Tobor Dominika, Grajek Mateusz, Szlachet Patryka, Korzonek-Szlacheta Ilona. The impact of caries on human health - a review of knowledge. Journal of Education, Health and Sport. 2022;12(9):846-855. eISSN 2391-8306. DOI http://dx.doi.org/10.12775/JEHS.2022.12.09.098
https://apcz.umk.pl/JEHS/article/view/39705
https://zenodo.org/record/7085437

The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of December 21, 2021. No. 32343. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical Culture Sciences (Field of Medical sciences and health sciences); Health Sciences (Field of Medical Sciences and Health Sciences). Punkty Ministerialne z 2019 - aktualny rok 40 punktów. Załącznik do komunikatu Ministra Edukacji i Nauki z dnia 21 grudnia 2021 r. Lp. 32343. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 01.09.2022. Revised: 02.09.2022. Accepted: 16.09.2022.

The impact of caries on human health - a review of knowledge

Dominika Tobor[1], Mateusz Grajek[2], Patryk Szlacheta[3], Ilona Korzonek-Szlacheta[1]

[1]Department of Prevention of Metabolic Diseases, Faculty of Health Sciences in Bytom, Medical University of Silesia in Katowice, 41902 Bytom, Poland

[2]Department of Public Health, Faculty of Health Sciences in Bytom, Medical University of Silesia in Katowice, 41902 Bytom, Poland

[3]Department of Toxicology and Health Protection, Faculty of Health Sciences in Bytom, Medical University of Silesia in Katowice, 41902 Bytom, Poland

*mgrajek@sum.edu.pl

Abstract

Dental caries is currently a huge social problem in many countries. Caries is a pathological process associated with the loss of minerals and the breakdown of the hard tissues of the tooth. The risk of its occurrence is very high, especially in children and adolescents. The development of caries is determined by the presence of plaque, the susceptibility of the tooth tissue, the substrate and the time factor. The state of oral health depends on a very age of factors, including hygiene habits, health-promoting education, prevention.

Keywords: dental caries, oral cavity, teeth, dental prevention

Introduction

Tooth decay is currently a huge social problem in many countries. The risk of its occurrence is very high, especially in children and adolescents. The state of oral health depends on a very age of factors, including hygiene habits, health-promoting education, prevention. The development of caries is determined by the presence of plaque, susceptibility of tooth tissue, substrate and time factor. Caries is a pathological process associated with the loss of minerals and the breakdown of the hard tissues of the tooth.

Caries was already recognized in ancient times, as evidenced by archaeological studies. Its intense development dates back to the 19th century in Europe, since the importation of cane sugar from South America and North America. In the 1970s, the development of the caries epidemic was somewhat halted by the wider use of fluoride in oral hygiene.

Worldwide figures on the number of people with tooth decay are alarming. In Europe, Poland is among the infamous leaders. Tooth decay occurs in developed countries and developing countries. It is widespread in Asia, South America. The least number of people
with tooth decay is recorded in Africa.

The aim of the review is to gather existing knowledge on the impact of caries on human health.

Caries - general information

Dental caries is considered a social disease. It is defined as a process of demineralization and remineralization of enamel, which occurs under the influence of organizational acids. There is a proteolytic breakdown of the hard tissues of the tooth.
According to the definition given by the World Health Organization, caries is "a pathological process of local, extrinsic origin, leading to decalcification of enamel, breakdown of hard carbon tissues and consequent cavity formation"[1] .
It is a bacterial disease caused by the bacteria *Streptococcus salivarius, Streptococcus mutas, Streptococcus mitis, Streptococcus sanguinis,* which have the ability to convert carbohydrates into sugars.

[1] Pawka B.,Dreher P., Herda J. et.al. Dental caries in childern as a social problem. Probl Hig Epidemiol 2010, 91(1): 5-7.

The literature emphasizes the acute and rapid course of this disease. In a very short period of time, there is a disease of the periapical tissues, pulp, sclerotic bones and loss of the crown of the tooth. Destroying the dentition, it contributes to the impairment of the masticatory organ, negatively affects the processes taking place in the digestive system.

