

Obesity and atherosclerosis in children

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ABSTRACT

Atherosclerosis, one of the leading causes of death in developed countries is characterized by lumen reduction of blood vessels due to local thickening of internal blood vessels caused by plaque/atheroma. It begins in childhood, goes for a long time without manifesting symptoms, increasing with age it begins to seriously threaten health. The most important risk factors for the development of atherosclerotic disease are: hyperlipidemia, hypertension, smoking, diabetes, high fibrinogen, excessive weight, increased level of homocysteine, physical inactivity, heredity and immune response in some diseases. The primary intention of prevention is to preclude the occurrence of risk factors for atherosclerosis, and the secondary is to prevent the development or aggravation of the illness along with the reduction or control of existing risks. There is an increasing number of studies that show that children are overweight, which in adolescence is certainly a risk factor for the onset of many chronic diseases, namely: cardiovascular, type 2 diabetes, orthopedic, and psychological diseases. The obesity epidemic is one of the most serious health problems of today affecting individuals of all ages. Atherosclerosis demands action with the aim of early detection and treatment as well as the reduction of development of risk factors for coronary artery diseases. Finding the most effective preventive measures for obesity in each country requires precise epidemiological data on the number of obese children and youth, as well as on their eating and activity habits.

Keywords: arteries, disease, overweight

INTRODUCTION

The most frequent disease of the arteries is atherosclerosis, which is characterized by lumen reduction of blood vessels due to local thickening of internal blood vessels caused by plaque/atheroma (1). Atherosclerosis is now one of the leading causes of death in developed countries (2). It begins in childhood, goes for a long time without manifesting symptoms, increasing with age it begins to seriously threaten health (1,2).

History of atherosclerosis dates back to 3.500 years ago. Scientists came to this conclusion in the National Museum of Egyptian Antiquities in Cairo when on the plate next to the mummy of Pharaoh Merneptah, who reigned between the 1213th and 1203rd BC and died at the age of 60, read that he was suffering from atherosclerosis and arthritis. All mummies were over 40 years of age at the

time of death - information to which scientists have come after a detailed analysis of the skeleton. The oldest mummy with atherosclerosis was Egyptian princess Ahmoz - Meritamen, who most likely lived between the 1580th and 1550th years before Christ. She died when she was a little more than 40 years old. Atherosclerosis and other cardiovascular diseases are often associated with modern times, but Ahmoz showed us that it was possible in her time as well. This led them to scan 52 mummies, people who had lived in ancient Egypt between 981st BC and 334 AD and paid special attention to the cardiovascular system. In 44 mummies they were able to identify the arteries and the heart, and the rest of it was impossible. The biggest surprise was that the walls of blood vessels, specifically the arteries in 20 male and female mummies, were coated with calcium, which leads to a build-up of atherosclerosis (3,4).

Of the ten most common causes of death, diseases of the heart and blood vessels, as a result of atherosclerosis, accounts for six (out of 10) (5,6). As a cardiovascular disease, atherosclerosis is an interdisciplinary problem, multifactorial in its etiopathogenesis, course and reper-

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cussions, demands the action of family doctors, physicians, pediatricians, cardiologist, paediatric cardiologist, neurologist, diabetologist, endocrinologist, cardiac and vascular surgeons, neurosurgeon, radiologist, specialist of nuclear medicine, epidemiologist, nutritionist, pathologist, biochemist, with the aim of early detection and treatment of atherosclerosis as well as the reduction of the development of risk factors for coronary artery diseases (7). The aim of this review was to evaluate atherosclerosis and obesity as well as risk factors there of from pathophysiological standpoint based on conducted cardiovascular health investigations and recommendations in this field of medicine.

