IJBPAS, May, 2022, 11(5): 2255-2267

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

REVIEW ON IMPORTANCE OF NUTRITION IN ORAL HEALTH & HYGIENE

INGOLE S[1], WANI M[*2], LIMAYE D[1, 2], BAHETI A[2], POLSHETTIWAR S[2] AND TAGALPALLEWAR A[2]

1: School of Public Health, Dr. Vishwanath Karad MIT World Peace University, Pune 411038, Maharashtra, India

2: School of Pharmacy, Dr. Vishwanath Karad MIT World Peace University, Pune 411038, Maharashtra, India

***Corresponding Author: Dr. Manish Wani: E Mail: manish.wani@mitwpu.edu.in**

Received 19th May 2021; Revised 18th July 2021; Accepted 10th Aug. 2021; Available online 1st May 2022

https://doi.org/10.31032/IJBPAS/2022/11.5.6067

ABSTRACT

A nutritional insufficiency occurs when the body does not absorb or have enough of a nutrient. Deficiencies can result in a variety of health problems, including digestive issues, dental problems, skin issues, diminutive or faulty bone growth/development, and also dementia. It has long been recognised that there is a correlation between nutritional deficit and oral health. Oral diseases affect nearly 3.5 billion people all over the world. Severe gum disease, which results in tooth loss affects 10% of the global population. Dental caries of primary teeth affects around 530 million children worldwide. A balanced diet supplying diverse vitamins, proteins, and minerals required by the body is necessary for a healthy mind and body. In today's modern culture, where all kinds of food are readily available, knowing what to eat, when to eat, and how much to eat is essential. Excess of anything, whether good or bad, is always unhealthy, therefore understanding the basics of nutrition are crucial. Public health is critical to a country's development, and without a healthy people to contribute, the aim of development will be impossible to achieve. In order to avoid deficiency disorders, one must consume at least the recommended amount of all nutrients in their regular diet. Documentation of oral nutritional deficiencies is very rare and few. This essay will go through the effects of nutritional deficiency diseases and its effects on oral health and also highlight the effects of nutritional deficiency.

Keywords: Oral Health, Nutrition, Processed food, Vitamin Deficiency, Protein Deficiency, Mineral Deficiency

INTRODUCTION

WHO defined "health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" **[1]** and to maintain overall wellbeing of human body and maintain health proper nutrition is very important.

Life cannot exist without food. All living things strive to achieve their nutritional requirements through food. But all foods do not have the same nutritional value and an individual's health is influenced by the type of food he or she consumes to satisfy hunger.

Oral health and nutrition have a mutually beneficial relationship. Intra orally, early symptoms of a variety of common degenerative diseases and nutritional deficiencies can be observed before they manifest elsewhere in or on the body. Mouth is very correctly called as *'Mirror of*

Nutritional Status [2]

Nutrition is the biochemical and physiological process by which an organism uses food to support its life. It includes ingestion, absorption, assimilation, biosynthesis, catabolism and excretion. Thus through nutrition body gets energy. Healthy eating habits can aid in the prevention of health issues. Impoverished nutrition can harm one's health and cause diseases including scurvy, plumpness, kwashiorkor, and metabolic syndrome. The world's water consumption has declined and consumption of sugar-sweetened beverages has increased. Intake of sweet flavoured drinks and foods that have been processed too has increased. Simultaneously intake of several foods that promotes health, such as fruits, vegetables, and legumes has reduced. Different types of meals contains different types of nutritional value such as vitamins, proteins, fats etc and all plays very important role for maintaining the health of an individual.

Today, everyone wants to have a lean and appealing physique, so they embark on a diet regime and eliminate certain foods from their daily diet without consulting an expert. Individuals can lose weight in a variety of ways, but many are unaware of and misunderstand how fatty foods and ineffective weight loss strategies can harm their health. Consuming a balanced diet, according to studies, is crucial for keeping a healthy weight. Individual behaviour, methods, and environments in a number of settings, such as healthcare facilities, businesses, schools, and communities, should all be focused on improving weight and diet. Adopting a diet and fat-loss regimen at random can have detrimental effects on one's body physiology **[3]**.