Demineralization of tooth enamel is a chemical process that can be represented by the following formula:

$$Ca_{10}(PO_4)_6(OH)_2 + 10H^+ \rightarrow 10Ca_2 + 6H(PO_4)^{3-} + 2H_2O$$

Demineralization of enamel results from the interaction of extrinsic and intrinsic and intrinsic acids. Factors affecting the formation of caries will be discussed in the next subsection.

Dental caries is characterized by a change in the color of the enamel, roughening of the surface at the site of infection, the presence of cavities and the development of transient pain.

In the literature, there are several types of caries classification, taking into account different division criteria. Table 1 shows the typology of caries.

Table 1 Classification of caries

The criterion for division	Types of caries
Place of occurrence	– enamel decay – dentin caries, – root caries
Mileage	– Acute caries (also known as wet caries), – Chronic caries (so-called dry caries),, – retained caries,
Clinical picture	– secondary caries, – atypical caries, – latent caries, – flowering humus, – circular caries, – bottle caries,
Advancement of carious lesions (according to WHO)	– D1: initial, – D2: surface, – D3: medium, – D4: deep

Source: own elaboration

Enamel caries is an early carious lesion involving the enamel. Stopping pathological changes is possible with proper hygiene, the use of fluoride compounds. In the case of dentin caries, it is necessary to remove the carious lesion and fill the cavity. This caries occupies dentin to varying degrees. In root caries, which most often occurs in the elderly, the lesions involve the root of the tooth[2] .

Taking into account the course of the carious process, the acute, chronic and retained forms were indicated. The acute form is characterized by soreness on drilling, soft consistency, yellow to light brown color. If the carious lesion does not develop for a long period of time then retained caries is diagnosed. The inhibition of the process can be caused by better oral hygiene, a change in diet. Mainly in the elderly there is chronic caries, characterized by a harder texture and a dark brownish color.

Secondary caries is a type of caries distinguished by its clinical picture. It develops in the marginal area of the current filling. It can result from a dentist's error when treating a cavity, poor quality dental material or a filling breaking off. Atypical caries is diagnosed in a tooth devoid of living pulp. Hidden caries, on the other hand, is only recognized by taking an x-ray. It is localized under apparently healthy enamel, on the chewing surface. Blooming caries is characterized by sudden coverage of lesions on many teeth. Lesions also occur on previously caries-free surfaces. It is most often diagnosed in adolescents who consume significant amounts of sugary drinks and sweets. Bottle caries occurs in children fed by bottle for a long time. It appears on the upper incisors of milk teeth. Circular caries involves at least two surfaces cervically. It can also surround the entire tooth in the form of a ring[3]

WHO presents a classification of caries taking into account the extent of the pathological process. Initial caries is characterized by a focal change in color, which is milky or brown. In superficial caries, there is destruction of the enamel, up to the dentin border. A non-deep, painless cavity appears. In medium caries, there is a significant cavity, separated from the tooth chamber by a thick layer of healthy dentin. Deep caries is an extensive cavity reaching almost to the pulp, from which it is separated by a thin , not always healthy layer of dentin[4] .

---

[2] Jańczuk Z, Kaczmarek U, Lipski M. Clinical course and division of dental caries. In: Jańczuk Z, Kaczmarek U, Lipski M (eds). Conservative dentistry with endodontics. Clinical outline. Warsaw: PZWL; 2014. 229-234.

[3] Jańczuk Z, Kaczmarek U, Lipski M. Clinical course and division of dental caries. In: Jańczuk Z, Kaczmarek U, Lipski M (eds). Conservative dentistry with endodontics. Clinical outline. Warsaw: PZWL; 2014. 229-234.

[4] Ismail AI, Pitts NB, Tellez M. The International Caries Classification and Management System (ICCMSTM): an example of a caries management pathway. BMC Oral Health. 2015.

The carious process (in addition to the initial decay) leads to necrosis and loss of the hard tissues of the tooth. This is an irreversible process, as once enamel and dentin are lost, their renewal is impossible.