PATHOPHYSIOLOGY

Pathophysiology of the disease represents damaged cells that line the inner surface of the arteries that endothelium due to chemical or mechanical damage (5). Elevated blood cholesterol, smoking, or elevated homocysteine (now one of the more investigated causes of atherosclerosis) are examples of chemical damage and mechanical damage to the cells: high blood pressure, damage of the catheter during diagnostic procedures or even infections (6). "Fatty streak" occurs as the first stage of development of atherosclerosis. It is totally reversible, which means that the cessation of the activities of harmful pathogens, endothelial cells recover completely (8). However, if exposure to adverse event continues, atherosclerotic plaque grows and narrows lumen. Consequently, reducing blood flow and tissue oxygen supply becomes insufficient (5). In the blood vessel itself, due to reduced elasticity, an increase of blood pressure occurs (5,6). Elevated blood pressure can lead to cracking in blood of the court or its stratification with the formation of aneurysm or plaque, which can calcify and slim down the vessel wall with the ability of forming a clot (5).

RISK FACTORS

The most important risk factors for the development of atherosclerotic disease are: hyperlipidaemia, hypertension, smoking, diabetes, high fibrinogen, male sex at younger and middle age, menopause in women taking oral contraceptives or hormone replacement therapy only with the presence of other risk factors, excessive weight, increased level of homocysteine, physical inactivity, heredity, and immune response in some diseases (7,8).

The process of hypertension starts in childhood (5). Etiopathogenetically it is multifactorial, a possible course and repercussions for health are longstanding and irreversible (9). Normotension offers important data in contribution to health, and increased blood pressure in childhood represents the site for preventive paediatric action (9).

In a study conducted among paediatric population in Sarajevo (10), which included 500 children, a correlation of

birth weight and blood pressure was investigated. Authors concluded that blood pressure measurement could serve for the detection of cardiovascular diseases in children 8-9 years of age. The main factors that influence birth weight were: sex (boys were heavier than girls up to 98 g), gestational age (preterm were lighter for 600 g), and smoking of pregnant mothers (newborns were for 219 g of lower birth weight in relation to mothers who did not smoke). Obese participants (important hypertension factor) have increased systolic blood pressure for 5.38 mmHg in relation to those participants with normal blood tension (10).

In the United States and Western Europe, where risk factors have been preventively eliminated for a long time, mortality rates fell below 50% (11). Prevention includes avoiding risk factors. The primary intention of the prevention is to preclude the occurrence of risk factors for atherosclerosis, and the secondary reason is to prevent the development or aggravation of the illness along with the reduction or control of existing risks. Primary prevention should begin as early as possible, even in childhood, creating a healthy diet, eliminating smoking, regular physical activity, which will prevent or at least slow the development of atherosclerosis (12).

The consequences of atherosclerosis are: coronary or ischemic heart disease, especially myocardial infarction, cerebrovascular disease and cerebrovascular accident (80% of all heart attacks and stroke occur due to atherosclerosis), narrowing or blockage of peripheral arteries, carotid arteries, particularly the legs, which can lead even to the development of gangrene. Since there is no specific cure for atherosclerosis, the best way to prevent this disease is prevention! In modern medicine, there is an increasing number of studies which show that children are overweight, which in adolescence is certainly a risk factor for the onset of many chronic diseases, namely: cardiovascular, type 2 diabetes, orthopaedic and psychological diseases. Therefore, the combination of these diseases and obesity at an early age causes shortening of the expected average length of life, contributes to a large burden of diseases in the next generation and threatens the functioning of the health care and health insurance system (12,13).

The obesity epidemic is one of the most serious global health problems today. It affects all ages. During the last two decades, the prevalence of obesity in European countries has tripled, 1/3 of children are obese! Already 50% of adults are overweight, and 1/3 of the European population is obese (14). Although genetic and hormonal factors are possible causes of increased body weight in children, excessive food intake and poor physical activity are undoubtedly the main cause of obesity (15). Sitting in front of the TV and computer while consuming calorie-rich fast food and sugary drinks, in the long run create an imbalance between the intake and con-

sumption of energy in the body. The result of this imbalance is excess body weight (15–18).

