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The role of proper maternal nutrition during pregnancy for caries prevention in both mother and child. Opinion of the working group of the Polish Alliance for a Cavity-Free Future on dental prophylaxis in pregnant women

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Keywords

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Summary

Introduction. Proper nutrition in pregnancy has effects on the health and well-being of the mother as well as is a key factor responsible for foetal growth and development, which are initiated at conception and last throughout pregnancy.
Aim. The aim of the paper was to present relevant data on the role of prenatal maternal nutrition for caries prevention in both mother and child.
Material and methods. Pubmed, EMBASE, MEDLINE, guidelines of dental associations and World Health Organization were searched using the following keywords: "diet", "dentition", "pregnancy", "oral health in pregnancy".
Results. The diet of a pregnant woman should be well-balanced and rich in proteins, calcium, phosphorus, fluorine and vitamins (A, C and D). Women should avoid sneaks between meals or at night to avoid dental plaque accumulation and oral pH decrease. Balanced nutrition influences the development of future nutritional habits of the child as taste receptors begin to develop already at month 4 of pregnancy. High maternal consumption of confectionery in this period may in the future increase the child's tendency to consume sweet food products.
Conclusions. There is a need to intensify dental prophylaxis among pregnant women through introduction and promotion of proper nutrition in dental offices, up-dating teaching programs for dental hygienists and education in birth schools.

Introduction

Proper nutrition in pregnancy has an impact on the health and well-being of the mother as well as is a key factor responsible for foetal development. After birth, the processes of growth and further development continue until early adulthood. Proper nutrition is of key importance for the general health at all stages of both pre- and postnatal life (1). The diet of a pregnant woman should contain all essential nutrients, which provide building material for the developing child as well as cover the energy needs of the mother. During pregnancy and lactation, there is an increased maternal

demand not only for energy, but also for nutrients and the following minerals: calcium, phosphorus, magnesium, iron, zinc, copper, iodine, selenium and vitamins: A, B_1, B_2, niacin, choline, pantothenic acid, B_6, B_{12}, C, E, and folates. Improper nutrition during this period may involve excess consumption or inappropriate choice of food products (e.g. increased consumption of carbohydrates, products rich in protein and fats, insufficient fruit and vegetable consumption, replacing meals with confectionery), which may lead to insufficient vitamin and nutrient intake, and, consequently, maternal and foetal metabolic disorders. Although energy demand in the first trimester is the same as before conception, the requirement for different nutrients is much higher in this period. Since the foetus derives necessary compounds from the mother's body, proper nutrition before conception, during pregnancy and lactation is necessary. The daily energy requirement increases by 360 kcal in the second trimester, and by 475 kcal in the third trimester compared to energy demand before pregnancy.

A well-balanced diet determines proper dental tissue formation and mineralisation as tooth buds begin to form during the embryonic period, with their further development and mineralisation continuing throughout pregnancy. Controlling maternal diet may help eliminate abnormalities in dental development associated with insufficient consumption of structural materials (1).

Furthermore, diet is an important element of caries prevention in pregnant women. The direct effects of nutritional habits on oral health status are due to the local action of food on the oral environment. Excessive consumption of carbohydrates is one of the risk factors for caries. Degradation of carbohydrates by cariogenic bacteria triggers the production of acids and oral pH drop, both of which affect dental tissue mineralisation. Consumption frequency and food consistency are also important for caries development.

Aim

The aim of the study was to develop dietary recommendations for prenatal maternal nutrition in the context of caries prevention in both mother and child.

Material and methods

We performed a review of research and recommendations of the World Health Organisation as well as teams of experts assessing the relationship between diet and oral hygiene in pregnant women and the presence of caries in their children was conducted by searching through databases, such as Pubmed, EMBASE and MEDLINE, using keywords such as "diet", "dentition", "pregnancy" and "oral health in pregnancy". The following filters were used: English language, original papers, review paper, recommendations, and guidelines.

Results

The effects of nutrients on dental development

Proper nutrition before and during pregnancy may have an impact on child's teeth. About 6 weeks after conception, deciduous teeth begin to form from foetal oral cells, which differentiate and divide to form a dental lamina, from which tooth buds will later develop. The process of dental mineralisation begins from the bell stage or at about 4 months gestation during dentin formation with enamel deposition (2, 3), which continues uninterrupted until adolescence (4).

Maternal systemic diseases, pharmacotherapy, nutrient deficiency or the effects of teratogens during pregnancy may affect deciduous and permanent teeth development both during pre- and postnatal life (5-8). For example, 83% of the enamel of central incisors, which erupt first, is already formed at birth. There is also a relationship between the dietary supply of different nutrients and the critical phase of dental mineralisation, which already begins at 4 months gestation. An insufficient level of mineralisation is a risk factor for early childhood caries (ECC) or enamel development disorders, which are also considered to be factors predisposing to ECC (9, 10).

