

REVIEW

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member of the scientific jury, included by order of the Rector of Medical University – Varna
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Subject: Dissertation for the acquisition of the educational and scientific degree “doctor”, in the doctoral program “Pediatric Dentistry”, professional field 7.2. Dental Medicine, from the field of higher education 7. Health and Sports.

Topic: "Nutrition and its influence on oral health in adolescence"

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1. General presentation of the procedure and the doctoral student

The presented set of materials on paper and electronic media is in accordance with the requirements of the Law on the Development of the Academic Staff of the Republic of Bulgaria and the Regulations for its implementation, as well as Art. 69 of the Regulations for the Development of the Academic Staff of the Medical University “Prof. Dr. Paraskev Stoyanov” – Varna, for the acquisition of the educational and scientific degree “doctor” at the Medical University – Varna and includes the following documents:

- Dissertation with appendices;
- Abstract;
- European format of the autobiography;
- Copy of diploma for completed Master’s degree;
- Order of enrollment;
- Protocol of the doctoral minimum exam;
- Order of expulsion with the right to defense;
- Protocol of the Constitutional Court with a positive decision on the readiness for defense;
- List of publications and participations related to the dissertation work;
- Copy of publications related to the topic of the dissertation; declaration of authenticity of the submitted documents.

Dr. Kristiana Lyubomirova Mineva was born on January 14, 1994 in the city of Pleven. She graduated as a dentist in 2019 at the Faculty of Dental Medicine of the Medical University “Prof. Dr. Paraskev Stoyanov” – Varna. In 2021 she was enrolled as a resident in the Department of Pediatric Dentistry, Faculty of Dentistry, Medical University-Varna. After passing a competitive exam, in the same year, she was appointed as an assistant and full-time doctoral student at the Department of Pediatric Dentistry, Faculty of Dentistry, Medical University of Varna, where she works to this day. As part of the Department's staff, Dr. Mineva teaches students from second to fifth year in Bulgarian and English. She is fluent in written and spoken English and Russian. Dr. Mineva has participated in national and international scientific forums, clinical trainings and conferences.

2. Relevance of the topic

The selection and assessment of the sustainability of a particular dietary pattern should be specific and involve various specialists from the fields of health, medicine, sociology and education, as well as from systems engineering, agronomic, veterinary and environmental sciences. A balanced diet provides essential nutrients for complete general and oral health.

Adequate intake of essential nutrients and vitamins is also crucial for oral health. However, in recent years, there has been increased access and every encouragement of adolescents to consume processed carbohydrate foods, carbonated and energy drinks.

Oral diseases are induced and also depend on the oral microbiome. Dysbiosis is caused by various factors including the host's diet, inflammatory reactions, systemic disorders, alcohol consumption, smoking. Diet and caries are closely related. The cariogenicity of food is relative and interdependent on many factors such as composition, frequency of feeding, nutritional components, sequence of food intake and duration of feeding.

During periods of rapid cell growth, nutrient deficiency can have an irreversible effect on oral tissues. Early malnutrition is associated with enamel hypoplasia, salivary gland hypofunction and changes in the composition of saliva. These changes increase the child's susceptibility to the development of caries of primary teeth.

The topics of nutritional prophylaxis and correct oral hygiene are fundamental in the care of children's oral health. The creation of forms of monitoring and evaluation lead to the real functioning of the recommended measures. Determining the nutritional model of modern society and the possibilities for controlling extreme conditions such as malnutrition and overeating would provide guidelines for a balanced diet in different periods of child development. Studies in the specialized literature on the advantages of a specific dietary pattern are contradictory. The development of such a dissertation will provide scientific analysis and justification for practical application.

I find the topic to be relevant and with real possibilities for more comprehensive implementation in our country.

3. Knowledge of the problem

The dissertation presented to me for consideration is written on 291 pages, of which 51 pages are an overview, 17 pages - material and methods, 84 own research and 40 discussion. It is illustrated with 20 figures and 44 tables. 503 literary sources were used, of which 5 are in Cyrillic and the rest in Latin. Half of them are from the last 10 years.