Diabetes

Patients with diabetes are at greater risk of oral fungus and mucosal injury due to xerostomia, as well as caries as a result of increased sugar levels in saliva. The symptom of diabetes is changes in the oral cavity, negatively affects the condition of the teeth and causes the development of disease. Many times it is the visit to the dentist that results in an earlier diagnosis of diabetes, resulting in an increase in the effectiveness of treatment. A person with diagnosed diabetes has more problems with oral diseases due to higher blood sugar levels, which in turn causes white blood cells to fail to fight bacterial infections. The untreated disease manifests itself, among other things, by a decrease in the amount of saliva in the mouth. Patients experience dry mouth, which can manifest as painful sensations. Failure to effectively treat the inflammation can result in tooth loss. Very often people with diabetes develop periodontitis and gingivitis, Treatment takes much longer than for people without diagnosed diabetes. In some cases, oral surgery is necessary[5] .

The risk of caries in people with diabetes is closely related to the treatment of the disease. People who are under constant supervision of a doctor, have balanced sugar levels, and take medication are less likely to develop caries. This fact is due to increased glucose levels in saliva, increased proliferation of bacteria. There is a faster formation of plaque[6] .

The risk of caries is higher in patients with type II diabetes. This type of diabetes is often associated with uncontrolled carbohydrate consumption and obesity.

It has been noted that in people with diabetes, caries is more common in the cervical region and affects the roots of teeth. Diabetes negatively affects chronic changes in periapical tissues

Cardiovascular diseases

Numerous studies have concluded that periodontitis is a significant risk factor for cardiovascular disease. The literature indicates the possibility of the following diseases:

[5] Lewusz K., Perz A., Godzieba A., Kaczr K. Patient with diabetes mellitus in the dental office.Dental Magazine. 2016;3; 74-79.
[6] Miko S., Albrecht M, Dental conditions and periodontal disease in adolescents with type 1 diabetes melitus. Br. Dent. J. 2010, 27;208;6.

atherosclerosis, ischemic heart disease, myocardial infarction, peripheral artery disease, infective endocarditis. The main etiological factor in the onset of periodontitis is the bacterium Streptococcus viridians found in the mouth. The bacterium directly damages the vascular wall with cytokines and inflammatory mediators that are released during periodontitis. This process results in the formation of atherosclerotic plaques, thickening of the inner and middle membrane complex, increased vascular stiffness and endothelial dysfunction. There is an increase in peripheral and central arterial pressure. This is followed by hypertrophy of the left ventricular muscle[7] .

Atherosclerosis is a chronic inflammatory disease process affecting the inner membrane of the arteries. Atherosclerosis negatively affects the quality of life of sufferers and is the cause of many deaths. The clinical manifestations of atherosclerosis are myocardial infarction, ischemic heart disease, ischemic stroke, and atherosclerosis of the inflamed arteries of the lower extremities.

The influence of periodontitis on the etiology of endocarditis has been scientifically confirmed. It is a disease with a complicated course, and if untreated can lead to death. It has also been shown that there is a high correlation between the presence of ischemic heart disease and the number of bacteria in periodontal pockets. Among other things, patients after myocardial infarction were found to have a significant number of bacteria in the flora of periodontal pockets. Based on other studies, a positive correlation between the total number of bacteria in the body of patients and cardiovascular disease has been proven. In addition, periodontal inflammation has been shown to predispose to hypertension as a result of the contribution of subgingival plaque bacteria.

The prevalence of periodontal disease and the high incidence of cardiovascular disease indicate the need for extensive preventive measures. Those undergoing cardiac treatment must have an oral evaluation. On the other hand, in those with established periodontitis, it is necessary to assess the risk of cardiovascular diseases.

Premature birth and low birth weight of the baby

During pregnancy, women should receive systematic dental care, taking special care of their oral hygiene. This is because during pregnancy the risk of caries increases, due to a change in

[7] Miśkiewicz A., Szparecki G. Periodontitis as a risk factor for cardiovascular disease. Dent. Med. Probl. 2010, 47, 4, 472-477.

the composition of the oral microflora. 40% of pregnant women are found to develop plaque. Another determinant of the possibility of caries development is nutritional changes in pregnant women. Many times there is an increased demand for foods that contain a significant amount of carbohydrates in their composition. Women often snack on these foods, which, along with a decrease in calcium levels during pregnancy, leads to an increased risk of caries and gum disease[8] .

