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Nutritional Considerations for the Pediatric Dental Patient

A project

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Fulfillment of the Requirement for the Bachelor of Dental Surgery

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Certification of the Supervisor

I certify that this project entitled " **Nutritional Considerations for the Pediatric Dental Patient**" was prepared by the fifth-year student **Rusul Akram Hussein** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the degree of the Bachelor Degree in Dentistry .

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Dedication

To my father who taught me the meaning of life.

To my mother the origin of my success.

To my brothers and sisters, may God bless them.

To my husband and soul mate who stand with me at every step and never let me alone .

To my all friends

They gave me the power to stay strong and never fall down.

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List of Abbreviation

%	Percentage
USDA	United States Department of Agriculture
BMI	Body mass index for children
US	United States

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Introduction

Nutrition is the physiological process by which organisms use food to support growth, metabolism, and repair. Nutritional stages are ingestion, digestion, absorption, transport, assimilation, and excretion. Good quality nutrition is extremely important for humans throughout their life course as it drives growth and development in children and helps prevent many systemic diseases in adults and malnutrition in older adults. Children and adolescents have high nutritional requirements relative to their size 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 (Frost, 2005).

Nutritional status and oral health are interconnected. Good nutrition is essential for optimal growth, development, and maintenance of all tissues and organs in the body, including the oral cavity. Poor or inadequate dietary habits can negatively impact oral health, on the other hand oral health problems including dental caries, dental erosion, soft-tissue lesions, and infection can result in inadequate nutrition which may impact weight status and ultimately growth (McKenna, 2021).

Aims of the study

To discuss the relationship between good nutrition and oral health and focus on healthful dietary and nutritional practices for dental patients presented within the framework of pediatric dentistry

Review of literature

1. Diet & Nutrition

Oral and systemic well-being is fundamentally linked with diet and nutrition. Diet denotes the local actions of food on oral tissues and includes the composition of food, its consistency, and the pattern as well as the frequency of eating. In contrast, nutrition describes the systemic effects of nutrients on the development, regeneration, and repair of tissues (Speirs and Beeley, 1992). There is a synergistic multidirectional relationship between oral health and nutrition and diet. 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. So not all diets are nutritious (Zohoori and Duckworth, 2020).

2. Malnutrition and Food Insecurity

According to Dean, (2016) malnutrition includes:

1. Under nutrition (inadequate intake of nutrients that potentially leads to deficiencies)
2. Over nutrition (excessive dietary intake of energy, fat, or cholesterol that predisposes individuals to chronic diseases).

While the latter excessive consumption pattern may be quantitatively more relevant to overall mortality and morbidity rates in contemporary United States (US) society than are nutrient deficiencies, malnutrition from dietary insufficiency has not been eradicated. Chronic malnutrition as measured by low weight for age and low growth rates has decreased; some of this decline has been attributed to better nutrition (Dean, 2016).

2.1 Pediatric Undernutrition

Undernutrition is the insufficient consumption of essential nutrients, resulting in health problems. 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. These children are much smaller and shorter than their counterparts and may lack mental and social skills as well as physical abilities such as rolling over, sitting, standing, and walking. Although there are numerous potential environmental and medical causes of failure to thrive, poor eating habits such as not having formal mealtimes or chronically eating in front of the television may play a role (Dean, 2016).

Typically, in mild but chronic undernutrition, weight loss with normal height and head circumference is seen. If the situation continues, growth will slow down, and head circumference and height will be below age- and gender-related standards. Severe lack of caloric intake results in a wasting condition known as marasmus. Adequate intake of calories with insufficient protein can produce kwashiorkor, a condition characterized by increased susceptibility to infections and edema (Eicher and Zhao, 2018).

According to Black, (2008) undernutrition may have several causes, only one of which is :

1. inadequate dietary intake.
2. Some cases may be secondary to poor socioeconomic status,
3. lack of education,
4. perceived allergies/food intolerances,
5. child neglect or abuse.
6. Historically, iron, calcium, and zinc are three minerals sometimes ingested only at marginal levels by many youths.
7. Vitamins D and B12 have also been found difficult to ingest at recommended levels among children and adolescents in research studies.

