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Diet and Nutrition in Pediatric Dentistry - A Review

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ABSTRACT

Diet and nutrition play a significant role as multifactorial environmental factors in the etiology and pathogenesis of orofacial diseases and disorders. They influence the growth and integrity of the oral cavity as well as the progression of diseases of the oral cavity. There is a synergistic relationship between nutrition and oral health. Oral infectious diseases, in addition to acute, chronic, and terminal systemic disorders with oral manifestations, have an effect on the ability to eat, as well as on food and nutritional status. Oral health should not be evaluated independently of overall health. The development of the cranium and the prevention of oral infections and oral malignancies are both significantly influenced by nutrition.This paper's goal is to review the evidence showing a link between diet, nutrition, and dental problems and to provide dietary advice for their prevention

INTRODUCTION

A balanced diet has the recommended servings of nutrients from each food group for human functioning at its best. Since energy is crucial to life, the study of nutrition is focused on the fundamental query of how the human body metabolizes and converts the components of food into energy. In fact, our need for energy is of such high priority that it can be met even when adequate amounts of the typical nutrient energy sources, such as carbohydrates and fats, are not consumed. One such nutrient is protein, whose primary function is to build tissue.The body may access the energy from food in four different ways: chemically, for the creation of new compounds, mechanically, for the contraction of muscles, electrically, for the activity of the brain and nerves, and thermally, for the control of body temperature.(1) Modern nutritional science is fairly new, despite the long history of research into food and nutrition. Less than 100 years ago, in 1926, the first vitamin was discovered and chemically characterized, marking the beginning of 50 years of research on disorders caused by nutrient deficiencies. Even more recent, with an increase in the last two or three decades and notably since 2000, is research on the role of diet in complicated non-communicable chronic diseases like cancer, diabetes, obesity, and cardiovascular disease.(3)

HISTORY

The first dietary advice was inscribed into a stone tablet in Babylonia around 2500 BC .

• The Ebers Papyrus first mentions scurvy about 1500 BC, and it was later shown to be caused by a lack of vitamin C. Walter Gratzer thinks that the science of nutrition likely got its start in the sixth century BC.

• In China, India, Malaya, and Persia, food was divided into "hot" (for instance, meats, blood, ginger, and hot spices) and "cool" (for instance, green vegetables). Hippocrates advised, "Let food be your medicine and medicine be your tooth," recognising and being concerned about obesity, which may have been widespread in southern Europe at the time.(4)With the establishment of the American Institute of Nutrition in 1928, nutrition gained official recognition as a separate field of study. This relatively young field of study is only about 100 years old. People started to realize the significance of CHO, LIPIDS, and PROTEINS for healthy growth and development around the year 300 B.C. Hippocrates had already acknowledged the role of diet in health.

BASAL METABOLISM AND BASAL METABOLIC RATE

The least amount of energy required for the regulation and maintenance of the key living functions, such as breathing, blood circulation, cellular activity, maintaining muscle tone, and regulating body temperature, is known as basal metabolism.(1)The amount of energy expended while awake and lying quiet at rest is known as the basal metabolic rate (BMR). Similar in definition, but not always tested before getting out of bed, is the resting metabolic rate (RMR). The RMR, which can range from less than 1200 to more than 3000 kcal/day for the majority of inactive adult Americans, is the primary source of daily energy.(2)

BALANCED DIET

The diet that includes a range of foods in amounts and ratios that meet the requirements for short periods of leanness as well as for energy, amino acids, vitamins, lipids, and other nutrients is appropriate for maintaining health, vitality, and overall well-being.A well-balanced diet provides enough energy and nutrition for optimal growth and development.(5)
(Dietary Guidelines for Americans 2005) Figure-1

Figure-1 Diet Charts-Kids

ENERGY FOR PHYSICAL ACTIVITIES

While simultaneously delivering enough micronutrients and fluids to meet the body's physiological needs, macronutrients are ingested in the right quantities to support energetic and physiologic needs without excessive consumption(6). Carbohydrates, proteins, and lipids, collectively known as macronutrients, supply the energy needed for cellular functions essential for daily operation (7). For appropriate growth, development, metabolism, and physiologic functioning, micronutrients (i.e., vitamins and minerals) must be consumed in relatively tiny amounts(8,9) The main source of energy in the diet is carbohydrates, which are most prevalent in grains, fruits, legumes, and vegetables.(10)

NUTRIENTS

Carbohydrates, lipids, proteins, vitamins, minerals, and water are the six groups into which nutrients are broken down. The macronutrients that provide energy or calories are proteins, lipids, and carbohydrates. In little amounts, vitamins and minerals are needed to maintain health because they are micronutrients. Each nutrient plays a unique function in the body, and they all operate in concert to promote the formation, maintenance, resistance, and repair of the oral cavity as well as to control other vital bodily functions. When nutrients are insufficient or excessive, this complex process is disrupted.(11)

RECOMMENDED DIETARY INTAKE

The National Academy of Medicine (NAM) of the National Academies has developed a system of dietary guidelines known as the Dietary Reference Intake (DRI) (United States).(12) It was implemented in 1997 to expand the currently available recommendations known as Recommended Dietary Allowances (RDAs, see below). The Reference Daily Intakes (RDIs) and Daily Values (%DV) used in nutrition labeling on food and dietary supplement items in the United States and Canada are different from the DRI values because they were based on outdated RDAs from 1968 that were revised as of 2016.(13)
The following equations are used to determine the RDA: "The RDA is set at two SDs above the EAR if the standard deviation (SD) of the EAR is known and the demand for the nutrient is symmetrically distributed:RDA=EAR+2SD(EAR)
Unless available data suggest a greater variance in requirements, a coefficient of variation (CV) for the EAR of 10% is assumed if data about variability in requirements are insufficient to determine an SD.(14) If 10% is taken to be the CV, then the RDA is equivalent to twice that amount when added to the EAR. The RDA's resulting equation is then RDA=1.2EAR According to statistics, this intake amount meets 97.5 percent of the population's needs."Figure-2