The dissertation contains all the basic elements for presenting a dissertation: introduction, literary review, goal and objectives, material and methods, results, discussion, conclusions, bibliography and applications.

The **literature review** is related to the topic. The scientific literature is analyzed. Most of the literary review presents the characteristics of the main nutritional components, as well as microelements and vitamins, presenting the propaedeutic knowledge studied at the university.

The literature review ends with a conclusion related to the development of the chosen scientific topic.

The aim of the scientific work is to investigate nutrition and its relationship with oral health in adolescence.

The implementation of the goal is realized through **three main tasks** with two subtasks of the first task. The tasks are formulated as follows:

1. To conduct a detailed analysis of the nutritional status of children aged 11-17 years 1.1 through anthropometric indicators

1.2 through dietary indicators

2. To conduct a comparative assessment of the main indicators of oral health in children aged 11-17 years with impaired nutritional status with and without the implementation of specific preventive measures and recommendations in the preventive program regarding nutrition.

3. To prepare modern recommendations and guidelines for regulated, balanced nutrition in relation to oral health in adolescents (11-17 years) based on the literature reviewed and the results obtained

Two hypotheses are also tested:

- The quality of the diet affects the nutritional status of children aged 11-17 years
- The quality of the diet affects the main indicators of oral health in children aged 11-17 years with impaired nutrition and nutritional status.

Research methods

The methods are aimed at each of the tasks.

The methods used from the 1st to the 3rd task include anthropometric, statistical methods and interview, which are described in detail.

The design of the study is a randomized controlled clinical trial with a test of two parallel groups. The studied patients are monitored for a period of six months.

The object of the study under the first task are 300 adolescents aged 11-17 years, who are examined and interviewed. The following indicators are monitored: 1) demographic indicators - age and gender;

2) anthropometric indicators - height, weight, HAZ-index, body mass index (BMI) and body mass index for age (BMIZ); and

3) dietary indicators - Diet Quality Index- Adolescent (DQI-A), diet, quantity and quality of food intake, physical activity, access to food, lifestyle and harmful habits of the child, risk factors and frequency of eating, personal preferences and eating habits.

In the second task, the subjects of the study are 210 adolescents aged 11-17 years with impaired nutrition and nutritional status from the city of Varna and the region. The number of persons included as material in both tasks is sufficient in volume. After randomization, 210 children, who from the first task were overweight or obese according to BMIZ-score, were distributed into two groups: experimental and control. In the experimental group there were 102 children with overweight and 3 with obesity. In the control group there were 101 children with overweight and 4 with obesity. The following indices are monitored:

DMFT- index, DMFS- index, SiC- index, International Caries Detection and Assessment System (ICDAS), CarieScan Pro system, activity (A) and reversibility (R) of carious lesions, PUFA- index, severity and number of teeth affected by erosion (E), presence of other types of non-carious lesions, 2) OHI-S- index, Plaque Control Record Index (PCR), Plaque Free Score (PFS), Papillary Bleeding Index (PBI), Gingival Index (GI), 3) lesions of the oral mucosa - localization, type of lesion, pain/discomfort.

A detailed questionnaire (survey), food diary, two outpatient cards (for nutritional status and oral health) were prepared.

Information is provided on the diet, quantity and quality of food intake.

To carry out the clinical study related to the oral health of adolescents with permanent baby dentition, the studied children were divided into two groups - experimental and control group. Clinical and paraclinical methods were used to assess the oral hygiene status, and for the study, optimal documentation was created for registering all necessary data, allowing systematic monitoring of the carious process, non-carious lesions affecting the TZT, oral hygiene, the condition of the soft tissues, with a view to effective treatment and prevention of oral diseases.

For statistical processing, modern statistical methods of analysis were used - the statistical package SPSS for Windows, version 25, Jamovi, version 2.4, Microsoft Excel. To check the normality of the distribution of quantitative variables, Kolmogorov-Smirnov was applied for groups of over 30 participants and Shapiro-Wilk for groups of under 30 participants. For comparison of two independent samples, depending on the type of distribution, Student's t-test, Mann-Whitney and Wilcoxon rank test were used for dependent samples. For more than two groups, respectively, analysis of variance (ANOVA) and Kruskal-Wallis with the application of Post Hoc tests for multiple comparisons. Pearson's χ^2 criterion, Fisher exact test and Kramer - for analysis of categorical variables. To study correlations, the Pearson correlation coefficient or Spearman's rank correlation coefficient was used. The significance level of the null hypothesis was set at $\alpha = 0.05$.