People and food have a variety of interactions. There is increasing need in knowing which nutrients we require, where to obtain them in food, how our bodies

utilise them, and the impact they have on our health. Other elements such as Civilization, religion, finance, and innovation are all taken into account while preserving and selecting the foods we eat. If we eat food in right amount in right combination our diet will provide all the nutrients we need to stay healthy. If we eat food of incorrect amount incorrect combination then essential nutrients will be missing in our body. However still maintaining right nutrition can be still very challenging and difficult because we eat for many other reasons and never eat thinking that we need nutrients to maintain a good diet. Moreover, the numbers of different nutrients important to human life are over 40 making things more complicated. These nutrients are needed to be consumed in our diets because these nutrients not made by our body. Different types of food contain different types of nutrients depending upon amounts and combinations. Each nutrient performs its functions in its own unique way. Nutrients in combination are needed for growth, to maintain and repair the body, and to reproduce.

Nutrients serve three primary purposes in the human body.

1) Supply energy
2) Supply antibodies
3) Establish a framework **[4]**

Nutrition through healthy diet can help avoid diseases, ailments, and difficulties, as well as identifying diseases and issues such as under nourishment, Allergies to foods and other metabolic disorders. The nutrients in meals are distributed equally throughout the body in a well-nourished body.

There are two types of nutrients in nutrition: micronutrients and macronutrients, both of which are vital in giving the right amount of nutrients. Micronutrients are minerals, vitamins, and water, whereas macronutrients are carbohydrates, proteins, and fats **[5]**.

EFFECTS OF PROCESSED FOOD ON ORAL CAVITY:

Processed food is widely available and used. Though it may have few advantages and benefits but have many drawbacks and adverse effects. The conversion of raw food constituents into a more usable state is known as food processing. Its benefits and drawbacks are as follows

Benefits of Processed food

1. We obtain food materials that are not in season.
2. It protects food from spoiling.
3. It makes food material available in far-flung locations.
4. The storage duration lengthens **[6]**.

Drawback of Processed

1. Nutrients are frequently lost in processed foods.
2. Iron and vitamin B are lost when rice is milled and polished.

3. There is nutrition and weight loss.
4. To some extent, the original flavour alters **[7]**.

Because all food enters the body through the mouth, Food has its effect on the mouth/oral cavity. Chips, such as potato chips, are similar to drugs in the fact that they stimulate the brain in a similar way. They produce dopamine, causing you to nibble more, and even deceiving your mind into thinking you still are hungry. If you prefer something crispy, swap out the chips for raw vegetables and hummus. Processed foods are high in sugar and carbohydrates, which puts your dental health at risk. Bacteria feed on the sugar and carbohydrates in your mouth, developing acids that erode your enamel.

The healthiest foods for your teeth are those found in nature. Fibre, vitamin A and C, protein, calcium, and other minerals are rich in carrots, celery, leafy greens, berries, apples, milk, salmon, and nuts. In contrast, processed foods often lack these nutrients that are essential for maintaining good oral health. These minerals strengthen your enamel and maintain your salivary flow, which can remineralize and clean the teeth **[8]**. Children's juice drinks are the leading cause of cavities, whereas energy drinks are the leading source of cavities in adults.

According to studies, energy drinks contain two times the amount of acids as sports drinks. This acid can cause reflux, which can contribute to tooth decay. Some energy drinks have an acidity similar to that of battery acid. After only one sip, an energy drink can erode tooth enamel and make teeth vulnerable, reducing the pH in saliva to dangerous levels. The body takes about 30 minutes to recover such pH levels **[9]**. According to dentists, people who take energy beverages are also more hyperactive. They may clench or grind their teeth, which can cause cracking and chipping. If decay isn't treated, it can get into these fissures, eat away at the enamel, and cause tooth loss. In order to maintain oral hygiene brush your teeth for at least two minutes every 12 hours with a soft-bristle brush, floss at least once a day. Wait 30 minutes after eating or drinking for the pH of your saliva to return to normal before brushing. Your tooth enamel will not be affected as a result of this procedure. Drink plenty of water and consume nutritious foods whenever possible to avoid tooth decay caused by energy drinks and processed foods.

