

### Review

# Oral health diseases among the older people: a general health perspective

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### Abstract

**Background:** The relationship between oral health and general health is gaining interest in geriatric research; however, a lack of studies dealing with this issue from a general perspective makes it somewhat inaccessible to non-clinical public health professionals. **Purpose:** The purpose of this review is to describe the relationship between oral health and general health of the elderly on the basis of literature review, and to give non-clinical medical professionals and public health professionals an overview of this discipline. **Methods:** This study was based on an in-depth review of the literature pertaining to the relationship between oral health and general health among the older people. The tools commonly used to evaluate dental health and the academic researches of male elderly people were also reviewed. And future research directions were summarized. **Results:** Dental caries, periodontal disease, edentulism, and xerostomia are common oral diseases among the older people. Dental caries and periodontal diseases are the leading causes of missing teeth and edentulism. Xerostomia, similar to dry mouth, is another common oral health disease in the older people. No clear correlation exists between the subjective feeling of dryness and an objective decrease of saliva. Rather, both conditions can be explained by changes in saliva. The General Oral Health Assessment Index (GOHAI) and the Oral Health Impact Profile (OHIP) are the main assessment tools used to examine oral health and quality of life in the older people. The GOHAI tends to be more sensitive to objective values pertaining to oral function. In addition, oral health studies in male elderly people are population-based cohort or cross-sectional studies, involving masticatory function, oral prevention, frailty problems, cardiovascular disease risk, and cognitive status. **Conclusion:** It is possible to reduce the incidence of certain oral diseases, even among individuals who take oral health care seriously. Oral health care should be based on the viewpoint of comprehensive treatment, including adequate nutrition, good life and psychology, and correct oral health care methods. In the future, researchers could combine the results of meta-analysis with the clinical experience of doctors to provide a more in-depth and broader discussion on oral health research topics concerning the older people.

### Keywords

General health; Oral health; Older people; Elderly population; Male elderly people

## 1. Introduction

Population aging is the trend of development in the world. The annual population growth rate is 1.2% of the global population; while the population aged 65 or over is 2.3% [1]. By 2025, the current population aged 60 or above is estimated to reach more than 1.2 billion [2]. By 2050, the number of individuals aged 80 and over will increase from 143 million in 2019 to 426 million, and they will account for 20% of the world's population [3, 4]. By then, there will be 2 billion older persons, 80 percent of whom will live in developing countries [5].

As chronic diseases gradually increase in developing countries, the quality of life related to oral health and the overall quality of life may deteriorate [6]. Contemporary health concepts believe that oral health should be defined as physical, psychological and social well-being related to oral conditions [6–8]. The oral cavity and other parts of the body must be viewed together, because oral health affects the overall health by causing considerable pain and suffering and further changing people's diet, speech, quality of life and happiness [6].

In the past, the main focus of oral research was on objective disease results (i.e. dental caries or periodontal disease) [9]. However, oral health does not only mean having a good tooth; it is an indispensable part of general health and is of vital importance to health, such as chronic oro-facial pain, oral and pharyngeal (throat) cancer, oral tissue lesions, and other diseases [10]. Nowadays, these oral diseases cannot be used as a standard to measure oral health completely, because it ignores the multi-level characteristics of oral health and other impacts on quality of life [11]. For these reasons, that have prompted many researchers to examine the relationship between oral health and general health [12–15]. The correlation between oral health and general health has been proved by evidence, which is also mentioned in the World Health Organization report 2003 [10, 16].

Oral health problems are pervasive among the older people [17–21]. Poor oral health can affect their physical, psychological, spiritual, cognitive, economic, and social well-being as well as quality of life [12, 13, 15, 22–28]. Two primary assessment tools have been developed to assess the oral health status of the older people: the General Oral Health Assessment Index (GOHAI) and the Oral Health Impact Profile (OHIP) [29, 30]. The GOHAI is a self-reported tool for measuring oral health quality of life (OHRQoL) among the older people. It focuses on the functions of oral health and its psychosocial impact [31]. The OHIP, which focuses on the negative effects of oral health problems, has been revised numerous times (e.g., OHIP-5, OHIP-14, and OHIP-26) [32–34]. Many researchers have also proposed improvement strategies and guidelines to improve one's quality of life based on these assessments [32, 35–41].

