Oral Manifestations Due to Nutritional Deficiencies & Systemic Diseases : A Review

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Abstract

Relationship between nutrition and oral health is multifaceted. Nutrient deficiency may result in oral symptomatology. Nutrition has both local and systemic impacts on the oral cavity. There are many factors which affects the nutrition as age, sex, and pregnancy. Clinical manifestations of nutrient deficiencies can have a significant impact on the function of the oral cavity. Functional properties of the oral cavity include taste, salivation, mastication, and swallowing food. The mouth is frequently the mirror of the body involved in conditions that affect the skin or other multiorgan diseases. In many instances, oral involvement precedes the appearance of other symptoms or lesions at other locations. Dentists and health professionals must recognize the manifestations of these deficiencies consider their causes and provide early treatment to prevent further compromise in nutrition status and to promote optimal nutrition, oral and overall health.

Keyword: Nutrition, manifestations, vitamins, nutrient deficiencies, symptoms, dental caries, Periodontal diseases, Hypogeusia, Angular stomatitis, Diabetes mellitus

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Introduction

Nutritional science investigates the metabolic and physiological responses of the body to diet. These compounds provide that needs both energy and essential molecules for growth and maintenance.

Nutrients are the constituents of food necessary to sustain the normal functions of the body. The sequences of biochemical steps through which substances in living things change from one form to another. With advances in the fields of molecular biology, biochemistry, and genetics, the study of nutrition is increasingly concerned with metabolism and metabolic pathways. The human body contains chemical compounds, such as water, carbohydrates (sugar, starch, and fiber), amino acids (in proteins), fatty acids (in lipids), and nucleic acids (DNA and RNA). These compounds in turn consist of elements such as carbon, hydrogen, oxygen, nitrogen, phosphorus, calcium, iron, zinc, magnesium, manganese, and so on. All of these chemical compounds and elements occur in various forms and combinations (e.g. hormones, vitamins, phospholipids, and hydroxyapatite).

Factors that Influence the Amount of a Nutrient Required to Meet the Needs:

1. **Age:** The nutrients vary from infancy to adulthood. For example, adults required about 0.8g of protein per kg of body, whereas infants need over 2g per kg.
2. **Sex:** For men are approximately 20% greater than those for women
3. **Other Factors:** For most nutrients are increased about 20 – 30 % above normal in pregnant and lactation women. Patients with injury or illness also show increased requirements for some nutrients.

The relationship between nutrition and oral health is multifaceted. Nutrition has both local and systemic impacts on the oral cavity (1). While diet and eating patterns have a local effect on the teeth, saliva and soft tissues, nutrition also has considerable implications and it gave a good assessment as a component of comprehensive care due to the systemic impact. Nutrients is essential to the growth, development, and maintenance of tissues, effectiveness of the immune system, prevention of cell damage and, in general, to increased resistance to many chronic, and some infectious diseases (1,2). The oral cavity is often one of the first sites where nutrient deficiencies can be clinically noted.

Nutrient deficiencies can have a clinical manifestations and a significant impact on the function of the oral cavity. The function of oral cavity include taste, salivation, mastication, and swallowing food. Any alterations in the structure and function of the oral cavity may compromise intake and contribute to the development of a nutrient-deficiency state.

Development of Nutrient Deficiencies

The oral cavity is a mirror of the body and have important anatomical location with a role in many physiologic processes, such as digestion, respiration, and speech. The mouth is frequently involved in conditions that affect the skin or other multi-organ diseases. In many instances, oral involvement precedes the appearance of other symptoms or lesions at other locations. An imbalance of supply and demand of nutrient will lead to deficiencies, that is meaning, inadequate to meet the demands of the body (3).

Oral tissues, such as the gingiva (gums), bone, teeth, and muscles of mastication (chewing muscles), are living tissues, and they have the same nutritional requirements as any other living tissue in the body. A poor diet can have defect impact on health, causing deficiency diseases such as scurvy, health-threatening conditions like obesity and metabolic syndrome, and such common chronic systemic diseases as diabetes, osteoporosis, and cardiovascular disease (4).

Nutrient stores may be not reflect in serum levels. If body stores are depleted, biologic and physiologic performance and cell functions became altered dependent on the specific nutrient (5).