Anything that may be good or bad is harmful if consumed in excess amount or is deficient. Poor nutrition and diet leads to deficiency of certain vitamins, proteins, minerals etc. leading to nutritional deficiency syndromes. Although on other hand excess of these is also harmful as it alters the physiology of body.

EFFECTS OF PROTEIN DEFICIENCY ON ORAL HYGIENE:

Protein deficiency is frequent in children between the ages of one and five. Proteins are necessary in greater quantities in the body since they are the building blocks of the body. Malnutrition is the common name for Protein deficiency it. Proteins serve as the foundation for gingival tissue. Gingiva contains a wide range of proteins, including collagen, laminin, elastin, fibronectin, and other matrix proteins. Integrin is one of the proteins that binds to all the other proteins. Collagen protein, which is necessary for collagen synthesis, generates the collagen fibres that provide structural integrity to gingiva. The structural integrity of gingiva is lost as collagen fibres are decreased, resulting in gingival degeneration. Mammals produce a lot of collagen fibres, but their number diminishes as they get older **[10]**. Similarly, fibroblasts are the synthetic cells responsible for the creation of collagen fibre. Fibroblasts are made from protein called as Vimentin. Fibroblasts are synthetic cells, and protein deficit causes a decrease in their quantity or a decrease in their activity rate, resulting in altered or reduced functionality **[11]**. Thus maintaining proper amount of proteins is important to have a healthy gingiva. The tooth is made up of organic and inorganic components. The organic fraction is 30-40%, while the inorganic portion is roughly 45 percent. The dentine of teeth is maintained by collagen and connective tissue, whilst hydroxyapatite crystals offer structural support to the entire tooth. The outer layer of teeth is enamel, and the inner layer is dentine, both of which include hydroxyapatite crystals. The hydroxyapatite crystal is made up of calcium and phosphorus ions **[12]**. Now, proteins are good source of phosphorus and calcium thus their deficiency compromises tooth integrity and thus leading to poor quality of teeth **[13]**. As overall tooth integrity is compromised by protein deficiency they become more prone to caries and thus decay.

In general protein deficiency can manifest following symptoms in oral cavity

1) Gingiva Degeneration
2) Oral cavity synthetic cells are harmed
3) Teeth are of poor quality
4) Teeth are more susceptible to caries **[14]**.

One of the common diseases related to protein deficiency having effect on oral cavity is Kwashiorkor.

Oral manifestations of Kwashiorkor are as follows.

1) Tongue becomes brightly reddened
2) The absence of papillae (smooth tongue)
3) Edema of the tongue's lateral part
4) Angular Cheilosis (dry corners of mouth)

5) Caries activity is reduced due to a shortage of carbohydrate substrate.
6) Teeth eruption is delayed **[15]**.

Various sources of protein are

1) Lean meats – beef, lamb, veal, pork, kangaroo.
2) Poultry – chicken, turkey, duck, emu, goose, bush birds.
3) Fish and seafood – fish, prawns, crab, lobster, mussels, oysters, scallops, clams.
4) Eggs.
5) Dairy products – milk, yoghurt (especially greek yoghurt), cheese (especially cottage cheese) **[16]**.

EFFECTS OF VITAMIN DEFICIENCY ON ORAL HYGIENE:

As mentioned earlier proteins are necessary in greater quantities in the body since they are the building blocks of the body, whereas vitamins are required in smaller amounts. There are two types of vitamins: fat soluble (Vitamin A, D, E, and K) and water soluble (Vitamin B, C, D, E, and F). Vitamins are categorised as essential or non-essential depending on whether they are consumed or may be quickly synthesised in the body.

Various vitamin deficiency conditions are as follows

1) Vitamin A deficiency causes hypoplasia of the enamel and atrophy of the salivary glands.

1) Rickets and enamel and dentine issues are caused by a deficiency of vitamin D.

2) Haemolysis and sterility are caused by a lack of vitamin E.

3) A deficiency of vitamin K causes bleeding, bruising, and haemorrhage in the gums.