2.1.1 Iron

Iron fulfills its primary role in the body as a component of blood hemoglobin and muscle myoglobin by providing cells with a constant supply of oxygen. It also functions as a cofactor for many enzymatic reactions in the body and is important for proper functioning of the immune system. Many of the adverse consequences of iron deficiency are associated with its most severe form, iron deficiency anemia. However, iron deficiency without anemia is associated with poor cognition and lower scholastic achievement in children and adolescents (Baker and Greer, 2010).

clinical signs of iron deficiency anemia may include weakness, fatigue, pallor, and numbness and tingling of the extremities (Dean, 2016).

According to Dean, (2016) oral manifestations are:

1. Glossitis and fissures at the corners of the mouth (angular cheilitis) it is common.
2. The papillae of the tongue may be atrophied, which gives the tongue a smooth, shiny, red appearance.
3. Pallor of the oral mucosa or lips may be observed.
4. Affected individuals may also be at increased risk for fungal infections, such as candidiasis.

Iron needs are higher during growth stages, and those most vulnerable to iron deficiency include pre-term and low birth weight infants, older infants and toddlers, teenage girls, and women of child-bearing age. Iron deficiency early in life appears related to behavioral problems in infants who score significantly lower on various tests measuring intellectual and motor functioning (Baker and Greer, 2010).

Prolonged bottle feeding for up to 48 months of age was positively correlated with increased prevalence of iron deficiency and may account for the higher prevalence in Hispanic toddlers (Singh, 2013).

Overweight toddlers have a significantly higher prevalence of iron deficiency than comparable normal-weight or underweight peers. This has also been observed in older children and adolescents (Dean, 2016) .

Vulnerable populations should be encouraged to eat iron-rich foods and breastfeed or use iron-fortified formula for infants. Iron is found primarily in meat, poultry, and fish. However, other foods such as beans, lentils, fortified cereal grain products, and certain vegetables can also contribute to dietary intake of iron (Dean, 2016) .

2.1.2 Zinc

The trace mineral zinc has important roles in growth and development, sexual maturation, immune function, and wound healing; it also has a role in taste and smell acuity. Recently, it has become a popular medicament for treating the common cold (Kurugöl *et al.*, 2006; Singh, 2013).

Chronic low dietary zinc intakes may produce a deficiency, as may low bioavailability, and/or adverse interactions with other nutrients. Iron and zinc share many common food sources, so individuals at risk for iron deficiency may also be at risk for zinc deficiency (Dean, 2016) .

Zinc is present in foods that are high in protein, such as:

beef, eggs, poultry, and legumes, as well as in whole grains, fortified, ready-to-eat cereals, and dark green and yellow vegetables. However, as is the case with iron, zinc from plant food sources is not as well absorbed as that found in animal foods (Briefel, 2000).

According to Dean, (2016) Clinical manifestation of zinc deficiency :

1. One of the first clinical manifestations of severe zinc deficiency in children is stunted growth.
2. Other signs and symptoms include abnormal immune responses
3. Decreased reproductive development and function
4. Skeletal abnormalities.

According to McDonald_and_Avery's, (2016) Oral manifestations of zinc deficiency :

1. Impaired wound healing .
2. Alterations of the oral epithelium.
3. Xerostomia.
4. Reduced or altered sense of taste or smell.
5. Reduced appetite.

During tooth formation, children with zinc deficiency may be at increased risk for dental caries. In addition, because of its impact on immune function, zinc deficiency may increase the risk of oral infections such as periodontal disease and candidiasis (Briefel, 2000) .

2.1.3 Calcium

Calcium and vitamin D function together to maximize the mineralization of bones and teeth. Calcium is also needed for proper nerve and muscle activity, blood clotting, and transport of ions across cell membranes. Individuals at risk for inadequate calcium intake include those who dislike milk and other food sources of calcium, as well as those with milk allergies, lactose intolerance, and mal absorptive disorders. Inadequate calcium intake over time can increase the risk of bone demineralization and osteoporosis. Osteoporosis is a bone disease of older individuals and is most diagnosed in postmenopausal women. It is

characterized by a reduction in the quantity of skeletal tissue and thus is often considered to be a geriatric disorder (Keye, 2007) .