The results are well described and accompanied by tables, graphs and figures.

Their **discussion** includes a comparison with studies in the scientific literature. The results obtained by the doctoral student determine the need to popularize the vision of a balanced nutritional model.

The intake of essential nutrients, vitamins and minerals, as well as the way in which food is consumed and prepared, is of great importance for oral health, maintenance of oral homeostasis and oral immunity.

The results of the first and second tasks of the dissertation analyze and interpret the physical activity, access to food, lifestyle and harmful habits of the child, risk factors and frequency of eating, personal preferences and eating habits.

In the experimental group, the children had an average DMFT index of 5, and in the control group, the DMFT index was 6. In children with impaired nutritional status, all children were affected by the carious process, with a statistically significant difference in the groups ($p=0.02$). In the experimental group, each child had an average of 2 caries (D) and two restorations (F), in contrast to the control group, where each child had an average of 4 caries and 1 restoration.

In the studied children in both groups, occlusal caries predominated, followed by approximal and smooth surface caries ($p<0.05$).

In the experimental group, the children had an average of two active carious lesions ($p < 0.001$), and in the control group, 4, and no reversible carious lesions were observed in both groups.

No statistically significant difference was observed in terms of plaque accumulation (DI-S, CI-S, PCR, PFS) in both groups ($p>0.05$). There was no statistically significant difference in gingival inflammation (PBI and GI) in both groups ($p > 0.05$).

A large percentage of children in both groups fell into the high-risk group, and very few into the medium and low-risk group ($p < 0.05$). There was no statistically significant difference between the experimental and control groups ($p=0.64$).

During the 6-month follow-up, a statistically significant difference was found between the experimental and control groups in terms of plaque accumulation DI-S ($p < 0.001$) and CI-S ($p < 0.001$), PCR ($p < 0.001$), PFS ($p < 0.001$), and gingival inflammation PBI ($p < 0.001$) and GI ($p < 0.001$). The mean value of OHI-S = 1.2 for the experimental group indicates that the majority of the examined children have satisfactory oral hygiene, while in the control group the mean value of OHI-S = 3 indicates that the majority of the examined children have poor oral hygiene ($p < 0.001$). The plaque-free tooth surfaces in the children in the experimental group were 25%, while in the control group - 0% ($p < 0.001$). The average value of PBI = 0.4 for the experimental group shows that the majority of the studied children have mild gingival inflammation, and in the control group the average value of PBI = 2 shows that the majority of the studied children have moderate gingival inflammation ($p < 0.001$).

The third task of the dissertation presents basic recommendations for a balanced diet in relation to oral health in adolescents, which are the result of a detailed analysis of the studied literature and the results obtained in the previous 2 tasks:

