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Original Article

Caries Prevalence in 12-year-old Children from Plovdiv – a Multifactorial Regression Analysis.

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Abstract

Introduction: Dental caries is among the most important social diseases. The changes in caries prevalence occurring in different regions provide important information about the influence of etiological factors – primary and secondary, and about understanding the connections between the factors themselves.

Aim: The aim of this study was to investigate the prevalence of dental caries in 12-year-old children from Plovdiv, Bulgaria and the effect of etiological factors – single-factor and multifactorial influence.

Materials and methods: The study included 228 children divided into 2 groups: group 1 - children living in the city of Plovdiv, city proper (125 children), and group 2 - children living in the surrounding villages (103 children). A questionnaire with an attached written consent form for clinical examination was completed by the parents of each child with results recorded in the WHO Oral Health Assessment Form for Children. Statistical analysis of the recorded data was used to determine DMFT index for the two groups, percentage of caries-free children and the influence of etiological factors through regression analysis.

Results: Statistical analysis showed the DMFT scores as follows - 1.568 for city proper, 2.917 for surrounding villages. The caries-free children were 38.4% and 17.5% for group 1 and group 2, respectively. OHI is the highest predicting factor in a multifactorial regression analysis with over 19% predictive function.

Conclusion: There was statistically significant difference in caries prevalence and percentage of caries-free children between the city proper and the surrounding villages. Etiological factors have specific influence in the investigated age group.

Keywords:

caries prevalence, children, etiological factors

INTRODUCTION

Dental caries is among the most important social diseases. It has been estimated in the Global Burden of Disease Study 2016 that oral diseases affect at least 3.58 billion people worldwide, with caries of the permanent teeth being the most prevalent of all conditions assessed.[1] Globally, it is estimated that 2.4 billion people suffer from caries of permanent teeth and 486 million children suffer from caries of primary teeth.

The age group of 12-year-old children is specific as they are expected at this age to have just completed their permanent dentition. Furthermore, at this age patients have a number of additional factors affecting their oral health - sex hormones, oral hygiene completely in their own care, access to a variation of carbohydrate-rich foods and multiple meals between the three main ones. WHO and the FDI (World Dental Federation) jointly formulated goals for oral health to be achieved by the year 2000 with 12-year-olds being one of the main target groups.[2]

Changes in the caries prevalence in different regions may provide important information about the influence of etiological factors – primary and secondary, and about understanding the relationships between the factors themselves.

Dental caries is defined as a 'biofilm-mediated, sugar-driven, multifactorial, dynamic disease that results in the phasic demineralization and remineralization of dental hard tissues' by Pitts et al.[3] in one of the newest definitions accepted by the FDI. The authors also accept that interaction between factors is important for the definition of caries risk categories, allowing a specified approach to dental care. Dental caries is an unevenly distributed, preventable disease with considerable economic and quality-of-life burdens.

AIM

The aim of this study was to investigate the prevalence of dental caries in 12-year-old children from Plovdiv, Bulgaria and the effect of etiological factors – single-factor and multifactorial influence.

MATERIALS AND METHODS

The study included 228 children divided into 2 groups: group 1 – children from the city proper (125 children), and children from the surrounding villages (103 children). No statistical difference in the caries prevalence was found related to the sex of the children.

A questionnaire with an attached written consent form for clinical examination was completed by the parents of each child and the results were recorded in the WHO Oral Health Assessment Form for Children. The questionnaire was age-specific. It includes questions regarding the three main groups of etiological factors – socio-economic, oral health, and nutritional. Statistical analysis of the recorded data was used to determine the DMFT index for the two groups, percentage of caries-free children, and the influence of etiological factors through regression analysis.

The DMFT index (Decayed / Missing / Filled Teeth) is an index system used in epidemiological studies for the prevalence of dental caries for more than 70 years. The index is considered a standard for dental caries research for the WHO with more than 7 thousand articles using it by the year 2010.[4]

Statistical analysis

In the statistical analysis we used analysis of variance to determine the quantitative variable, DMFT, a correlation analysis - a Pearson test, to evaluate the strength of relationship between single etiological factors and caries prevalence, and regression analysis to evaluate the predictive function of single etiological factors through single regression analysis, as well as the combined effect of multiple factors - multifactorial or multiple regression analysis.