Achieving a high peak bone mass is the first line of defense against osteoporosis. Low calcium intake, particularly in combination with low levels of physical activity, may compromise the attainment of optimal peak bone mass. This is a particularly important consideration for adolescent girls because almost half of the adult skeletal mass is formed during the second decade of life, and calcium accumulation normally triples during the pubertal growth spurt. Unfortunately, this is the very age group that is at highest risk for low calcium intakes (Dean, 2016) .

This problem may be alleviated by educating youth to select more calcium-rich foods (e.g., cheese, yogurt, fortified breakfast cereals, fortified orange juice concentrates) or to consider using calcium supplements. Calcium carbonate has a good absorption rate and has been characterized as a relatively inexpensive supplement containing a high percentage level of calcium (Keye, 2007).

2.1.4 Vitamin D

Vitamin D is a fat-soluble vitamin that promotes the absorption of calcium from foods in the gastrointestinal tract, leading to proper mineralization of bones and teeth. As a result, having adequate stores of this vitamin is crucial for proper skeletal and dental development. Vitamin D also acts in concert with parathyroid hormone to maintain tight control of blood calcium levels (Patrick and Ames, 2014) .

A slight reduction in blood calcium concentration stimulates secretion of parathyroid hormone, which mobilizes calcium and phosphorus from the skeleton to re-establish calcium homeostasis in the blood. Vitamin D seems to play a role in immune function; in addition, lack of this vitamin may contribute to several diseases, including hypertension, multiple sclerosis, and certain

cancers. It has recently been suggested to be a factor in serotonin synthesis in the brain and to perhaps play a role in autism (Zohoori and Duckworth, 2020).

According to Weng, (2007) Vitamin D deficiency is increasingly being recognized as pandemic. The problem is three-fold:

1. There is a lack of appreciation that exposure to sunlight is a significant source of vitamins.
2. Few foods naturally contain vitamin D.
3. Foods that are fortified with vitamin D are often not consumed in sufficient amounts to meet the requirement.

Exposure to sunlight is the major source of vitamin D for most people. Natural sources of this vitamin are fatty fish such as salmon, mackerel , and herring , as well as fish oil , including cod liver oil. In the United States, although some juices, breads , yogurts , and cheeses are enriched with vitamin D, fortified milk is considered as the primary dietary source of the vitamin (Cashman, *et al.*,2008).

Because vitamin D is an essential nutrient for proper skeletal development, children who receive too little may develop rickets a bone disease characterized by bone deformities, poor muscle development, abnormal spinal curvature, and bowed legs (Zohoori and Duckworth, 2019).

2.1.5 Vitamin B12

Vitamin B12 is one of the B-complex vitamins, and cobalt is present within the molecule, classifying it as the only vitamin containing a mineral element. Vitamin B12 is essential in producing red blood cells in the bone marrow and for myelin synthesis in the nervous system. B12 is thought to be present only in animal foods (meat, fish, eggs, and dairy products), and as a result, strict vegetarians are considered to be at risk for a dietary deficiency. Those suffering

from anorexia nervosa and bulimia are also considered to be vulnerable to a deficiency (Dean, 2016).

Chronic vitamin B12 deficiency can result from a lack of the vitamin in the diet, and it can also be due to an autoimmune reaction in which intrinsic factor, a stomach protein required for the absorption of B12, is not produced. The lack of intrinsic factors can result in a vitamin B12 anemia known as pernicious anemia, which is characterized by large, immature blood cells. Additional signs and symptoms of deficiency of this vitamin include pallor, dizziness, fatigue, weight loss, confusion, hypotension, and peripheral nerve degeneration. Oral manifestations of vitamin B12 deficiency include soreness of the soft tissues and atrophic glossitis (Palmer, 2003).

