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# Mathematical-Statistical Research of the Influence of Various Factors on Caries Development in Ukrainian Children up to 6 Years

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## Abstract

The medical-mathematical substantiation of the significance of various risk factors of early childhood caries development is presented. Seventy risk factors have been analyzed. It was revealed that for children up to 3 years of age the most significant for caries development are the factors connected with substratum for cariogenic microflora, with the child general health and pathology of mother's pregnancy. For children of 4-5 years of age the importance of factors connected with the supply of necessary substances such as vitamin D is increased, and the importance of a mother's pregnancy pathology is reduced.

**Keywords:** children up to 6 years of age, early childhood caries, risk factors of caries development, mathematical-statistical methods of research

## Introduction

Dental caries is a common, complex, chronic disease that results from an imbalance between multiple potential etiological (risk) factors and multiple protective factors over time [1-3]. This definition is very exact concerning early childhood caries (ECC) which has been a major public health problem over many years and still continues today. Many factors may be responsible for the development of this disease. Some investigators detected significant relationships between ECC with feeding practices, snacking habits, oral hygiene status, socioeconomic background, education level and so on but some other studies did not show such relationships [4-14]. In fact, because caries has multifactorial nature, combination of the predisposing fac-

tors should be considered when identifying infants with an increased risk of the disease.

The aim of this study was to present medical-mathematical background for clinical-informative and probabilistic-prognostic relevance of risk factors of dental caries in children up to 6 years old.

## Material and Methods

600 children of both genders were selected. 400 of them were aged up to 3 years and the half (200 children) had dental caries. 200 children were between 3 and 6 years old, and 150 from them had dental caries. All parents signed an informed consent form and answered a structured questionnaire in order to evaluate the risk factors for dental caries, including perinatal and postnatal factors, information about parents (age, health, education, knowledge concerning dental care), mother's pregnancy, partus, baby's health immediately after birth. Oral hygiene and di-

Table 1. The dependence of dental caries in children up to 3 years old on different factors.

The factors which may influence ECC development	Student's t-test	Chi-square test	Spearman rank correlation coefficient
Factors which facilitate maternal oral microorganisms transmission to child ('salivary contacts')	0.000	0.000	0.364***
Hygienic index of Silness-Loe	0.000	0.000	0.372***
Duration of bottle feeding	0.000	0.000	0.389***
Exudative-catarrhal diathesis during the first year of life	0.000	0.000	0.274***
Otorhinolaryngological diseases during the first year of life	0.000	0.000	0.273***
Sweets consumption frequency per day	0.000	0.000	0.278***
Gastrointestinal diseases during the first year of life	0.000	0.000	0.251***
Hygienic index of Ribeiro	0.000	0.000	0.267***
Developmental defects of dental tissues	0.000	0.000	0.227***
Age of tooth brushing beginning	0.000	0.000	0.235***
Age of finishing of night feeding	0.000	0.000	0.233***
Diseases of respiratory system during the first year of life	0.000	0.000	0.229***
Stomatitis in anamnesis	0.000	0.000	0.218***
Diseases of musculoskeletal system during the first year of life	0.000	0.000	0.204***
Different chronic diseases of father	0.000	0.000	0.205***
Pregnancy pathology	0.000	0.000	0.182***
Influence of unfavorable factors during mother's pregnancy	0.000	0.000	0.178***
Medicines intake during mother's pregnancy	0.002	0.001	0.155**
Gestosis in anamnesis	0.002	0.002	0.155**
Presence of bottle feeding	0.002	0.002	0.152**
Age of beginning of tooth brushing with tooth paste	0.003	0.002	0.151**
Oral breathing	0.008	0.007	0.133**
Non-carrying of mother's pregnancy in anamnesis	0.009	0.009	0.130**
Calcium supplements intake during the first year of life	0.014	0.014	-0.123*
Acute diseases during mother's pregnancy	0.019	0.020	0.119*
Mother's age	0.008	0.030	0.132**
Congenital malformations	0.035	0.033	0.105*
Active dental caries in parents	0.039	0.039	0.103*

Error probability concerning deviation from null hypothesis:

\* -  $< 0.05$ ; \*\* -  $< 0.001$ ; \*\*\* -  $< 0.0001$

There are some differences between presented results and the data about the dependence of dental caries in children 4-5 years old on different factors (they are presented in Table 2).

etary habits also were registered. Information about child's general health included a presence of different diseases in the first and next years of life, the data about weight, physical and psychical development, consumption of medicines and vitamin D. Medical information was copied from individual medical cards. Children were examined by one investigator in a dental office using standardized methodology recommended by WHO (1997). A child was considered to have ECC if at least one cavity was present. Caries was charted using the World Health

Organization oral health survey basic methods criteria and enamel hypoplasia using the modified Developmental Defects of Enamel index. The biofilm was visually inspected, without disclosing solutions, and it was classified according to the indices proposed Silness and Loe and by Ribeiro et al. [4, 15]. About 70 factors that may have direct or indirect influence on caries development were analyzed.

The mathematical-statistical research was performed in several steps.



Table 2. The dependence of dental caries in children 4-5 years old on different factors.

