

Review Article

Nutritional considerations in pediatric dentistry- A review

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ABSTRACT:

Diet and nutrition are significant influencers of oral health status in pediatric population and can affect the development and progression of oral diseases and conditions such as dental caries, gingival and periodontal diseases, erosion etc. Nutrition can be classified as micro- (vitamins and minerals) and macro- (carbohydrates, protein, and fat) based upon dietary requirements. The relationship between diet and nutrition with the oral health is bi-directional as compromised integrity of the oral cavity can also influence an individual's functional ability to eat. Children and adolescents have high nutritional requirements relative to their size to meet demands for growth, development, and physical activity. In the present article, the authors highlight the importance of balanced diet and nutrition in child's oral health and possible complications of inadequate dietary intake in context to pediatric population.

Keywords- Balanced diet, Dental caries, Flourides, Malnutrition, Nutrition.

Received: 21 May, 2023

Accepted: 25 June, 2023

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This article may be cited as: Darshan V, Kumar P, Bal SCB, Singh B, Gupta P. Nutritional considerations in pediatric dentistry- A review. J Adv Med Dent Scie Res 2023;11(8):37-42.

INTRODUCTION

Nutrition is the physiological process by which an organism consumes food to support its growth, metabolism and functional repair. Good quality nutrition is extremely important for humans throughout their life course as it drives growth and development in children and thus helps in preventing many systemic diseases arising as a result of malnutrition. Children and adolescents have high nutritional requirements to meet demands for growth, development, and physical activity. Dietary patterns and habits established early in life will influence health in the short and longer-term.¹

A variety of dietary factors are hypothesized to influence the oral cavity including macro- and micronutrients, vitamins, salivary Ph and eating behaviours. In addition, many medical conditions require a change in dietary habits. Since there is bi-directional relation between diet and nutrition with the oral health, poor or inadequate quality of diet and

eating habits have significant negative impact on oral health. In reverse many oral health problems such as caries, erosion, soft-tissue lesions and chronic infection can result in inadequate dietary intake resulting in impaired growth.²

In the present article, the authors discuss briefly about various nutrients and their effect on pediatric patients and the clinicians must focus on healthy dietary and nutritional practices for dental patients within the scope of pediatric dentistry.

DIET AND NUTRITION

A healthy diet and proper nutritional intake is important for well being and positive health of the individual. Diet in simple terms refers to the composition, consistency of the ingested food and the pattern as well as the frequency of eating. While, nutrition can be described as the systemic effects of nutrients on the growth, development, regeneration and functional repair of tissues.³ In other words, diet

refers to the total amount of food consumed by individuals, whereas nutrition is the process of utilizing food for the growth, metabolism, and repair of tissues.⁴

CLASSIFICATION OF NUTRIENTS

Nutrients can be broadly classify into macro and micro nutrients.

1. Macro-nutrients-

a) Carbohydrates- Carbohydrates are quantitatively the most important dietary energy source for most populations, usually contributing 55–75% of total daily energy requirements (WHO 2003). The average intake of dietary carbohydrates is more in developing countries. They are predominantly derived from plant foods.

b) Fats and lipids- These are defined as a group of organic compounds that are insoluble in water but soluble in non-polar solvents. In contrast with carbohydrates, lipids are not polymers but smaller molecules extracted from the tissues of plants and animals.⁵ Fats can be considered as long-term fuel reserve, owing to their high energy density. They can also act as solvents in the absorption of fat-soluble vitamins and utilised as the precursors for hormone synthesis.⁵

American Academy of Pediatrics in 1982 emphasizes the need for dietary fat and cholesterol at least during the first year of life, therefore they do not recommend the use of reduced-fat milk during infancy.

c) Proteins- Proteins are the most common nitrogen-containing compounds in the diet. Proteins are considered as the building blocks of life since they are constituent of various vital structural and functional components within cells and tissues of the body. Proteins are involved in acid-base balance, fluid regulation and osmosis, immunity, growth, differentiation, gene expression etc. Proteins are made up of long chains of amino acids, linked by peptide bonds.

Low intake of animal-sourced proteins during late pregnancy is believed to be associated with low birth weight.⁶

2. Micro-nutrients- These include vitamins and minerals which is required in minute amounts in most foods and are essential for normal metabolic function.

a) Vitamins- They are a group of organic compounds that cannot be synthesized by humans and should be provided in the diet. Vitamins are classified into 2 groups based on their solubility.⁷

1- Fat-soluble (vitamin A, D, E, and K)

2- Water-soluble (vitamin C and B complex).

b) Minerals –They are a group of inorganic elements that must be provide from the external source and are necessary for a variety of functions such as the formation of bones and teeth, constituents of body fluids and tissues and nerve propagation.