Diet & Nutrition Play a Key Role in

* Tooth development.
* Gingival and oral tissue integrity.
* Bone strength.
* Prevention and management of diseases of the oral cavity

The medical history and presenting symptoms with examination is important to detecting deficiency conditions and possible causes. Any diseases can increase nutrient consumed and thereby leading to a deficiency. Infections in the oral cavity due to bacteria and fungus may alter tissue integrity, increase nutrient utilization.

Inadequate intake may be due to functional difficulties such as poor dentition, tooth loss, xerostomia, and systemic disease, as well as socioeconomic problems, anorexia, and depression, also prolonged poor dietary intake due to ill-fitting dentures and difficulties with mastication has been shown to result in inadequate intake of zinc, calcium, and B6 (6).

Effects of nutrient deficiencies on tooth development as dental caries:

Teeth are made from protein matrix that is mineralized with collagen (requiring vitamin C), calcium, and phosphorus to form a hydroxyapatite (requiring vitamins D and A).

The decay process was happened by plaque formation, sticky mix of microorganisms, protein, polysaccharides, and bacteria metabolizing fermentable carbohydrate produce acid. Acid production oral pH<5.5 allows tooth demineralization. So gradual demineralization of enamel; proteolytic destruction of tooth structure as calcium and phosphorus, can be affected any tooth surface.

Streptococcus mutans-most common bacteria involved fermentable carbohydrate. While protein foods, eggs, fish, meat and poultry; most vegetables, fats, sugarless gums, do not contribute to decay do not cause a drop in salivary pH.

Malnutrition & Periodontal Disease

Periodontal diseases, a group of infectious diseases which are mostly chronic, affect the supporting tissues of the teeth. Malnutrition may make the periodontium more susceptible to infectious organisms because compromised

host defense responses toward the oral flora. The stage of the infection related to varying degrees in malnourished individuals(7, 8). This could result in a greater amount of periodontal destruction, leading to a compromised dentition.

Periodontal (gum) diseases, including gingivitis and periodontitis, are serious infections that, left untreated, can lead to tooth loss, which can affect one tooth or many teeth. Nutritional deficiencies (notably vitamin C and folate) can alter the disease process, periodontal diseases are not caused by these deficiencies nor can they be cured by nutrient supplementation alone(9,10). There are multiple causes of gingivitis including: chronic diseases such as diabetes; medications including phenytoin and calcium channel blockers, also some drugs, such as oral contraceptives, anti-depressants, and certain heart medicines, pregnancy, tobacco users also are at increased risk for periodontal disease, research proves that up to 30% of the population may be genetically susceptible to gum disease, there are certain times in a woman's life when extra care is needed—times when mature and change such as puberty or menopause, during these particular times, a woman's body experiences hormonal changes that can affect many of the tissues in body, including the gums, gums can become sensitive, and at times react strongly to the hormonal fluctuations. Also many serious conditions such as hypertension, cancer, and numerous other health problems, also is a risk factor for periodontal disease. Spongy, red, bleeding and painful gingiva is also noted in scurvy, an advanced vitamin C deficiency disease. In severe gingivitis, the easy bleeding and soreness of the gingiva may make eating difficult and contribute to poor intake. Soft, nonirritating, temperate and mildly flavored foods and fluids should be provided to meet energy and nutrient needs. Vitamin A deficiency (11) was cited as a cause of periodontal disease, folate deficiency that a deficiency of this vitamin is the cause of gingivitis.

Oral Cavity Defect Due to Nutrient Deficiencies

Nutrient deficiencies may causes abnormal color, topography, size and sensations
in the oral cavity (12), other abnormal findings such as glossopyrosis (painful and burning tongue and soft tissue), dysgeusia (altered taste), angular cheilitis (painful, dry cracked corners of the mouth). Abnormal findings may reflect oral manifestations of a many systemic diseases, medications, disorders to the oral cavity, or a nutrient deficiency (13).

The Effect of Tooth Loss & Dentures

Tooth loss may affect ability to chew, relationship between loss of teeth and reduced intake of fruits and vegetables. Dentures are often ill-fitting (especially common after weight loss); problem foods included fresh fruits and vegetables, chewy and crusty breads and chewy meat like steak, saliva production decreases reduced chewing ability, lower calorie and nutrient intake occurs for many simple nutrition. Older, edentulous (having no teeth) patients who have had a stroke with the accompanying chewing and swallowing problems may be at significant nutritional risk, particularly if they are living alone and on a limited income.