From the clinical viewpoint, general health implies the state of health of the body as a whole, or of a community. Note that relatively few studies have reviewed oral health among the older people from a general health perspective. Our objective in this study was to describe the relationship

between the oral health and general health of the older people based on a review of the literature, with the aim of laying the foundation for specific research and giving non-clinical medical professionals and public health professionals an overview of the subject.

## 2. Materials and methods

According to the above research purpose and past relevant literature, this section can be divided into four parts. Firstly, to introduce the common geriatric oral diseases, which mainly lists the main common diseases of oral health of the elderly and introduces their characteristics and prevention methods. Secondly, to discuss the relationship between oral health disease and general health is to show that they are interrelated, not independent, which helps non-clinical researchers to look at the problem from a systematic perspective. Thirdly, to evaluate the tools of oral health among the older people. A brief introduction of oral health-related quality of life assessment tools for the older people will give non-clinical researchers a preliminary understanding to promote the future application scope and value of these scales. Finally, to discuss the related researches on male elderly people.

### 2.1 Introduction to common geriatric oral diseases

The most common issues pertaining to oral health among the older people are dental caries, periodontal problems, missing teeth, and xerostomia [21, 42–44].

#### 2.1.1 Dental caries

Dental caries (tooth decay) in permanent teeth is the most common health condition among the older people [42, 43, 45, 46]. Prospective cohort studies based on community residing older people populations have shown that among the older people, dental caries affects an average of one tooth surface per person per year [47–52]. Note that this is similar to the incidence observed among teenagers and young adults [53]. Dental caries involves the dissolution (also known as tooth demineralization) of the outer enamel layer by acid produced through the metabolism of dietary carbohydrates by oral bacteria [54–56]. Caries is a slow dynamic process involving the demineralization and remineralization of the dental structure. The process is highly sensitive to pH changes in plaque biofilm. Generally, plaque of low pH (i.e., higher acidity) promotes the dissolution of hard tissue components. In the event that the pH remains below a threshold for an extended duration (e.g., after the consumption of free sugar), the teeth are susceptible to gradual decalcification of dental minerals and continuous loss of calcium and phosphate. The cavities that form following extended demineralization can cause pain and discomfort. When cavities spread to the inner pulp of the tooth, they can also cause infection, sepsis, and tooth loss [45]. Among the older people, the exposed root surface is more prone to demineralization than is the surface of the crown. It is for this reason that brushing teeth at

least twice a day with fluoride toothpaste is recommended [54]. Among individuals at high risk of tooth decay, the incidence of root caries can be reduced by adjusting the fluoride dose in their toothpaste from 1,450 ppm to 5,000 ppm [57–59]. Some studies reported found that regular use high-dose fluoride toothpaste (5,000 ppm) in conjunction with quarterly treatments of chlorhexidine or silver fluoride diamine varnish can inactivate existing root caries and/or reduce the occurrence of new root caries [58–60].

### 2.1.2 Periodontal diseases

Periodontal disease (i.e., gum disease) is another common oral disease of the older people [61]. It is a chronic inflammatory disease affecting the tissue surrounding and supporting the teeth. Periodontal disease is generally categorized as gingivitis and periodontitis [62]. The initial onset of the condition (referred to as gingivitis) is characterized by gingival hemorrhage, reversible inflammation of periodontal soft tissue, and damage to bone around the teeth. In addition, the periodontitis is characterized by irreversible inflammation of periodontal soft tissue and loss of periodontal tissue support [45, 63]. The clinical manifestations of periodontitis include loss of attachment, periodontal pocket plugs (gaps in the gum and surrounding bone), gingival bleeding, and alveolar bone loss. The leading cause of periodontal disease is poor oral hygiene, which allows for the accumulation of pathogenic microbial biofilm (plaque) in the gingival and subgingival margins [64, 65]. The most basic prevention policy is limiting the formation of dental biofilm (via regular brushing and flossing) and the removal of accumulated plaque by clinicians using specialized equipment [66]. Controlling for other risk factors can also help to reduce the risks of gum disease. Note that smoking, diabetes, nutritional defects, and osteoporosis have all been associated with an impaired immune response, which can leave the patient susceptible to advanced tooth decay [54, 67, 68].

