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Nutritional Considerations in Pediatric Dentistry

A Project Submitted to
The College of Dentistry, University of Baghdad, Department of Pedodontics & Preventive Dentistry in Partial Fulfillment for the Requirement to Award the Degree of Bachelor of Dental Surgery

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Certification of the Supervisor

I certify that this project entitled " Nutritional Considerations in Pediatric Dentistry " was prepared by the fifth-year student " Mohamed Salem Ibrahim" under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Supervisor's name :
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DEDICATION

Being a family means you are a part of something very wonderful. It means you will love and be loved for the rest of your life. The most important thing in the world is family and love.

To my family my greatest gift in life who provide me with limitless pleasure and give me my purpose in life.

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1.Introduction

Nutrition is the physiological process by which organism uses 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**).

2.Aims of the study

The aims of this review are to :

1) Analyze the current scientific evidence on the relationship between nutrition and oral health in childhood.
2) Focus on healthful dietary and nutritional practices for dental patients presented within the framework of a pediatric dentistry.
3) Discuss briefly nutrients and their effect on pediatric patients generally.

3.Review of literature

3.1 Diet & Nutrition

Oral and systemic well-being is fundamentally linked with diet and nutrition. Diet denotes the local actions of foods 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 & 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 & Duckworth, 2020).**

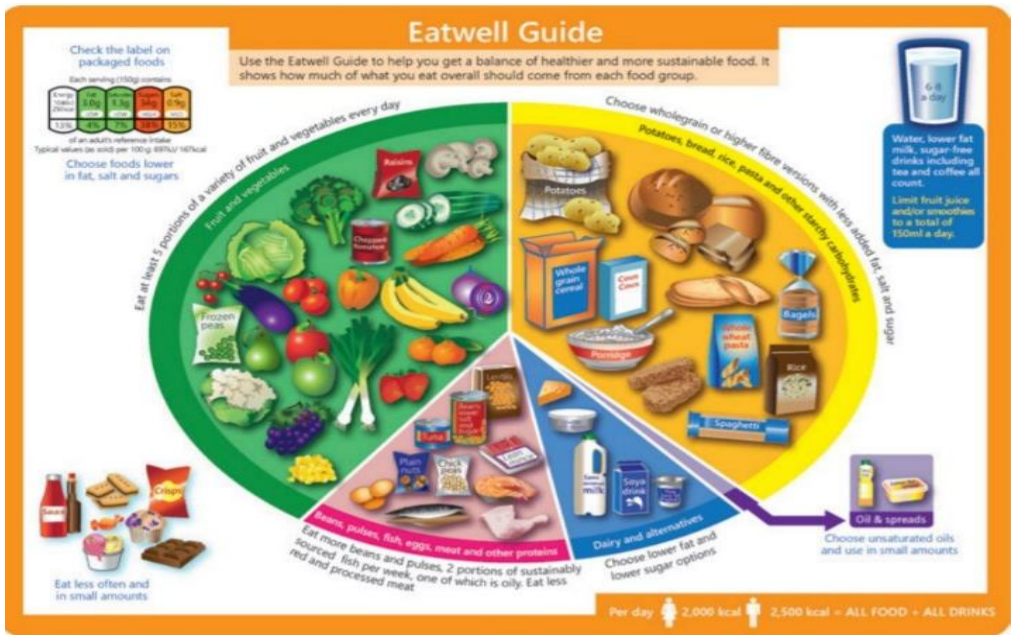

Figure (1) Eat well guide **(Public Health England, 2016)**

3.2 Energy Balance

Energy balance is the difference between energy intake, which can be

metabolized, and total energy expenditure. It could be said that the human body's energy state is balanced when its energy expenditure is equal to its energy intake.

According to the definition given by the **World Health Organization (WHO),** the energy requirement is 'the level of energy intake that will balance energy expenditure when we have a body size, composition, and a level of physical activity consistent with long-term good health'.

Energy requirements are influenced by various factors, such as current developmental stage, body size, the intensity of physical activity, gender, illness, injury, etc. Energy expenditure consists of three components:

1) The energy spent on daily activities and physical exercise.
2) The energy spent in response to a variety of thermogenic stimuli (thermogenesis), which include the food consumed, certain drugs, low temperatures, muscle tension, stress, and similar psychological states.
3) Basal metabolic rate (BMR) is the amount of energy spent for basal metabolism, which represents voluntary and involuntary vital bodily functions.

All forms of energy can be converted to heat and all energy the body uses is lost as heat, for this reason, the energy that is consumed, stored, and spent is expressed as its heat equivalent.

The first unit of energy employed in nutrition was the calorie [the amount of energy needed to raise the temperature of 1 gram (g) of water from 14.5 to 15.5◦C]. In the context of food and nutrition, the kilocalorie (1000 calories) has been traditionally used (**Dimosthenopoulos, 2010**).