Altered Taste

Hypogeusia, or diminished taste, is noted in zinc deficiency. Other non-deficiency state causes of altered taste include radiation to the head and neck, diabetes mellitus, and Sjögren's syndrome. Taste should be conducted to determine which taste sensations remain.

Changes in the Tongue

There are several changes that can occur on the tongue during nutrient deficiency states.
A painful, magenta colored, atrophic, smooth tongue is noted during a riboflavin deficiency. Glossitis may also be evidence of a vitamin B6, folate or B12 deficiency. However, during a chronic folate deficiency, the tongue papillae will become atrophied, resulting in a shiny, smooth surface appearance. Glossitis with loss of filiform papillae may also be seen in individuals with iron-deficiency anemia. A niacin deficiency results in a raw beefy, bright red, swollen, and painful tongue. Glossodynia may also be present in diabetes, resulting in painful mastication and swallowing.

Angular Stomatitis & Cheilosis

Stomatitis; inflammation of oral mucosa. Angular stomatitis (painful fissures at the corners of the mouth) and cheilosis (dry scaling of the lips and corners of the mouth) are common findings in riboflavin deficiency. Similar findings may be noted with niacin and B6 deficiency states. The similarity of these findings may be due to riboflavin's role in B6 and tryptophan (which is converted to niacin) metabolism. Angular stomatitis, however, may be associated with iron deficiency anemia (14). Angular cheilitis, however, is often associated with fungal infections, lip-sucking, and dehydration (15).

Oral Manifestations of Systemic Diseases in Relation to Nutrient Deficiencies:

Diabetes Mellitus:

Diabetes mellitus is a systemic disease associated with delayed wound healing and oral manifestations which may alter nutrient intake and so effected the nutrition status. Poorly controlled diabetes mellitus is associated with glossodynia, xerostomia, candidiasis, gingivitis, periodontitis and altered taste (16, 17, 18). Up to 30% of individuals over the age of 19 with type 1 diabetes have periodontal disease (18). Good oral health important in order for individuals to be able to consume a diet adequate for maintaining glycemic control, in order to restore oral and overall health.

Pregnancy & Contraceptive Pill

The oral mucous membrane, and the gingiva, undergo changes during pregnancy which, from clinical and histological observations, should be termed pregnancy gingival hyperplasia, gingivitis beginning in the second or third month of pregnancy that increases in severity throughout the eighth month. During this time, some women can notice nutrient deficiencies due to swelling, bleeding, redness or tenderness in the gum tissue; and diseases that interfere with the body's immune system may worsen the condition of the gums. The gingival changes observed occasionally in women taking oral contraceptives may also be due to hormonal causes.

Renal Disease & Renal Transplant Patients

Oral manifestation due to nutritional deficiency has significant appearance in related to renal disease. Significant restriction of dietary protein, sodium, potassium, phosphorus and fluid intake is necessitated for management of patients with renal failure. Iron deficiency anemia, osteomalacia, and deficiencies of other water soluble vitamins may occur. Direct consume of drug-induced immunosuppression, or as a result drug pharmacokinetics will lead to different oral problems arise in these patients. Oral health and nutrition status must be monitored in the management of the transplant Patient (19).

The immunosuppressive medications and steroids have oral- and nutrition-related results including impaired glucose tolerance, osteoporosis, osteopenia and defect integrity of the oral cavity soft tissue. Dental appearance including ulcerative stomatitis, xerostomia, gingival hyperplasia (GH), and urea in the saliva can effect the nutritional status and dietary intake. The high simple carbohydrate diet followed by individuals with end-stage renal disease combined with the presence of xerostomia increases risk of tooth decay(20).

Gastrointestinal Diseases

Ulcerative Colitis

The oral cavity is the portal of entry to the gastrointestinal tract. Lined by stratified squamous epithelium, the tissues of the mouth are often involved, as lesions which manifested in the oral cavity as diffuse labial, gingival, or mucosal swelling, aphthous ulcerations or superficial hemorrhagic ulcers or angular stomatitis occurs in many of patients (21).

Chronic Liver Disease

Chronic liver disease affects many systems of the body. The coagulation pathway is one such system. The liver synthesizes many of the clotting factors necessary for hemostasis. In patients with advanced liver disease visible in the oral mucosa is jaundice, which is the yellow pigmentation that results from the deposition of bilirubin in the submucosa. In addition, vitamin K, a fat-soluble vitamin, requires proper liver function to be adequately absorbed from the intestines, in liver disease the resultant impaired hemostasis can be manifested in the mouth as petechiae or excessive gingival bleeding with minor trauma, it occurs in the absence of inflammation as a result of the defects of clotting factors (22).

