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**EPIDEMIOLOGICAL AND MICROBIOLOGICAL
ASPECTS OF GINGIVITIS IN CHILDREN**

Summary of PhD thesis

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Introduction

In the context of increasing concerns for children's oral health, this PhD thesis aims to explore the epidemiological and microbiological aspects of gingivitis in children aged 12 to 15 years. Gingivitis is one of the most common conditions of the oral cavity and can have significant consequences on the overall health of the individual.

Gingivitis, as a common condition among children, can negatively affect not only their oral health, but also their physical, psychological and social condition. Untreated or neglected gingivitis in childhood can lead to serious complications such as periodontitis and premature tooth loss, affecting the child's mastication function, speech and self-confidence. It is also important to note that gingivitis in children can be a public health problem because the prevalence of this condition is high among the young population.

This research approach consisted in carrying out studies based on the application of validated questionnaires to a group of children aged between 12 and 15 years, which complements the information obtained from 2 studies carried out at the level of a group of children from rural areas, one observational and an experimental one. Questionnaire survey is an effective method for collecting a large amount of data in a relatively short period of time. This enabled information to be obtained directly from the subjects, giving them the opportunity to express their perceptions, attitudes and behaviors related to oral health. The questionnaires included a small number of leading questions that have already been used in published studies and have been shown to meet the criteria of applicability and comprehension of 12 – 15 years-olds. The experimental study involved the participation of children selected according to the criteria for inclusion in the project, and the activities carried out were the evaluation of plaque, tartar and bleeding indices to establish the degree of oral hygiene and gingival inflammation, as well as the determination of salivary pH and the quantitative and qualitative determination of periodontal pathogens present in supra- and subgingival bacterial plaque.

Working hypothesis and general objectives

The working hypothesis supports the modification of the microbial flora in children with chronic gingivitis following current local prophylaxis measures.

The general objective of the research was to investigate the epidemiological and etiopathogenic aspects of microbial gingivitis in children aged between 12 and 15 years, with the aim of preventing the worsening of periodontal diseases.

To fulfill the general objective, a series of specific objectives were outlined:

- specific objective #1: Assess children's perception of their oral health and oral care and eating habits.

- specific objective #2: Determination of clinical indices and periodontal pathogens in a group of children with chronic gingivitis from rural areas.

- specific objective #3: Determining the impact of prophylactic treatment on clinical indicators and microbial colonizers from bacterial plaque in a group of children with chronic gingivitis from rural areas.

Synthesis of chapters

The structure of the PhD. thesis includes two parts: the general part represented by Chapters 1 and 2 which presents the state of knowledge and the original part which includes Chapters 3-7 and refers to the research carried out. The thesis ends with Chapter 8, which includes the general conclusions and personal contributions, followed by the bibliography.

The general part represents a synthesis of the specialized literature. **The first chapter**, "General considerations regarding gingivitis in children and adolescents", begins with notions of anatomy and physiology of the marginal periodontium and continues with the presentation of the clinical forms of gingivitis encountered in children and adolescents. **Chapter 2**, "Microbiological aspects of gingivitis in children and adolescents", reveals a series of observations regarding the etiology of periodontal diseases and presents the periodontal pathogens present in the bacterial plaque and their roles in the initiation and progression of periodontal diseases.

The personal part begins with **Chapter 3** where the working hypothesis and specific research objectives are presented, and in **Chapter 4** we find information on the groups of recruited participants and the applied research methods.

The research in **Chapter 5**, "Children's perception of oral health in relation to personal habits", was based on the analysis of the answers to two questionnaires completed by a group of 137 children between the ages of 12 and 15 who attend two secondary schools in Bucharest. The questionnaires, applied in accordance with the ethics of scientific research, included a small number of suggestive questions that have already been used in published studies and that meet the criteria of applicability and understanding for children aged 12-15 years.

The first questionnaire allows the assessment of the children's perception of oral health, a subjective but essential component that can influence their oral hygiene behaviours, and the second questionnaire assesses their personal habits, allowing the collection of data on the frequency of tooth brushing, the use of toothpaste with fluoride, consumption of sweets and sugary drinks, and visits to the dentist. This information is essential to understand children's daily habits and how they influence their oral health. The results of this study were published in the Romanian Journal of Oral Rehabilitation.

Bleeding gums was considered a less important clinical sign than carious damage, even though 73.7% of children considered medical treatment necessary in case of bleeding gums and 78.8% would go to the dentist because of this manifestation and only 33.5% considered gingival bleeding to be a sign of disease.