### 2.1.3 Edentulism and missing teeth

Edentulism refers to the state in which an individual has lost all of their natural teeth; i.e., the culmination of gradual tooth loss throughout one's adult life [42]. A number of studies have confirmed that the rate of tooth loss is higher among the older people [48, 69–74]. The two leading causes of edentulism are untreated caries and chronic periodontal disease [75, 76]. Note that trauma and other orthodontic indications can also lead to tooth loss [77].

Beyond aesthetic considerations, edentulism can greatly hinder chewing ability, which can in turn lower one's quality of life through a deterioration of physical function, an increased risk of disease, and even cognitive impairment [78–81]. Note that tooth loss is also viewed by many as a sign of economic impoverishment [82, 83].

Several studies have shown that missing tooth can have a negative impact on the quality of life and damage normal activities, such as vocalization, swallowing, chewing and social life [84]. In addition, it is also related to general health conditions, such as hypertension, obesity and cardiovascular

diseases [85, 86]. Overall, edentulism is one of the most severe problems affecting oral health [87, 88].

### 2.1.4 Xerostomia and dry mouth

Xerostomia is another common oral disease in many patients [89]. The term xerostomia refers to dry mouth resulting from reduced or absent saliva flow. Lack of saliva can lead to tooth decay and other oral diseases, and saliva is responsible for cleaning the oral cavity and removing particles that may produce different odors [90]. Saliva is an important protective layer of oral mucosa and plays a role in protecting oral mucosa [91]. Therefore, xerostomia and dry mouth are both a complex oral problem commonly experienced by the older people, which can adversely affect one's oral health, general health, and quality of life [92, 93].

Generally, clinicians differentiate between dry mouth and xerostomia as though they represent different conditions. The term xerostomia is the subjective feeling of having dry mouth [94]. The term dry mouth is generally used to describe salivary gland dysfunction based on salivary output, such as decreased salivary secretion (decreased saliva), increased salivary secretion (excessive saliva), or changes in salivary components [95, 96]. By contrast, xerostomia is generally used to describe a subjective feeling based on responses to a questionnaire survey [92]. Note however that one World Health Organization (WHO) study failed to detect a significant difference in saliva flow between cases of dry mouth and cases of xerostomia [97]. In other words, xerostomia refers to a subjective feeling occurring in the presence of normal or abnormal saliva flow, which is not necessarily related to clinical symptoms (dry mouth) [98, 99].

Xerostomia is associated with hyposalivation; however, the two conditions are mutually exclusive. In other words, patients with normal salivary function may experience dry mouth, while patients with decreased salivary function do not necessarily experience dry mouth [100, 101]. Nonetheless, the occurrence of xerostomia may be indicative of a decrease or change in salivary secretion, which can increase susceptibility to oral complications [97].

The occurrence of xerostomia has been linked to head and neck radiotherapy, Sjogren's syndrome, drug use, age, and gender [102, 103]. Identifying the precise reason of the condition can be challenging; however, prescription drugs are the most common cause [104]. In one study on vulnerable older people populations (aged > 65 years old with mobility difficulties or complicated health conditions), the prevalence of xerostomia ranged from 17% to 40% [105]. In addition, 20% of patients aged 65 or above have some type of salivary gland abnormality in the past studies [106].

However, medication-induced saliva secretion reduction is the most common cause of xerostomia in this age group, as most elderly people take at least one xerogenic medication [107]. Older people individuals commonly experience multiple chronic diseases at the same time, and many of these conditions are treated using prescription drugs. More than 400 drugs can cause salivary gland dysfunction, and which 80% of the most common prescription drugs have

been reported to cause salivary secretion reduction [106, 108, 109]. Many drugs and drug interactions impose side effects, including low salivary flow rate and xerostomia [110, 111]. Therefore, it has been found that the incidence and severity of salivary secretion reduction are directly proportional to the amount of medications taken by patients [112].