RESULTS

The analysis of variance was used to assess the caries prevalence in the two groups ($p<0.05$). The estimated values were as follows – 1.568 for city proper, 2.917 for surrounding villages. Despite the fact that both groups fulfil the Global goals for Oral Health of the WHO for the year 2000, there was a statistically significant difference between them. The results for this variable are presented in **Fig. 1**.

The next important variable analysed was the percentage of caries-free children. The results for the city proper group was 38.4% and 17.5% for the second group from the surrounding villages. Once again the results showed a statistically significant difference between the two groups (**Fig. 2**).

Regression analysis of the data from answers collected by questionnaires associated with caries prevalence was performed.

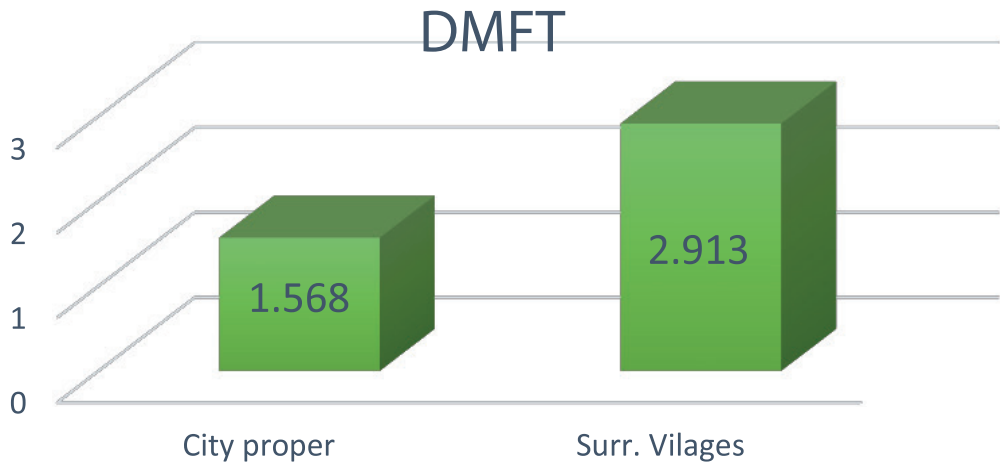

Figure 1. Caries prevalence in 12-year-old children from the city of Plovdiv and the surrounding villages.

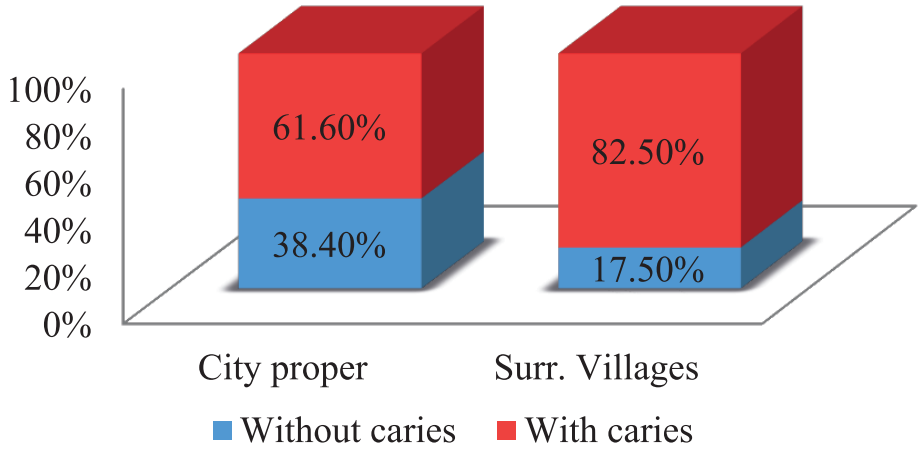

Figure 2. Percentage of caries-free 12-year-old children from the city of Plovdiv and surrounding villages.