2.2 Pediatric Overnutrition

For most children and adolescents in the United States today, negative health outcomes brought on by malnutrition are far more likely to be related to overconsumption of food, sodium, and calories than to deficiencies brought on by under consumption of food and nutrients. In other words, the risk of a child suffering from type 2 diabetes related to obesity is considerably greater than that of getting scurvy due to insufficient vitamin C intake (Dean, 2016).

2.2.1 Overweight and Obesity

Obesity is the result of an imbalance between daily energy intake and energy expenditure resulting in excessive weight gain. Obesity is a multifactorial disease, caused by a myriad of genetic, cultural, and societal factors. Various genetic studies have shown that obesity is extremely heritable, with numerous genes identified with adiposity and weight gain. Other causes of obesity include reduced physical activity, insomnia, endocrine disorders, medications, the accessibility and consumption of excess carbohydrates and high-sugar foods, and decreased energy metabolism (Klove, 2019).

Obesity is traditionally defined as the excessive accumulation of fat in the body, whereas overweight means weighing more than is considered normal. These terms are often defined based on BMI. BMI is calculated by dividing the individual's weight in kilograms by the square of the height in meters. When BMI is plotted on age- and gender-appropriate growth charts, overweight individuals can be identified as those between the 85th and 95th percentiles for age and gender. It is clear that this mathematical calculation is rather complex and can best be determined online by means of a BMI calculator (Dean, 2016).

Table (1): Body mass index for children (Dean, 2016)

Value	Standard
<5th percentile	Underweight
5th to <85th percentile	Normal weight
85th to <95th percentile	Overweight
≥95th percentile	Obese

There are many consequences of obesity, both short- and long-term consequences. An estimated 61% of overweight youth have at least one additional risk factor for heart disease, such as high cholesterol or high blood pressure. Overweight children are at greater risk for bone and joint problems, as well as obstructive sleep apnea, which has been observed in as many as one in six obese children. The latter condition can lead to daytime somnolence, neurocognitive abnormalities, and impaired learning. Because obese children tend to become obese adults, the potential impact of childhood obesity on the health care system is enormous. It has been suggested that the increased medical care costs associated with obesity may be greater than those associated with smoking and drinking alcohol (Sturm, 2002).

As overweight young people grow older, they are at increased risk for heart disease, type 2 diabetes mellitus, stroke, several types of cancer, and osteoarthritis. The current epidemic of type 2 diabetes escalating in children and

adolescents is associated with obesity and a persistently elevated BMI. Roughly one in four obese children (aged 4–10 years) has been reported as glucose intolerant (Sinha *et al.*, 2002) .

As previously mentioned, this type of eating pattern from childhood through adult life contributes to obesity as well as diabetes, hypertension, coronary heart disease, and certain types of cancer. Regrettably, the factors contributing to future obesity are thought to begin in infancy and early childhood. Since these diseases only become evident during adulthood despite having their origins in childhood and adolescence, they provide the health care professional with a potential avenue for preventive medicine (Savage, *et al.*, 2007) .

Any effort to attack the obesity problem should focus not only on making better food choices but also on increasing physical activity levels, which increases energy use and helps achieve a healthy weight. Exercise promotes both physical health and emotional well-being. How much and how often you exercise is a major determinant of both morbidity and mortality. It has been identified as a national priority area for promoting the health of the US population (Dean, 2016) .

Walking as a means of transportation is a component of an active lifestyle associated with a reduced risk of chronic diseases and an increased sense of well-being; however, time spent walking has declined among US children disorders (Sherman and Thompson, 2004) .

3. Eating disorders

Disordered eating is a term that includes a full spectrum of unhealthy eating behaviors from inappropriate dieting to clinical eating. The mass media are viewed by many as major contributors in influencing disordered eating behaviors in young people through the presentation of often unattainable

physical images and emphasis on the “thin ideal (Fernandez and Pritchard, 2012).

3.1 Anorexia Nervosa

Preoccupation with appearance and body weight during adolescence may lead to anorexia nervosa, a condition of self-induced starvation. Anorexia may be of the restrictive type, in which food intake is severely limited, or of the binge eating/purging type, in which individuals engage in self-induced vomiting or the misuse of laxatives, diuretics, or enemas. This illness, which is much less common in males and is also less common than bulimia nervosa, is characterized by self-imposed weight loss, amenorrhea, and a distorted attitude toward eating and body weight (Dean, 2016).