Regarding tooth brushing, 66.4% of the children considered that it is necessary to perform it twice a day, and regarding the use of dental floss as a secondary means of oral hygiene, 65.7% of the respondents considered that this should be used to remove food stuck between the teeth and only 3.6% thought it was useful for removing plaque.

The children's answers to the second questionnaire show a low frequency (0-3 times/day) of the consumption of sweets in the majority of children (80.3%) in the group. Tooth brushing was done several times a day by the majority of children (77.4%), and regarding the type of toothpaste, 43.8% of the respondents knew the active compound of the toothpaste and used a toothpaste with fluoride.

Addressability to the dentist indicated that most children (57.7%) go to the doctor when needed and that 72.3% of them never missed a doctor's appointment. Regarding the reasons for going to the doctor, they were closely divided between pain (24.8%), control (37.9%) and other reasons (37.3%).

It is obvious that oral education among children is very important, because good health habits acquired at a young age can be maintained in adulthood, and this is important not only for oral health, but also for maintaining adequate general health, in fact also supported by previous studies showing the importance of an oral health program in schools to develop children's oral hygiene skills.

The results obtained show that, although the degree of information about caries and periodontal pathology among children is still low, the need to see the dentist is known and this is where the parental role most likely comes into play, despite the fact that over a quarter of the respondents declare that does not keep treatment appointments.

Chapter 6, "Evaluation of clinical indices of oral health and periodontal pathogens in a group of children with chronic gingivitis", had as its main objective the investigation of oral health by means of plaque, tartar and bleeding indices to establish the degree of hygiene oral and gingival inflammation, as well as the local microbial flora as a risk factor, in a group of children with gingivitis from rural areas.

The study was a transversal one and was carried out in a group of 17 children (71% girls) aged between 12 and 15 years (average age 13.6 ± 1.41 years) from rural areas, in compliance with ethics in scientific research. The working method consisted of intraoral examination of the children and noting in the observation sheet the presence of bacterial plaque, calculus and bleeding on probing. Salivary pH was determined using GC tests (GC Saliva Check Buffer, Tokyo, Japan), and the kit from Hain Lifescience GmbH (Nehren, Germany) was used to collect biological samples from the gingival sulcus.

In the analysis of the clinical indices of plaque, calculus and bleeding percentage, it was observed that more than half of the children have a plaque index percentage greater than 50%. The calculus index values were also increased, being in the range of 8.03%-51.78%, with an average of 27.02%. Gingival bleeding was present in all 17 children, with a mean value of 14.97%. Salivary pH values varied between 6.4 and 7.6 among the participants, with an average of 6.98, being in the normal range of 6.2-7.6 which corresponds to a neutral and basic pH.

Following microbiological laboratory analyses, the most frequent species found were: *Fusobacterium* spp., which was present in all 17 (100%) children and *Campylobacter* spp., found in 13 (77%) children, followed by *E. corrodens* which was detected in 11 (65%) children. Bacteria from the red complex were also quite common, they were found in almost half of the children and in a high load (Table 1). We also find *A. actinomycetemcomitans* in a large quantity, which we find in 7 (41%) of the children (Table 1).

Table 1. Presence and bacterial load of *A. actinomycetemcomitans*, *T. denticola*, *P. gingivalis*, *T. forsythia* bacteria

Num	<i>A.actinomycetemcomitans</i>	<i>T.denticola</i>	<i>P.gingivalis</i>	<i>T.forsythia</i>
BM	3	1	3	3
CG	3	3	3	3
CR	0	2	3	2
HS	0	0	0	0
NR	0	0	0	0
SI	3	0	0	0
SV	3	0	0	0
FC	0	0	0	0
TB	3	0	0	0
FI	0	3	3	3
IR	0	0	0	0

NAM	0	0	0	0
SR	0	0	0	2
TM	3	0	0	0
TA	0	0	0	0
TE	3	1	2	3
TMa	0	0	3	2
Index 0 = undetectable Index 1 = sporadic ($>10^3$) Index 2 = plentiful ($>10^5$) Index 3 = abundant ($>10^6$)				

Discussions of clinical index values show close values to those in our study, especially for plaque and calculus index. There are some different reports regarding gingival bleeding on probing and there are also some contradictions between urban and rural variations. Regarding the prevalence of periodontal pathogens of the red complex in children, there are few data in the literature for this age group and in some cases the data are contradictory.

The results of the research suggest a lack of concern regarding oral hygiene among children, due to increased values of clinical indices and high microbial load with periodontal pathogens at the level of bacterial plaque.