The condition of the hard tissues of the teeth is also affected by a pregnant woman's vomiting, heartburn. They expose the teeth to excessive contact with stomach acid. It is recommended to portion meals and take them with greater frequency . [9]

In pregnant women, there is a change in the hormonal profile, which affects the condition of the gums. Gingivitis, periodontitis can occur. These oral diseases can cause the following complications during pregnancy: premature birth, low birth weight of the baby, the appearance of gestational diabetes, the onset of pre-eclampsia, which manifests itself as hypertension, swelling of the face and limbs, and the presence of protein in the urine[10] .

Pregnancy is not a contraindication to dental treatment. It is necessary to remove the plaque that develops, which is a substrate for the development of periodontal disease. During pregnancy there is also an increased secretion of saliva, the reaction of which becomes acidic. Under the influence of estrogen, the gums become hypertrophied and congested, which promotes their swelling and bleeding.

Any infection that develops in the mouth increases the risk of transferring the mother's bacteria into the baby's bloodstream, which can result in premature birth. The weight of premature babies is low, less than 2.5 kg. Women who gave birth to a low birth weight baby were found to have bacteria in the oral microflora that were significantly higher in number than women who gave birth to normal birth weight infants[11] .

The link between neglecting the treatment of gingivitis, periodontitis and fetal abnormalities, premature birth is due to the passage of pathogenic bacteria from the oral cavity to the placenta through the blood vessels. In the mother's placenta, there is an enhancement of local synthesis of cytokines and other inflammatory mediators, resulting in premature birth, low

---

[8] Blasszczak B., Piotrowska M., Brukwicka I. Oral health problems in pregnant women. Journal of Clinical Healthcare. 2017; 1; 15-19.
[9] Trębska- Świstelnicka M. Prevention. Plaque-dependent gingivitis. Med Trib 2011; 8: 6-8.
[10] Bręborowicz G. (ed.) Obstetrics and gynecology. Warsaw; PZWL; 2010.
[11] Baehni PC. et al. Interaction of inflammatory cells and oral microorganisms. Infect. Immun 2009; 24:233-243.

birth weight of the newborn. According to studies, as much as 60% of perinatal mortality in children is due to poor oral health. In addition, as a result of premature birth and low birth weight, the child is at risk for malformations and childhood diseases (e.g. blindness, deafness, asthma, obesity, type II diabetes, heart disease[12] .

References:

Arabska-Przedpełska B., Pawlicka H., Współczesna endodocja w praktyce, Lodz: Bestom DENT; 2011.

Baehni PC. et al, *Interaction of inflammatory cells and oral microorganisms. Infect*, Immun 2009; 24.

Banach J., *Clinical evaluation of the efficacy of toothpastes with triclosan and other formulations on inhibition of bacterial plaque and gingivitis - a review of the literature,* „Journal of Dentistry" 2008, 61, 3.

Barlett J.D., Lee Z., Eright J.T., et. al, *A developmental comparison of matrix metalloproteinase -20 and amelogenin null mouse enamel*, „Eur. J. Oral Sci.", 2006, 114 (suppl. 1).

Barnett M. L, *The role of therapeutic antimicrobial mouthrinses in clinical practice. Control of supragingival plaque and* gingivitis, , J. Am. Dent. Assoc: 2003.

Bartel H., *Medical embryology. An illustrated textbook*, Warsaw: PZWL; 2009.

Bloch B., *Cleaning interdental spaces*, , "TPS Prevention," 2008; 10.

Blaszczak B., Piotrowska M., Brukwicka I., *Oral health problems in pregnant women*, „Journal of Clinical Healthcare", 2017; 1.

Bręborowicz G. (ed.), *Obstetrics and Gynecology*, Warsaw; PZWL; 2010.

Cameron A. Widmer R., *Pediatric Dentistry*, Wroclaw: Edra Urban & Partner; 2012.

Davies RM., Ellwood RP., Davies GM, *The national use of fluride toothpaste*, , Int J Dent Hygiene 1, 2003.

[12] Kazmierczak W, Fiegler P, Fiegler-Męcik H. et al. Active periodontal tissue inflammation-an underestimated risk factor for preterm birth. Gynecol Prakt 2004; 3(78): 40-43

Dolińska E., Pietruska M., Paniczko A., *Evaluation of the effect of MERIDOL and LISNERE rinses on the periodontal status of generally healthy adults with chronic periodontitis*, „Annals of the Pomeranian Medical Academy in Szczecin", 2007; 53.