Due to the increase of microflora (especially *Streptococcus mutans*), the incidence of dental caries is increased, the protective effect of mucous saliva is weakened, the debridement efficiency of dental saliva is reduced, and most importantly, the buffering capacity is lost [113]. When the buffering capacity is impaired and the pH value decreases, decalcification of teeth will occur [114]. Frequent acid exposure can cause irreversible decalcification, leading to corrosion, wear and dental caries [115]. However, the loss of dexterity and deterioration of oral hygiene in the older people will have an additional effect to increase the risk of dental caries [116]. Therefore, the medication-induced reductions in saliva secretion increase the risk of many oral diseases, including dental caries (especially root and incisal caries), candidiasis, halitosis, oral burns, taste disorders, and difficulties in chewing, speaking, and swallowing [92, 117].

So far, patients with medication-induced salivary secretion reduction can use xylitol, saliva substitutes, peripheral salivary glands and central salivary glands [95]. Since there is no ideal medication that can effectively treat the special conditions of hyposalivation and xerostomia [95]. Therefore, doctors must pay attention to the prevention and treatment of possible complications caused by saliva deficiency, which is of vital importance to patients [89, 95].

## 2.2 Relationship between oral health disease and general health

The human body is a huge system, and each organ is a subsystem of this system. These subsystems interact with each other. The oral cavity and other parts of the body must be viewed together, because oral health affects the overall health by causing considerable pain and suffering and further changing people's diet, speech, quality of life and happiness [6, 118].

Medical researchers have long posited that health begins with the oral cavity [119, 120]. Many pathological changes in the oral cavity indicate the direct or indirect effects of underlying systemic diseases. A healthy oral environment can have a positive effect on one's overall health, whereas an unhealthy oral environment can increase the likelihood of physical disease [121]. Periodontal disease has been identified as a risk factor for diabetes and cardiovascular disease [112, 123].

Researchers have also identified a link between oral health and mental health. The most common mental health issues (e.g., depression, anxiety, schizophrenia, manic depression, and dementia) are often associated with a lack of awareness and self-care as well as dental phobia, which can result in oral health, such as caries and periodontal diseases [124–126]. It is also difficult for many people with a mental health condition to enter facilities for dental care [127]. One meta-analysis

study reported that the causes of poor oral health in adults with severe mental diseases included poor perception of oral health self-needs, duration of psychotropic drug treatment, and reduced access to dental care [128]. Compared with the general population, individuals with mental disorders face a higher risk of dental caries, tooth loss, and loss of all teeth [129, 130]. In a survey of the older people population, it was found that common mental disorders, such as depression, anxiety, sleep disorders, and psychosomatic disorders, are also related to oral health [131]. In addition, edentulism and missing teeth diseases are also related to general health conditions, such as hypertension, obesity and cardiovascular diseases [85, 86]. Furthermore, Some oral health diseases can also have a negative impact on the quality of life and impair normal activities, such as vocalization, speaking, swallowing, chewing and social life [84, 92, 117].

Researchers have reported that the relationship between oral diseases and systemic diseases (physical or psychological) can be very complicated. A healthy oral cavity is amenable to food consumption (without pain) and social interactions (without embarrassment) [132, 133]. Overall, oral health can be a strong predictor of general health status [134–137].

## 2.3 Tools for the evaluation of oral health among the older people

Traditional methods for measuring oral health mainly use clinical dental indicators, supplemented by oral health-related quality of life (OHRQoL) measures [138].

The two main tools for the evaluation of OHRQoL among the older people are the GOHAI and OHIP. The GOHAI is a self-reported measure of OHRQoL status comprising 12 questions pertaining to the functional and psychosocial effects of oral health, measured using a Likert scale with scores ranging from 1-5 [31]. Clinical evaluation results include the number of natural teeth and the presence of one or more caries (yes/no) [139]. Several versions of the GOHAI have been translated into multiple languages. Naito *et al.* [140] developed a Japanese version of the GOHAI. Sánchez-García *et al.* [141] verified a Spanish version of the GOHAI for use with the older people population in Mexico. Chahar *et al.* [12] used the scale to assess the oral health-related quality of life among older people outpatients in public hospitals in Delhi, India. Ting *et al.* [142] used the scale to evaluate Effectiveness of an oral function intervention on the oral function of older Taiwanese people. Eguchi *et al.* [143] used the scale to determine the distribution of healthy elderly individuals undergoing regular dental check-ups and identify any environmental or associated oral factors. Nitri *et al.* [144] investigated the association between sociodemographic factors, health-related characteristics, functional status and OHRQoL through the GOHAI scale.

