

**” VICTOR BABEȘ” UNIVERSITY OF MEDICINE
AND PHARMACY FROM TIMIȘOARA
FACULTY OF DENTAL MEDICINE
DEPARTMENT I**

DRĂGAN RAMONA-CRISTINA



DOCTORAL THESIS

**PREVALENCE, SEVERITY AND RISK FACTORS
ASSOCIATED WITH DENTAL CARIES IN
CHILDREN AGED 6-12 YEARS IN ROMANIA**

– A B S T R A C T –

Scientific Coordinator

PROF. GĂLUȘCAN ATENA, MD, PhD

T i m i ș o a r a

2 0 2 2

TABLE OF CONTENTS

LIST OF PUBLICATIONS	V
LIST OF ABBREVIATIONS	VI
FIGURE INDEX	VII
TABLE INDEX	VIII
ACKNOWLEDGMENTS.....	IX
INTRODUCTION.....	X
 1. GENERAL PART	 1
1.1. PREVALENCE OF CARIES - AN ORAL HEALTH PROBLEM, AN ESSENTIAL DETERMINANT OF QUALITY OF LIFE	1
1.1.1. ORAL HEALTH: GLOBAL ANALYSIS AND WHO CLASSIFICATIONS.....	3
1.1.2. ORAL HEALTH PROGRAMMES. ORAL HEALTH RESOLUTION .	7
1.1.3. SEVERITY AND PREVALENCE OF CARIES WORLDWIDE	10
1.1.4. SEVERITY AND PREVALENCE OF CARIES IN ROMANIA. DATA FROM THE LAST 10 YEARS	15
1.2. CURRENT PRINCIPLES ON EVALUATION AND CARIES DIAGNOSTIC METHODS	17
1.2.1. EVALUATION METHODS FOR DENTAL CARIES: SELF- ASSESSMENT	17
1.2.2. METHODS OF DIAGNOSIS OF DENTAL CARIES: DMFT INDEX	18
1.2.3. METHODS FOR DIAGNOSING DENTAL CARIES: ICDAS INDEX.....	19
1.2.4. METHODS OF DIAGNOSIS OF DENTAL CARIES: COMPREHENSIVE ASSESSMENT	22
1.3. MAIN DETERMINANTS OF ORAL HEALTH STATUS.....	24
1.3.1. ASSESSMENT OF RISK FACTORS FROM GENERAL HEALTH TO ORAL HEALTH	24
1.3.2. LEVEL OF PARENTAL EDUCATION	25
1.3.3. ORAL AND DENTAL HYGIENE	27
1.3.4. DIETARY HABITS.....	27
1.3.5. COUNTRY DEVELOPMENT INDEX.....	29
1.3.6. RISK FACTORS MANAGEMENT	31
 2. SPECIAL PART	 35
2.1. OBJECTIVES AND METHODOLOGY OF THE RESEARCH.....	35
2.1.1. OBJECTIVES.....	35
2.1.2. RESEARCH DIRECTIONS	35
2.1.3. MATERIAL AND METHOD.....	35
2.1.4. METHODOLOGY - DATABASE AND PROCESSING METHODS.	36

2.2. STUDY 1- THE CORRELATION BETWEEN THE SEVERITY AND PREVALENCE OF CARIES AND RISK FACTORS IN CHILDREN AGED 6 YEARS IN ROMANIA	37
2.2.1. INTRODUCTION	37
2.2.2. AIM OF THE STUDY	39
2.2.3. MATERIAL AND METHODS.....	39
2.2.4. RESULTS.....	43
2.2.5. DISCUSSIONS.....	46
2.2.6. CONCLUSIONS	48
2.3. STUDY 2- ORAL HYGIENE HABITS IN 6-YEARS-OLD CHILDREN IN ROMANIA.....	49
2.3.1. INTRODUCTION	49
2.3.2. AIM OF THE STUDY	50
2.3.3. MATERIAL AND METHOD.....	50
2.3.4. RESULTS.....	51
2.3.5. DISCUSSIONS	62
2.3.6. CONCLUSIONS	63
2.4. STUDY 3- THE SEVERITY AND PREVALENCE OF CARIES ASSOCIATED WITH ORAL HEALTH BEHAVIORS IN 12-YEARS-OLD CHILDREN IN ROMANIA	64
2.4.1. INTRODUCTION	64
2.4.2. AIM OF THE STUDY	64
2.4.3. MATERIAL AND METHODS.....	64
2.4.4. RESULTS.....	70
2.3.5. DISCUSSIONS	76
2.4.6. CONCLUSIONS	79
2.5. STUDY 4- THE IMPACT OF PARENTAL EDUCATION ON ORAL HEALTH BEHAVIOR IN 12-YEARS-OLD CHILDREN IN ROMANIA.....	80
2.5.1. INTRODUCTION	80
2.5.2. AIM OF THE STUDY	82
2.5.3. MATERIAL AND METHODS.....	82
2.5.4. RESULTS.....	84
2.5.5. DISCUSSIONS	89
2.5.6. CONCLUSIONS	91
3. GENERAL DISCUSSIONS.....	92
4. ELEMENTS OF ORIGINALITY AND PERSPECTIVES THAT THE PHD THESIS REVEALS	94
5. CONCLUSIONS	96
REFERENCES	99
APPENDIX	I