3.3 Classification of Nutrients :

Some important nutrients and their impact on the oral cavity and general health of pediatric patients will be discussed below:-

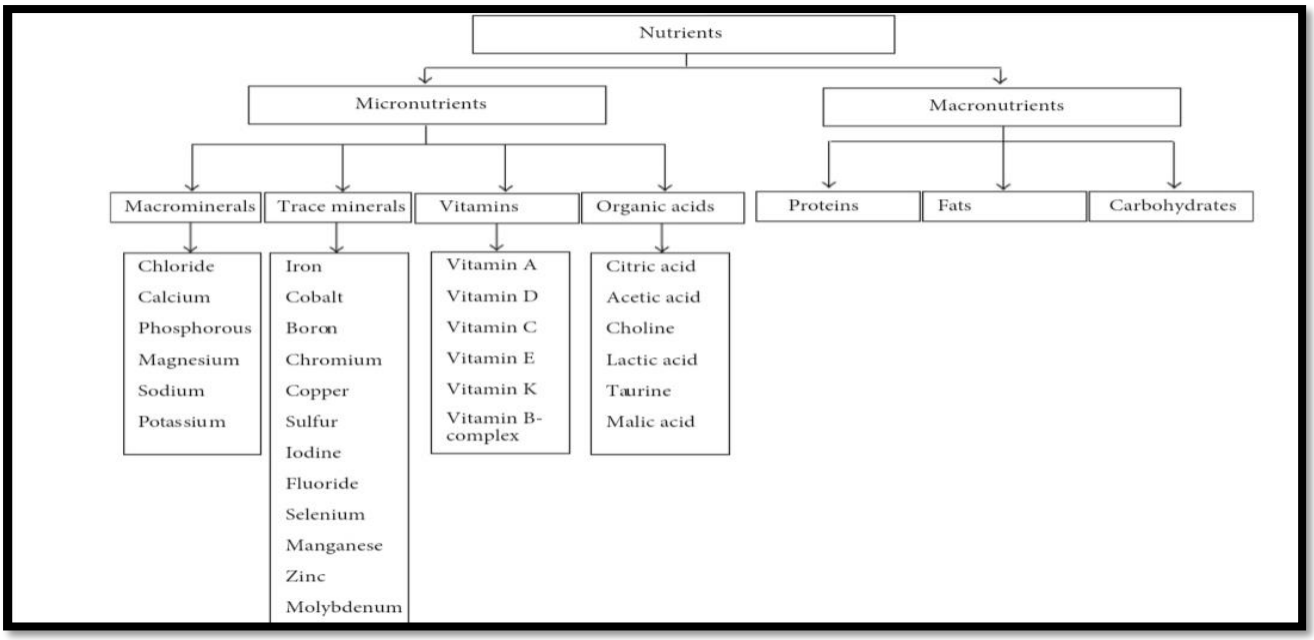

Figure (2) Classification of Nutrients **(Siddiqui et al., 2014).**

3.3.1 Carbohydrates

Carbohydrates are quantitatively the most important dietary energy source for most populations, usually contributing 55–75% of total daily energy requirements **(World Health Organization 2003)**. The average intake of dietary carbohydrates is more in developing countries. They are predominantly derived from plant foods. Carbohydrates are composed of carbon, hydrogen, and oxygen in a ratio of 1:1:2, respectively.

Carbohydrates are also often classified into 3 groups (**Mahan et al. , 2003) :-**

1) Monosaccharides.
2) Disaccharides and oligosaccharides.
3) Polysaccharides.

Since only about 5% of starch is broken down in the mouth, starchy foods are not a major risk factor, unlike simple sugars, for dental caries.

Carbohydrates are mainly digested in the small intestine where monosaccharides

are absorbed into the bloodstream. Insulin, glucagon, and epinephrine are hormones that control blood sugar concentrations. When blood glucose concentration is too high, insulin is secreted by the pancreas, which stimulates the transfer of glucose into the cells, especially in the liver and muscles. Another well-known function of carbohydrates is to impart sweetness to the food (**Dimosthenopoulos, 2003).**

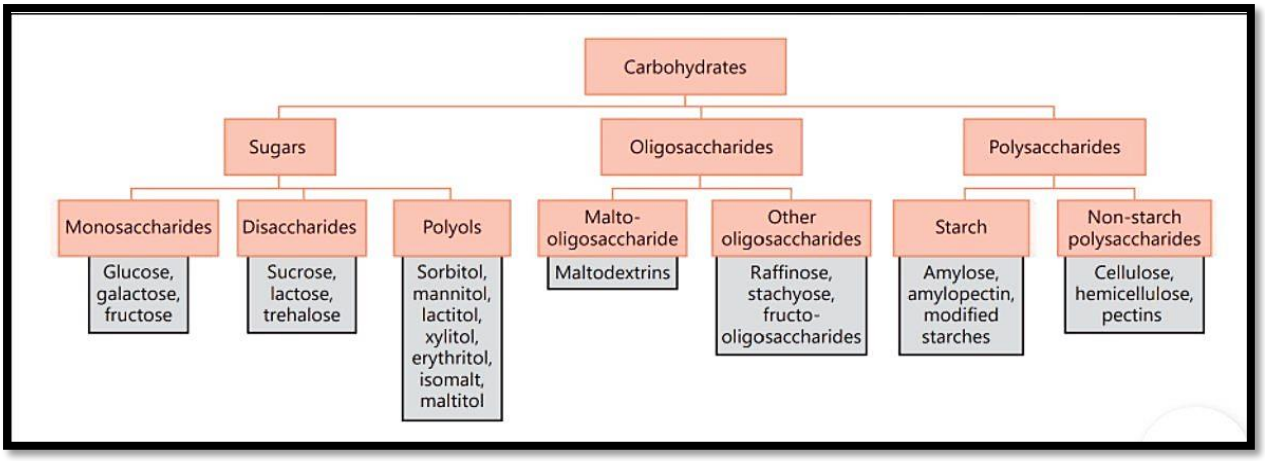

Figure (3) Classification of carbohydrates **(Hujoel, 2009)**

3.3.2 Fat & Fatty Acid

lipids have been 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 **(Mahan et al., 2003).**

Fats, owing to their high energy density, are used by the organism as a long-term fuel reserve. Additionally, they act as solvents in the absorption of fat-soluble vitamins and they are the precursors for hormone synthesis (**Dimosthenopoulos, 2003).**

Fatty acids are the key constituents of lipids in food and the body they are categorized into two large categories:

1. Saturated (with no double bonds).

2. Unsaturated, which is subdivided into :

- Monounsaturated fatty acids (MUFA), which have one double bond.
- Polyunsaturated fatty acids (PUFA), which have more than one double bond.

