



# Oral manifestations of nutritional disorders

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**Abstract** Nutritional deficiencies occur when body metabolic requirements are not matched by intake and absorption. Reasons for this discrepancy are numerous, but often social, economic, medical, and even psychiatric factors may play a role. Vitamins and minerals are required for appropriate rapid cell turnover of the oral mucosa. The oral cavity is a unique anatomic environment that may manifest early signs of nutritional disorders as well as other indicators of systemic disease. Knowledge of these oral manifestations and associated findings will allow a practitioner to consider a nutritional disorder when evaluating oral changes and, in turn, initiate appropriate therapy. A systematic approach to examination of the mouth and perioral skin is suggested. A detailed medical and social history complements the physical examination in identifying patients at risk for nutritional disorders and heightening the clinical suspicion to warrant additional nutritional screening. The rising prevalence of anorexia and bulimia, as well as fad diets, add to the population of patients at risk for vitamin and mineral deficiencies that a clinician must now consider. © 2017 Elsevier Inc. All rights reserved.

## Introduction

A balance between nutritional intake and metabolism is required for optimal function of the human body. This balance can be altered by deficiency states, resulting from medical maladies such as Crohn disease (CD), cystic fibrosis, bariatric surgery, parenteral and tube feeding, allergic states, HIV infection, malignancies, and other malabsorption or hypermetabolic states.<sup>1,2</sup> Preexisting conditions altering body protein stores, such as renal or hepatic disease or plasma cell dyscrasias, may mask or confound nutritional deficiencies.<sup>3</sup> Vitamins and minerals, such as zinc and essential fatty acids, are often excluded in parenteral nutrition and formula.<sup>4</sup> Social factors such as poverty, homelessness, famine, war, and even crash diets and food fads may contribute to insufficient nutritional intake.<sup>1</sup> For example, noma, also known as orofacial gangrene,

is associated with poverty and follows the geographic distribution of malnutrition and vitamin A deficiency.<sup>5–7</sup> Poor oral intake may also be secondary to psychiatric illnesses, such as eating disorders, autism, perceived allergies, or substance abuse.<sup>1,2</sup> The effect on multiple body systems of removing a certain element indicates the necessary integration of all nutrients into a functioning metabolic organization.<sup>8</sup> Paucity of one nutrient may contribute to the deficiency of others.<sup>9</sup> Inadequate intake, malabsorption, and nutrient wasting are the primary reasons for nutrient imbalance.<sup>9</sup>

The oral cavity is often one of the first sites to manifest clinical signs of systemic disease and nutritional deficiency; therefore, an examination of the mouth may help to formulate an early diagnosis.<sup>9–12</sup> An explanation for this phenomenon is the rapid rate of epithelial cell turnover in mucous membranes (3–7 days)<sup>13</sup> compared with the skin (up to 28 days).<sup>7,14</sup> Anatomic structures of the oral cavity with rapid cell growth and turnover are repeatedly exposed to chemical, mechanical, thermal, and infectious stressors and are at risk for damage

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when confounded by nutritional deficiencies.<sup>15</sup> The dorsal surface of the tongue allows a specific example of susceptibility to insult. The frequency of associated clinical involvement of the area in nutritional deficiencies may be explained by its rapid epithelial cell turnover, which is the highest in the oral cavity.<sup>15,16</sup> As such, the mucosa may then be susceptible to additional stress and potential infection from the flora of the local microenvironment.<sup>7,17</sup>

Conversely, pain, discomfort, and mastication difficulty may also result in nutritional deficiencies.<sup>9</sup> A cross-sectional study of British adults found that the cohort with more teeth had a higher oral intake of protein, fat, carbohydrates, fiber, calcium, iron, vitamin B<sub>5</sub>, and vitamins C and E.<sup>18</sup> Additionally, studies comparing edentulous patients to patients with normal dentition found that tooth loss correlated with poor nutritional intake.<sup>19</sup> It may also be postulated that edentulous patients have less nutritious diets than dentate patients.<sup>7,19</sup> Poor dentition and ill-fitting dentures in turn contribute to limited or monotonous intake.<sup>9</sup> Examination of 1374 older patients in Brazil revealed that the need for dental prostheses was significantly associated with overall health status, as were frailty and socioeconomic dependence.<sup>20</sup> These studies highlight the interplay between dentition and nutrition, confirming the importance of the dental examination in patients at risk for malnutrition.