4) Symptoms of Vitamin B complex deficiency include glossitis, stomatitis, Burning Mouth Syndrome, Beriberi, sore eyes, inflammation, and anaemia.

5) Vitamin C deficiency causes scurvy. (gingival recession, loose teeth, bleeding gums, swollen gums) **[17]**.

Vitamin C shortage, as described in the protein deficiency section, is crucial for maintaining healthy gingiva. Collagen fibres are diminished when vitamin C (ascorbic acid), which is important for collagen production, is deficient. Thus, vitamin C deficiency affects collagen formation. Scurvy is a condition due to a deficiency in vitamin C. Because of a lack of collagen as a result of a vitamin c deficit, the gingiva becomes more prone to bruising and so bleeds and recedes, causing the tooth to become loose in its socket **[18]**. Treatment includes administration of oral vitamin C supplements.

Vitamin A insufficiency is linked to salivary gland atrophy, which decreases the oral cavity's defence power against infection and its ability to buffer plaque acids **[19]**. Vitamin D is required for greater calcium absorption from the diet,

which is a significant component of dentine and enamel, thus, a deficiency causes dentine to remineralize poorly, resulting in dentine defects. .Vitamin D has an impact on how calcium is deposited in the bones, making it essential for proper bone development and growth **[20]**. Vitamin D deficiency rickets can cause bone deformities and discomfort, as well as poor growth, fractures, and convulsions. Vitamin K is necessary for blood clotting because it is required by the proteins that form the fibrin webbing in the later stages of the clotting process. Vitamin K is required for the activation of clotting proteins, which initiates the final stage of the clotting process **[21]**.

Some other diseases of oral cavity related to vitamin deficiency are as follows-

1) Angular chelitis- Development of swollen red patches in the corner on the outside angle of mouth is called as angular chelitis. It can occur on both sides or only on one side of the mouth. Loss of appetite due to irritation of lips and burning sensation in mouth. It has been associated with deficiency of vitamin B12 and B2 **[22]**.

2) Burning mouth syndrome – A burning sensation in the mouth or oral cavity is common and can include numbness or tingling of the tongue, bad breath, sore throat, and even a sore throat. A multi-factor condition has been linked to vitamin deficiency. Vitamin B1 (thiamine), B2 (riboflavin), B6 (pyridoxine) and B12 (cynocobalamin) have all been identified as contributors to the disease **[23]**.

3) Enamel Hypoplasia- It is a defect that arises during developmental stages of teeth. Both deciduous and permanent teeth can be affected. It thins the enamel of the teeth's outer layer. Enamel is the toughest substance in the body, but it cannot mend itself since it lacks synthetic cells, necessitating treatment. Apart from being thin, enamel also exhibits white patches, pits, and grooves on the tooth surface, providing ideal circumstances for bacterial growth and tooth decay. Enamel hypoplasia has been linked to vitamin D insufficiency during developmental phases or maternal vitamin D deficit. Dentists use resin-bonded sealants, amalgam or gold fillings, and crowns to address the condition **[24]**.

Sources for various vitamins are as follows [25]

Name of vitamin	Source of vitamin
Vitamin A	Oil , fish , liver , eggs, carrot
Vitamin B	meat , cereals , peanuts , vegetables, wheat , carrot
Vitamin C	Lemons , grapes , tomatoes, oranges, apples
Vitamin D	Animal fat , milk , ghee, butter
Vitamin K	Liver , green vegetables
Vitamin E	Vegetables , milk , egg yolk , vegetable oils

EFFECTS OF MINERAL DEFICIENCY ON ORAL HYGIENE:

Minerals are required in very minimal quantities. These includes various metals, non-metals and salts. They are required for the growth of the body and do not provide energy. Various sources of minerals are as follows **[26]**.

Name of Mineral	Source of mine
Sodium	common salt , fish , egg , milk
Potassium	banana , vegetables and meat
Calcium	milk, egg, green vegetables
Iron	liver , kidney, apple , green vegetables, bajra
Iodine	salt water, fish , common sea food.