The **Chapter 7** study "Impact of hygiene procedures on gingival inflammation in a group of children with chronic gingivitis from rural areas" aimed to determine the impact of prophylactic hygiene treatment on plaque/calculus/bleeding indices and salivary pH, as well as the changes in the microbiota of the bacterial plaque following these procedures, in a group of children with chronic gingivitis from the countryside.

The examination was performed one month after prophylactic treatment and the same children from the study in Chapter 6 were investigated. The children were re-evaluated for plaque, calculus and bleeding indices, salivary pH, as well as microbial flora, following the same protocol and the same materials as in the initial assessment.

Following prophylactic treatment, an improvement in outcomes was observed in terms of plaque, calculus and bleeding index values (Figures 1-3); Salivary pH did not change, remaining within normal limits.

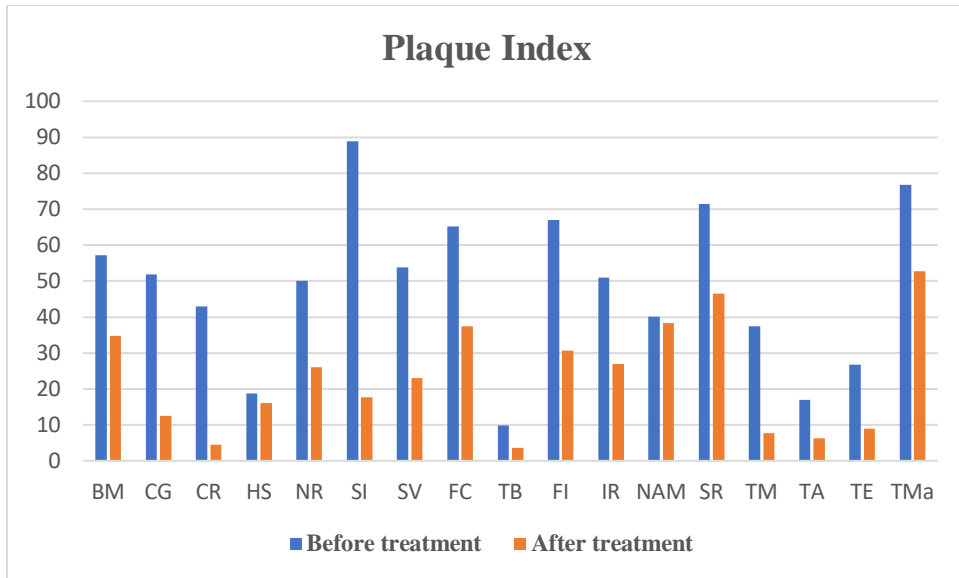


Figure 1. Comparison of pre- and post-treatment plaque index

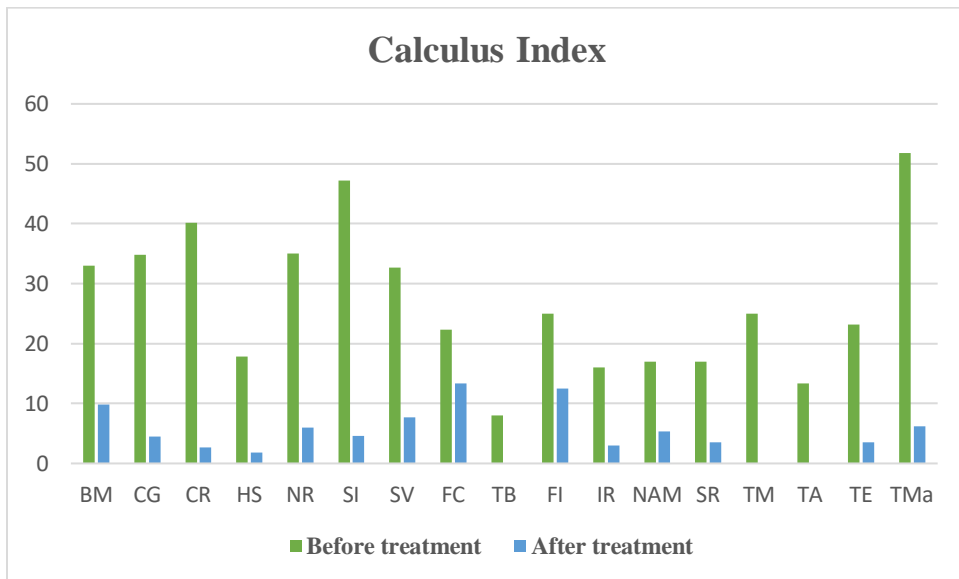


Figure 2. Comparison of pre- and post-treatment calculus index

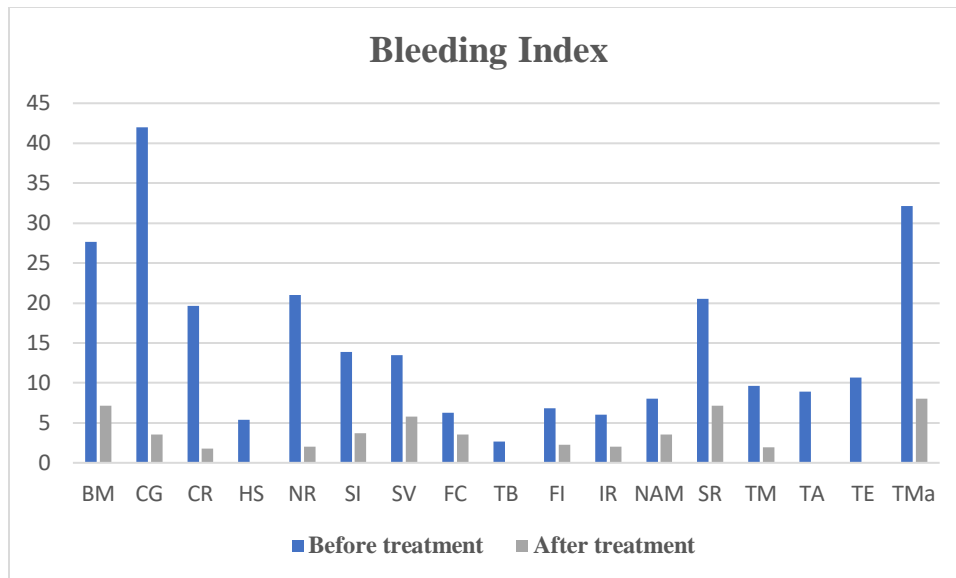


Figure 3. Comparison of pre- and post-treatment bleeding index

Following the microbiological analysis, the absence of periodontal pathogens from the red complex and the bacterium *E. nodatum* is noted. Also, *A. actinomycetemcomitans*, which was initially found in 7 (41%) children and in a high bacterial load, is now present in only one child and in a low amount.

Discussion of this study examines the effect of plaque removal procedures on gingival inflammation. Numerous studies support the effectiveness of mechanical and chemical control of bacterial plaque in order to reduce its level. However, in addition to biological determinants there are other factors such as personal and family experience, health behaviors and beliefs, and socio-economic status, which have been shown to be determinants of what should be included in dental risk assessment.

The results of this study demonstrate the effectiveness of professional hygiene interventions on the reduction of clinical indices of plaque/tartar/bleeding in rural children with gingivitis, but also a reduction of the bacterial load in the same group.

Chapter 8 "General conclusions and contributions" presents the general conclusions and personal contributions to the conducted studies.