Recommended Dietary Allowance (RDA) for Iron

Life Stage	Age	Males (mg/day)	Females (mg/day)
Infants	0-6 months	0.27	0.27
Infants	7-12 months	11	11
Children	1-3 years	7	7
Children	4-8 years	10	10
Children	9-13 years	8	8
Adolescents	14-18 years	11	15
Adults	19-50 years	8	18
Adults	51 years and older	8	8
Pregnancy	all ages	-	27

Figure-2 RDA IRON CHART

CLASSIFICATION OF FOOD

Food can be categorised based on their chemical properties, functions, essential qualities, concentrations, and nutritional value.(figure-3)

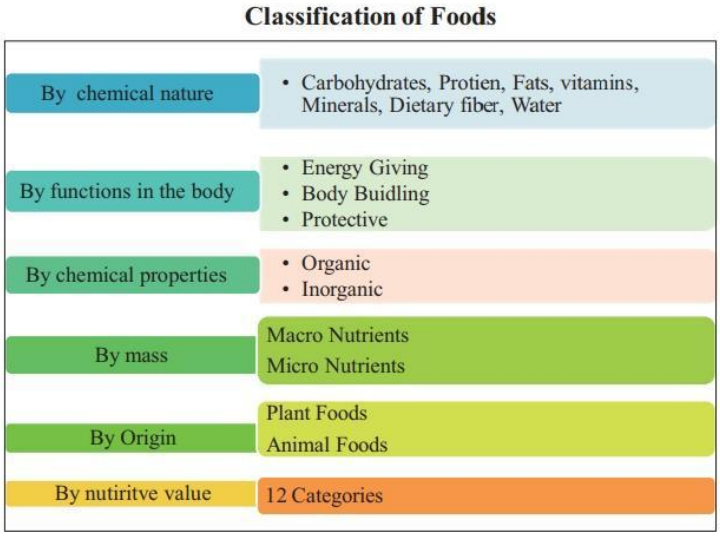

Figure-3 Foods Classification

a) According to chemical nature
- Carbohydrates
- Vitamins
- Proteins
- Dietary fibers
- Fats
- Water minerals

b) According to their function in the body ENERGY GIVING FOODS
Protein, lipids, and carbs are all categorized as calorie-containing nutrients because they provide the body with the energy it needs to function. Energy-giving foods include rice, chapatti, bread, potatoes, sugar, oil, butter, and ghee.
PROTECTIVE FOODS
The nutrients that control bodily functions are vitamins and minerals. They shield us from a number of illnesses. Several examples include fruits and vegetables. Therefore, we must regularly consume these.

c) According to its chemical properties
ORGANIC:Organic nutrients are those that contain the element of carbon.
INORGANIC:Inorganic nutrients are those that don't contain the carbon element. Proteins, lipids, carbohydrates, and vitamins are among the organic nutrients. Water and minerals are inorganic.

d)According to its nutritive value
- Cereals and millets
- Pulses
- Nuts and oil seeds Vegetables

- Green leafy vegetables
- Non-leafy vegetables
- Roots and tubers
- Fruits
- Milk and milk products
- Animal foods—meat, fish, liver, egg etc Carbohydrate foods
- Condiments and spices(15)

FUNCTIONS OF FOOD

The primary purpose of food is to sustain life. Body need energy to maintain involuntary functions that are necessary for life to continue. It is also necessary for tasks like working, maintaining a home, and engaging in leisure activities. It transforms waste into usable nutrients needed for warmth and growth. Bodybuilding is an additional crucial role. An infant's weight at birth ranges from 2.5 to 3.0 kg, and by the time they reach adulthood, they will weigh 50 to 60 kg. This is only possible if the appropriate foods are given from birth until adulthood. Eating contributes to maintaining the body's structure and repairing tissues that have been worn out.ood controls a variety of bodily functions, including the heartbeat, regulation of body temperature, muscle contraction, water balance, blood coagulation, and elimination of waste items. Additionally, it strengthens the body's defense mechanisms and immune system.We do have numerous recommendations for the consumption of foods including fruits, vegetables, fish, meat, whole grain products, less salt, maintaining a healthy body weight, abstaining from alcohol use, and drinking clean, safe water.(16)

FOOD GUIDE PYRAMID

The USDA started using graphics to portray the Guidelines in 1988 in order to communicate the messages of diversity, proportion, and moderation. The Nutrition Labeling and Education Act mandated the inclusion of nutritional labels on all grocery items in 1994 after the 1992 release of the Food Guide Pyramid.

Basic seven

To help with the Second World War's food crisis, the USDA released the "Basic Seven" in 1943, a particular adjustment to the dietary recommendations. The seven categories were cereal, bread, butter, all types of meat, cheese, fish, and poultry, as well as milk, vegetables, fruit, eggs, and produce.figure-4