Anorexia nervosa rarely begins before puberty and probably manifests across a wide range of severity levels. Affected individuals often lack the ability to recognize that their emaciated bodies are too thin. Despite their advanced state of wasting, they may continue to believe that they are overweight (Brown and witherspoon, 2002).

According to Attia and Becker *et al.*, (2013) The three diagnostic criteria for anorexia nervosa are the following:

1. Persistent restriction of energy intake leading to significantly low body weight (in context of what is minimally expected for age, gender, developmental trajectory, and physical health).
2. Either an intense fear of gaining weight or of becoming fat, or persistent behavior that interferes with weight gain (even though significantly low in body weight).
3. Disturbance in the way one’s body weight or shape is experienced, undue influence of body shape and weight on self-evaluation, or persistent lack of recognition of the seriousness of the current low body weight.

A wide range of complications, including many of the consequences of starvation, is possible in anorexia nervosa. Fat depletion is the most obvious physical consequence. Qualitative deficiencies in the diet may lead to anemia, hypoproteinemia, and sometimes vitamin deficiencies. Serious electrolyte imbalances, notably hypokalemia, can occur when vomiting or laxative or diuretic abuse is practiced. Anorexia may be accompanied by enlargement of the parotid glands, edema of the legs, increased facial hair, and reductions in blood pressure and pulse rate. Nutritional deficiencies may lead to glossitis, gingivitis, a reduction in the amount and pH of the saliva, and an increase in dental caries susceptibility. Dental erosion may be evident on the palatal aspects of anterior and posterior teeth secondary to the use of sports drinks, caffeinated/carbonated drinks, wine, vinegar, and lemon juice used to quell sensations of hunger. Anorexics who engage in self-induced vomiting may exhibit epithelial erosion, gingivitis, and dental erosion on the palatal surfaces of the maxillary anterior teeth (Russo *et al.*, 2007).

Outpatient treatment is preferred for most individuals. Treatment is typically multidisciplinary and involves medical, nutritional, social, and psychological components. If the illness is severe and family and environmental circumstances are too damaging, or if there is little response to outpatient treatment, then hospitalization is indicated (Treasure, 2010).

Fluoxetine hydrochloride appears to help control the obsessive-compulsive behavior involved in both anorexia nervosa and bulimia. This drug raises the brain levels of serotonin, and consequently, the urge to binge and the preoccupation with food appear to lessen (Dean, 2016).

3.2 Bulimia

Another eating disorder, bulimia nervosa, is characterized by binge eating and invariably by self-induced vomiting. It also is more prevalent in young

women and is more common than is anorexia nervosa. It usually begins during late adolescence or early adult life. Its prevalence among males is probably vastly underestimated because of underreporting (dean,2021).

According to Attia *et al.*, (2013) The American Psychiatric Association's diagnostic criteria for bulimia nervosa are the following:

1. Eating, in a discrete period of time (e.g., within any 2-hour period), an amount of food that is definitely larger than what most individuals would eat in a similar period of time under similar circumstances.
2. A sense of a lack of control overeating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating).
3. Recurrent in appropriate compensatory behaviors to prevent weight gain, such as self-induced vomiting; misuse of laxatives, diuretics, or other medications; fasting; or excessive exercise.
4. The binge eating and compensatory behaviors both occur, on average, at least once a week for 3 months.
5. Self-evaluation is unduly influenced by body shape and weight.
6. The disturbance does not occur exclusively during episodes of anorexia nervosa.

Although it is more medically benign than anorexia nervosa, bulimia nervosa is associated with significant health consequences. Approximately half of patients with this disorder have fluid and electrolyte abnormalities. Hypokalemia develops in a small percentage of patients. Enlargement of the parotid glands, esophagitis, and gastric necrosis may also occur. Because of the exposure of the tooth surfaces to the highly acidic regurgitated gastric contents, enamel erosion is common among patients with bulimia nervosa. The degree of enamel damage can be extensive (Dean, 2016).