Mucocutaneous signs are, however, not specific for malnutrition states.<sup>8,21</sup> Although some signs may suggest a particular nutrient abnormalities, none are pathognomonic for a specific deficiency.<sup>15</sup> Overlap of clinical findings is often noted on examination. Interestingly, when patients are monitored over multiple recurrences of the same nutritional deficiency, a predictable order and site of occurrence of lesions are identified.<sup>15</sup> Additionally, the severity of oral manifestations may not be proportional to the metabolic disturbance.<sup>10,12</sup> Response to specific therapy, however, is mirrored by resolution of the characteristic lesion of the lips, gums, tongue, and buccal mucosa.<sup>22</sup>

In evaluation of nutritional disorders, a thorough history, review of systems, and physical examination and a high degree of clinical suspicion are required.<sup>10</sup> Addition of laboratory tests may be helpful; however, serum levels of vitamins may not always reflect nutrient stores.<sup>9,23</sup> Anthropometrics, simple methods for estimation of an individual's body components, may be useful in assessing overall nutrition state.<sup>3</sup>

## Examination of oral cavity

The oral cavity has three main types of mucosa: masticatory mucosa, lining mucosa (including buccal and labial mucosa), and specialized mucosa of the dorsal tongue. The masticatory mucosa has a keratinized stratified squamous epithelium located on the hard palate and gingiva. A nonkeratinized stratified squamous epithelium composes the soft mobile mucosal lining in most of the oral cavity, such as the inside coating of the

cheeks, lips, and soft palate. The specialized mucosa with lingual filiform and scattered fungiform papillae is found anteriorly to the circumvallate papillae and comprises the anterior part of the dorsal aspect of the tongue.<sup>15</sup>

A review of the components of an appropriate history and physical examination, when evaluating for a nutritional deficiency, suggested starting with a general observation of a patient's mobility, facial symmetry, hair, and overall condition before evaluating the oral cavity.<sup>12,24</sup> These subconscious assessments are often inherently performed during the initial patient introduction. The oral examination should be prefaced with questions regarding recent changes in taste, presence of a burning sensation, pain, or bleeding gums. If dentures are present, it is prudent to have the patient remove these.<sup>12</sup> Using a light source, tongue depressor, and gloves, the oral examination starts with an evaluation of the lips for cracking, fissuring, or color changes.<sup>12</sup> Mucosal alterations, periodontal inflammation, gingival bleeding, and dentition should be assessed.<sup>25</sup> The tongue depressor can be useful to move the cheeks laterally to allow careful evaluation of the attached gingivae, teeth, and the sulci. The dorsal and ventral surfaces of the tongue are examined by asking the patient to protrude the tongue, move it from side to side, and touch the tip of tongue to the hard palate.<sup>12</sup> The tongue can also be manipulated by the examiner by grasping the tip with cotton gauze and moving accordingly (Figure 1). The vestibule may be examined by retracting the buccal mucosa with a tongue blade (Figure 2). It is helpful to have the patient use the index finger and thumb to evert outwardly both the upper and lower lip (Figure 3). This permits evaluation of the soft labial mucosa, teeth, and gingiva. The hard and soft palates are best seen with a handheld light source with the patient tilting the head slightly back.

## Changes specific for oral sites

Nutritional deficiencies can affect some or all of the oral cavity tissues, including teeth, periodontal tissue, salivary glands, mucous membranes, and perioral skin.<sup>7</sup> Signs of anemia, for example, affect multiple areas, producing generalized mucosal pallor, atrophic glossitis, angular stomatitis, recurrent aphthous stomatitis affecting the soft mucosal surfaces of the buccal and labial mucosae, and superimposed candidosis, which is nondiscriminatory in location.<sup>25,26</sup> Atrophic glossitis is not specific for a particular subtype of anemia, because it occurs with several deficiencies. Similarly, oral ulcerations can be present in several types of anemia, as well as in systemic diseases such as CD, systemic lupus erythematosus, and blistering disorders, including mucous membrane pemphigoid and pemphigus vulgaris.

The dorsal surface of the tongue is exquisitely sensitive to insults from B-complex vitamin deficiencies.<sup>15</sup> Surface continuity of the tongue, as well as changes in the papillae, color, overall size, and sensation, can all be altered with nutritional insults. Papillary changes may include hypertrophy, flattening,

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