ABSTRACT

GENERAL PART

Dental caries is the most prevalent chronic condition in communities in all geographic regions and is the leading cause of dental pain and tooth loss. According to the World Health Organization, major improvements in oral health can be seen, but globally there is still a high burden of disease. In recent decades, dental caries has been the most important public dental disease and dental health problem, due to the high level of affected population worldwide and especially in developing countries. The 2017 Global Burden Disease study states that in both temporary and permanent teeth dental caries is the disease with the highest prevalence and second highest incidence for oral diseases. Dental caries is considered an oral disease and its course can be reversed if diagnosed in the early stages of enamel demineralization.

According to the World Health Organization, risk factors influencing oral hygiene are dietary behavior and inadequate oral hygiene. Preventive behavior plays a key role in ensuring good oral health for children. The preventive behavior dimension covers issues such as oral hygiene, access to dental services, proper care of teeth and gums, use of appropriate cleaning objects and use of toothpaste. These elements, which relate to the specifics of oral care, as well as visits to the dentist, should be carried out regularly from an early age in order to prevent health problems developing in the body. Poor oral hygiene leads to tooth decay, which if not treated properly can lead to tooth loss. Children's adoption of consistent behavioral habits starts at home with their parents, especially their mothers. Especially for younger children, the role of parents and caregivers is essential for caries control. Dietary behavior seems to play also a significant role in the development of dental caries, which is caused by excessive sugar consumption

A strong relationship between socioeconomic status and caries risk has been confirmed by several epidemiological studies. Socioeconomic status has been described as the strongest 'upstream' determinant of poor oral health in children and plays an important role in health behavior, health service use and environmental exposure. Access

to oral care and quality of nutrition are directly affected by deprivation. Health behaviors are also influenced by social structure and environment and are considered a causal pathway to poor oral health in early life. Although oral health is not life-threatening, the impact on an individual's general health and quality of life is very significant, affecting sleep, intellectual capacity, intellectual activity and self-esteem.

Among children, dental caries has not been abolished as a disease, but just monitored at a certain degree. Data from epidemiological studies of the World Health Organization's Oral Health Programme show that over the past two decades the prevalence and severity of dental caries in children in developed countries has decreased while in some developing countries it has increased.

While at international level the concern of the scientific community is reflected in an increased availability of data on children's oral health, in case of Romanian schoolchildren the number of scientific studies carried out so far is low, the data collected are limited to very small areas and usually in urban or peri-urban agglomerations. Although oral health is considered to be an important component of general health, influencing general health, eating and talking ability of the children or school attendance, a review of the literature revealed that there are no data available at national level on possible studies targeting oral health at the age of 6-12 years.

SPECIAL PART

This research is part of the first Romanian National Oral Health Survey regarding the dental status of the schoolchildren aged 6 and 12 years old, aiming to analyze the main risk factors that influence the prevalence and the severity of dental caries in relation to elements related to the specificity of the child and the objective reality in which he lives.

GENERAL OBJECTIVES

The main objective of the research was to assess the oral health status of children aged 6-12 years in Romania, evaluating their preventive and eating habits.

The secondary objectives were to identify the correlations between the prevalence and severity of caries and preventive habits, dietary habits, socio-economic situation, area of origin, level of parental education, and also to evaluate the oral hygiene methods and dietary practices used by the target group.

The **Special part** is structured in 4 studies, as follows:

In the **1st study** the severity and prevalence of caries in correlation with the risk factors was assessed in a group of 6-years-old schoolchildren.

The **2nd study** was aimed to characterize the oral hygiene habits in 6-years-old schoolchildren.

The **3rd study** describes the severity and prevalence of caries associated with oral health behaviors in 12-years-old schoolchildren.

The **4th study** investigates the impact of parental education on oral health behaviors in 12-years-old schoolchildren.

MATERIAL AND METHODS

Stage 1 of the research involved the preparation of a timetable for the conduct of the entire study, the development and validation of questionnaires to assess oral health status, to be completed by the parents of the 6-year-olds and 12-year-olds respectively.