Proper structure of mineralised dental tissues, which determines resistance to caries, primarily depends on the sufficient supply of mineral salts, such as calcium, phosphorus, fluorine, magnesium, molybdenum, manganese and vitamins, particularly vitamin A, C and D (11, 12).

The effects of different nutrients on oral health is reflected by the symptoms of their deficiency occurring during the development of dental buds. Vitamin A and D deficiency as well as protein and energy deficiency in pregnancy are risk factors for enamel hypoplasia and salivary gland atrophy in the child, which may result in decreased salivary buffer capacity, and, consequently, increased susceptibility to caries (13-15). Vitamin deficiency is observed in the case of malnutrition due to fat and carotene deficiency; elimination of dairy products, fresh fruit and vegetables; in the case of impaired fat digestion and absorption; as well as in patients with liver failure (16). Vitamin deficiency in pregnancy may lead to impaired tooth morphogenesis, dental hypoplasia, delayed eruption, enamel hypoplasia in the form of hypoplastic defects, as well as impaired odontoblast differentiation and function, manifesting in atypical dentin formation (14), and impaired dental mineralisation (13). The main sources of vitamin A include animal and fish liver, dairy products, eggs, yellow vegetables (carrot) and green leaves (spinach, cabbage, lettuce), tomatoes, red peppers, gooseberries, gooseberry, black currants, melon and mango. It should be noted that retinoids (vitamin A derivatives) have teratogenic effects, whereas carotene (a form of vitamin A found in fruit and vegetables) has no toxic effects. The daily requirement for vitamin A is increased during pregnancy and lactation,

i.e. 0.9-2.7 mg, and its deficiency may lead to premature birth and low birth weight (17), which are also risk factors for ECC, as well as increased bleeding secondary to placenta praevia (16).

Vitamin D_3 is an essential catalyst for the calcium-phosphate metabolism. Along with parathormone and calcitonin, it is responsible for mineralisation and resorption of bone tissue, absorption, as well as the use and regulation of phosphate and calcium levels in the body. The oral symptoms of vitamin D deficiency include reduced dental arches, malformation of the maxillary bones and the alveolar ridge leading to malocclusion, impaired tooth eruption or even primary retention. Vitamin D deficiency may result in ameloblast dysfunction with insufficient enamel, dentin and root cement mineralisation; delayed eruption and a reduced size of molars. Deciduous teeth hypomineralisation due to vitamin D, calcium and phosphate deficiency may increase the risk of EEC (2, 18). On the other hand, excess of this vitamin may induce structural changes in teeth, such as thinner enamel layer. The daily demand is 300-600 IU, and up to 800 IU in the third trimester and during lactation (18).

Calcium and phosphate deficiency during foetal life significantly affects dental tissue mineralisation. Vitamin D decreases calcium levels in cellular plasma. Insufficient dietary supply of calcium, phosphates and vitamin D results in decreased calcium levels in the cellular matrix, leading to enamel hypoplasia or hypomineralisation, impaired dental tissue integrity and delayed eruption. Impaired dental tissue formation due to prenatal calcium, phosphate and vitamin D deficiency is irreversible and may affect both, deciduous and permanent teeth (5, 18).

Vitamin C also has a significant impact on dentin development (19). The compound is necessary for normal integrity and function of odontoblasts, fibroblasts and chondroblasts (6, 19, 20). It is also essential for collagen synthesis. Collagen forms the organic matrix in the process of calcium phosphate crystal deposition and bone mineralisation (19, 21). Vitamin C deficiency during odontogenesis leads to odontoblast atrophy (20), as well as irregular, reduced dentin deposition and impaired tooth growth. Fragile vessels in the pulp may cause odontoblast dysfunction, leading to dentin hypoplasia. Long-term vitamin C deficiency causes scurvy, which may in turn, cause oedema, gingival bleeding and loss of dentition. Vitamin C and vitamin A exhibit a synergistic action, promoting tooth development and mineralisation (19). Food products rich in vitamin C include milk, potatoes, vegetables (cabbage, celery, tomatoes, onions, kale, kohlrabi, broccoli, pepper), citrus fruits, blackcurrants, wild rose, and kiwi. Iron and iodine ions have an impact on proper odontogenesis. Iodine deficiency may result in delayed eruption and malocclusions. Insufficient iron levels during foetal life may impair dental tissue integrity, delay growth and development, as well as cause salivary gland dysfunction. Furthermore, both these minerals are essential for the general growth and development of the foetus (3).

Fluorine affects many metabolic processes associated with the proper mineralisation of hard tissues. Additionally, fluorine inhibits enzymatic reactions, cellular respiration, carbohydrate and fat metabolism, and the synthesis of certain hormones (22). The 1994 WHO report includes a statement that there is not enough evidence that the endogenous use of fluoride during pregnancy reduces the child's susceptibility to caries. The placental barrier is a mechanism limiting the penetration of this element into the foetal circulation. The local prophylactic effect of fluorine on the teeth in a pregnant woman is due to the use of hygiene preparations containing this compound (22-26).