Anemia

Mucosal conditions, such as glossitis, recurrent aphthae, candidal infections, and angular stomatitis may be more common in patients with anemia. Glossitis may be the first sign of folate or iron or vitamin B12 deficiency. The tongue appears reddened, and the papillae

are atrophic, producing a smooth appearance. Fatigue and decreased resistance to infection are common systemic symptoms. The oral mucosa exhibit pallor. This pallor is a common and easily recognizable feature of anemia.

Angular stomatitis is commonly caused by a candidal infection, and it has been due to iron deficiency (23).

Xerostomia

Dry mouth(hyposalivation or xerostomia), it may be seen in severe vitamin A deficiency states (12) and in protein calorie malnutrition. The primary causes of xerostomia include medications, Sjögren's syndrome, diabetes mellitus, and radiation to the head and neck (16). Altered taste sensations are frequently reported by individuals with xerostomia (24). Inadequate salivary flow can also contribute to oral infections, including dental caries and glossopyrosis (16, 24), also have difficulty with eating, swallowing, and speech. The former can result in decreased food intake and poor nutrition. The reasons for this vary from medication to medication but can range from dehydration (e.g., with diuretics) to anticholinergic activity (e.g., with some antidepressants).

Under or Low Intake Nutrition & Oral Health

Under nutrition may produce characteristic signs and symptoms in the oral cavity. The oral diseases associated with vitamin deficiencies are common in emerging "third-world" nations. In these countries, the limited supply of nutrient-dense foods or the lack of specific nutrients in the diet (vitamin C, niacin, etc.) may produce characteristic oral manifestations. In addition, unusual food practices, such as chewing sugar diet throughout the day or other regional or cultural nutritional practices may decrease the oral health of specific populations.

For example, in a typical B vitamin deficiency, a person may complain that the tongue is red and swollen and "burns" (glossitis), that changes in taste have occurred, and that cracks have appeared on the lips and at the corners of the mouth (angular cheilosis). In a vitamin C deficiency, petechiae (small, hemorrhaging red spots) may appear in the oral cavity, as well as on other parts of the body, especially after pressure has been exerted on the tissue. In addition, the gums may bleed upon probing with a dental instrument.

In humans, calcium deficiency causes the production of hypoplastic enamel (poorly mineralized enamel) similar to the osteoporosis produced in bone. Teeth appear to have a biological priority over bone when calcium is limited in the diet.

The mouth is frequently the mirror of the body involved in conditions that affect the skin or other multiorgan diseases. In many instances, oral involvement considered the first location of many symptoms or lesions at other parts.

Nutrition risk evaluation was part of the scope of practice of all health professionals; early detection of risk for nutrient deficiencies during medical or dental exams, recognition of oral manifestations of nutrient deficiencies and other diseases (25,26,27). There is a clear relation between oral health and nutrition. Nutrients plays a big role in maintaining the normal function of the oral cavity (27). Nutrient deficiencies will cause oral defect and this alter dietary intake, resulting in deficiency states, malnutrition and poor wound healing following procedures or surgeries.

In our study we were found that many systemic conditions are known to adversely affect the mouth or teeth, and these patients require additional oral care and management so a dental evaluation should accompany the medical and psychological evaluation of a suspected eating disorder.

The diet of early modern humans varied significantly depending on location and climate. The diet in the tropics tended to be based more heavily on plant foods, while the diet at higher latitudes tended more towards animal products (28).

In our study especially our city due to social behaviors , due to several time war, because of terrorism, low socioeconomic, all this lead to poverty, physical destitution, hunger and lack of healthy food, also because religious reasons our women must cover all the body with black cloths, and wear a veil and sometimes black gloves when they go outdoors. These factors act as a good reason for preventing the people from taking a good healthy foods, so increased in nutritional deficiencies. This issue also was discussed as, they reported that “people of cultures such as Bedouins living in the Nagged Desert, who are required to have most of the skin surface covered by clothing, due to prevent them from exposed to the heavy sun light, are prone to develop vitamin D deficiency”.