Animal fats tend to be richer in saturated fatty acids compared to vegetable fats.

Based on the nutritional need, fatty acids are also categorized as essential and non-essential amino acids.

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.

3.3.3 Proteins

Proteins are the most common nitrogen-containing compounds in the diet. While plant structures are mainly built on carbohydrates, proteins are vital structural and functional components within every cell of the body of humans and animals. Proteins are essential for life processes, as they are involved in acid-base balance, fluid regulation, immunity, growth, differentiation, gene expression, metabolism, and many other functions.

Since most foods contain either animal or plant cells, they are natural sources of protein. Amino acids function as substrates for protein and nucleic acid synthesis and are involved in protein turnover, enzyme activity regulation, nitrogen transport, oxidation-reduction reaction, etc (**Hoffman & Falvo, 2004).**

Proteins are made up of long chains of amino acids, linked by peptide bonds. The proteins in the human body are made from 20 different amino acids.

Based on nutritional requirements, amino acids are categorized into 3 groups:

1) Essential amino acids are those that cannot be synthesized in the human body and, therefore, must be consumed through the diet. They are methionine, threonine, tryptophan, valine, isoleucine, leucine, phenylalanine, and lysine.

2) Semi-essential amino acids, which cannot be synthesized in adequate amounts in the body and therefore require augmentation through the diet, include histidine and arginine, which are essential for children but not adults.
3) The non-essential amino acids which can be synthesized in the liver from other amino acids in this group include (alanine, arginine, asparagine, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, and tyrosine) (**Godfrey et al., 1996).**

All essential amino acids should be available during the process of protein synthesis in the body.

Proteins are essential for the growth, repair, and maintenance of health. Low intake of animal-sourced proteins during late pregnancy is believed to be associated with low birth weight. Meat-based diets have also been shown to cause a significantly greater net protein synthesis and greater gains in lean body mass compared to vegetarian diets, which could be a function of reduced breakdown of protein with the former (**Campbell et al., 1999).**

3.3.4 Micronutrients

Vitamins and minerals are nutrients that are found in trace amounts in most foods and are essential, in little amounts, for normal metabolic function.

3.3.4.1 Vitamins

Are a group of organic compounds that cannot be synthesized by humans and should be provided by the diet, otherwise, their deficiency could cause adverse health conditions. Vitamins are classified into 2 groups based on their solubility **(Zohoori & Duckworth, 2019) :**

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

2- water-soluble (vitamin C, and B complex).

Table (1) Fat soluble vitamins **(Zohoori & Duckworth, 2019).**

Vitamin	Physiological function	Dietary sources
Vitamin A	Necessary for 1) Visual pigments. 2) Required for cell differentiation, gene regulation, reproduction, immune function. 3) It is essential for bone and tooth growth.	Two fundamental forms: retinoid found in animal foods and carotenoids in plant foods. Since both are good sources, true dietary deficiencies are generally not likely to be a problem.
Vitamin D	Required for 1) Calcium balance/homeostasis. 2) Bone health. 3) Cell differentiation. 4) Immune system.	Mushrooms, dairy milk, fortified non-dairy milk, fortified cereals, cod liver oil, tuna, salmon, and egg yolks.
Vitamin K	Necessary for 1) Blood clotting. 2) Calcium metabolism. 3) Bone health.	Green leafy vegetables and produced by bacteria in the large intestine.
Vitamin E	1) Membrane antioxidants. 2) Heart health. 3) Protects cell walls.	Seeds, nuts, and vegetable oil.

Table (2) Water-soluble Vitamins **(Zohoori & Duckworth, 2019)**

Vitamin	Physiological function	Dietary sources
Vitamin C	1) Required for the synthesis of carnitine, catecholamine, adrenaline, noradrenaline, and cortisol. 2) Potent antioxidant. 3) Formation of collagen.	Citrus fruits, cabbage, berries, and peppers.
Vitamin B1 (Thiamine)	Cofactor for oxidative decarboxylation, both in the Krebs cycle and in converting pyruvate to acetyl-CoA. For normal muscle function. Important for nerve function.	Whole grains, dried beans, peas, peanuts and animal proteins.
Vitamin B2 (Riboflavin)	Supports the release of energy from food and a cofactor in the mitochondrial respiratory chain.	Whole grains, green and yellow Vegetables, and animal proteins.
Vitamin B3 (Niacin)	1) As a cofactor in the mitochondrial respiratory chain. 2) Release of energy from foods.	Lean meats, fish, poultry, whole grains, corn, and sweet potatoes.