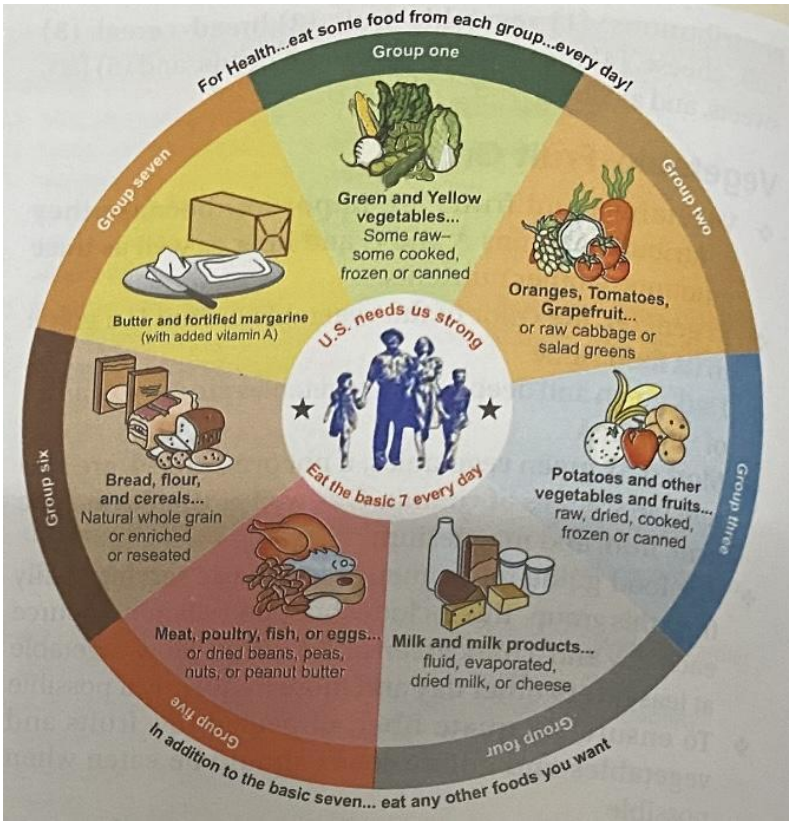

Figure-4 Basic Seven Pyramid

Basic four

The 'Basic Four' were developed in 1956 and used until 1979 as a means of simplification; the categories were milk, vegetables and fruit, meat, and grain. In response to the surge in chronic diseases, the USDA added fats, sweets, and alcoholic beverages as a fifth group to its list of harmful dietary

categories in the late 1970s. A Pattern for Daily Dietary Choices, the USDA's food guide, was not widely known even though it was issued annually starting in the 1980s.(71)

Food wheel approach

Included objectives for nutrient sufficiency and moderation.

- The Food Guide Pyramid was built on five food groups and serving sizes. Food portions per day are offered at three calorie levels. initially depicted as a food wheel for a Red Cross nutrition workshop. figure-5

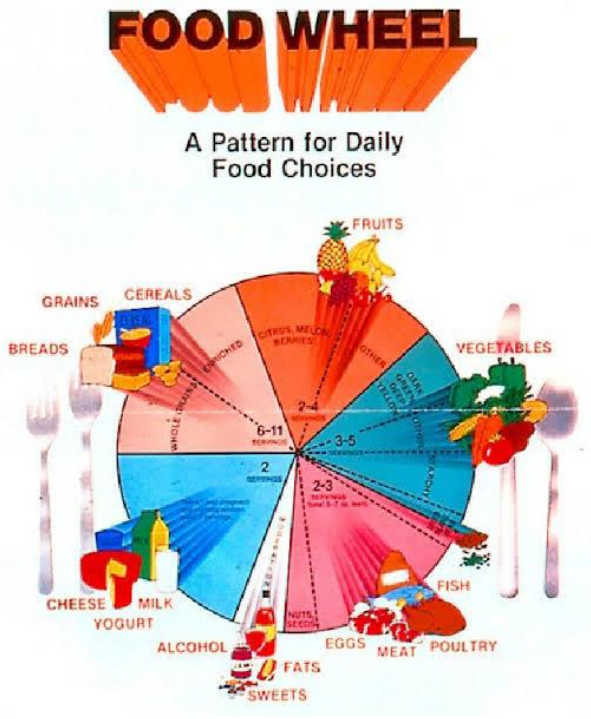

Figure-5 Food Wheel Pyramid

In 1992, the USDA unveiled the Food Guide Pyramid, a recognisable nutrition tool. It was designed in the shape of a pyramid to imply that one should consume more meals from the base of the pyramid and less food and drink from its top.
The Food Guide Pyramid showed balance and variety in each of the five food and beverage categories that ascended in horizontal tiers from the bottom to the tip: breads, cereals, pasta, and rice; fruits and vegetables; dairy products; eggs, fish, meat, and poultry; plus alcohol, fats, and sugars.(17)Figure-6

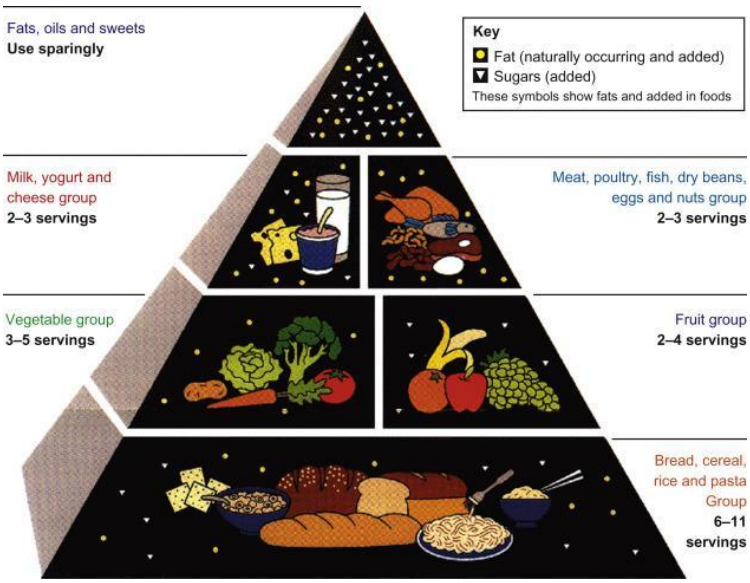

Figure-6 food pyramid

My Pyramid, an updated version of the Food Guide Pyramid, was released by the USDA in 2005. The depiction of food groups in ascending vertical bands highlighted the appropriate ratios of dietary groups. To indicate activity, a picture of a person climbing stairs surrounded the pyramid. Quantities were measured in cups and ounces rather than portions.Figure-7

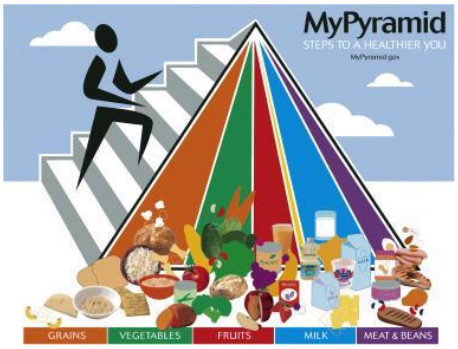

Figure-7 food quantities

MY PLATE

The U.S. Department of Agriculture (USDA) developed MyPlate, a simple meal plan, to assist parents in preparing wholesome, balanced meals for their children. The divided plate is separated into pieces for cereals, vegetables, fruits, and protein-rich foods. The interactive, user-friendly MyPlate website offers clear recommendations like: choose diversity – the best meals balance foods from various food groups. Put fruit and vegetables on half of your child's plate and at least half of the grains. Instead of serving sugary drinks, you serve whole grains like oatmeal, whole-wheat bread, and brown rice. You also serve fat-free or low-fat (1%) milk and water. serve reasonable-sized portions.