Inadequate nutrition in the period from conception to approximately 12 years of age can affect the formation of enamel, causing pits and areas of roughness and these can be more susceptible to decay.

Research demonstrates that stress can make it more difficult for the body to fight off infection, including periodontal diseases; a diet which low in important nutrients can compromise the body's immune, already know, tobacco use is linked with many serious illnesses such as cancer, lung disease and heart disease, as well as numerous other health problems.

We've probably heard a few old wives' tales about pregnancy, including “A tooth lost for every child.” While it seems far-fetched, it actually is based loosely in fact.

Careful periodontal monitoring and excellent oral hygiene is especially important for women who may be noticing changes in their mouths during times of hormonal fluctuation. To help ensure good oral health,

Women often become anemic during pregnancy because the demand for iron and other vitamins is increased. The mother must increase her production of red blood cells and, in addition, the fetus and placenta need their own supply of iron, which can only be obtained from the mother.

Most people in our society, carbohydrate food is the main meal to fill hunger, as well as the adaptation of fast foods that contain insufficient nutrients, the use of soft drinks and the lack of eating vegetables, fruits and meat and failure to eat food containing vitamins and minerals led to the emergence of sign and symptoms that represent lack of healthy nutrition and affect the health of mouth and teeth.

As mentioned, lifestyle- and obesity-related diseases are becoming increasingly prevalent all around the world. There is little doubt that the increasingly widespread application of some modern food processing technologies has contributed to this development. The food processing industry is a major part of modern economy,

Nutrition is taught in schools in many countries. In England and Wales the Personal and Social Education and Food Technology curricula include nutrition, stressing the importance of a balanced diet. However, statistics collected by the World Health Organization from 1990-2000 show in France may have been underestimated and, in fact, may be similar to that of neighboring countries(30).

In 1992, The U.S. Department of Agriculture introduced the Food Guide Pyramid. In 2002, a Natural Justice study showed a relation between nutrition and violent behavior. In 2005, a study found that obesity may be caused by adenovirus in addition to bad nutrition(31).

Dietary and physical activity guidelines from the USDA are presented in the concept of a food pyramid, which superseded the Four Food Groups.

The U.S. Department of Health and Human Services provides a sample week-long menu which fulfills the nutritional recommendations of the government (32).

Conclusion

The dentist must have a good experiences and social communication, and competence and caring for the patients. Improving the awareness of nutritious meal choices and establishing long-term habits of healthy eating have a positive effect on cognitive and spatial memory capacity, potentially increasing a student's potential to process and retain academic information. It is important for physicians to recognize the link between systemic disease and oral findings. Some systemic conditions may first manifest with oral findings and a trained physician may detect and diagnose these conditions earlier, thereby initiating treatment sooner. Patients experiencing this side effect should be monitored and encouraged to maintain good oral hygiene and frequent dental visits.

References

1. American Dietetic Association. Position of The American Dietetic Association: Oral health and nutrition. J Am Diet Assoc 1996; 96(2):184-189.
2. Navia J. A new perspective for nutrition: The health connection. Am J Clin Nutr 1996; 61(Suppl):407S-409S.
3. McClaren DS. Chapter 55: Clinical manifestations of human vitamin and mineral disorders: A resume. In: Shils ME, Olsen JA, Shike M, editors. Modern nutrition in health and disease. 8th ed. Philadelphia: Lea and