Vitamin B5 (Pantothenic acid)	Plays an essential role in the Krebs cycle And as a component of coenzyme A.	Fortified cereals, mushrooms, rice and sweet corn.
Vitamin B6	1) Release of energy from foods. 2) Used as a cofactor by nearly 100 enzymatic reactions, mainly in protein and amino acid metabolism. 3) Necessary for healthy immune and nervous systems.	Potatoes, chickpeas, yeast, nuts, bulgur wheat, fish, rice and bananas.
Vitamin B7 (biotin)	As a cofactor, involved in the metabolism of fatty acids, amino acids, and utilization of B vitamins.	Peanuts, almonds, soy protein, eggs, yogurt, and sweet potatoes.
Vitamin B9 (Folic acid)	1) As a family of cofactors that carry C1 units required for the synthesis of thymidylate, purines, and methionine. 2) Essential for metabolic pathways involving cell growth, replication, and survival of cells. 3) Essential for DNA and red blood cell formation.	Dark green leafy vegetables, yeast and wheat.

Vitamin B12	1) Essential for the metabolism of fats and carbohydrates. 2) Synthesis of proteins and new cells, especially red blood cells. 3) Activates folates.	Fortified cereals, nutritional yeast, algae, and animal products.

Many vitamins can have serious side effects or even prove to be toxic if taken in excess, this is why overdoses must be avoided. This applies especially to the fat-soluble vitamins, as they can accumulate in the body, reaching potentially dangerous levels.

Vitamin A and D toxicity syndromes are well documented, while vitamin K may also be toxic in water-soluble form. Some examples of well-known side effects due to vitamin excess are (**Dimosthenopoulos et al., 2010)** :

- Headaches (vitamin A).
- Vomiting (vitamins A and D).
- Nausea (vitamins D, C, nicotinamide, vitamin B6).
- Spontaneous abortions and birth defects (vitamin A).
- Diarrhea (vitamin C, pantothenic acid, choline, carnitine).
- Hemolytic anemia and kernicterus (vitamin K).
- Hepatomegaly (vitamin A, niacin).

3.3.4.2 Minerals

Are a group of inorganic elements that cannot be made by the body and are necessary for a variety of functions, including:

1) The formation of bones d teeth.
2) Essential constituents of body fluids and tissues.

3) As components of enema systems.
4) For normal nerve function.

Based on the quantity needed by the body, minerals have been categorized into 2 major groups:

1) Macro minerals with a requirement of ≥100 mg/day.
2) Micro minerals (trace elements) with a requirement of <15 mg/day, which include ultra-trace elements that are necessary at a level of µg/day and can enter the body through inhalation, and drinking water, and dietary components **(Mahan, 2008).**

3.3.4.2.1 Calcium

Calcium and vitamin D work 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 malabsorption disorders. Inadequate calcium intake over time can increase the risk of bone demineralization and osteoporosis, this problem may be alleviated by educating young people 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).**

3.3.4.2.2 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. Iron and zinc share many common food sources, so individuals at

risk for iron deficiency may also be at risk for zinc deficiency.

Zinc is present in foods that are high in protein. One of the first clinical manifestations of severe zinc deficiency in children is stunted growth. Other signs and symptoms include abnormal immune responses, decreased reproductive development and function, and skeletal abnormalities. Oral manifestations include impaired wound healing, alterations of the oral epithelium, xerostomia, reduced or altered sense of taste or smell, and 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 et al., 2000**).

3.3.4.2.3 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 the 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 in children and adolescents.

Clinical signs & symptoms of iron-deficiency anemia may include:

1) Weakness.
2) Fatigue.
3) Pallor.
4) Numbness and tingling of the extremities.

Common oral manifestations are:

1) Glossitis and fissures at the corners of the mouth (angular cheilitis).

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 **(Baker & Greer, 2010).**

Iron needs are higher during growth stages, and those most vulnerable to iron deficiency include preterm and low-birthweight infants, older infants and toddlers, teenage girls, and women of child-bearing age. Somewhat surprisingly, overweight toddlers have a significantly higher prevalence of iron deficiency than do comparable normal-weight or underweight peers. This as also been observed in older children and adolescents. Possible explanations for this association include a greater intake of foods high in calories, but low in iron, an alteration in iron absorption or metabolism, and a reduced level of physical activity among overweight children. To prevent iron deficiency, vulnerable populations should be encouraged to eat iron-rich foods and breastfeed or use the 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 the dietary intake of iron **(Dean, 2016).** Excess iron, which can be accumulated under certain conditions, is harmful as well, as it can be toxic to cells and tissues. Two pathological conditions associated with iron overload are :

1) Hemosiderosis, in which too much iron is deposited in the tissues, and
2) Haemochromatosis, is a rather rare, genetically predetermined disease.

Iron supplements are not needed unless the infant is not eating food containing iron by 4 to 6 months of age. The infant may need an iron source earlier if the mother was anemic during pregnancy or while breastfeeding **(Dimosthenopoulos et al, 2010).**

3.3.4.2.4 Magnesium

Magnesium is another mineral with important roles in human metabolism and is widespread in both animal and plant food (**Dean, 2016).**

3.3.4.2.5 Phosphorus

Phosphorus is an essential mineral nutrient 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. It is found in practically each food item in the human diet. As a result, a dietary deficiency is extremely unlikely (**Dimosthenopoulos et al., 2010).**

3.3.4.2.6 Sodium

Sodium, along with potassium and chloride, is involved in body fluid osmolality and plays the most decisive role in determining extracellular osmolality. It is necessary for the good functioning of the nervous system and the muscles (**Dimosthenopoulos et al., 2010).**