Oral Manifestations of mineral deficiency [27]

1) Tooth decay
2) Stiffness TMJ
3) Alveolar bone defects
4) Brittle teeth
5) Weak bones

Inadequate calcium and phosphorus during pregnancy can cause bone abnormalities, insufficient calcification of the teeth, malformations of the teeth, as well as an increased risk of dental decay. When calcium and vitamin D intake is inadequate during childhood and adolescence, bone density and mass decrease. As a result of osteoporosis, the jaw bones become porous and brittle. Lack of calcium and phosphorus can also cause tooth mobility, early teeth shedding, and diminished jaw bone strength **[28]**. Lack of fluoride may lead to cavities **[29]**.

1) Because bones require calcium, and teeth are fundamentally bones, calcium is essential for teeth. It gives teeth strength while also preserving their structure and integrity. The amount of calcium required by the body varies with age; for adults between the ages of 18 and 50, the daily requirement is 1000 mg, increasing to 1200 mg as they get older. Teeth become brittle and decay-prone as a result of calcium deficiency **[30]**.
2) Potassium acts similar to vitamin D, it increases mineral absorption and deposition in teeth and jaw bones thus increasing their strength and integrity.
3) Phosphorus plays supportive role in helping improve the calcium absorption thus indirectly contributing to provide strength **[31]**.
4) Flouride is a mineral which is ingested via drinking water, food and industrial pollution. Fluorosis is a disease caused by the accumulation of fluorides in the body's tissues. Excess fluoride in the diet, which is most typically found in drinking water, has an adverse effect on the teeth and bones. Dental fluorosis is a serious health problems caused by it.

People who are exposed to high levels of fluoride experience dental effects far sooner than skeletal consequences. Children are affected by dental fluorosis, which discolours and disfigures the teeth **[32]**. Fluorosis is primarily caused by high fluoride levels in consumable water in India, with the exception of portions of Gujarat and Uttar Pradesh, where industrial fluorosis is also prevalent. India's MoHFW initiated the National Programme for Prevention and Control of Fluorosis in 2008-09 with the goal of preventing, diagnosing, and managing fluorosis in endemic areas.

EFFECTS OF CARBOHYDRATE ON ORAL HYGIENE:

Carbohydrates are primary source of energy for our body as well as major contributor for development of dental caries. Carbohydrates are converted to acid when they react with microorganisms in the mouth. This acid causes cavities to grow on the tooth surface, which are later colonised by bacteria, resulting in caries. Preventive measures include brushing in the morning and before bed to lower the amount of carbohydrate in the oral or dental cavity. Caries are one of the most common health problems globally. Caries formation is multifaceted, although carbohydrates constitute the most common and crucial contributor. Carbohydrate digestion begins in the oral cavity, and acids, primarily lactate, are created through the glycolytic pathway when carbohydrates are consumed. Furthermore, carbohydrates serve as a food supply for bacteria in the mouth, promoting their growth when consumed often. The acid breaks down tooth structure, allowing bacteria to colonise the pits and cracks on the surface of the tooth, resulting in caries. Table sugar (sucrose) is thought to have a high cariogenic potential, but milk sugar (lactose) has a lower cariogenic potential **[33]**. To avoid dental caries simple habits can make a difference like brushing twice daily, avoid eating sweet or anything else before sleeping, flossing and use to mouthwashes.

Various sources of Carbohydrates are

1) Cereals
2) Fruits like banana, apple, grapes, mango etc
3) Vegetables
4) Milk and dairy products

EFFECTS OF FATS/ LIPIDS ON ORAL HYGIENE:

These are concentrated source of energy and are not readily available as a source of energy. At cellular level they maintain the integrity of cells. As deficiency of others sources leads to their side effects but in case of fats, its excess levels causes the issue.

Oral manifestations of fats/lipids excess-

1) Enamel and Dentine integrity compromised
2) Contributes to High bacterial build up on teeth
3) Sticky and ropy saliva
4) Teeth more prone to caries **[34]**.

CONCLUSION

Learning about nutritional values of different food and their by-products is one thing but not everyone has access to all the facilities and good food. The main reason for poor nutrition is not lack of education or awareness but its poverty. In our developing country India, population is already a problem as we fail to use it as a resource plus to make it worse we also high number of poverty.

