children. The rs1050450 polymorphism did not show a statistically significant association with S-ECC in this sample of patients. To reduce the prevalence of carious lesions in primary teeth, these findings highlight the importance of genetic polymorphisms, which allow clinicians to inform parents and caregivers of preschoolers' risk of developing caries and to encourage good oral hygiene habits by explaining the host susceptibility principle.

The results of the three research directions converge towards a deeper understanding of the multifactorial nature of S-ECC, where the interaction between dietary habits, oral hygiene, access to prevention and genetic predisposition play a crucial role. It has been shown that early initiation of brushing, control of sugar consumption, topical fluoride treatments and parental involvement can significantly reduce the incidence and severity of carious lesions. In parallel, the identification of genetic polymorphisms associated with oxidative stress (*SOD2* rs4880) brings a new dimension to the assessment of caries risk, suggesting the potential for personalized approaches. Thus, effectively combating S-ECC requires an integrated strategy, based on both behavioral and educational interventions and individual genetic profiles.