Single regression analysis shows results for the three main groups of factors as follows:

1. Socio-economic factors:

• Upon analysis of the importance of separate factors towards the proportion of variance Eta² (ratio of variance explained in the dependent variable by a single predictor while controlling for other predictors) the predictive function was low - between 0.3 and 1.3% (**Table 1**).

• Using the coefficient of determination (R^2) (the proportion of the variance in the dependent variable that is predictable from the independent variable(s)), the analysis shows that 19% of socio-economic factors are associated with caries prevalence in the 12-year-old age group.

2. Oral hygiene factors:

• Oral hygiene factors, which affect caries prevalence separately as marked by the Eta² values, are 'frequency of tooth brush change' with predictive function value of approximately 3% and 'use of additional oral hygiene – mouthwash' with approximately 4%. The rest of the factors from the group have a very low predictive function value between 0.1 and 0.9% (**Table 2**).

• Results for the coefficient of determination (R^2) for this group of factors show that approximately 16% of the oral hygiene factors are associated with caries prevalence in the 12-year-old age group.

3. Nutritional factors:

• Nutritional factors, which affect caries prevalence separately as marked by the Eta² values, are 'number of in-between meals', 'sugary sweets during in-between meals', 'doughy foods during in-between meals' with a predictive function value of between 1% and 5%. The other factors from this group have a low predictive function value of 0.1% to 0.4% (**Table 3**).

• Results for the coefficient of determination (R^2) for this group of factors show that approximately 40% of the nutritional factors are associated with caries prevalence in the 12-year-old age group.

Multifactorial (multiple) regression analysis was performed including all the data from the questionnaire as well as additional data from the clinical check-up about the OHI index by Greene-Vermillion, the levels of dental fluorosis and malocclusions.

Results from the multiple regression analysis suggest that the OHI index has the highest predictive function value of all investigated factors – 19.2%. Other factors of significant importance are 'place of residence' – 14.8%, 'parental education level' – 2.9%, 'number of in-between meals' – 2.7%. These and other significant factors are presented in **Fig. 3**.

DISCUSSION

The 12-year-old children are a target group for the WHO and FDI. This fact explains why there are so many studies on the specificity of etiological factors and their effect on caries development. DMFT as a tool for indexing caries prevalence has gained worldwide use and is helping in creating and reassessing it over the course of time. This makes possible for dental prevention to work on both international and national level, as well as specify effective prevention techniques for smaller groups and individuals.

One of the first major DMFT maps of the world was created by Leclercq et al.[5] in 1987. It showed changes in the global DMFT values ranging from 2.43 in 1980 to 2.78 in 1985. Following this study, multiple studies have investigated local, regional and national levels of the DMFT index.[6-10] In 2005, Bratthall[11] reported a global DMFT level

Table 1. DMFT – Socio-economic factors relationship

Factors	Mean square	F	P	Eta	Eta²
DMFT – Parental education level	171.454	36.279	0.000	0.377	0.142
DMFT – Family socio-economic status	72.302	13.565	0.000	0.186	0.035
DMFT – Self-assessed oral health of parents	77.833	15.103	0.000	0.254	0.065

Table 2. DMFT – Oral hygiene factors relationship

Factors	Mean square	F	P	Eta	Eta²
DMFT – Oral hygiene frequency daily	38.419	7.307	0.000	0.219	0.048
DMFT – Duration of brushing	46.834	8.845	0.000	0.197	0.039
DMFT – Frequency of tooth brush change	54.440	10.575	0.000	0.260	0.068
DMFT – Use of additional oral hygiene (AOH)	57.195	10.659	0.001	0.154	0.024
DMFT – Use of AOH - dental floss	41.464	7.676	0.006	0.131	0.017
DMFT - Use of AOH - mouthwash	206.424	41.070	0.000	0.292	0.086
DMFT – Use of AOH - gum	12.065	2.206	0.138	0.071	0.005
DMFT – Use of AOH – tooth-picks	0.550	0.100	0.752	0.015	0.000
DMFT – Use of AOH – interdental brushes	15.925	2.917	0.088	0.081	0.007