3.3.4.2.7 Iodine

Iodine is considered essential because it is a constituent of hormones thyroxine and triiodothyronine, which are necessary for normal physical and mental growth (i.e. maintenance of metabolic rate, thermoregulation, protein synthesis, and connective tissue integrity) (**Dimosthenopoulos et al., 2010).**

3.3.4.2.8 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 o its role in the mineralization of bones and teeth. 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 apatite crystals of the developing tooth which helps in improving r resistance to acid demineralization. In addition, the ingested F can return to the oral cavity rough saliva and crevicular fluid and influence de- and re-mineralization processes (**Thompson, 2018).**

Chronic exposure to excessive systemic F, during critical periods of tooth development, can result in fluorosis in both primary and permanent teeth. The most important period for the development of dental fluorosis in permanent incisors, as well as the first permanent molars, is the first 3 years of life, especially between 6 and 24 months whereas for the later developing permanent canines and premolars the risk period could be up to 8 years of age. Daily administration of individualized dietary supplements of sodium fluoride is desirable for young children who live in areas where a community or school water fluoridation is not practiced. Beginning fluoride supplementation at birth probably gives some protection against caries in deciduous teeth. Because calcification of the permanent dentition is just beginning during the first 6 months, very little if any fluorosis is likely to result from giving a 0.2- or 0.3- mg supplement.

To avoid the possibility of dental fluorosis, the prescribed amount should be

adjusted downward in proportion to the amount of fluoride provided in the water **(Whitford, 1996 ; Robinson et al., 2004).**

3.3.5 Water

Water is a vital component of any healthy diet it is essential for the preservation of life, and e 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 **(Katsilambros & Dimosthenopoulos, 2010).**

3.4 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. Its importance declines after weaning. Some of the earliest investigations regarding milk and dental caries were carried out by **Sprawson (1932-1947)**, who concluded that milk improved oral health. **Mellanby and Coumoulos (1944)** found that milk is attributed to the improvement of children's teeth. Eighty p cent of the carbohydrate in milk is lactose. Various other components of milk have been considered to be protective against dental caries, namely minerals, casein, other proteins, and lipids. Cow's milk contains about 4.8g of lactose per 100ml of milk. This amount could be sufficient to classify milk as cariogenic, but there is much evidence that lactose is the least cariogenic of the common dietary sugars. In addition, the high once rations of calcium and phosphorus in milk will help to prevent the dissolution of the f enamel. Other components, principally casein, are likely to be protective as well. Thus, it is possible that milk could be caries-promoting (due to the lactose content), caries-

preventing, or somewhere between these two (**Rugg-Gunn, 1993).**

Breastfeeding promotes infant health because breast milk contains:

1) Antiserum.
2) Ceruloplasmin.
3) Intrinsic factor.
4) Antibodies

Formula manufacturers have been at simulating the same components of breast milk however a replica has never been produced. In addition, there are other benefits that mother and baby can access only through breastfeeding. Infants and children who have been fed a canned milk formula deficient in pyridoxine have developed severe irritability and convulsions.

Fermentation of milk leads to the production of lactic acid and the resulting fall in pH inhibits growth of many pathogenic organisms. One of the most important of these fermented foods is yogurt, which has been traditionally fermented with Lactobacillus bulgaricus. The lactose content reduces substantially during fermentation although some galactose remains: other constituents are unchanged **(Southgate, 2000).**

A high proportion of commercial yogurts contain added sugars and flavoring, complicating inter the predation of research into cariogenicity. Information on the dental effects of yogurt is limited. As long as sugars are not added, there is o reason for suspecting that the effects of yogurt would differ from those of milk.

Cheese is the curd (solids) of milk separated from the whey (liquid) by coagulation, it contains most of the protein, calcium, and riboflavin.

1) Cheddar cheese is a whole-milk cheese product that has been cured (preserved by salting).
2) Processed cheese is pasteurized and is made by blending different cheeses

and adding emulsifiers.

3) Cottage cheese is made from pasteurized skim milk and provides high-quality protein and a few calories.
4) Cream cheese is made from whole milk, and cream is added. Cream cheese contains a high percentage of fat and vitamin A and much less protein than cottage cheese, therefore, it is usually placed in the fifth food group with the fats.

Many lactose-intolerant people can also digest yogurt and aged cheese, as the bacteria or molds used to ferment these products break down the lactose during processing (**Nizele & Papas, 1989)**.

Sugar is added to food for a multitude of functions: 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 caries was established in the latter half of the 19th century. Many factors influence this relationship:

1) The availability of sugar for bacterial digestion.
2) The presence of acidogenic bacteria in the plaque on teeth.
3) The ability of fluoride and saliva to counteract bacteria and acids.

Frequency of sugar intake as a determinant of the cariogenicity of the diet fits better with the knowledge of the caries process than does the amount of sugar per intake. 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 **(Sheiham, 2001)**

In some countries, it is common to flavor milk, especially milk for children, with sugar and other flavorings. In most countries, the sugar added is sucrose and the most common other flavoring is coco. It is reasonable to assume that adding sucrose to milk will increase cariogenicity, but at what concentration will the added sucrose overcome the caries-protective properties of plain milk, it is s an interesting question. The question is complicated by the knowledge that cocoa itself may have caries-protective properties **(Woodward, 2020).**

Mattos-Graner et al. (1998), 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. **Dunning and Hodge (1971),** reported results of a 2-year clinical trial in American children and young adults. Caries increment was slightly higher (of borderline statistical significance) in children drinking milk with 6% sugar added, compared with children drinking plain milk. Thus, it is probable that adding sugar to milk increases the risk of caries development, this evidence comes from several types of study on human and animal as well as laboratory studies. The concentration of added sugar at which caries development might begin is uncertain but maybe as low as 2%. There is too little information on the effect of cocoa flavoring to draw conclusions.