Green=vegetables

The greatest area on the plate is represented by the green vegetables component of MyPlate. Vegetables are inherently low in calories, include fiber, and contain many of the vitamins and minerals that children need for optimum health. The group of vegetables consists of:

- shady green vegetables (like broccoli, spinach, and kale)
- orange and red produce (like squash, carrots, and sweet potatoes)
- Beans and peas (including lentils, black-eyed peas, and kidney beans, which are all in the protein group)
- fibrous veggies (like corn, potatoes, and plantains)
- Other vegetables, such as green beans and cauliflower, are ones that don't fit into the first four categories.

Red= Fruits

Fruits are a crucial component of a diet that is balanced. They contain fiber, potassium, and minerals including vitamin C. Fruit may be used fresh, frozen, or canned.

When purchasing canned fruit, go for fruit that has been packed in juice as opposed to heavy or light syrup. And serving the entire fruit rather than 100% fruit juice is preferable. Fruit liquids include less fiber per serving and more sugar and calories than whole fruit.

Orange= Grains

All foods derived from wheat, oats, cornmeal, barley, or other grains fall under the grain category. This group includes pasta, bread, tortillas, cereal, and rice.

Kids should consume whole grains, such as oatmeal, brown rice, and whole-wheat bread, for at least half of their daily grain intake. Dietary fiber found in whole grains makes kids feel fuller and can be used to treat and prevent constipation. A diet high in whole grains may also lower the risk of developing diabetes and heart disease.

White bread and white rice are examples of refined grains that have undergone further processing that removes many of the nutrients. Most refined grains are enhanced, which means that after processing, nutrients—aside from fiber—are added back.

Purple= protein foods

Protein-rich foods assist the body in maintaining and repairing muscles, skin, blood, and other bodily structures. They include essential vitamins and minerals, such as iron.

Beef, poultry, shellfish, dried beans and peas, eggs, nuts, and seeds are examples of foods high in protein. Protein-rich soy products like tofu and veggie burgers are also available. Select lean or low-fat meats when eating.

Blue= Dairy

Milk and other dairy products, such as yogurt and cheese, are included in this category. Dairy products such as soy yogurt and calcium-fortified soy milk are also included. Dairy products also contain protein and vitamin D in addition to calcium. The body needs calcium to absorb vitamin D for strong bones and teeth. Dairy products do not include foods derived from milk such as butter, cream, and cream cheese because they are low in calcium. Give children over the age of two low-fat or nonfat milk and dairy products.(73) figure-8

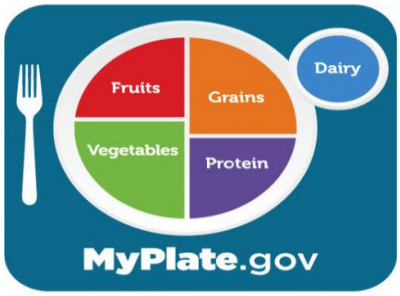

Figure-8 my plate

MEDITERRANEAN DIET PYRAMID

The eating patterns of Mediterranean adults who live long lives were used to design the Mediterranean diet pyramid. It promotes group eating and an active lifestyle while adhering to a basic food pyramid guideline (rather than specifying exact serving sizes). It is linked to: > Lower risk of dementia and memory issues > Lower risk of vascular disorders like stroke and diabetes(18,19) Figure-9

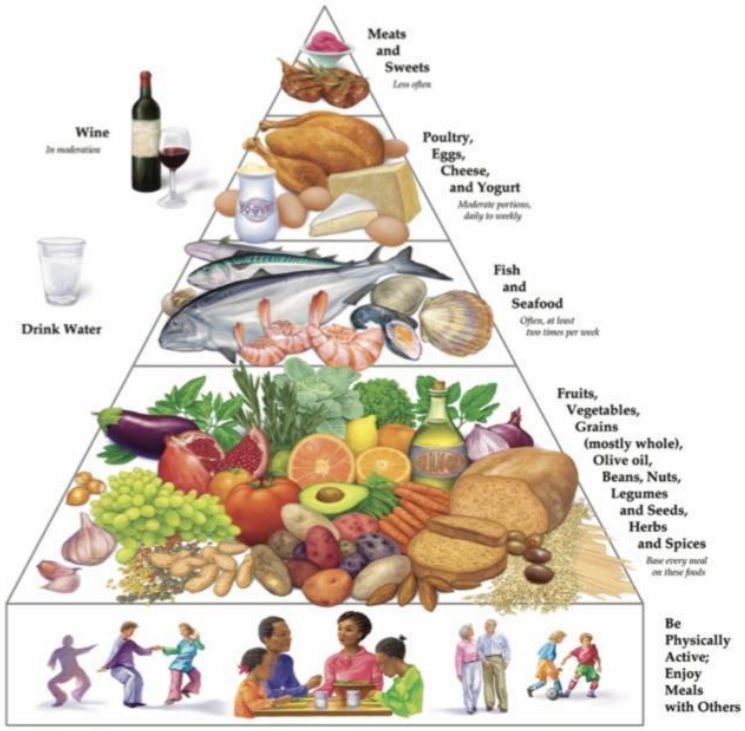

Figure-9 Mediterranean Pyramid

CARBOHYDRATES

All bodily cells need energy to function, and carbohydrates also contain dietary fibre. Except for young children, who require a somewhat higher amount of fat in their diets, adults should get 45–65% of their total calories from carbohydrates. The recommended maximum daily intake for added sugars is 25%. Americans should make cooked dry beans and peas, whole grains, vegetables, fruits, and other fiber-rich foods a cornerstone of their diet. A nutrient-rich source of carbs is dairy products. For those who are active, carbohydrates serve as their main source of energy. People who are sedentary, like the majority of Americans, should consume fewer calories from carbs to balance their energy needs and achieve and maintain a healthy weight.(20)