Phase 2 involved the development of collaboration protocols by obtaining agreement from the Romanian Ministry of Health, obtaining WHO support, informing and obtaining agreement from the County School Inspectorates, obtaining collaboration with the schools and teachers to be involved.

Step 3 consisted in the calibration procedure of the examiners involved in the data collection.

During stage 4, the oral health assessment questionnaires were delivered to the parents of children aged 6 years, respectively to the children aged 12 years.

During the final stage, a clinical examination of the children was carried out and the questionnaires obtained were collected so that the data could be entered into a database for further statistical processing.

Schools were selected according to the total number of children registered in the 42 counties of Romania and the sample size was estimated taking into consideration a sampling error of $\pm 3\%$ at a 95% confidence interval. The estimates indicated that a total of 1067 assessments were needed for each target population. In order to create a nationally representative sample, publicly available information available online for all 41 school inspectorates and for Bucharest, the capital of Romania, was collected and verified. For the 6-years-old age group, the number of children enrolled in pre-school education was established. For the 12-years-old age group, the total number of schoolchildren was determined and expressed as a percentage of the total number of children enrolled in the 8th grade National Examination for each school in Romania. Publicly available information was gathered from all 4696 schools and evaluated, determining the distribution of the target group. A nationally representative, stratified and randomized sample was created based on administrative units (counties) and type of residence (e.g., urban versus rural areas). The total number of students was determined for each county, and the resulting percentage of children was calculated and used to estimate the number of children sampled from each county. The total number of children was then distributed by urban or rural residence and the final sample size was determined. To select schools in urban or rural regions, the randomization function (MS Excel) was used. In total, 49 schools were selected consequently.

At the time of data collection, children were examined in a classroom or any available room with the teacher present during the procedure, using special lighting sources and examination kits. Radiographs were not used for diagnosis. The examination

was performed from one tooth to the adjacent tooth. A tooth was considered present if any part of it was visible in the oral cavity. If the permanent tooth and the primary tooth occupied the same tooth space, the condition of the permanent tooth was recorded. The ICDAS criteria were used to classify the severity of visual caries lesions, and the ICCMS Guidelines for Practitioners and Educators was used to classify the presence of filling material on all available tooth surfaces of permanent and primary teeth. Cotton rolls were utilized to remove dental plaque or food debris. ICDAS codes for each surface were recorded on a specific chart. ICDAS codes 1 and 2 were recorded as "A" because air drying was not possible. The examination schedule was attached to the questionnaire and informed consent was obtained from each participant.

The questionnaire consists of 15 questions that make up the two dimensions of behavioral types (prevention and nutrition) behaviors that radically influence the care and health of children's oral cavity.

The studies were cross-sectional and were carried out over a one-year period. Both data collection using questionnaires based on WHO standards and data recording the prevalence and severity of caries by direct examination of schoolchildren were carried out during this period of time. The studies were conducted ethically in accordance with the World Medical Association Declaration of Helsinki. Parents or caregivers of the children involved in the research gave their written informed consent. Informed consent was obtained from all subjects involved in the study. The protocol was approved by the Ethical Committees of the Romanian Ministry of Health (No.3411/05.04.2018), Ministry of Education (No. 1573/12.03.2019) and University of Medicine and Pharmacy "Victor Babes", Timisoara, Romania (no.29/28.09.2018).

RESULTS

A sample of 809 children with an average age of 6.48 years was examined. The gender distribution was relatively even within the sample (47.22% male and 52.78% female). Overall, 42.65% of the children lived in rural communities and 57.35% in urban

communities, with the majority residing in small communities. 14.76% (106 children) had a DMFT index of 0. The mean DMFT of the sample was 4.89 and the SiC index of the whole sample was 9.83. The preventive and dietary behaviors were correlated with three clinical indices to establish the existence or absence of significant differences among Romanian schoolchildren: mt = missing teeth, the number of teeth with code 97/98 indicates teeth that have been extracted due to caries; rt = restoration (number of surfaces that have a restoration/sealing): as teeth can have 4-5 surfaces each, this index can take on high values; d3t = number of surfaces with a caries code greater than 3 (cavity enamel). Codes start from 0 to 6-7 and codes from 3 upwards indicate the presence of enamel lesions (the rest are incipient lesions without enamel damage).

A negative association could be observed between DMFT and parental education level, being predicted by both father's and mother's education level. The Poisson analysis showed significant associations between DMFT and consumption of fruit ($= 0.04$, $SE = 0.01$, $p < 0.05$), carbonated beverages ($= 0.04$, $SE = 0.01$, $p < 0.01$), milk ($= 0.05$, $SE = 0.01$, $p < 0.01$) and tea ($= 0.05$, $SE = 0.01$, $p < 0.01$).