1. Nutrition in adolescence must be in line with the necessary energy needs of the body,
2. It is necessary to eat whole foods to stimulate the chewing act and salivation, avoiding refined, culinary processed foods or also known as "industrial foods", packaged foods if possible.
3. Pay attention to the quality of food consumed during snacks, the way of eating, number and duration of snacks.
4. In order to improve the quality of the diet, it is desirable for adolescents to replace high-energy snacks with low-energy alternatives. (230)
5. If possible, pay attention to the quality of the food consumed (animal meat and products from pastured animals, naturally grown fruits and vegetables).
6. Seek and obtain additional information about prebiotic and probiotic properties and meanings of foods.
7. Fresh, seasonal, local, organic vegetables/fruits, legumes (rich in fiber and protein such as: beans, chickpeas, lentils, peas) and seeds, whenever possible (at every meal). In order to be more easily digestible and maximally easily absorbed nutrients, legumes should be pre-soaked before cooking.
8. Daily consumption of fruits and vegetables, with a predominance of vegetables. Vegetables should be consumed at least two servings per day. Fruits up to two servings per day. Vegetables and fruits should be half of the portion for one meal.
9. Grains and fiber – barley, brown/black rice, buckwheat, oatmeal, millet, quinoa or other grains to be consumed daily – 1-2 servings, preferably whole grains.
10. Meat – 2-3 times a week and fish 2-3 times a week – white meats are preferred. It is recommended to limit red meat to 1-2 servings a week.
11. Milk and dairy products – consumption twice a day, paying attention to the fat content of the products used.
12. Eggs – 2 to 4 times a week.
13. Fats, oils, nuts – each meal should contain the three main components – protein, carbohydrate and fat. It is mandatory that they be natural, not processed or refined fats, with a higher content of polyunsaturated fatty acids. The intake of essential nutrients, vitamins and minerals, as well as the way in which food is consumed and prepared, is of great importance for oral health, maintenance of oral homeostasis and oral immunity. As a result of a detailed analysis of the literature reviewed and the results obtained by us in previous tasks, working basic recommendations for a balanced diet in relation to oral health in adolescents were prepared. The use of rapeseed, soybean, corn, safflower oil or other unsaturated oils is preferred instead of solid fats during food preparation.
14. Daily consumption of raw nuts (almonds, walnuts, pecans, pine nuts, cashews, hazelnuts), seeds (pumpkin, sunflower, sesame, chia, flaxseed) up to twice a day and sub-rules (avoid/limit refined table salt).
15. Include in the menu chilled, unpasteurized and sugar-free fermented foods (apple cider vinegar, kefir, sauerkraut, types of cheese).
16. Limit consumption of "modern", refined foods (maximum 1 meal per day, no more than 3 times a week), fast food, sugar (including honey, agave syrup, brown sugar, coconut sugar, molasses, maple syrup).
17. Avoid fruit juices (100% fruit juice up to 230 ml per day, consume whole fruits, reduce the amount of added fruit in smoothies. It is recommended to limit fruits with a higher fructose

content and a high glycemic index (grapes, cherries, pineapple, watermelon, prunes) and dried fruits.

18. Avoid drinks that are sources of added sugars, including flavored milks (e.g. chocolate, strawberries) or containing low-calorie sweeteners, carbonated drinks, caffeinated, sports and energy drinks.

19. Alcohol consumption is not recommended in adolescence. Alcohol consumption only exceptionally (holidays), rarely, under parental control, without the use of hard alcohol.

20. Do not use nicotine products

21. Limit frequent consumption of high-calorie sauces such as Alfredo, cream sauces, cheese sauces and Hollandaise.

22. Eat regularly, limit harmful eating habits, such as eating out-of-town, from a food kiosk, in the car, on the couch at home, etc.

23. Limit eating out to no more than one time (restaurants, food establishments, street food, ordering food), at the expense of home-cooked food.

24. Hold regular family dinners to encourage social interaction and create a model for eating that adolescents can emulate.

25. Avoid consuming carbohydrate foods and drinks while adolescents spend time in front of a TV, phone, laptop, tablet, as they unconsciously consume large amounts of "empty" calories.

26. It is desirable to limit a sedentary lifestyle, recommending no more than 1-2 hours of screen time per day.

27. Regular physical activity with moderate intensity (practising sports if desired) several times a week, adequate rest (sleep) per day and weight control are recommended.

28. Water intake depends on gender, age, physical activity and other factors, such as personal preferences. 1.5 l-2 l. daily water intake is recommended.

29. Test blood levels of vitamin D, B9 and B12. If necessary and after consulting a doctor, supplement with vit. D, vit. B9, vit. B12, vit. C.

The conclusions are presented after the conclusion. The individual tasks do not end with conclusions.

Conclusions are presented with fairly general information from the results obtained and previously commented on.

4. Characteristics and evaluation of the dissertation work and contributions

The researched material is sufficient. An interpretation and discussion of the obtained results have been made.