DIETARY FIBERS

Childhood dietary fiber consumption is linked to significant health advantages, particularly in terms of encouraging regular bowel movements. Additionally, dietary fiber may lower the chance of developing adult-onset diabetes, certain malignancies, and cardiovascular disease in the future. There are currently few exact recommendations for children's dietary fiber consumption.(21)Dietary fiber is particularly beneficial for children's health since it encourages regular bowel movements. Currently, children appear to be consuming insufficient amounts of dietary fiber to promote health and avoid disease. It is good to advise that children older than 2 years old increase their daily dietary fiber intake to at least their age + 5 g. The "age + 5" rule states that dietary fiber consumption should increase from 8 grams per day at age 3 to 25 grams per day by age 20. 25 to 35 g/day of dietary fiber are advised after the age of 20.(22)Figure-10

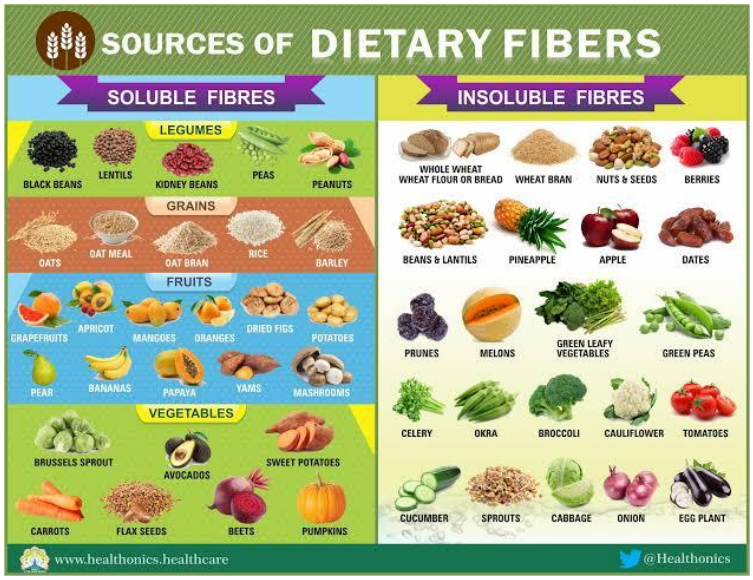

Figure-10 Dietary Fibers Sources

FERMENTABLE CARBOHYDRATE

Glucose,Fructose,sucrose and starches.Carbohydrates that can be fermented by colonic bacteria are those that are ingested in the human diet but not digested by the digestive system. This can contain hemicelluloses, pectins, gums, certain mono- and disaccharides, polyols, and oligosaccharides (OS), as well as resistant starches, non-starch polysaccharides, and oligosaccharides. Beneficial colonic bacteria selectively ferment some of them to encourage the growth and colonization of other beneficial bacteria, including non-starch polysaccharides, OS, and several mono- and disaccharides(23-25)

CARBOHYDRATES AND DENTAL CARIES

Since the original investigations conducted in the 1950s, there has been speculation and support for a link between dietary habits and dental caries (26,27). Evidence from the past ten years has shown that eating habits, in particular the consumption of free sugars, play a significant role in the emergence of dental caries, are a required condition for this condition, and influence other factors such as dental biofilm (28-30).The local impact of carbohydrates on dental tissue or their metabolization by cariogenic microbes in the oral cavity are essentially what the term "diet's effect on dental caries" refers to. A wide variety of foods contain carbohydrates, however the monosaccharides (glucose and fructose) and disaccharides (sucrose, lactose, and maltose), which have a low molecular mass and are referred to as sugars, are those that are more readily fermented by bacterial species. A carbohydrate called starch has a complicated, bulky structure that prevents it from diffusing in dental biofilm and from being used by bacteria for metabolism.(31)

Through extracellular and intracellular processes, sucrose ingestion enables cariogenic bacteria to utilize sugar as their main energy source and drives biochemical activities, as shown in figure-11. The difference in caries experiences between individuals and populations is largely caused by variations in dietary patterns, particularly the consumption of free sugars.(32)

Intracellular	Extracellular
• After the ingestion of sugar, microorganisms produce organic acids as metabolic by-products, which lower the pH to 5.0 or lower, favouring the demineralisation process • Cariogenic microorganisms are able to produce and store intracellular polysaccharides, which serve as a substrate reservoir to be used for the production of energy between meals in which carbohydrate sources are not available • The production of acid promotes a shift in the balance or resident plaque microflora favouring bacteria that preferentially grow under acidic conditions, which leads to the selection of more cariogenic microflora if the pH remains repeatedly low	• Sucrose is especially cariogenic because it serves as substrate through the polymerisation of glucose and fructose for the synthesis of extracellular polysaccharides in dental plaque • Extracellular polysaccharides promote bacterial adherence to dental surfaces and contribute to the integrity of biofilm by increasing its porosity, thereby enabling sugars to diffuse from the outer layers to deeper areas of the biofilm • Biofilm formed in the presence of sucrose has low concentrations of calcium and fluoride, which are critical ions in the demineralisation-remineralisation process

Figure-11 carbohydrates(intra and extracellular)

The difference in dietary habits, particularly the consumption of free sugars, is substantially to blame for the disparity in caries experiences between individuals and communities. There is evidence that two crucial aspects (risk factors)—the age at which sugar is introduced and the frequency of its consumption—potentiate the effect of dietary behaviours in dental caries and should be the focus of interventions. The amount of free sugar consumed

should also be the focus of interventions, as sugar is now recognised as a prevalent risk factor for non-communicable disorders, including dental caries.(33,34)