Table 3. DMFT – Nutritional factors relationship

Factors	Mean square	F	P	Eta	Eta²
DMFT – Number of in-between meals	110.647	23.236	0.000	0.371	0.138
DMFT – Fruit during in-between meals	28.623	5.270	0.022	0.109	0.012
DMFT – Juice during in-between meals	3.071	0.559	0.455	0.036	0.001
DMFT – Carbonated drinks during in-between meals	24.292	4.465	0.035	0.100	0.010
DMFT – Sugary sweets during in-between meals	105.175	20.008	0.000	0.209	0.044
DMFT – Doughy foods during in-between meals	157.601	30.678	0.000	0.256	0.065

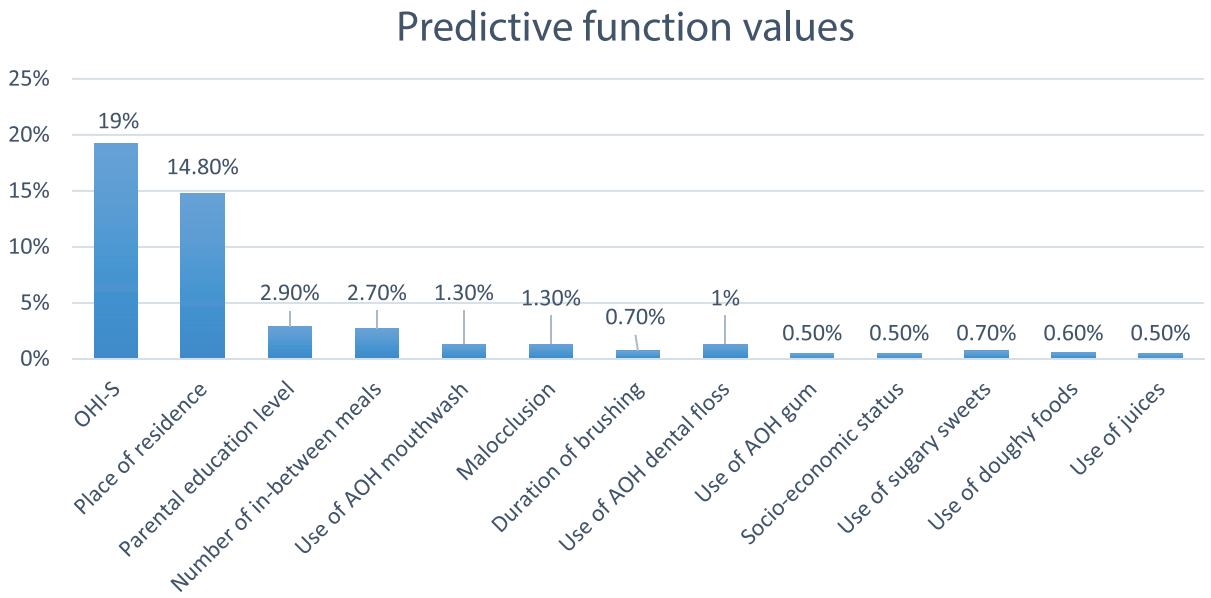

Figure 3. Multiple regression analysis of etiological factors for dental caries in 12-year-old children in Plovdiv

of 1.61. Another study, performed in 2011 in a master thesis by Natarajan[12] showed global DMFT values of 1.67. In 2012, in a study by Moreira[13] global DMFT levels were estimated to be at 2.11. The next study that investigated global DMFT values was carried in 2015 by Gavriilidou NN[14] and the result it reported was 1.86.

The Global Goals for Oral Health for the year 2000 of the WHO and FDI mark the caries prevalence value for 12-year-olds at 3. The DMFT values of our study show that despite the statistically significant difference in caries prevalence in the city proper and the surrounding villages, both study groups meet the Global Goals. The WHO and FDI, however, are expected to renew the Global Goals in the year 2020 at a lower level of DMFT thereby stimulating preventive care even more.