Although unanimity of opinion does not exist, the suggestion has been made that tooth brushing after vomiting promotes enamel loss and that, instead, patients should be instructed to rinse with an alkaline solution such as sodium bicarbonate dissolved in water. Other suggestions include the use of liquid sugar-free antacids, water, or milk. A fluoride treatment should be considered because of its potential for re-mineralizing previously demineralized areas of the dentition. Daily rinses with 0.5% sodium fluoride and administration of a 1.1% neutral fluoride gel in custom trays can be recommended (Willumsen *et al.*, 2005; Osteu *et al.*, 2006) .

Most bulimic patients can be treated effectively as outpatients. Although antidepressant medications may be useful in some cases, a multidisciplinary approach to treatment is often indicated (Treasure *et al.*, 2010). There is some evidence that individuals, particularly girls, who have family meals in a positive atmosphere are at lower risk for bulimia. Family meals may serve a protective function against disordered eating as well as other problems by acting as a forum for working through various issues (Neumark *et al.*,2007) .

3.3 Binge Eating Disorder

The essential feature of binge eating disorder is recurrent episodes of binge eating that must occur, on average, at least once per week for 3 months. It is defined by the consumption of excessive amounts of food along with the sensation of loss of control.

According to Attia *et al.*, (2013) The following are Diagnostic and criteria for this disorder:

1. Recurrent episodes of binge eating. A recurrent episode is characterized by both of the following:

- A. Eating in a discrete period (e.g., within any 2-hour period) an amount of food that is larger than what most people would eat in a similar period of time and under similar circumstances.
 - B. A sense of a lack of control overeating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating).
2. The binge eating episodes are associated with three or more of the following:
- A. Eating much more rapidly than normal.
 - B. Eating until feeling uncomfortably full.
 - C. Eating large amounts of food when not feeling hungry.
 - D. Eating alone because of feeling embarrassed by how much one is eating.
 - E. Feeling disgusted with oneself, depressed, or very guilty afterward.
3. Marked distress regarding binge eating is present.
4. Binge eating occurs, on average, at least once a week for 3 months.
5. Binge eating is not associated with the recurrent use of inappropriate compensatory behavior as in bulimia nervosa and does not occur exclusively during the course of bulimia nervosa or anorexia nervosa.

Patients with binge eating disorder may be treated as outpatients in a multidisciplinary manner. In overweight patients with binge eating disorder, the goals include achieving a sustainable weight loss and abstaining from binge eating. Pharmacotherapy with antidepressants and selective serotonin reuptake inhibitors has been used. Other classes of medications, such as anti obesity drugs and anticonvulsants, have also been studied and have shown some success. Psychotherapy in the form of cognitive behavioral therapy has been a popular approach, and other modalities such as exercise, self help, and virtual

reality therapy have also been tried as adjunctive therapies for binge eating disorders (Dean, 2021).

Furthermore, some studies indicate that there may be a benefit to combined behavioral therapy and pharmacotherapy in the treatment of binge eating disorder; however, more research is needed for a better understanding of the long-term effects of these treatments. As health care professionals deal with eating disorders in their patients, they recognize that primary prevention combined with early detection and treatment clearly helps reduce morbidity and mortality in affected youth (Treasure *et al.*, 2010).

4. Nutritional considerations during different development stages in pediatric patients and their effect on oral health

Nutrition effects on the timing of teeth emergence can be considered in two different ways: if fatness is taken into account, a positive but only slight relationship can be found between weight and dental development (Nystrom *etal.*,2001; Mugonzibwa *et al.*, 2002), on the other hand, if the effects of stunting or wasting considered as a result of nutritional deficiency, it is clear that eruption of both primary and permanent teeth will be delayed, except for earlier eruption of first permanent incisors and first permanent molars, which can show either earlier or later than normal emergence time (Kaczmarek, 1994; Kochhar and Richardson, 1998). There is evidence that chronic malnutrition, which continues after early childhood is linked with delayed teeth eruption (Psoter *et al.*, 2008).