Regarding the occurrence of dental pain 31.7% of children's parents in grade 0 in Romania reported that their son/daughter had never had toothache in the last 12 months, 51.7% reported positive that in the last 12 months their son/daughter had had toothache once or twice. 8.7% of parents of children in class 0 in Romania reported that their son/daughter had experienced tooth pain almost every month in the last year, 2.9% of them felt toothache almost every week, and 1.4% of children in class 0 felt toothache in their mouth almost every day, while 3.6% of parents could not remember if their son/daughter had toothache in the last year. Of the 809 grade 0 subjects interviewed, the majority of children's parents reported that they had visited the dentist once (21.8%) in the past year, 21.6% had never received dental care (had not visited a dentist) in the past 12 months, 16.6% had visited the dentist twice, and 9.6% of subjects had visited the dentist more than four times in the past 12 months. For 6-year-olds, the main reason for visiting the dentist is pain, problems with teeth, gums or mouth (41.9%), followed by routine dental check-up (38.7%), and last is treatment or follow-up (16.6%).

A total of 814 school children (388 boys and 426 girls) aged 11 to 14 years, with a mean age of 12.29 ± 0.6 years, participated in the studies. The value of DMFT index determinate for the sample was 2.93 ± 2.70 .

The percentage of caries-free children in Oltenia was 17.81% in rural regions and 26.32 in urban regions, while in north-western Transylvania the percentages were lower: 4.00% in rural regions and 20.00% in urban regions. In addition, the mean number of dental caries was higher in north-western Transylvania: 4.24 (SD 5.44) in rural regions and 2.42 (SD 3.97) in urban areas. The highest number of dental caries was observed in the central part of the country (Central Transylvania), with an average of 6.05 (SD 9.11) in rural areas and 3.92 (SD 6.55) in urban areas. The average number of fillings was higher in the northern part of the country and lower in the south. Moldova, the north-eastern part of the country, had the highest average number of restorations (4.09; SD 4.17 in rural areas and 3.48, SD 3.49 in urban areas), while Oltenia (southern part) had the lowest number of restorations (0.52, SD 1.21) in rural areas and 1.05 (SD 1.72) in urban areas. The capital, Bucharest, had the highest percentage of caries-free areas (26.26%), and the western part of the country (Banat) had the lowest percentage of caries-free areas in urban areas (10.22%). In terms of lesion severity, incipient caries lesions were more common in the western part (Banat) and north-western part of the country (north-western Transylvania), while extensive caries lesions were observed in the other regions.

Regarding the correlation between type of dietary behavior and gender, the results showed a significant positive correlation for boys consuming fresh fruit (0.17**), biscuits, cookies, cream, sweet pies, sweet buns (0.27**), jam/honey (0.14**), sugar chewing gum (0.38**), sweets/candies (0.21**), sweetened milk (0.23**), sweetened tea (0.36**) and cocoa sweetened with sugar or honey (0.16**). According to the results of the study there is a strong negative statistical association between father's education and the children's consumption of biscuits, cookies, crème, sweet pies and sweet buns (-0.09**) sweetened drinks (-0.15**) sweet/candies (-0.14**). In terms of mother's education, the results showed also a strong negative relation with the consumption of biscuits, cookies, crème, sweet pies and sweet buns (-0.12**) sweetened drinks (-0.19**)

chewing gum containing sugar (-0.16**) sweets /candies (-0.18**) sweetened tea (-0.10**) cocoa with sugar or honey (-0.09**)

In terms of parental education level and its impact on the oral health behavior in 12 years-old children, the results showed that there was a significant negative relationship between mother's education and the frequency of toothache and discomfort reported by children in the past 12 months. As for the relationship between mother's education and the frequency of dentist visits reported by children, there was a positive and significant relationship, meaning the higher the mother's education level was, the more the number of children's visits to the dentist were. A significant and positive association could be observed between father's education and frequency of tooth brushing in children, so the higher the level of father's education, the higher the frequency of cleaning children's teeth. Mean DMFT, is significantly and negatively correlated with mother's education level, meaning that the higher the mother's education level, the lower the DMFT index in children.