Febiger; 1994. pp. 909-923.
4. Long RG, Hlousek L, Doyle JL. Oral Manifestations of Systemic Disease. Dermatol Clin. 1998; 65:309-315.
5. Beaton GH, Patwardhan VN. Physiological and practical considerations of nutrient function and requirement. In: Beaton GH, Bengoa JM, editors. Nutrition and preventive medicine. Geneva: World Health Organization Monograph Series No.62; 1976. pp. 445-481.
6. Sebring NG, Guckes AD, Shou-Hua L, McCarthy GR. Nutritional adequacy of reported intake of edentulous subjects treated with new conventional or implant-supported mandibular dentures. J Prosthet Dent 1995; 74:358-363.
7. Enwonwo CO. Interface of malnutrition and periodontal diseases. Am J Clin Nutr 1995; 61(Suppl):430S-436S.
8. Enwonwu C. Cellular and molecular effects of malnutrition and their relevance to periodontal diseases. J Clin Periodontol 1994; 21:643-657. Oral Manifestations of Nutrient Deficiencies— Touger-Decker
9. Ismail AI, Burt BA, Eklund SA. Relation between ascorbic acid intake and periodontal disease in the United States. J Am Dent Assoc 1983; 107:927-931.
10. Leggott PJ, Robertson PB, Jacob RA, et al. Effects of ascorbic acid depletion and supplementation on periodontal health and subgingival microflora in humans. J Dent Res 1991; 70(12):1531-1536.
11. Shaw JH. The relation of nutrition to periodontal disease. J Dent Res 1962; 41(Suppl):264-274.
12. Dreizen S. Dietary and nutritional counseling in the prevention and control of oral disease. Compend Contin Educ Dent 1989; 10(10):558-563.
13. Touger-Decker R, Sirois D. Physical assessment of the oral cavity. Support Line 1996; 18(5):1-3.
14. Sweeney MP, Bragg J, Fell GS, Yip B. The relationship between macronutrient depletion and oral health in geriatrics. J Oral Pathol Med 1994; 23:168-171.
15. Brightman VJ. Red and white lesions of the oral mucosa. In: Lynch MA, Brightman VJ, Greenberg H, editors. Burket's oral medicine, diagnosis and treatment. 9th ed. Philadelphia: J.B. Lippincott Co.; 1994.
16. Touger-Decker R, Sirois D. Chapter 33: Dental health. In: Powers M. Handbook of diabetes medical nutrition therapy. Baltimore: Aspen Publishers; 1996. pp. 638-648.
17. Emrich LS, Shlossman M, Genco RJ. Periodontal disease in non-insulin dependent diabetes mellitus. J Periodontol 1991; 62:121-131.
18. Centers for Disease Control. National diabetes fact sheet. November 1, 1997. Atlanta: Centers for Disease Control; 1997 Nov. 1 (www.cdc.gov).
19. US Renal Data System (USRDS). 2007 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States. Bethesda, Md: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 2007. Available at http://www.usrds.org/reference_2007.htm. Accessed June 13, 2011.
20. Darwazeh A.M., Jordan University of Sciences and Technology, Irbid, Jordan, and M.A. MOHAYA, Saudi National Guard Dental Services, Riyadh, Saudi Arabia Oral and Dental Hygiene. The Preliminary Program for First African and Middle-East IADR Federation Conference (September 27-29, 2005)
21. Handlers JP. Oral manifestations of gastrointestinal disease. J Calif Dent Assoc. Apr 1999;27(4):311-7. [Medline].
22. Chuang TY, Stitle L, Brashear R, Lewis C. Hepatitis C virus and lichen planus: A case-control study of 340 patients. J Am Acad Dermatol. Nov 1999;41(5 Pt 1):787-9. [Medline].
23. Caldemeyer KS, Parks ET, Mirowski GW. Langerhans cell histiocytosis. J Am Acad Dermatol. Mar 2001;44(3):509-11. [Medline].
24. Rhodus NJ, Brown J. The association of xerostomia and inadequate intake in older adults. J Am Dietet Assoc 1990; 90(12):1688-1692.
25. Heymsfield SB. Nutrition support at the scientific frontier. J Parenter Enteral Nut 1997;21(5):252-258.
26. American Dietetic Association. Position of the American Dietetic Association: Nutrition Education of Health Professionals. J Am Diet Assoc 1998; 98(3):343-346.
27. American Dietetic Association. Position of the American Dietetic Association: Oral health andnutrition. J Am Diet Assoc 1996; 96(2):185-189.
28. Villa P, Bouville C, Courtin J, et al. (July 1986). "Cannibalism in the Neolithic". Science 233 (4762): 431–7. doi:10.1126/science.233.4762.431. PMID 17794567
29. Taha S.A., Dost S.M., Sedrani S. H.,(1984).: 25- Hydroxy vitamin D and total calcium . Extraordinarily low plasma concentrations in Saudi mothers and their neonates. Pediatr, Res; 18 : 739-741.
30. Ducimetière P, Lang T, Amouyel P, Arveiler D, Ferrières J (January 2000). "Why mortality from heart disease is low in France. Rates of coronary events are similar in France and Southern Europe". BMJ 320 (7229): 249–50. doi:10.1136/bmj.320.7229.249/a (inactive 2010-03-17). PMC 1117444. PMID
31. Red Book: Report of the Committee on Infectious Disease. American Academy of Pediatrics. 2006; Pickering LK (editor): 831-835.
32. US Department of Health and Human Services. Oral health in America: A Report of the Surgeon General. Rockville MD: US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health; 2000. Available online at http://www.nidcr.nih.gov/ DataStatistics/ SurgeonGeneral. Accessed January 18, 2007.