Dietary and hygiene habits in pregnant women

Changes in the dietary habits of a pregnant mother, such as increased carbohydrate intake and meal frequency, snacking between main meals as well as indigestion, nausea and vomiting that occur in some women in the first trimester, may have adverse effects on oral health. Frequent snacking of confectionery and drinking fruit and sweet juices cause frequent salivary pH drops, which increases the risk of caries and may also lead to enamel erosion and dental hypersensitivity. The changes in dietary habits are often associated with the belief that it is necessary to "eat for two" (21, 27, 28).

Epidemiological studies in a group of pregnant patients confirmed a change in this type of behaviour. Women declared, among other things, increased frequency of meals, increased appetite, more frequent consumption of sweet food products, as well as night-time consumption of confectionery and other products (28-31). According to some authors, foetal taste receptors begin to develop at 4 months gestation (8 months according to other authors). In the same period, maternal tendency to consume large amounts of confectionery, which may in the future increase the child's tendency to consume sweet products, may be observed (32-37). Additionally, the study showed insufficient intake of vegetables, fruit, dairy products and proteins. Also, low awareness of the impact of diet on the course and development of pregnancy was demonstrated among women (11, 31). In many cases, the increased frequency of food consumption does not correlate with intensified oral hygiene, which may be a potential risk factor for caries. Therefore, refraining from frequent snacking, consumption of acidic foods, as well as sweetened and carbonated beverages is advised.

Oral environment

Decreased oral pH may be due to the observed increase in α-amylase activity in pregnant women, which may increase the amount of substrate for cariogenic bacteria. Gastro-oesophageal reflux may also be responsible for the decrease in salivary pH in pregnancy. Reduced

salivary pH accompanied by increased supply of substrates for bacterial metabolism create an environment that promotes enamel demineralisation. Increased serum progesterone levels are responsible for reduced levels of bicarbonates, which are a natural salivary buffer. Additionally, nausea and vomiting followed by gastro-oesophageal reflux contribute to long-term contact of enamel and gastric acids (38-40).

The principles of proper nutrition in pregnancy

The diet of a pregnant woman should not differ from a well-balanced diet of every human being. The nutritional status of a woman both before conception and during pregnancy has an impact on the development and future health of the child. Improper diet may lead to premature birth, low birth weight, anaemia, cardiovascular diseases, hypertension, diabetes, obesity, intrauterine growth inhibition, morphological changes in the kidneys, high risk of metabolic syndrome in adulthood, as well as abnormal neurogenesis (abnormal brain development, neural tube defects, abnormal development of the skeletal system) (38). A well-balanced diet in the aspect of caries prevention is not limited to the choice of appropriate nutrients, but is also associated with the way of consumption (food consistency, frequency of meals) (39).

The diet of a pregnant woman should be varied to avoid nutrient deficiency. Therefore, pregnant women should choose products with the highest nutritional value, but low in calories to avoid increased weight gain. According to the US guidelines, the optimal weight gain during pregnancy depends on the baseline body weight. For pre-pregnancy weight deficiency (BMI < 18.5) the recommended weight gain is 12.5-18 kg. The weight gain should range between 11.5 and 16 kg for normal BMI (18.5-24.9), 7-11 kg for overweight (BMI 25.0-29.9) and 5-9 kg for obesity (BMI ≥ 30) (36). Excess weight gain increases the risk of long-term obesity both in the mother and the child, which consequently increases the risk of obesity-related cardiovascular diseases. It also promotes diabetes in pregnancy, hypertension, neonatal macrosomia, premature birth or the need for Caesarean section. On the other hand, insufficient weight gain in pregnancy is associated with low birth gain, which increases the risk of perinatal mortality and morbidity as well as may cause developmental disorders in childhood and contribute to cardiovascular diseases, diabetes and hypertension at a later age (40).

Conclusions

The most important principles of maternal nutrition in pregnancy are as follows:

1. The diet should be well-balanced and rich in protein, calcium, phosphorus, fluorides and vitamins (A, C and D). Vitamin and mineral supplementation is recommended in cases where there is no adequate supply of vitamins, micro- and macronutrients.
2. The number and frequency of meals are as important as the quality of diet. Snacking between meals or at night should be avoided as it leads to continuous dental plaque formation and oral pH drops.
3. A well-balanced diet has an impact on the shaping of the child's future dietary habits as taste receptors begin to develop already at month 4 of pregnancy. High maternal intake of confectionery during this period may in the future increase the child's tendency to consume sweet food products.

The working group on dental prophylaxis in pregnant women of the Polish Alliance for a Cavity-Free Future recommends the introduction and promotion of the principles of proper nutrition in dental surgeries, teaching programs for dental hygienists and the educational program in birth schools, as well as intensification of the already implemented activities.

Conflict of interest

None

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