Oral hygiene as described by the OHI index created by Greene-Vermillion, has been a subject of research for its relation to caries prevalence in a number of studies as well. Milciuviene et al.[22] describe OHI and by association oral hygiene, use of additional oral health tools and fluoridation as highly important for the reduction of caries in both 12-year-olds and older adolescents. De Almeida et al.[23] confirm that both personal oral hygiene of the 12-year-olds and the oral hygiene of their parents are factors associated with caries prevalence. Gupta et al.[24] describe the connection between daily sugar intake, body mass index and OHI on one hand and dental caries on the other. They concluded that of the three, only OHI was related to caries prevalence and that OHI had a significant effect on caries prevalence in 12-year-olds. Shabani et al.[25] also confirm the strong relation between OHI and caries prevalence in their study of children aged 10-15. Our findings about OHI and its significant role in dental caries aetiology confirm the results of all these studies.

Kumar et al.[15] did a meta-analysis of over 2500 scientific publications related to the aetiology of dental caries in 12-year-olds. The team describes the fact that most of the studies put the emphasis on single socio-economic or behavioural aspects of life and few publications actually take into consideration overall family burden or oral hygiene behavior of 12-year-olds or their parents. The authors conclude that children from families with lower socio-economic status suffer more often and from more severe forms of caries. Our findings that children of parents with higher educational levels have lower caries prevalence confirm these results as well.

Urbanization has been pointed as a main factor for caries prevalence tightly related with socio-economic status. The results of John et al.[16] and Sufia et al.[17] describe urbanization as a complex factor both directly and passively connected to caries prevalence, thus confirming the results from our multifactorial regression analysis about Place of residence. Similar data was described by other authors[18-21] and confirmed by the results of the regression analysis we performed.

CONCLUSION

There is statistically significant difference in caries prevalence and percentage of caries-free children between the city proper and the surrounding villages. OHI has the highest predictive function on caries prevalence for 12-year-old children.

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Распространение кариеса среди 12-летних детей из Пловдива - многомерный регрессионный анализ.

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Абстракт

Введение: Зубной кариес является одним из важнейших социальных заболеваний. Изменения в распространении кариеса, происходящие в разных регионах, дают важную информацию о влиянии этиологических факторов - первичных и вторичных и позволяют понять взаимосвязь между этими факторами.

Цель: Целью данного исследования было изучение распространения кариеса зубов у детей 12-летнего возраста из Пловдива, Болгария, и влияние этиологических факторов - однофакторное и многофакторное влияние.

Материалы и методы: В исследование приняло участие 228 детей, разделённые на две группы: дети 1 группы, проживающие в городе Пловдив, в самом городе (125), и дети 2 группы, проживающие в соседних населённых пунктах (103 ребёнка). Анкета с письменной формой согласия на клиническое обследование была заполнена родителями каждого ребёнка, и результаты были занесены в статистический отчёт ВОЗ по гигиене полости рта детей. Статистический анализ данных использовался для определения индекса DMFT для обеих групп, процента детей, не затронутых кариесом, и влияния этиологических факторов с помощью регрессионного анализа.

Результаты: Статистический анализ показал, что значения DMFT составляют: 1,568 для самого города, 2,917 для соседних населённых пунктов. Дети, не затронутые кариесом, составляли 38,4% и 17,5% соответственно в 1-й и 2-й группах. Индекс гигиены полости рта (OHI-Oral-Hygiene Index) является лучшим прогностическим фактором в многофакторном регрессионном анализе с более чем 19%-ной прогностической функцией.

Заключение: Установлена статистически значимая разница в распространении кариеса и процентном отношении детей, не затронутых кариесом, между самим городом и соседними населёнными пунктами. Этиологические факторы оказывают особое влияние на исследуемую возрастную группу.

Ключевые слова

распространение кариеса, этиологические факторы, дети