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 (Carruth *et al.*, 2004).

The emergence of dentition and feeding skills is followed by the development of food preferences and the stable eating behaviors that support daily food intake and dietary patterns associated with growth and body composition during early childhood (Birch and Fisher, 1998).

In early life, differences emerge in eating behaviors that can track into later childhood and have a sustained impact on energy intake and weight gain (Forde, 2019). These include differences in microstructural patterns of eating and specific eating behaviors such as eating rate, average bite size, and chews per bite (Fogel, 2017).

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. The presence of dental diseases can negatively affect children's growth and development processes, untreated carious lesions cause pain and discomfort during meals. There are deviations in the quality and quantity of the ingested nutrients, patients are self-restricted to several types of foods consumed, which usually do not meet the physiological needs of the body at this age. Scientific studies also testify for improving the indicators of growth and development in children after treatment and restoration of the deciduous teeth affected by caries and its complications, there is an increase in the weight of the children and attaining values corresponding to age-appropriate, this is due to the recovery of appropriate conditions for a normal quantitative and qualitative intake of nutrients (Sheiham, 2006).

The risk of developing caries in children is directly related to the frequency and type of meals. Frequent intake of high carbohydrate foods results in lower

pH in the dental plaque, increased acid production by microorganisms, and demineralization of dental tissues. The type and consistency of carbohydrates consumed also determines the caries risk. Some foods are more retentive to the dental surfaces and facilitate the formation of plaque (Leong *et al.*, 2013).

Early childhood caries (ECC) has been defined as “the presence of one or more decayed (non cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth” in children from birth through 71 months of age as in figure (1) (Drury *et al.*, 1999).



Figure (1) Early childhood caries (Zafar, 2009).

According to Tanzer, (2001) Severe ECC is characterized by the presence of:

- A. One or more decayed, missing, or filled smooth surfaces in children less than months.
- B. Cavitated, filled, or missing (due to caries) smooth surfaces in the primary maxillary anterior teeth.
- C. Multiple decayed, missing, or filled surfaces in children aged 36 to 71 months. The etiology of ECC is multifactorial, the presence of oral bacteria and fermentable carbohydrates are necessary, yet proper oral hygiene and regular fluoride exposure reduce the risk of caries.

Nursing bottle caries is a type of caries characterized by rapid onset and extensive destruction of most of the deciduous teeth in infants who hold nursing bottles and pacifiers in their mouths over long periods of time, e.g., falling

asleep with the nipple of the bottle or pacifier in the mouth. In this situation, there is direct contact of the teeth with water, juice, or milk sweetened with sugar, syrup, or honey as in figure (2) (Zafar *et al.*, 2009).



Figure (2) Nursing bottle caries (Caufield, 2012).

4.1 Infancy

Three characteristics of infants combine to make their nutritional needs unique these are:

- A. Their high energy needs per unit body of weight to support rapid growth.
- B. Their immature digestive tracts and kidneys.
- C. Their small size.

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 (Burgess *et al.*, 2019).

4.2 Toddlers

Ellyn Satter describes the “Division of Responsibility” in feeding between parents and children (Ellyn Satter, 2023).

- A.** It is the role of the parent to provide age-appropriate foods with scheduled meals and snacks in a consistent place (e.g., at the table versus in front of the TV). Family meals are encouraged.
- B.** It is the role of the child to determine whether or not to eat the provided food.

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. During this phase, it is emphasized to offer a variety of food textures including finger foods.

4.3 Preschoolers and School-aged children

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. It is recommended eating together as a family as often as possible and involving children in food preparation appropriate for their skill level (Burgess *et al.*, 2019).

General nutrition guidelines for children (American Academy of Pediatrics 2009):

- A.** Make available and offer a colorful variety of fruits and vegetables for children to consume every day.
- B.** Limit intake of foods and beverages with added sugar or salt.
- C.** Keep total fat between 25% and 35% of total calories for children 4 -18 years of age.
- D.** Offer fruits, vegetables, fat-free or low-fat dairy, and whole-grain snacks.
- E.** Offer child-appropriate portions.