The concept of public health refers to equal health for all, but we are still far from achieving this aim because poverty has not been eradicated. Providing food to young children in government schools and other centres would never contribute to a healthy population; rather, it will simply fill the stomach of a poor child for a short time. Various people in many nations are not educated beyond high school but still eat well every day; the reason for this is that they can work in small businesses despite having no higher education or degree since they are exploited and considered as a resource for the country. This situation is diametrically opposed to the one in our country, where we place a higher emphasis on education than on abilities, failing to build a resource in favour of merely developing an employee. We, as a nation, should strive to ensure that no one goes to bed hungry, and that regardless of our financial, gender, or religious differences, everyone should come forward and assist in whatever way they can. There is also no oral and dental health policy or well-planned oral and dental health care delivery system. There is a model for an oral healthcare programme, but it has yet to be executed adequately due to under-motivated policymakers **[35]**.

REFERENCES

[1] Saracci R. The world health organisation needs to reconsider its definition of health. *BMJ.* 1997; 314(7091): 1409-1409.

[2] Sheetal A, Hiremath VK, Patil AG, Sajjansetty S, Kumar SR. Malnutrition and its oral outcome - a review. J Clin Diagn Res. 2013; 7(1): 178-180. doi:10.7860/JCDR/2012/5104.2702

[3] Moynihan Paula, Petersen Poul Erik. Diet, nutrition and the prevention of dental diseases. *Public Health Nutrition.* 2004; 7(1a): 201-226.

[4] Chen Y, Michalak M, Agellon LB. Importance of Nutrients and

Nutrient Metabolism on Human Health. *Yale J Biol Med*. 2018; 91(2): 95-103.

[5] Tas¸g˘ın E. Macronutrients and Micronutrients in Nutrition. International Journal of Innovative Research and Reviews. 2017; 1(1): 10-15.

[6] C J K Henry, C Chapman. The Nutrition Handbook for Food Processors. 2002. Woodhead publishing.

[7] Hall Kevin D., Ayuketah Alexis, Brychta Robert, *et al*. Ultra-Processed Diets Cause Excess Calorie Intake and Weight Gain: An Inpatient Randomized Controlled Trial of Ad Libitum Food Intake. *Cell Metabolism.* 2019; 30(1): 67-77.e3.

[8] Neel E A, Aljabo A, Strange A, *et al*. Demineralization-remineralization dynamics in teeth and bone. *International journal of nanomedicine.* 2016; 11: 4743-4763.

[9] Halvorsrud K., Lewney J., Craig D., Moynihan P. J. Effects of Starch on Oral Health: Systematic Review to Inform WHO Guideline. *Journal of Dental Research.* 2019; 98(1): 46-53.

[10] Séguier Sylvie, Godeau Gaston, Brousse Nicole. Collagen Fibers and Inflammatory Cells in Healthy and Diseased Human Gingival Tissues: A Comparative and Quantitative Study by Immuno histo chemistry and Automated Image Analysis. *Journal of Periodontology.* 2000; 71(7): 1079-1085.

[11] Alberts B, Johnson A, Lewis J. New York: Garland Science; 2002. Fibroblasts and Their Transformations: The Connective-Tissue Cell Family. *Molecular Biology of the Cell.*

[12] Pajor Kamil, Pajchel Lukasz, Kolmas Joanna. Hydroxyapatite and Fluorapatite in Conservative Dentistry and Oral Implantology—A Review. *Materials.* 2019; 12(17): 2683-2683.

[13] Griffin Susan O., Jones Judith A., Brunson Diane, Griffin Paul M., Bailey William D. Burden of Oral Disease Among Older Adults and Implications for Public Health Priorities. *American Journal of Public Health.* 2012; 102(3): 411-418.

[14] Pflipsen M, Zenchenko Y. Nutrition for oral health and oral manifestations of poor nutrition and unhealthy habits. *General dentistry.* 2017; 65(6): 36-43.

[15] Russell Stefanie l., Psoter Walter J.,

Jean-Charles Germain, Prophte Samuel, Gebrian Bette. Protein-energy malnutrition during early childhood and periodontal disease in the permanent dentition of Haitian adolescents aged 12-19 years: a retrospective cohort study. *International Journal of Paediatric Dentistry.* 2010; 20(3): 222-229.