The dissertation candidate has proposed contributions of an original nature, but since the topic of the influence of nutrition, taking into account anthropometric data and connection with oral health has been worked on in the Departments of Pediatric Dentistry of the Faculty of Dental Medicine - Plovdiv and the Faculty of Dental Medicine - Sofia, I consider it collegial to share and compare the experience of the related departments, which is significant and published. I accept these contributions as follows:

I. Contributions of a practical and applied nature

- An algorithm with 29 nutritional recommendations has been developed and proven to improve the quality of the diet in relation to oral health in adolescents.

II. Contributions of a confirmatory nature

- The DQI-A score was used to study the quality of the diet and a relationship with anthropometric indicators in adolescents aged 11-17 years was established.
- Adolescents who track the composition, content and caloric value on the food label have a higher DQI-A score.
- Dynamics of the main indicators of oral health after improving the quality of the diet by implementing specific nutritional recommendations in the preventive program of the studied adolescents has been proven.
- The overall stress level of adolescents depends on the small amount of sleep per day on weekdays, increased coffee consumption, long screen time and eating in front of a screen, which also determines the low quality of their diet.
- Consumption of sweetened foods and beverages, as well as "fast foods" is associated with a lower DQI-A score in adolescent girls and boys with impaired nutritional status, as well as with a deterioration in their oral health indicators.
- A strong functional relationship has been confirmed between the relevant criteria for the severity of carious lesions according to the ICDAS system and spectroscopy with the CarieScan Pro device.

5. Assessment of the publications and personal contribution of the doctoral student

The doctoral candidate has presented 3 publications related to the dissertation work - 1 in a Bulgarian journal and 2 in an international journal. Dr. Mineva has made two participations in national and international forums, presenting materials from the dissertation work.

The presented publication activity is sufficient and meets the minimum requirements.

6. Critical remarks and recommendations (on the conducted research and the presented materials).

The structure of the dissertation work is not properly formed, which is why there are many repetitions. There is no established proportionality in the individual parts. A huge number of literary data have been reviewed, and a review has been presented, in which much of the information is studied in the propaedeutic course of study and is generally known. The conclusion repeats entire paragraphs of the methodology and results. There is no established methodology for collecting anthropometric data, which is already done with an application in a software program for correctness and completeness. There is no consultation with a specialist dietitian to give recommendations and refine the research. There is no critical analysis and justification of the literature data. The scientific supervisor, who knows the requirements for writing a dissertation, should have given the necessary guidelines. On the other hand, diligence and thoroughness were shown in creating a specific tool for studying the quality of the diet and recommendations for a balanced diet related to oral health were derived, based on precise statistical processing, which I assess as useful.

I recommend that Dr. Mineva present some of her developments in this dissertation at forums in the country in order to popularize her results among general practitioners and dentists, pediatricians and the public.

7. Abstract

The content and quality of the abstract corresponds to the developed work and was prepared according to the requirements of MU-Varna. The abstract reflects in a synthesized form on 63 pages the main results achieved in the dissertation, main conclusions and relevant contributions.

CONCLUSION

The scientific work submitted for review is the personal work of the dissertationist and meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation and the Regulations of MU - Varna.

The dissertation examines a current topic of children's nutrition in a certain period of adolescence and its impact on oral health. The doctoral student Dr. Kristiana Lyubomirova Mineva possesses theoretical knowledge and practical skills in the scientific specialty under study. The developed work demonstrates opportunities for collecting and interpreting scientific information, but a more in-depth and comprehensive examination of the scientific problem is necessary with the setting of additional clinical tasks and their monitoring over time with follow-up more than six months. Dr. Mineva presents a work with the possibility of practical applicability.

Despite the critical remarks made, due to the diligence, good presentation and knowledge of statistical data processing, I declare my **positive assessment of the presented dissertation** work on the topic "Nutrition and its influence on oral health in adolescence" and recommend to the members of the scientific jury **to award the educational and scientific degree of 'doctor' to Dr. Kristiana Lyubomirova Mineva**, a full-time doctoral student in the doctoral program in pediatric dentistry at the Department of Pediatric Dentistry, Faculty of Dentistry, Medical University "Prof. Dr. Paraskev Stoyanov" - Varna.

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Prof. Dr. Ani Belcheva, MD