- F. Engage in at least 60 minutes of moderate to vigorous physical activity on most,
- G. if not all, days of the week.
- H. Provide food that is safe (avoid unpasteurized milk/juices and raw or undercooked meat, poultry, eggs, fish, and shellfish).

4.4 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.

According to Thomas, (2014) Approaches to Communication with Adolescents in Nutrition Intervention

- A. Keep the adolescent’s psychosocial and cognitive development in mind.
- B. Generally, younger teens are more concrete in their thinking.
- C. Develop rapport.
- D. Avoid judgment.
- E. Expect experimentation with varied eating behaviors.
- F. In the context of specific education about nutrition and physiology, ask teens to identify one or two goals.

Some Iraqi studies regarding the relationship between nutritional status and oral health shown in table (2).

Table (2): Iraqi studies about the relationship between nutritional status and oral health.

Author, year	Sample	Results
Al-Ghalebi, 2011	1350 children (696 males and 654 females) aged 9 10- years in the primary	-The prevalence of malnutrition described by the BMI indicator was 5.9%. -For the total sample, no significant differences were recorded in mean dmfs/DMFS and different grades of nutritional status indicator.

	school of Nassiryia city.	-No significant differences concerning plaque, gingival and calculus indices between different grades of BMI indicator (P>0.05).
Suhail, 2014	444 kindergarten children aged 4-5 years in Al-Ramadi city	-The prevalence of malnutrition described by Waterlow's indicator, was found to be 3.4%, 14.4%, 6.1% short term, dwarf, and long-term respectively. -The percentage of caries-free children among the well-nourished was 73.9% while 6.1%, 13.6%, 6.16% among short term, dwarf, long term respectively. -dwarf children had higher dmfs value than other nutritional statuses well-nourished, short term, and long term). -Plaque index and gingival index were reported to be higher among short term, dwarf, and long-term children than in well-nourished, the mild gingivitis was the more prevalent grade among the total sample. No significant difference was recorded in the calculus index between the malnourished and well-nourished children
Ahmed , 2015	(1807) four to fifteen years old children and teenagers from kindergarten, primary, secondary schools in Basrah city	The prevalence of malnutrition according to height for age, weight for age, and weight for height nutritional status indicators were found to be 7.4 % stunting and 1.9% severe stunting, 3.7 %, and severe underweight, 1.5% wasting, and 1.6% severe wasting respectively. -Among normal children and teenagers described by height for age nutritional status indicator, most teeth significantly erupted earlier than stunted except the lateral incisors which erupted earlier in stunted boys than in acceptable boys, but the result was not significantly accepted. The greatest difference in median eruption age of permanent teeth between acceptable and stunted was found in girls with the second molar tooth.
Hamid, 2019	580 children 4 and 5 years old	-The percentage of children underweight was 11.89 % -According to nutritional status (BMI indicator), the mean value of dmfs and

	from kindergarten in Tikrit city	ds was higher among children underweight than among other children, with no significant difference ($P > 0.05$) -The percentage of demarcated and diffuse opacities was more in children with normal weight while hypoplasia was more in children with underweight
Abbas S.,2019	891 children from different schools in urban and rural areas in Al-Hillah city	-The prevalence of underweight children was recorded by using Body Mass Index (BMI) 5.05%, girls were more well- nourished than boys with a significant difference. -Children living in rural areas have shown well-nutritional status than the children living in urban areas with significant differences. -Underweight children have shown more affected by dental caries in primary dentition than permanent dentition with a significant difference. -No significant differences were recorded between PI, GI, enamel defects, and nutritional status.

Conclusion

Diet and nutrition have an interconnected relationship with oral health and thus general health of pediatric patients, and since newborns and children are in development stage, they require more energy to accommodate the ongoing development.

Malnutrition causes disturbance in the normal development of teeth and hence it will affect the newborn feeding and vice versa. Public health and pediatric dentistry share common concerns, goals, and interventions. Both recognize that 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. Effective collaborations between clinicians who care for individual children and public health authorities who care for populations of children are essential to reduce the oral disease burden among children and assure children's health and welfare.

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