Many research has been carried out in order to find sugar substitutes. Non-sugar sweeteners are excellent sugar substitutes they both satisfy and provide sweetness and sometimes provide energy as well, it is divided into :

1-Nutritive sweeteners which include sugar alcohols. Popular in sugar-free gums, mints, and diabetic candies, sugar alcohols are less sweet than sucrose. Foods with sugar alcohols have health benefits that foods made with sugars do not have, such as a reduced glycemic response and decreased risk of dental caries. Also, because sugar alcohols are absorbed slowly and incompletely from the intestine, they

provide less energy than sugar, usually 2 to 3 kcal of energy per gram. However, because they are not completely absorbed from the intestine, they can attract water into the large intestine and cause diarrhea. Some examples of sugar alcohols include **(Brown, 2010)** :

- Sorbitol (D-glucitol) is a sugar alcohol that is made commercially from glucose by hydrogenation. It is about 60% as sweet as sucrose and is used as a sweetening agent in diabetic foods and so-called sugarless gums and candies.
- Mannitol & Dulcitol are obtained by the hydrogenation of mannose and galactose, respectively, and have a variety of industrial uses as food improvers and sweetening agents.
- Xylitol is a naturally occurring pentose alcohol that can be derived from various types of cellulose products, such as wood, straw, cane pulp, or seed hulls. Its sweetness is similar to that of sucrose, and it produces a cooling sensation in the mouth.

In dental plaque, microbial fermentation of most sugar alcohols proceeds at a slower rate than the fermentation of sucrose and results in the production of little or no acid.

2- Non-nutritive sweeteners, also called alternative sweeteners, are manufactured sweeteners that provide little or no energy. They include Saccharin, Aspartame, Acesulfame-K.. etc. **(Nizele & Papas, 1989 ; lohner, 2017).**

3.5 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 et**

al.,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. Growth height typically ceases at around 16 years of age for girls and 18 years for boys but with muscle and bone development continuing for both sexes until well into adulthood. 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 **(Carruth et al., 2004 ; Van den Engel-Hoek et al., 2014).**

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 & 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)**.

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.

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 **(Alvarez et al., 1988).**

The risk of developing caries in children is directly related to the frequency and type of the 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 a plaque (**Leong et al. , 2013).**

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.).

According to scientific studies, foods and beverages such as milk, dairy products, and fluoridated water have caries-protective effects. These products increase the amount of calcium, phosphorus, and fluorine in the plaque, stimulate salivation, reduce the harmful effects of carbohydrates, and contribute to the remineralization process of acid-attacked tooth surfaces.

A daily habit of three meals and three snacks, every 30 minutes in length with an

additional 30 minutes for the plaque pH to return to normal, theoretically supports 6 hours of demineralization and 18 hours of remineralization. Rapidly growing children and adolescents require frequent opportunities to consume energy to support growth, restrictive meal patterns (e.g., three meals, no snacks) are inappropriate (**Tinanoff & Palmer, 2000).**

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 **(Drury et al., 1999) .**

Severe ECC is characterized by the presence of:

1) One or more decayed, missing, or filled smooth surfaces in children less than 36 months.
2) Cavitated, filled, or missing (due to caries) smooth surfaces in the primary maxillary anterior teeth.
3) 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 **(Tanzer, 2001).**

Figure (4) Early childhood caries **(Zafar, 2009).**

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. Some Pedodontics have even seen this type of rampant caries in children who drink unsweetened milk from their nursing bottles. Usually, the nursing bottles are used as pacifiers at bedtime for children who are much beyond the bottle-feeding age **(Zafar et al., 2009).**

The child usually lies down with the nursing bottle in the mouth. The tongue extends slightly out of the mouth and covers the lower anterior teeth. As the child falls asleep, active sucking stops, so that the movements of the jaw that normally stimulate the anticaries factors, salivary flow and salivary buffering, no longer take place. In short, the problem is compounded by low salivary flow during sleep. This is a perfect oral environment for the enhancement of the carious process, particularly when a sugary beverage pools around the teeth. The beverage spreads over the upper teeth and the lower posterior teeth, but not over the lower incisors, which are covered and protected by the tongue. The unprotected teeth develop rampant caries. (**Winter et al., 1966**) noted the dietary habits of 200 children with rampant caries and came to the conclusion that there was a direct cause-and-effect relationship between the sugar-sweetened contents of the nursing bottle and the extensive carious damage to the teeth.

Figure (5) Nursing bottle caries **(Caufield , 2012).**

Often the first signs of malnutrition and lack of vitamins (mainly vitamin A and B) are the manifestations of the oral mucosa, there is a characteristic clinical picture of glossitis, stomatitis, angular cheilitis, and others (**Kristeva, 2016).**

Epidemiological studies show that the risk of developing oral cancer decreases with increased consumption of fruit and vegetables due to the high content of vitamin C and its antioxidant and protective properties **(McLaughlin et al., 1988 ; Morse 2004).**

3.5.1 Infancy

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

1) Their high energy needs per unit body of weight to support rapid growth.
2) Their immature digestive tracts and kidneys.
3) 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).**

Signs of developmental readiness for solid foods may appear a few weeks before or just after 6 months of age **(Delaney & Arvedson, 2008) :-**

• Has better head control.