Calcium- Both Calcium and vitamin D are required for proper mineralization of bones and teeth. In

addition, calcium is also required for proper nerve and muscle activity, blood clotting, and transport of ions across cell membranes. Individuals who avoid milk and related products are at a greater risk of calcium deficiency. Inadequate dietary calcium intake over time can significantly increase the risk of tetany and osteoporosis. This problem may be alleviated by consuming calcium-rich foods (e.g., cheese, yogurt, fortified breakfast cereals, fortified orange juice concentrates) and calcium supplements.⁸

Zinc-The trace mineral zinc has important roles in growth and development, sexual maturation, immune function, wound healing, taste and smell acuity. Iron and zinc share many common food sources, so individuals at risk for iron deficiency may also be at risk for zinc deficiency. Severe zinc deficiency in children can result in stunted growth. Other signs and symptoms may include abnormal immune responses, decreased reproductive development and function, and skeletal abnormalities. Oral manifestations include impaired wound healing, alterations of the oral epithelium, xerostomia, possible risk of dental caries, alterations in taste sensation and reduced appetite.

Zinc deficiency may also increase the risk of periodontal disease and candidiasis because of its effect on immune system.⁹

Iron-Iron is a important constituent of hemoglobin and muscle myoglobin, by providing cells with a constant supply of oxygen. Iron is also an important constituent of various enzymes and functions as a cofactor for many enzymatic reactions.

Iron deficiency in childrens and adults may result in iron-deficiency anemia. Clinical signs & symptoms of may include weakness, fatigue, pallor, numbness and tingling of the extremities. Common oral manifestations are atrophic glossitis, angular cheilitis, atrophy of the filiform papillae resulting in tongue which is smooth, shiny, red in appearance, generalised pallor of the oral mucosa and lips, increased risk of candidiasis.¹⁰

Magnesium-Magnesium is another mineral with important roles in human metabolism and is widespread in both animal and plant food.¹¹

Phosphorus- Phosphorus is required for strong bones and teeth since it's the second most abundant inorganic compound in the body after calcium. Phosphorus also plays an important role in carbohydrate, lipid, and protein metabolism.

Iodine-Iodine is considered essential because it is a constituent of hormones thyroxine and tri-iodothyronine, which are necessary for normal physical and mental growth (i.e. maintenance of metabolic rate, thermoregulation, protein synthesis, and connective tissue integrity).^{1 2}

Fluoride-Fluoride (F) is a natural element found at different concentrations in water, air, soil, and food. Since F is extremely electronegative, it mainly appears as F compounds rather than in its free elemental form. There are 2 general forms of F;

organic and inorganic. Dentifrice ingestion can be a considerable source of systemic F intake in children younger than 6 years of age, as they are not in full control of their swallowing reflex. Most toothpaste usually contains 1,000–1,450 mg F/kg and therefore 1 gram of toothpaste contains about 1.0–1.5 mg F (WHO 2022). Depending on the age of the child, the amount of dentifrice used, and rinsing habits, children could ingest 0.13–0.59 mg F per tooth brushing session. F is of nutritional and public health importance and is considered a valuable nutrient by the American Dietetic Association (ADA) because of its role in the re-mineralization of teeth and bones.

The US Food and Drug Administration (FDA) has regarded F as the only substance for the prevention of dental caries. F achieves its anti-caries effect through systemic and topical actions. During tooth development, ingested (systemic) F is incorporated into the hydroxyapatite crystals of the developing tooth which helps in improving the resistance of tooth to acid demineralization.¹³

Water-Water is a vital component of any healthy diet it is essential for the preservation of life, and aids in regulation of the body's temperature and metabolism. Water is beneficial for the treatment of obesity since adequate water intake has direct and indirect effects on the regulation of body weight. Drinking a lot of water, which is always advised during weight-reducing diets before the main meal, can help to fill the stomach, decrease appetite and determine the total amount of food consumed increasing weight loss.¹⁴

Milk, Dairy Products and Additive Sugars- Milk is an important part of the human diet: for infants, it is the only source of essential nutrients. Some of the earliest investigations regarding milk and dental caries were carried out by **Sprawson**¹⁵ who concluded that milk improved oral health. **Mellanby and Coumoulos**¹⁶ found that milk is attributed to the improvement of children's teeth.