In Chapter 5, the obtained results show that most children go to the dentist only when needed, while only one third of children have regular visits. This suggests the need to encourage regular preventive visits, which allow early detection and treatment of dental and periodontal

problems, before they become severe. Patient and parent education should emphasize the importance of regular dental visits and their benefits for maintaining oral health.

In Chapter 6, the evaluation of clinical indices and microbial flora from the bacterial plaque biofilm in a group of children and adolescents aged between 12 and 15 years from rural areas brings new information about indicators of oral hygiene and gingival inflammation in this population segment less investigated. The results can be used to sensitize decision makers and promote public policies that support access to quality continuing education and oral hygiene services.

In Chapter 7, the obtained results emphasize the importance of professional hygiene interventions in the management of oral health in children and adolescents aged between 12 and 15 years. The study demonstrated that hygiene procedures (ultrasonic scaling, professional brushing and the use of the airflow technique) have a significant impact on reducing the bacterial load and improving clinical indices. Also, the results can serve as a basis for the development of practical guidelines and effective intervention strategies, adapted to the specific needs of children and adolescents.

The PhD thesis reveals the importance of interdisciplinary collaboration between dentists, teachers and public health professionals to develop and implement integrated prevention and treatment programs. This collaboration can ensure a holistic approach to oral health that includes not only professional hygiene interventions, but also education, behavioral support and access to appropriate resources for long-term oral health maintenance.

It is important in the future to investigate how different intervention strategies can be adapted and implemented in diverse cultural and socioeconomic contexts to ensure equitable access to quality oral care for all children and adolescents, both urban and rural environment.

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List of published scientific papers

1. **Popa Ș**, Păunică S, Giurgiu MC, Bodnar D, Suciu I, Totan A, Dumitriu AS, Didilescu AC. Dental biofilm-induced gingivitis in children and adolescents. A literature review. *Rom Biotechnol Lett.* 2021;26(3):2664-2670
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