• Can sit up and lean forward.

• Signals when they are full (e.g. turn head away).

• Can pick up food and try to put it in their mouth.

• Has vertical jaw movement (munching).

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.
8) Choking hazards.

3.5.2 Toddlers

Ellyn Satter describes the "Division of Responsibility" in feeding between parents and children (**Satter 1987-2000).**

1) 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.
2) It is the role of the child to determine whether or not to eat the provided food.

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. Often rejects unfamiliar foods several times.

1) By 12-18 months, acquires full chewing movements.

2) By 18 months, eats most foods without coughing and gagging.
3) By 24 months, eats most of the same foods as the rest of the family with some extra preparation to prevent choking.

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.

3.5.3 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. In this stage the child starts to develop undesirable diet-related behaviors if he wasn't under careful monitoring by the parents. When small quantities of food are consumed throughout the day, a person may never become truly hungry. The result is an increased intake of highly palliative, processed foods. Such habits allow for multiple exposures to fermentable carbohydrates and subsequently increase caries risk. Depending on the degree of snacking and the nature of foods consumed, snacking may lead to inadequate energy intake with weight loss, excessive energy intake with weight gain. Recommendations include providing appropriate quantities of ‘‘forbidden’ ’foods at meals/snacks because allowing access to ‘‘forbidden’’ foods without judgment limits their perceived importance. Parents are responsible for providing access to appropriate food (**Thomas, 2014).**

Frequent intake of energy-containing beverages increases risk of dental

carries and may blunt the appetite. Such beverages may or may not displace nutrient-dense foods or beverages, leading to inadequate nutrient intake or excessive energy intake. 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.
5) Offer child-appropriate portions.
6) Engage in at least 60 minutes of moderate to vigorous physical activity on most, if not all, days of the week.
7) Provide food that is safe (avoid unpasteurized milk/juices and raw or undercooked meat, poultry, eggs, fish, and shellfish).

3.5.4 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.

Approaches to Communication with Adolescents in Nutrition Intervention

1) Keep the adolescent's psychosocial and cognitive development in mind.
2) Generally, younger teens are more concrete in their thinking.
3) Develop rapport.
4) Avoid judgment.

5) Expect experimentation with varied eating behaviors.
6) In the context of specific education about nutrition and physiology, ask teens, to identify one or two goals **(Thomas, 2014)**.

3.6 Some Iraqi studies regarding the relationship between nutritional status and oral health

Table (3) Iraqi studies

Author, year	Sample	Results
Diab B., 2003	4089 children from primary school in five governorates in the middle region of Iraq	-The prevalence of malnutrition described by three indicators, height for age, weight for age, weight for height were found to be 49.00%,18.20%, and 9.70% respectively -Normal children had significantly lower dmfs values, gingival index,x, and hypoplastic teeth than mal-nutrient children. -A significant positive correlation between numbers of permanent teeth and daily nutrient intakes of protein, calcium, and phosphorus.
Alsaadi A., 2008	478 children aged 6-11years, 239 normal weighted and 239 overweight children	-10.04% of the total sample of overweight children was caries-free which is higher than that among the normal weighted children 1.26%. -dmfs for the overweight was (9.49±7.54) significantly lower than that among the normal weighted children (12.55±8.27) -DMFS among the overweight children (1.27±.05) was significantly lower than that among the normal weighted children (1.72±.01). -The salivary flow rate among the overweight children (1.00 ± 0.17) was found to be significantly higher than that among the normal weighted children (0.85±0.43) -The level of salivary copper, zinc, calcium, and total protein were higher among the overweight children than the normal weighted children, while the salivary iron level was lower among the overweight than that among the normal weighted children.

Al-Ghalebi S., 2011	1350 children (696 males and 654 females)aged 9 10- years in the primary school of Nassiryia city	-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. -No significant differences concerning plaque, gingival and calculus indices between different grades of BMI indicator (P>0.05).
Suhail I., 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 ststatuseswell-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 H. 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 H.,2019	580 children 4 and 5 years old from kindergarten in Tikrit city	-The percentage of children underweight was 11.89 % -According to nutritional status (BMI indicator), the mean value of dmfs and 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.

3.7 Eating out

Children and teenagers continue to obtain more of their meals outside of the home, often from fast-food establishments. From the late 1970s through the mid-2000s, 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% **(Guthrie et al., 2002).** Fast food intake increased total fat, saturated fat, sugar, sodium, and protein for teenagers **(Powell & Nguyen, 2013).**

Recent systematic reviews examining the association between eating out, dietary intake, and weight concluded that eating away from home is a risk factor for higher fat and calorie intakes and lower consumption of micronutrients **(Lacchat et al., 2011)**. However, it remains less conclusive about weight gain, especially in young populations **(Bezerra et al., 2012)**. Along with an increase in eating outside the home, there is a trend toward expanded food-serving sizes. Most marketplace portions of foods exceed standard serving sizes by at least a factor of 2 (e.g., bagels and sodas) and sometimes by a factor of 8 (e.g., cookies).

The current serving sizes are often two to five times larger than the size originally marketed. These changes in dietary patterns parallel the progressive increase in obesity.

Eating dinner at home in a dining area and helping to prepare meals was associated with a decreased body mass index (BMI) in children. Furthermore, in teenagers, **Berge et al. (2013)** found that positive interpersonal communications with family members at the dinner table were associated with lower BMI and greater vegetable consumption.

3.8 Malnutrition

According to the **World Health Organization (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.