The factors which may influence ECC development	Student's t-test	Chi-square test	Spearman rank correlation coefficient
Sweets consumption frequency per day	0.000	0.000	0.527***
Hygienic index of Ribeiro	0.000	0.000	0.404***
Factors which facilitate maternal oral microorganisms transmission to child ('salivary contacts')	0.000	0.000	0.434***
Duration of breastfeeding	0.000	0.000	-0.150*
Hygienic index of Silness-Loe	0.000	0.000	0.447***
Age of tooth brushing beginning	0.000	0.000	0.425***
The number of toothbrushes per year	0.000	0.000	-0.338***
Active dental caries in parents	0.000	0.000	0.303***
Gestosis in anamnesis	0.000	0.000	0.307***
Age of beginning of tooth brushing with tooth paste	0.000	0.000	0.326***
Vitamin D intake during the second year of life	0.000	0.000	-0.315***
Presence of bottle feeding	0.000	0.000	0.305***
Stomatitis in anamnesis	0.000	0.000	0.243***
Pregnancy pathology	0.000	0.000	0.270***
Otorhinolaryngological diseases during the first year of life	0.000	0.000	0.192**
Frequency of acute diseases during the first year of life	0.000	0.000	0.235***
Frequency of acute diseases during the third year of life	0.000	0.001	0.230**
Gastrointestinal diseases during the first year of life	0.000	0.001	0.182*
Father's age	0.001	0.001	0.172*
Oral breathing	0.000	0.001	0.207**
Frequency of acute diseases during the second year of life	0.000	0.001	0.217**
Developmental defects of dental tissues	0.000	0.002	0.133*
Diseases of respiratory system during the first year of life	0.0002	0.003	0.189**
The number of courses of antibiotic therapy per life	0.002	0.004	0.198**
Abnormal labor	0.002	0.009	0.169*
Diseases of musculoskeletal system during the first year of life	0.002	0.013	0.154*
Different chronic diseases of father	0.005	0.014	0.162*
Vitamin D intake during the first year of life	0.009	0.015	-0.165*
Different chronic diseases of mother before pregnancy	0.011	0.016	0.165*
Disbacteriosis in anamnesis	0.018	0.021	0.159*
Exudative-catarhal diathesis during the first year of life	0.008	0.031	0.135
Age of the first additional feeding	0.007	0.043	0.110
Absence of mother's higher education	0.046	0.047	0.139*
Frequency of medical syrups intake	0.047	0.073	0.120

Error probability concerning deviation from null hypothesis:

\* - < 0.05; \*\* - < 0.001; \*\*\* - < 0.0001

At first the most significant relationship between different factors and dental caries were found with the use of Student's t-test, nonparametric Mann-Witney's test and Spearman correlation coefficient.

Next factors and indicators of dental caries for the final analysis were selected. The nominal variables with more than two values were transformed into nominal-

dichotomic (indicator variables). The final list of factors for the calculation of their significance for caries development was obtained after this selection and transformation.

Next step was the investigation of dependence of caries development on selected factors in children up to 3 years and 4-5 years old. Student's t-test, Chi-square test and Spearman rank correlation coefficient were used.



## Results

The significance of different factors for dental caries development in children up to 3 years and 4-5 years old was evaluated. The dependence of dental caries in children up to 3 years old on different factors is presented in Table 1. The factors are presented in order of a decrease of the significance according to Chi-square test.

## Discussion of Results

The highest levels of statistic relevance of caries development in children up to 3 years old had the factors connected with substratum supply for cariogenic microflora (8 factors with  $p < 0.001$ ), with the child general health (5 factors), pathology of mother's pregnancy (3 factors) and heredity (1 factor). The importance of food habits and poor mouth cavity hygiene were studied by many researchers [4-12], however general child health as a risk factor for this disease was not paid sufficient attention. The meaning of local factors for early caries development seems to be logic, and contrary to this – some revealed regularities need to be explained [16]. Thus, exudative-catarrhal diathesis is classified as constitutional abnormality which is followed by frequent allergic reactions and reduced infection resistance. So, frequent caries occurrence in this group of children can be associated with general resistance decrease of a child's organism.

A high relevance factor of stomatitis for caries development is to be considered not as a risk factor of ECC development but rather as some indicator of poor functioning of protection system which may cause the lesion of both mucous membrane of mouth cavity and hard tooth tissue [10].

As Table 2 shows, the highest levels of statistic importance for caries development of children 4-5 years old are factors connected with substratum supply for cariogenic microflora (7 factors with  $p < 0.001$ ), with the child general health (3 factors), with organism supply with necessary substances (3 factors), pathology of mother's pregnancy (1 factor). As to pre-school children compared with younger children, it becomes obvious that the importance of the factors for caries development connected with pregnancy pathology and general diseases of the first year of life is decreased while the importance of the components required for the support of dental health (calcium, vitamin D, etc.) is increased.

In a group of senior children such factors appeared to be important as the frequency of acute diseases in the third year of life (the period of full temporary dentition, when local cariogenic effect is on all teeth, in particular on second molars which are at the stage of secondary mineralization), the number of antibiotic therapy courses taken by a child per life cycle and frequency of medication intake in the form of syrup. The latter factors influence, considerably dental status of senior children taking into consideration their general disease occurrence compared

to younger children. The intake of vitamin D appeared to be important for caries development in this age group, the second year of life being more important, when a breast feeding which facilitated more adequate digestion of necessary mineral component by a child was over. The relationship between ECC and some general factors in pre-school children also was the subject of researches [17-19], but highlighting the principal factors in different age periods were not performed before.

## Conclusion

Caries development in early-age children is connected with some controlled and non-controlled factors. The research on their role and share in the development of this pathological process made it possible to draw tables of the most significant factors for the development and progress of the disease which in turn allows evaluating the risk of caries development in each separate case.

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