The most accurate parameter for assessing obesity is the body mass index (BMI), which represents the body weight divided by the square of body height expressed in kg/m². Obese people have a BMI greater than or equal to 30 (19,20). Factors related to the onset of obesity are changed diet, reduced physical activity, increased inactivity (17). The alarming trend of the obesity epidemic, especially the increase in prevalence among young people, confronts every community with a problem that has huge health, economic and social consequences.

The aetiology of obesity is complex (genetic, environmental, economic factors) (8). Early childhood is a crucial period for obesity prevention (16). Children adopt eating habits from the environment in which they grow up. Parents should be a positive example for adopting eating habits. Unhealthy eating habits, including excessive salt and sugar intake, are among the preventable factors that contribute to obesity (17).

What to do to prevent CVD? It is necessary to establish dialogues in cardiovascular medicine with the aim of obesity prevention! Schools can provide and offer different options for school snacks with the introduction of more fruits and vegetables in the diet, fibre and nutrients, which favours the proper physical and mental development of children for which the community is responsible; if a child eats bakery or dried meat products every day, there is a nutritional deficit of vitamins and minerals with potential health risks. Obesity does not come only from excessive food intake, but it is a combination of irregular meals, sedentary lifestyle and certain dissatisfaction and stress. Prevention is the key! (13–15).

INVESTIGATION FROM BALKAN COUNTRIES

Bosnia and Herzegovina

The study on risk factors for the development of cardiovascular disease represents the most massive study in Bosnia and Herzegovina, which was carried out in the Sarajevo Canton, including the age of 0-65 years (a total of 42,828 respondents surveyed) (15).

According to the results, majority children do not eat healthy food at home. The most important factors that influence the development of obesity include sedentary lifestyle, high frequency of taking sweets and thick juices, and inadequate nutrition of children at school (15). Preventive and therapeutic activities must be carried out continuously among the widest possible population. Prevention of obesity consists of nutrition intake according to up-to-date guidelines regarding the input of carbohydrates, fats, proteins, vitamins and fluids (12). Maintaining the regular physical activity, both in school and in their free time. Promotion of continuous education about

healthy eating and healthy lifestyle (activity, not smoking) habits in all primary and secondary schools in the country, as well as the involvement of teams of family doctors in order to monitor the nutritional status of school children and youth was needed (14).

The influence of nutrition on oral and general health of children and adolescents has been recently investigated. Oral diseases have the highest global prevalence among all diseases, with the presence in almost 1/2 of the world's population. The most common oral diseases are caused by dental plaque, i.e., dental caries and periodontal diseases. Early childhood dental caries occurs in about 7% of children worldwide (21). Among the periodontal diseases, gingivitis is dominant. Dental plaque represents a specific oral biofilm present on hard dental and periodontal tissues, which in its patho (physiological) form primarily causes dental caries and gingivitis (21). One of the main conditions for the pathological predominance of dental plaque is the (mis)use of refined carbohydrates in the diet over time (22). The need for sweet food is not only a matter of culture and customs of the climate, but an evolutionary primal instinctive way of feeding the human species in order to quickly obtain energy for the functioning of the organism. The sweet taste dominates over other types of taste, it is established already intrauterine in the foetal period, and is strengthened postpartum by breastfeeding (21). Apart from the described most dominant local harmful effect of nutrition on oral health, which has repercussions on the general plan, its direct harmful effect on the general state of health is many times greater. The role of nutrition, primarily refined carbohydrates, in the development of caries has been relatively well researched, and is considered one of the leading risk factors for the development of caries (22). In Bosnia and Herzegovina, the influence of nutrition as a risk factor for caries in children aged 12 years from the Sarajevo area was examined, with special reference to the influence of nutrition on the occurrence of caries in children and adolescents of different socioeconomic status (23,24) showed that a cariogenic diet and a large number of daily meals are one of the leading causes of tooth decay, and in children and adolescents of poor socio-economic status, even the leading cause. Also, data collected on respondents aged 4-6 years from the Sarajevo area showed that diet is an important risk factor for tooth decay in preschool children as well (25). There is still a lack of data for Bosnia and Herzegovina on the influence of nutrition on the occurrence of caries for all population groups. Research conducted in Serbia on overweight school-age children, adolescents and the repercussions on the occurrence of oral diseases indicated that being overweight was significantly associated with a higher probability of developing gingivitis and negatively associated with caries prevalence (26). Also, recent research from England showed linear and moderate association between obesity and dental caries in