STUDIES ON SUGARS

The degree of acidity that a carbohydrate causes in dental plaque is a good indicator of how well it can be metabolized by oral bacteria through the glycolytic pathway, which determines a carbohydrate's cariogenic potential [Maehara et al., 2005]. Compared to more complex carbohydrates like starch, monosaccharides like glucose and fructose can enter the glycolytic pathway directly after being converted to fructose-1,6-biphosphate. However, more complex carbohydrates like fructose must first be broken down into more simple sugars. As a result, glucose and fructose are more cariogenic than starch and cause a faster and more noticeable pH reduction in dental plaque [Bibby and Krobicka, 1984].Figure-12

FIGURE-12 stages of caries

In comparison to glucose, fructose, and sucrose, the milk sugar lactose causes a lesser pH reduction in plaque, making milk less cariogenic [Johansson and Lif Holgerson, 2011]. Table sugar (sucrose) is regarded as the most cariogenic sugar because oral bacteria can use it as a source for the production of extracellular (EPS) and intracellular (IPS) polysaccharides, as well as because it typically causes the greatest pH drop in plaque [Lingstrom et al., 2000; Newbrun, 1967; Bowen, 2002]. Insoluble glucans can help bacteria cling to surfaces [Schilling and Bowen, 1992] and increase plaque porosity, allowing bacteria and sugar to permeate deeply into tooth structure [Shellis and Dibdin, 1988], resulting in a "stickier" plaque than that produced in the absence of sucrose.(35)Figure-13

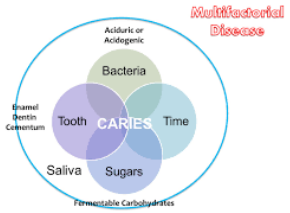

Figure-13 multifactorial disease caused by sugars

HOPEWOOD HOUSE STUDY

Harris (1963), Sullivan and Harris (1958),

The dental health of kids between the ages of 7 and 14 was tracked during a 10-year period. The Hopewood home diet's two main characteristics were a severe ban on refined meat and a complete absence of meat. This study's CONCLUSION said that The average DMFT for 13-year-old children was 1.6. In comparison to the general child population, 10.753% of Hopewood House's children were caries-free, whereas only 0.4% of 13-year-old state school students were.(36)

THE VIPEHOLM STUDY

The goal of the Vipeholm study, which was undertaken between 1945 and 1953 in a Swedish adult mental facility, was to ascertain the connection between food, the frequency of sugar consumption, and dental caries. The factors included the kind of sugar consumed (sticky or non-sticky form), as well as how frequently sugar was consumed (at meals or in between meals). The subjects (436 patients) were separated into a control group, six major test groups, and two additional groups based on gender for the bread and 24-toffee groups.(37)

TURKU STUDY

(Makinen & Scheinin 1972-74)

The study, which compared the carcinogenicity of sucrose, fructose, and xylitol, was conducted in Turku, Finland.

Xylitol is a delicious chemical that plaque microorganisms do not digest. In a two-year study, 125 young individuals were split into three groups based on their personal preferences, and they consumed the majority of their daily caloric intake using these sugars (Sucrose group - 35 people, Fructose group - 38 people, and Xylitol group - 52 people).(38)

FURTHER STUDIES

The disaccharide sucrose is the most significant source for EPS formation, and it is also the carbohydrate that acidogenic bacteria use to make acids most efficiently (Aires et al., 2008; Ccahuana-Vasquez et al., 2007; Cury, Rebello, and Del Bel Cury, 1997). There are numerous other biofilm species that can metabolize free sugars (Klein, Hwang, Santos, Campanella, & Koo, 2015). Recent studies have proven a direct link between eating sugar and

developing more caries (Bernabe, Vehkalahti, Sheiham, Lundqvist, & Suominen, 2016).According to the study, sweets and caries have a linear dose-response connection. To lower obesity, type 2
diabetes, and dental caries, the World Health Organization (WHO) has decreased the recommended for free sugars intake from 10% (WHO, 2003) to 5% of daily energy intake (Moynihan & Kelly. 2014: WHO, 2015). This recommendation has recently been supported by another study based on a clinical trial (Saido, Asakura, Masayasu, & Sasaki, 2016). Free sugars' role in caries has been underlined and reiterated (Sheiham & James, 2015).(39)

HEREDITARY FRUCTOSE INTOLERANCE

A rare autosomal recessive genetic condition known as hereditary fructose intolerance (HFI) results from a mutation in the aldolase B enzyme on chromosome 9q22.3. A fructose load causes fructose 1-phosphate to rapidly build up and manifest with its after-effects. Children are typically affected by digestive difficulties, eating problems, a sweets aversion, and hypoglycemia.(40)One common monosaccharide is fructose, which can be found in honey, numerous fruits, and many vegetables.(41)) Fructose is absorbed from the intestine after consumption by the glucose transport proteins GLUT 5 and 2.(42) Aldolase B deficiency is the cause of the medical illness known as hereditary fructose intolerance (HFI).(43)Due to dysregulation of gluconeogenesis, glycogenolysis, and decreased inorganic phosphate, it is characterized by hypoglycemia, lactic acidosis, hypophosphatemia, hyperuricemia, hypermagnesemia, and hyperalaninemia(44)

TREATMENT

HFI care requires a multidisciplinary approach with the involvement of a pediatrician, clinical geneticist, nutritionist with experience in metabolic disorders, hepatologist, and nephrologist because it is a complex metabolic illness. The absolute avoidance of foods containing fructose, sucrose, and sorbitol is the cornerstone of HFI management (FSS)(45).Figure-14

Foods that are high in excess fructose	Foods containing glucose in balance with, or in excess of, fructose

• **Fruits:** apple, pear, mango, watermelon
• **Certain fruit juices**
• **Vegetables:** asparagus, frozen peas
• **Honey**
• **Some sweetening ingredients:**
  o High-fructose corn syrup
  o Fruit juice concentrate
	✓ **Berry fruit:** blueberry, cranberry, raspberry, strawberry
	✓ **Citrus fruit:** clementine
	✓ **Other fruits:** fresh banana, honeydew melon, jackfruit (tinned in syrup), kiwi fruit, passion fruit, pineapple, rhubarb
	✓ **Maple syrup, rice malt syrup**

Figure-14 foods to be taken and avoided during HFI

PROTEINS

In a well-balanced diet, protein is a key macronutrient that is necessary for development, muscle strength and function, immune system health, wound healing, and general tissue homeostasis. Dietary proteins are essential for maintaining good dental health in addition to general health(46).