[16] Kerksick C M, Arent S, Schoenfeld B J. International society of sports nutrition position stand: Nutrient timing. *J Int Soc Sports Nutr.* 2017; 14(1): 33-33.

[17] Cagetti Maria Grazia, Wolf Thomas Gerhard, Tennert Christian, Camoni Nicole, Lingström Peter, Campus Guglielmo. The Role of Vitamins in Oral Health. A Systematic Review and Meta-Analysis. *International Journal of Environmental Research and Public Health.* 2020; 17(3): 938-938.

[18] Léger D. Scurvy: Reemergence of nutritional deficiencies. *Can Fam Physician.* 2008; 54(10): 1403-1406.

[19] Krishnamurthy S, Vasudeva S B, Vijayasarathy S. Salivary gland disorders: A comprehensive review. *World J Stomatol.* 2015; 4(2): 56-71.

[20] Souza A P, Kobayashi T Y, Neto Lourenço, *et al*. Dental manifestations of patient with Vitamin D-resistant rickets. *J Appl Oral Sci.* 2013; 21(6): 601-606.

[21] Merli G J, Fink J. Vitamin K and thrombosis. *Vitamins and hormones.* 2008; 78: 13-14.

[22] Park K K, Brodell R T, Helms S E. Angular cheilitis, Part 1: Local etiologies. *Cutis.* 2011; 87(6): 289-295.

[23] Aljanobi Hawra, Sabharwal Amarpreet, Krishnakumar Bralavan, Kramer Jill M. *Is it Sjögren's syndrome or burning mouth syndrome? Distinct pathoses with similar oral symptoms.* 2017.

[24] Martos Josué, Paim Emanuele, Gewehr Andréa. Aesthetic approach for anterior teeth with enamel hypoplasia. *Contemporary Clinical Dentistry.* 2012; 3(5): 82-82.

[25] Semba Richard D. The Discovery of the Vitamins. *International Journal for Vitamin and Nutrition Research.* 2012; 82(5): 310-315.

[26] Soetan K O, Olaiya C O, Oyewole O E. The importance of mineral elements for humans, domestic animals and plants: A review.

African J Food Sci. 2010; 4(5): 200-222.

[27] Edward R, David H T, Solomon A M. Hunter's Tropical Medicine and Emerging Infectious Disease. 9. Saunders 2012.

[28] Krall Elizabeth A. The Oral Effects of Osteoporosis. *Nutrition in Clinical Care.* 2001; 4(1): 22-27.

[29] Horst Jeremy A., Tanzer Jason M., Milgrom Peter M. Fluorides and Other Preventive Strategies for Tooth Decay. *Dental Clinics of North America.* 2018; 62(2): 207-234.

[30] Cormick Gabriela, Belizán Jose M. Calcium Intake and Health. *Nutrients.* 2019; 11(7): 1606-1606.

[31] Lacruz Rodrigo S., Habelitz Stefan, Wright J. Timothy, Paine Michael L. Dental Enamel Formation and Implications for Oral Health and Disease. *Physiological Reviews.* 2017; 97(3): 939-993.

[32] Denbesten P, Li W. Chronic fluoride toxicity: Dental fluorosis. *Monogr Oral Sci.* 2011; 22: 81-96.

[33] Palacios Cristina, Rivas-Tumanyan Sona, Morou-Bermúdez Evangelia, Colon Alina M., Torres Roxana Y., Elías-Boneta Augusto R. Association between Type, Amount, and Pattern of Carbohydrate Consumption with Dental Caries in 12-Year-Olds in Puerto Rico. *Caries Research.* 2016; 50(6): 560-570.

[34] Gunstone F.D. The major sources of oils, fats, and other lipids. In: Fatty Acid and Lipid Chemistry. Springer, Boston, MA. 1996. https://doi.org/10.1007/978-1-4615-4131-8_3.

[35] Gambhir R S, Gupta T. Need for oral health policy in India. *Annals of Medical and Health Sciences Research.* 2016; 6(1): 50-50.