Sugar is added to food for a multitude of functions such as fermentation, preservation, and also to satisfy the consumer's preference for sweetness. Unfortunately, sugar consumption is also a main etiological factor for dental caries. The relationship between sugar and dental caries was established in the latter half of the 19th century. Many factors influence this relationship such as the availability of sugar for bacterial digestion, the presence of acidogenic bacteria in the plaque on teeth, the amount of fluoride intake and buffering capacity of saliva to counteract bacteria and acids. Caries results from an imbalance between demineralization and remineralization of tooth minerals. Frequent sugar consumption and acidogenesis by plaque bacteria cause demineralization. The effect of the frequency of sugar intake is hard to discern from the amount of sugar intake since the frequency of sugar intake and the amount of sugar consumed in populations are closely correlated.¹⁷

Study conducted by **Mattos-Graner et al. (1998)**¹⁸ recorded that children who had drunk milk with added sugar had a higher caries experience than children who had drunk milk with no added sugar. In another study by **Dunning and Hodge (1971)**¹⁹, reported results of a 2-year clinical trial in American children and young adults. Caries increment was slightly higher in children drinking milk with 6% sugar added compared with children drinking milk without sugar. Thus, it can be concluded that the addition of sugar to milk increases the risk of caries development. The concentration of added sugar at which caries development might begin is uncertain but maybe as low as 2%.¹⁹

NUTRITIONAL CONSIDERATIONS IN PEDIATRIC PATIENTS AND THEIR EFFECT ON ORAL HEALTH

Mugonzibwa et al, 2002²⁰ and **Psoter WJ et al 2008**²¹, on the basis of their study results concluded that the eruption of both primary and permanent teeth will be delayed in chronic nutritional deficiency.

The stages of early life may be broadly defined as infancy, preschool year, childhood, and adolescence, each of these periods has its own energy and nutrient requirements reflecting specific rates of growth and development. The first year of life (infancy) is characterized as a time of extraordinary growth and development, with rates of growth slowing over the next 10 years or so until adolescence and thereafter accelerating again during puberty until adulthood. Growth height typically ceases at around 16 years of age for girls and 18 years for boys. Newborn infants are born with oral anatomy that is optimized to support suckling during breast and/or bottle-feeding. However, within the first 24 months of life, their oral anatomy undergoes enormous changes in the transition to a toddler's oral cavity that has the requisite volume, dentition, and muscle coordination to masticate and swallow complex textures.²²

Disturbances in the orofacial structures and normal chewing function have a negative impact on the processes of nutrient intake which is vital for growth and development in childhood. On the other hand, unbalanced nutrition can also adversely affect oral structures.²³

NUTRITION CAN AFFECT DENTAL STRUCTURES BY TWO MECHANISMS

1) After absorption of nutrients, they exert endogenous effects on the teeth before their eruption into the mouth. This concerns dental germination, organic matrix formation, and mineralization processes. As a result of unbalanced dietary intake, enamel and dentin hypoplasia, fluorosis, reduced number of teeth, alteration in the shape of teeth, change in odontoblastic differentiation, pulp alterations, etc. may occur. According to **(Psoter et al., 2008)** chronic early childhood, malnutrition can cause a

slow tooth eruption and replacement and an increased risk of developing caries. The resorptive action of food after tooth eruption is associated with the creation of a cariogenic or caries-protective oral environment.²¹

- 2) The exogenous influence of food on dental structures can cause dental diseases and dental erosions. Studies show that increased intake of high acid foods and beverages increases the chemical destruction of hard tooth tissues.²⁴

Evidence of the effect of the frequent and high sugar consumption, carbohydrate retentivity and the time of ingestion on caries development is the Vipeholm study (**Gustafsson, 1956**). The results show that additional sugars in food significantly increase caries activity, but the degree is strictly dependent on the consistency of carbohydrates themselves. The risk of caries is higher when the consumed sugar or confectionery is out of the main daily meals and is in a form requiring extra time in the oral cavity (lollipops, candy, etc.).

NUTRITION IN THE PERIOD OF INFANCY

The mother should be advised to continue breastfeeding. The pediatrician should promote the importance of breastfeeding beyond 6 months while supporting the mother regarding her decision. It is recommended that all infants who are breastfed be given a liquid vitamin D supplement of 400 IU (10 µg) every day. A small amount of water can be offered from an open cup. Parents should avoid delaying the introduction of solid foods beyond about 6 months of age to reduce the risk of iron deficiency, solid foods can be offered before or after breast milk.²⁵

PRACTICAL RECOMMENDATIONS FOR INITIATING COMPLEMENTARY FOODS (AMERICAN ACADEMY OF PEDIATRICS, 2009)

- 1) Introduce one single ingredient food at a time to identify possible allergic reactions.
- 2) Choose foods that provide key nutrients, such as iron and zinc.
- 3) Introduce a variety of foods by the end of the first year.
- 4) Withhold cow's milk (and other milk substitutes not formulated for infants) during the first year of life.
- 5) Ensure adequate calcium intake when transitioning to complementary foods.
- 6) Do not introduce juice during the first 6 months of life.
- 7) Ensure safe ingestion and adequate nutrition when choosing and preparing homemade foods.