Proteins are not all made equal. Both non-animal (plants) and animal (meats, eggs, and milk) sources of dietary protein are available. A protein's biological value (the proportion of necessary to non-essential amino acids), protein efficiency ratio (how well a protein supports growth), and net protein utilization all contribute to the assessment of a protein's quality (the percentage of amino acids converted to tissue protein versus the amino acids digested).Additionally, calcium and vitamin D, which are found in diets high in protein (particularly animal protein), help older persons retain their teeth(47).Importantly, the calcium and phosphorus included in dairy products like milk and cheese help prevent teeth from demineralizing by keeping the mouth's pH at 5.5 and lowering the risk of tooth decay (48,49). Additionally, there is a negative correlation between the prevalence of periodontitis in the adult population and milk and dairy product consumption (50).

Researchers hypothesize that lactic acid in fermented dairy products suppresses the growth of periodontal infections by lowering oral pH, while the precise mechanism behind this connection is yet unknown (51).Despite allergic reactions and lactose intolerance, milk is a good source of protein and organic nitrogen for people of all ages. The whey fraction of milk protein, according to data from a rat study, increases bone collagen, improves bone strength, and inhibits the loss of alveolar bone by raising hydroxyproline, which can increase the coherence of bone(52,53) There are minor milk proteins and bioactive peptides like lactoferrin and transferrin in addition to the two main milk proteins, casein and whey. These bioactive dairy peptides have been proven in several in vitro, in situ, and in vivo investigations to lower the incidence of dental decay (54).For instance, salivary lactoferrin contributes to oral antimicrobial defenses by limiting the development of microorganisms linked to periodontal disease and controlling the inflammatory reactions that go along with it (55). In addition, milk contains a bioactive ingredient called casein phosphopeptides-amorphous calcium phosphate (CPP-ACP), which is made of casein phosphopeptides (CPP) and amorphous calcium phosphate (ACP). The calcium phosphate concentration of dental plaques can be increased and calcium phosphate can be stabilized by CPP in milk (56)

Additionally, Streptococcus mutans, a prevalent cariogenic bacteria in the oral cavity involved in plaque formation, cannot form a biofilm when CPP-ACP is incorporated into oral care products.This lessens the chance of dental caries by preventing S. mutans from adhering to the tooth surface. However, this impact from consuming regular dietary amounts of dairy products has not yet been proven.(57)Figure-15

Age	Protein requirements
0- 12 months	9.1 grams per day
1-3 years	13 grams per day
4-8 years	19 grams per day
8-10 years	1.5 grams per kg body weight 5 x Bodyweight = Required proteins per day
10 - 13 years	1 gram per kg body weight x Bodyweight= Required proteins per day

FIGURE-15 Recommended Intake Of Proteins

LIPIDS

They are defined as any group of organic compounds, such as fats, oils, waxes, sterols, and triglycerides, that are lubricious to the touch, soluble in nonpolar organic solvents but insoluble in water, and make up the majority of the structural components of living cells along with carbohydrates and proteins. By preventing contact between bacteria and carbohydrates in diet and limiting the production of fatty films, this lipid changes the surface characteristics of enamel. At low pH, it demonstrates antimicrobial characteristics.(58)Figure-16.

Recommended Daily Intake				
	Children		*Adolescent*	*Adults*
	Ages: 1 - 3 years	*Ages: 4 - 13 years*	*Ages: 14 - 18 years*	*Ages: 18+*
Total Fat % kcal	30 - 40%	25 - 35%	25 - 35%	25 - 35%
Saturated Fat % kcal	Less than 10%	Less than 10%	Less than 10%	Less than 10%
Omega-3 (linolenic acid)	0.7 grams	0.9 - 1.2 grams	1.1 - 1.6 grams	1.1 - 1.6 grams
Omega-6 (linoleic acid)	7 grams	10 -12 grams	11 - 16 grams	12 - 17 grams

FIGURE-16 Recommended Intake Of Lipids

VITAMINS

Vitamins are any of a group of organic compounds that are necessary for healthy growth and nutrition and must be consumed in small amounts in the diet because the body is unable to synthesize them. These organic, calorie-free molecules are essential for human health. They are further divided into water and fat soluble categories.(59) Figure-17

Type	Vitamin	Function
Fat soluble vitamins	Vitamin A	Forms oral epithelium
		Enhances immune system
		Wound healing
		Antioxidant
		Atrophic changes in ameloblast
		Decrease in number of salivary acini
	Vitamin D	Calcium and phosphate metabolism
		Builds skeletal bones and teeth
		Alveolar process support
	Vitamin K	Prevention of dental caries in incubated mixtures of saliva and glucose
	Vitamin E	Degenerative changes in muscles
		Changes in CNS
Water soluble vitamins	Vitamin B complex	Formation of new cells
		Cofactor for nutrients
		Pyridoxine alters oral flora thus decreasing caries causing organisms and finally decreases caries
		Niacin decreases susceptibility of caries
	Vitamin C	Aids in collagen formation
		Promotes capillary integrity
		Enhances immune response

Figure-17 Functions Of Vitamins In Related To Dental Caries

MINERALS

They are homogenous, naturally occurring inorganic solids with specified chemical compositions, crystalline structures, colors, and hardness. They are inorganic, tiny, vital molecules that start numerous biological processes but have no calories. Minerals like iron, zinc, and copper promote the production of collagen, speed up wound healing, and control inflammation.(60)Figure-18 and recommended intake of minerals(RDI) given below (61)Figure-19

Effect	Minerals
Cariostatic	Fluoride, phosphate
Mild cariostatic	Molybdenum, Galium, Sr, B, Li, Au, Fe
Caries inert	Ba, Al, Ni, Pd, Ti
Caries promoting	Se, Mg, Cd, Pt, Pd, Si