children by some demographic factors. Interventions that reduce obesity and dental caries may have a greater impact on specific groups of the population (27). Since oral health is an inseparable part of general health, and nutrition is an important determinant of child and adolescent overall health, we believe that it is necessary to conduct research focusing on the analysis of nutrition and improper nutrition leading to increased body weight and obesity in children and adolescents, and their comprehensive impact on oral health

The impact of oral health of pregnant women on cardiovascular health in children has been investigated in Bosnia and Herzegovina and Croatia (28) investigating more prominent predictors of early cardiovascular risk for increased body mass index, high values of blood pressure and the thickening of the intima-media carotids complex in comparison to children whose mothers had good oral health during pregnancy. The results showed that poor eating habits impacted the diameter of blood vessels and flow. Unhealthy dietary plans will most probably lead to poor oral health and the presence of periodontitis, which could contribute to the thickening of carotid intima-media (29). The results so far indicate that pregnant women have a high level of awareness of the importance of oral health and eating habits and their impact on child development (28). There was a significant connection between diet and oral health status of mothers with some segments of the development of cardiovascular system in infants (28).

The investigation of the frequency of consumption of sweet and salty snacks among children aged 2-18 years in relation to their mothers' education level from Mostar (B&H) (30) showed that a higher level of education among mothers does not necessarily equate to proper nutritional knowledge.

There is a clear increase in the consumption of processed food in B&H (31) and worldwide (32). While mothers' education can impact children's eating habits, nutrition literacy is more crucial. Healthy eating habits should form an integral part of the educational program for pregnant women, parents, and caregivers. Nutrition education programmes should also be integrated into curricula for preschool and school children. Inadequate nutrition and unhealthy lifestyles can lead to a wide range of metabolic and health problems in the adult population later on (28).

The investigation of an association between poor eating habits and children's body weight in Mostar (B&H) showed significantly higher prevalence of overweight and obesity in the group that consumed sweet and salty snacks daily, and boys had a higher prevalence of overweight and obesity compared to girls (33).

Countries in the region

Cardiovascular diseases are still the leading cause of death in Croatia, and the main risk factor is high LDL

cholesterol (34). This is an asymptomatic condition in which the patient is not aware of the danger. In schools in Croatia, a systematic examination will verify whether higher cholesterol is present in children. Hereditary high cholesterol in school children in the future will be detected as a part of the systematic examination for enrolment in primary school (34). This will help to detect children with already high LDL cholesterol and they will be provided with directions for further treatment, but such information would also be important for the child's family, who will equally be referred to check the value of LDL cholesterol due to suspected familial hypercholesterolemia.

The documents of the EU and the Horizon 2020 project (2018-2023), which are in accordance with the Global Obesity Prevention Measures for the Countries of the European Region provided in the European Charter on Counteracting Obesity (35,36) in 2006, and the initiative from Croatia, should also be the health strategy in B&H, as well as in European countries.

The presented cardiovascular and oral health database for the Balkans region can be used as a geographic, demographic and epidemiologic source of information for the detection and identification of new potential risk factors for preterm delivery and possible atherosclerosis development.

In conclusion, this review shows the importance of initiating prevention of atherosclerosis in early life and provides a summary of the major paediatric recommendations for prevention of atherosclerotic disease. It also highlights limitations of current knowledge and indicates areas for future research.

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