NUTRITIONAL REQUIREMENTS IN TODDLERS

According to the **American Academy of Pediatrics 2009**, growth slows compared with the first year

resulting in decreased appetite with erratic and unpredictable food intake. Breastfeeding should continue as long as the mother and child want, if not breastfed, advice to offer 500 mL (2 cups) of pasteurized when cow milk (vitamin D fortified goat milk) each day.

PRE-SCHOOLERS AND SCHOOL AGED POPULATION

It is the progressing stage to the adult eating pattern but needs adult modeling. Food consumption moderates to match a slower rate of growth. Eats most foods without coughing and choking. It's recommended to offer iron-rich foods at each meal.

The recommendation is to provide diet soda pop or other sugar-free beverages. Diet soda pop or other sugar-free beverages are not associated with increased caries risk or excessive energy intake.

GENERAL NUTRITION GUIDELINES FOR CHILDREN (AMERICAN ACADEMY OF PEDIATRICS 2009)

- 1) Make available and offer a colorful variety of fruits and vegetables for children to consume every day.
- 2) Limit intake of foods and beverages with added sugar or salt.
- 3) Keep total fat between 25% and 35% of total calories for children 4 – 18 years of age.
- 4) Offer fruits, vegetables, fat-free or low-fat dairy, and whole-grain snacks.

Adolescents -The onset of puberty presents increased nutrition risk due to dramatic changes in physical, cognitive and emotional development. Menstruating females may need iron supplementation.

Eating out - Children and teenagers continue to obtain more of their meals outside the home, often from fast-food establishments. From the late 1970s through the mid2000s, the percentage of daily calories consumed in fast-food restaurants by children aged 2-18 years grew from 2% to 13%, while full-service restaurants' contribution to their daily caloric intake increased from 1% to 5% .²⁶ Fast food intake increased total fat, saturated fat, sugar, sodium, and protein for teenagers.²⁷

Malnutrition - According to the WHO, malnutrition is the 'cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions, and is the greatest risk factor for illness and death worldwide.

Malnutrition includes undernutrition which is defined as the inadequate intake of nutrients leading to deficiency diseases. Failure to thrive is a concern sometimes observed among infants and children. This term refers to individuals whose current body weight or rate of weight gain falls significantly below that of other children of similar age and gender.

Nutrient undernutrition may have several causes such as inadequate dietary intake, poor socioeconomic

status, illiteracy, perceived allergies/food intolerances and child neglect.¹¹

FEEDING & EATING DISORDERS AND OTHER MALNUTRITION DISEASES

Disordered eating is a term that includes unhealthy eating behaviors from inappropriate dieting to clinical eating disorders.²⁸ These includes-

Anorexia Nervosa- It is condition of self-induced starvation. Anorexia may be of the restrictive type, in which food intake is severely limited, or of the binge eating in which individuals engage in self-induced vomiting or the misuse of laxatives, diuretics, or enemas. It is characterized by self-imposed weight loss and amenorrhea

Bulimia Nervosa – It is characterized by binge eating and invariably by self-induced vomiting. It also is more prevalent in young women and is more common than anorexia nervosa.¹¹

KWASHIORKOR AND MARASMUS

Kwashiorkor (A West African word for ‘displaced child’) is a severe form of undernutrition, which develops in individuals on diets with a low protein/energy ratio. The main symptoms of Kwashiorkor are edema, wasting, liver enlargement, hypoalbuminemia, steatosis, an depigmentation of skin and hair.

Marasmus (Greek word meaning ‘to waste away’) is the other form of malnutrition, which is caused by the inadequate intake of both protein and energy. The main symptoms of marasmus are severe wasting, with little or no edema, minimal subcutaneous fat, severe muscle wasting, and abnormal serum albumin levels.

Coeliac Disease – Is an autoimmune disorder triggered by the ingestion of gluten, a protein found in wheat. Ingestion of gluten damages the villi in the small intestine resulting in malabsorption of nutrients including iron, folic acid, calcium, and fat-soluble vitamins. It can be diagnosed at any age. Treatment includes lifelong adherence to a gluten-free die.²⁹

CONCLUSION

Diet and nutrition have an interconnected relationship with oral health and overall general health of the pediatric patients. Since newborns and children are in development stage, they require more energy to accommodate the ongoing development. Malnutrition cause disturbance in the normal development of teeth and hence it will effect the newborn feeding and vice versa. Thus it becomes very necessary to carefully monitor diet and nutrition in child by the parents and paediatric dentist. Children’s oral health must be promoted and ensured through policies and programs that affect children within the contexts of their families, communities, and society.

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