Oral Cavity Area	Clinical Manifestation	Nutrient Deficiencies
Lips	Cheilosis, Angular fissures	Niacin, B6, riboflavin, iron
Gingiva	Spongy, bleeding, abnormal redness	Vitamin C
Tongue	Glossitis, (red, raw, fissured), Pale, atrophic, smooth/slick (filiform papillary atrophy , Magenta color	Folate, niacin, iron, B6,Iron,folate riboflavin

Table 1: Nutrition Risk Factors to Consider in Clinical Examination

1.Anemia	10.Kidney transplant	19.Soft tissue abnormality
2.Corticosteroids drugs	11.Medication	20.Stress
3.Depression	12.No sun light	21.Starvation
4.Diabetes mellitus	13.No money for eat or low socioeconomic	22.Tooth loss
5.Diet reduced as regime	14.Oral contraceptive pill	23.Tobacco
6.Fungal infection	15.Pregnancy	24.Ulceration in the mouth
7.Genetic or inherited diseases	16.Poor dentition	25.Vascular disease
8.Hormonal changes for puberty or post menopause	17.Radiation therapy	26.Vitamins deficiency
9.Inflammatory bowel disease	18.Renal disease	27.Xerostomia

Table 2: Local and systemic causes of nutritional deficiencies.

Clinical Feature	Associated Finding	Associated Disorder	Nutritional Considerations
Difficulty biting \ chewing food	Partial or total edentulous Lack of occlusion ill-fitting dentures	Bone defect, Abnormal occlusion	Modify diet consistency, Loss of anterior occlusion-modify for difficulty biting, Loss of posterior occlusion -modify for difficulty chewing
Burning of mouth	May be with or without associated erythema edema (stomatitis)	Anemia, Diabetes, Candidiasis	Determine etiology of deficiency, Determine cause of poor glucose control, modify diet, evaluate cariogenicity, evaluate for dysgeusia,dysphagia
Burning of the tongue	Glossitis, Pale, atrophic, smooth tongue	deficiency of iron, folate, B6, niacin, and/or riboflavin deficiency of iron, folate,B12	Determine etiology; treat with diet & /or supplements as needed. The same above
Angular fissures of mouth (stomatitis) lips	Drug – induced Dry, cracked lips	Niacin, riboflavin, B6,iron deficiency, dehydration,	Determine the etiology.
Xerostomia	Dental caries Candidiasis Burning mouth and tongue	Drug – induce Xerostomia Connective tissue disorder. Diabetes	Push fluids; evaluate cariogenicity of diet, Modify food consistency and choices to reducepain (limit spicy,hot, acidic, & seasoned foods) Evaluate masticatory efficiency & modi -fyfood choices. Evaluate glucose control, modify diet.
Bleeding tendency	May be with or without associated edema	Anemia, Diabetes	evaluate cariogenicity of diet, Modify food consistency and choices to reduce pain. Evaluate masti-catory efficiency & modify food choices.
Pain	Dental caries Candidiasis Burning mouth and tongue	Calcium deficiency, Drug - induce Connective tissue disorder.	Determine etiology of deficiency, Determine cause of poor glucose control

Table no. 3: Abnormal Oral Findings
Associated With Local and Systemic Disease

Nutrient	Effect on tissue	Effect on caries
Protein /calorie malnutrition	Delay tooth eruption Decrease tooth size Decrease enamel solubility Salivary gland dysfunction	Yes
Vitamin D/ calcium/ phosphorus	Lowered plasma calcium level Hypomineralization (hypoplastic defect) Compromised tooth integrity (decrease minerals concentration) Delay eruption pattern.	Yes
Vitamin A	Decrease epithelial tissue develop Tooth morphogenesis dysfunction.Decreased odontoblast differentiation Increased enamel hypoplasia.	Yes
Vitamin C	Dental pulpal alteration Odontoplastic degeneration Aberrant dentine	No
Iron	Slow growth, salivary gland dysfunction	Yes

Table no. 4: Effect of Nutrient Deficiencies on Tooth Development