According to the **United States Department of Agriculture (USDA)**, food security is generally defined as "access by all people at all times to enough food for an active, healthy life." Conversely, food insecurity describes a "household-level economic and social condition of limited or uncertain access to adequate food." Hunger is an individual-level physiological condition that may result from food insecurity, and refers to "a potential consequence of food insecurity that, because of prolonged, involuntary lack of food, results in discomfort, illness, weakness, or pain that goes beyond the usual uneasy sensation.", Data regarding the food security of U.S. households are obtained by **USDA (2014)** from federally sponsored national surveys. The food security status of each household is categorized according to the following labels :-

- High food security.
- Marginal food security.
- Low food security.
- Very low food security.

Results suggested poorer health status for children living with persistent household

food insecurity. Food insecurity has also been associated with increased mental and substance abuse disorders in adolescents (**McLaughlin, et al,2012).**

Malnutrition includes:

1- Undernutrition can be defined as inadequate intake of nutrients that potentially lead to deficiency diseases.

Failure to thrive is a concern sometimes observed among infants and c 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 ma lacks 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.

Nutrient undernutrition may have several causes, only one of which is inadequate dietary intake. Some cases may be secondary to poor socioeconomic status, lack of education, perceived allergies/food intolerances, and child neglect or abuse **(Dean, 2016).**

2- Overnutrition is an excessive dietary intake of calories, fat, or cholesterol that predisposes individuals to chronic diseases. Excessive consumption patterns may be quantitatively more relevant to overall mortality and morbidity rates in contemporary U.S. society than are nutrient deficiencies, the latter has not been eradicated.

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 underconsumption of food and nutrients. Simply stated, obesity results from a chronic imbalance between energy intake and energy expenditure, in

which the former exceeds the latter. However, its increasing incidence is related to a complex array of genetic, environmental, psychosocial, biological, and economic factors. Obesity is traditionally defined as the excessive accumulation of fat in the body, whereas being overweight means weighing more than is considered normal. These terms are often defined based on Body Mass Index (BMI). BMI is calculated by dividing the individual's weight in kilograms by the square of the height in meters **(Dean, 2016).**

Table (4) BMI values and standards for children **(Dean, 2016)**

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

The most common physical signs of protein and energy malnutrition (PEM) are **(Dimosthenopoulos et al, 2010) :**

1) Weight loss and cachexia.
2) Decreased subcutaneous tissue and reduction in muscle and body tissue mass, which can be most often observed in the legs, arms, buttocks, and face.
3) Oedemas.
4) Neurological problems and abnormalities.
5) Oral changes (red and usually swollen mouth, lips, and gums).
6) Muscle cramp and pain.
7) Skin changes (dry and peeling, frail, swollen, pale, loss of elasticity, and poor healing).
8) Hair changes (dry and discolored).

3.9 Feeding & Eating Disorders and Other Malnutrition Diseases

Physical appearance is of prime importance for most teenagers, and for some adolescent girls in particular, getting "thin enough" can become an obsession because women and men are often secretive about their eating disorders, existing epidemiologic studies may underestimate the true prevalence of these conditions **(Faine, 2013).** Disordered eating is a term that includes a full spectrum of unhealthy eating behaviors from inappropriate dieting to clinical eating disorders (**Sherman & Thompson, 2004).**

3.9.1 Anorexia Nervosa & Bulimia Nervosa

Anorexia Nervosa 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. It is characterized by self-imposed weight loss, amenorrhea, and a distorted attitude toward eating and body weight.

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 anorexia nervosa **(Dean, 2021).**

3.9.2 Kwashiorkor and Marasmus

Kwashiorkor (from the 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, and the possible depigmentation of skin and hair.

Figure (6) Kwashiorkor & Marasmus **(sori, 2018**)

Marasmus (from the Greek word for 'to waste away') is the other form of malnutrition, which is caused by the inadequate intake of both protein and energy. It is a form of severe cachexia with weight loss as a result of wasting in infancy and childhood. The main symptoms of marasmus are severe wasting, with little or no edema, minimal subcutaneous fat, severe muscle wasting, and abnormal serum albumin levels **(Dimosthenopoulos et al, 2010).**

3.9.3 Food Allergies

Food stimulates an immune response which can be life threatening and the only treatment is avoidance of the allergen; milk, egg, peanut, tree nuts, wheat, soy, fish, and shellfish are responsible for most IgE mediated allergic reactions. Avoidance diets can place children at risk of inadequate nutrient intake which, in turn, can affect growth. In particular, cow's milk allergy is associated with growth impairment in children that persists through adulthood **(D'Auria, 2019).**

3.9.4 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. Coeliac disease can be diagnosed at any age Treatment for coeliac disease is lifelong adherence to a gluten-free diet (**Lebwohl et al., 2018**).

3.9.5 Colic

Colic is a feeding disorder of infants characterized by paroxysmal abdominal pain and severe crying. The etiology of colic is unknown. Characteristically, the infant cries loudly and continuously, often for several hours. Colic can place extreme stress and fatigue on the family, so active support and counseling for the mother and other family members are important **(Holt et al., 2011).**

3.9.6 Pica

Is an eating disorder characterized by ingestion of nonfood items or food items consumed in abnormal quantities or forms. Examples of ingested items include starch, peeling paint, paper, soil components, flour, and coffee grounds. **(Moris et al., 2021).**

4.Conclusion

Diet and nutrition have an interconnected relationship with oral health and thus general health of the pediatric patients, and 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. 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 the 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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