DISCUSSIONS

Poor oral health remains a major problem in all countries and there are major inequalities in oral health both within and between countries, despite the fact that most oral diseases are easily preventable by simple and effective means. Efforts need to be focused on research into effective prevention of oral diseases at the population level, understanding the social determinants of oral health and integrating oral health care into larger programs aimed at reducing the global burden of non -communicable diseases. Aspects related to the fact that oral diseases have been included in the spectrum of non-communicable diseases, the fact that oral health is an integral part of general health and that it shares major common risk factors with other non-communicable diseases has been highlighted previously. Given that oral health problems are extremely important among schoolchildren, determining personal parameters that influence the prevalence of caries is essential for their prevention efforts.

Caries can be considered a behavioral disease. The main risk factor that significantly influences oral hygiene is eating behavior. Food plays a very important role in oral hygiene because what we eat every day directly affects our teeth and gums. Sweetened drinks, sweets, starch contribute to tooth decay. In order to have good oral hygiene and prevent dental problems, it is necessary to educate children from an early age about the importance of nutrition.

Parental attitudes toward children's oral health depend on their education. Low parental education is considered one of the predisposing factors leading to poor child health, including oral health. Also, parental education levels are directly associated with family socioeconomic status. Children living in poverty or poor housing, who have poor diets or lack access to high quality early education, are more likely to face chronic diseases in adulthood and intergenerational perpetuation of poverty and poor health.

The results of the scientific research studies in this PhD thesis provide original, clear and concise data on the oral health status of children aged 6-12 years in Romania, using standardized assessment instruments recommended by the WHO. According to the literature, this is the first study at national level, which had as its target group schoolchildren with an average age of 6 and 12 years in Romania. In order to have an overall picture of the oral health of schoolchildren, it is desirable to carry out scientific research studies using a similar methodology on a regular basis so that the data obtained can be compared on the one hand, but also integrated on the other, so that health policies can meet the prophylactic and curative needs of children.

CONCLUSIONS

The research was successful in achieving the aims as stated at the beginning of the survey. The prevalence of caries in children aged 6 years is high in Romania compared to WHO recommendations for this age group. Only a small part of this age group has a DMFT equal to 0. The severity of caries in Romanian children aged 6 years is influenced by parameters such as parents' education level, poor diet and county

development index. Related to risk factors, there are negative correlations between the level of education of parents, both mother and father, and DMFT in the group aged 6 years in Romania. Related to dietary habits, there are statistically significant correlations between the presence of dental caries and the consumption of sweetened milk, tea and cocoa and carbonated drinks in the case of 6 years-old schoolchildren. Prevention in Romania is not a component of oral hygiene that receives much attention among children. There are significant differences regarding preventive habits between urban and rural children aged 6 years old. Children aged 6 years- old resident in urban area report more regular visits for dental check-ups and more frequent tooth brushing.

The prevalence and severity of caries in Romanian 12 years-old schoolchildren is strongly influenced by their social-economic environment as well as their specific consumption behaviors, DMFT for this age group being 2.93 ± 2.70 . In terms of risk factors, parents' education level influences the prevalence of caries in Romanian schoolchildren. The results suggest that the increased prevalence of caries may be due to low levels of parental education. The prevalence of caries in the group of schoolchildren aged 12 years is influenced by the dietary behaviors, such as the consumption of carbonated soft drinks, milk, sweets, tea and cocoa. The prevalence of caries in 12 years-old children is influenced by the rural or urban area of residence. The number of restorations is influenced by the children's gender, parents' education level and consumption of carbonated soft drinks and cocoa. There was a correlation between oral health, status, preventive behavior and educational level of parents/caregivers of children in Romania.

The original contributions refer to the development and organization of the first national study using consistent methodology for the whole national sample, first national assessment of the prevalence and severity of caries for the 6 and 12 years-old Romanian schoolchildren. This is also the first study which identifies the relation between the preventive and dietary habits and the dental health status of Romanian schoolchildren aged 6 and 12 years old and the way the level of parental education influences the dental health status of 12-year-old children in Romania.

With these data at their disposal, decision-makers can propose the possibility of designing and implementing measures and policies for prevention and early intervention in the case of oral diseases, starting from primary school, given that the schoolchildren are a risk group, and continuing throughout the secondary and high school cycle. Given the considerable number of children with caries, the results of the study support the idea of an educational program, child-oriented, about the possible causes of caries lesions, about caries evolution in the absence of intervention on the causative factors. In the absence of a national health education programme for the population on oral health, caries is occurring at younger and younger ages and treatment needs are becoming increasingly complex. Based on the results obtained by processing the questionnaires administered to the 12-year-old schoolchildren participating in the study, as well as the data obtained from the parents of the 6-year-old children participating in this first national study, the central idea of implementing an oral health programme in order to improve the level of oral health knowledge, which is materialized by the adoption of healthy attitudes and behaviors in the oral health sphere with long-term implications at national level.