Freeman R., *Moderate evidence supports a relationship between sugar intake and dental caries*, „Evid Based Dent" 2014;15(4).

Górska R., Pietruska M., Dembowska E., et al, *Prevalence of periodontal disease in persons aged 35-44 years in populations of large urban areas*, „Dent Med Probl." 2012.

Herman N., Ryniewicz A. M., Ryniewicz W., *Analysis of determinants of enamel resistance to wear*, Part I., *Identification of biological and mechanical structure of enamel and its formation on tooth crowns*, Eng. Biomat., 2010, 95.

Ismail A. I., Pitts N. B., Tellez M., *The International Caries Classification and Management System (ICCMSTM): an example of a caries management pathway*, BMC Oral Health. 2015.

Jańczuk Z., Kaczmarek U., Lipski M., *Stomatologia zachowawcza z endodocją*. Warsaw: PZWL; 2014.

Jańczuk Z., Banach J., *Oral mucosal and periodontal diseases*, Warsaw; PZWL, 2004.

Joiner A., *Review of the effects of peroxide on enamel and dentine properties*, „Journal of Dentistry, 35, 2007; 12.

Kasiak M., *Toothpastes - composition and action*, , "TPS Prevention", 2009; 9.

Kazmierczak W., Fiegler P., Fiegler-Męcik H. et al, *Active periodontal tissue inflammation - an underestimated risk factor for preterm birth*, „Ginekol Prakt.", 2004; 3(78).

Klimuszko e., Sierpińska T., Gołębiewska M., *Construction of enamel and its resistance to pathological factors. A literature review*, , "Prosthodontics of Dentistry", 2015, LXV, 3.

Lewusz K., Perz A., Godzieba A., Kaczr K., *Patient with diabetes mellitus in the dental office*, „Dental Magazine", 2016; 3.

Madlena M., Dombi C., Gintner Z., Bánóczy J., *Effect of amine fl uoride/ stannous fl uoride toothpaste and mouthrinse on dental plaque accumulation and gingival health*, „Oral Dis.", 2004; 10.

Mielczarek A., Kwaśny M., Burdyńska S., *Erosive lesions of enamel - assessment of nanofidelity*, „Nowa Stomatologia", 2008, 1.

Miko S., Albrecht M., *Dental conditions and periodontal disease in adolescents with type 1 diabetes melitus*, „Br. Dent. J.", 2010, 27;208.

Miśkiewicz A., Szparecki G., *Periodontitis as a risk factor for cardiovascular disease*, „Dent. Med. Probl". 2010, 47, 4.

Monitoring the oral health of the Polish population 2016-2020, Ministry of Health Warsaw: 2021.

Okeson J., *Treatment of temporomandibular dysfunctions and short-circuit disorders*, Lublin, Czelej Publishing House; 2018

Pawka B., Dreher P., Herda J. et.al., *Dental caries in childern as a social problem*, „Probl Hig Epidemiol." 2010, 91(1).

Piatkowska D., *Anatomy of permanent teeth and conservative dentistry in phantom exercises*, Lodz: BESTOM DENTO; 2009

Piekoszewska-Ziętek P, Turska-Szybka A., Olczak-Kowalczyk D., *Dentogenital infections - a review of the literature*, „Nowa Stomatol.", 2012; 2: 120-134.

Sawicki W., Malejczuk J., *Histology*, Warsaw: PZWL; 2012.

Stanlej J., Ash M., *Dental structure, physiology and occlusion*, Wroclaw: Edra Urban&Partner; 2014.

Stodolak A., Fuglewicz A., *Prevention of dental caries in children and adolescents and promotion of oral health - the role of health care professionals*, „General Medicine and Health Sciences, 2014, Vol. 20, No. 1.

Szeląg N. *Toothbrushes - part 1*, , "Dental Assisting", 2016; 1.

Trębska-Świstelnicka M. Prevention. Plaque-dependent gingivitis. Med Trib 2011; 8: 6-8.

Wójtowicz A., Malm A., *Microbiological basis of caries in the aspect of its prevention*, „Microbiology" 2009; 5.

Woynarowska B. (ed.), *Prevention in pediatrics,* Warsaw. PZWL; 2008.

Wolf H.F., *Periodontology*, Lublin: Czelej Publishing House; 2006.