FIGURE-18 Effects Of Different Minerals On Dental Caries

Mineral nutrients and trace elements	Recommended Daily Intakes (RDI) (per day)	Reference
Calcium	600 mg	NIN (2009b)
Magnesium	340 mg	NIN (2009b)
Sodium	1500 mg	http://en.wikipedia.org /wiki/ dietary_ref_intake
Potassium	3800 mg	http://en.wikipedia.org /wiki/ dietary_ref_intake
Iron	17 mg	NIN (2009b)
Zinc	12 mg	NIN (2009b)
Manganese	2.0 mg	NIN (2009b)
Copper	2.0 mg	NIN (2009b)
Selenium	36 µg	WHO (2004)
Molybdenum	45 µg	http://en.wikipedia.org /wiki/ dietary_ref_intake
Cobalt	29 µg	http://en.wikipedia.org /wiki/ dietary_ref_intake
Chromium	33 µg	WHO (2002)

FIGURE -19 Recommended Intake of Minerals

DIET COUNSELING

The main goals of pediatric nutrition are optimal growth and development.

- Food is merely a vehicle for nutrient delivery; the nutrients supply energy for growth, act as structural elements, and take part in all metabolic processes of the body. Food is more than simply nutrients, though; sensory, emotional, social, and cultural connotations also play a role in determining what people eat.
- Making adjustments gradually is one of the main goals of dietary counseling so that long-term success is possible.
- Any changes might be implemented over the course of several weeks, making it easier to achieve your main objective. Dietary counseling can assist with establishing a balanced diet for an individual or a family, with weight loss, or just with feeling better overall by eating healthier.

Diet chart

Health practitioners can identify a person's diet-related caries risk behaviors by asking about their food intake patterns, diet adequacy, consumption of fermentable carbohydrates (including naturally occurring and added sugars), and usage of fluoride toothpaste.

Dental health diet score

The diet score for dental health awards points for an acceptable consumption of food from each food group in addition to bonus points for eating foods that are especially suggested since they are the best suppliers of the 10 nutrients needed to achieve and maintain dental health.

- For often consuming foods that are overly sweet—their sweetness coming from added refined sugar or intense natural sugars—points are deducted from this total. The oral health diet score makes a difference.

Calculating a dental health score

Step-1

- List all of the foods and beverages you consume on a normal weekday, including snacks, to determine your average daily intake.
- Note the time the meal or snacks were consumed, the quantity consumed (in household measurements), the method of preparation, and the total amount of sugar added.

Step-2

- Mark the items in the diary that have been sweetened with additional sugar or are concentrated natural sweets (honey, raisins, figs, and so forth). Put the uncirculated foods or plates with mixed foods into one or more of the relevant food groups.
- Check the relevant food group block for each serving of the items that are reported in the food intake diary.

- Add up all the checks, then multiply by the indicated number. The maximum number of points that can be awarded for the meat, milk, and fruit, vegetable, and bread-cereal groups is 24 apiece.
- Increase the points. The total represents the food group score (96 is the highest score).

Step-3

- Which of the following foods contains at least one of the ten nutrients necessary for dental and oral health? The foods that are good suppliers of the nutrients necessary for good health in general and dental oral health in particular are included in the Nutrient Evaluation Chart.
- A single food item, like broccoli, can appear in numerous columns. Additionally, you can check more than one food in a column.
- No matter how many items are checked in the column, only seven points are awarded for each nutrient (56 is a perfect score).

Step-4

- List the sweets and meals that are sweetened with sugar along with how often they are consumed each day.
- Sort each candy into one of three categories: liquid, solid and sticky, or slowly disintegrating.
- If you eat each item at least 20 minutes apart, tick the box next to it in the frequency column.
- Increase the amount of checks. If the candy is liquid, multiply by 5, if it's solid, by 10, and if it's slowly dissolving, by 15.
- List the items in the Points column and add their totals.

Step-5

- Now combine everything. Add the Sweet Score and the 4 Food Group Score to the Totaling the Scores page.
- Nutrition advice is recommended if the 4 Food Group Score is subpar or insufficient and the Sweet Score is in the "Watch Out" zone.(62)figure-20
-

Example

10:00 A.M. 1 jelly donut
12:00 Noon ham and cheese sandwich
1 c milk
1 cupcake
3:00 P.M. 1 coke
5:00 P.M. 1 cough drop

From	Frequency	Points
Liquid	✓ x 5 =	5
Solid and sticky	✓✓ x 10 =	20
Slowly dissolving	✓ x 15 =	15

TOTAL SCORE = 35

Decay Promoting Potential

Form	Frequency	Points
Liquid Soft drinks, fruit drinks, cocoa, sugar and honey in beverages, nondairy creamers, ice cream, sherbet, gelatin dessert, flavored yogurt, pudding, custard, popsicles	_____ x 5 =	
Solid and Sticky Cake, cupcakes, donuts, sweet rolls, pastry, canned fruit in syrup, bananas, cookies, chocolate candy, caramel, toffee, jelly beans, other chewy candy, chewing gum, dried fruit, marshmallows, jelly, jam	_____ x 10 =	
Slowly Dissolving Hard candies, breath mints, antacid tablets, cough drops	_____ x 15 =	

TOTAL SCORE = _____

Totaling the Scores

4 Food Group Score :

72 – 96	Excellent
64 – 72	Adequate
56 – 64	Barely Adequate*
56 or less	Not adequate*

Sweet Score :

5 or less	Excellent
10	Good
15 or more	"Watch Out" zone

Figure-20 Diet Score Charts

CONCLUSION

Education about nutrition can enlighten people about how their diet affects their health and what foods to eat to be healthy. The basic nutrients covered in this review include carbohydrates, vitamins, lipids, sugars, proteins, and minerals. An individual needs a well-balanced diet for healthy growth and development. Long-term effects of any nutrient increase or decrease could be disastrous. Changes in the oral cavity result from nutritional deficits. However, there are no dietary inadequacies that will bring about these changes on their own.They can only change the periodontium's health, which exacerbates the harmful effects of regional variables and high occlusal stresses.

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