The OHIP questionnaire initially comprised 49 statements; however, it has been revised into versions of various lengths, such as the OHIP-5, OHIP-14, and OHIP-26 [31–34]. The OHIP-14 comprises 14 questions measuring the negative impact of oral problems on personal life, such as physical limitations, physical pain, psychological discomfort, physical dis-

ability, mental disability, social disability, and handicap of oral health in the previous 12 months [33]. It also uses a Likert-like format with scores ranging from 1-4 [145, 146]. Sheng *et al.* [147] explored the correlation between oral health and quality of life of the older people in Southwest China using the Community Periodontal Index (CPI) and the OHIP-14. Kuo *et al.* [148] verified a Taiwanese version of the OHIP-49 and developed a short form of the OHIP-14 for the older people. Kireilytė *et al.* [149] tested a Lithuanian version of the OHIP-14 among older people adults. Lu and He [150] evaluated the reliability and validity of the Chinese version of the 5-item oral health impact profile (OHIP-5). Takahashi *et al.* [151] used the OHIP-14 scale to clarify the prevalence of sarcopenia in older dental clinic outpatients and its relationship with OHRQoL and oral health status. Ahmad *et al.* [152] determined the impact of hyposalivation and the saliva pH on the quality of life and caries status of geriatrics population through the OHIP-14 scale. Saxena *et al.* [153] assessed the effect of oral diseases on oral health related quality of life of institutionalized elderly using OHIP-14 questionnaire.

Several studies have compared the effectiveness of the OHIP-14 and the GOHAI. Overall, it appears that the two assessment tools are comparable; however, a few researchers have noted that the GOHAI is more sensitive to objective values related to oral function [154–159].

#### 2.4 The related researches on male elderly people

In the past, oral health studies of male elderly people were mainly based on the population-based cohort studies or cross-sectional studies to explore the impact of oral problems on various aspects. For chewing function, a study on masticatory function and general health of elderly Australian men found: [160] (1) the decrease in the incidence of edentulism disease in the elderly may improve masticatory and eating functions. (2) Maintaining more than 20 natural teeth and preventing active crown caries and root caries may enhance masticatory function and promote self-reported health and oral health. (3) Australian elderly men have lower ability to chew hard food and higher proportion of discomfort symptoms when eating, which is related to the common prevalence rate.

For oral prevention, a cohort study on the health status of Australian men aged 70 and above found that the prevalence rate of periodontal disease and dentition restoration burden are very high, which indicates that elderly Australian men need to pay more attention to prevention and health care [161]. In addition, for frailty problem, a population-based cohort study of older British men showed that oral health problems are associated with old people becoming frailty or old people developing frailty. Therefore, it is very important to identify and manage the poor oral health status of the elderly to prevent frailty [162]. Another study of frailty and oral health in the older men, showed the frailty was independently associated with the presence of dental caries [163]. For cardiovascular disease risks, a prospective cohort study in elderly men showed that more than 10 times of

tooth extraction was an independent predictor for cerebral infarction in addition to age, HDL-C, hs-C-reactive protein and diabetes [164]. In term of cognitive, a cross-sectional study of oral health and cognitive status in the male elderly, which results showed that male elderly with fewer than 20 natural teeth and male elderly with limited chewing ability are more likely to have related cognitive impairment. In addition, male elderly with cognitive impairment have fewer teeth and limited chewing ability [165].

### 3. Conclusions

Oral health is an essential topic in geriatric preventive medicine, with direct as well as indirect effects on the overall health and quality of life of the individual. Dental caries and periodontal diseases have been identified as the major causes of missing teeth and edentulism. Xerostomia is an oral health issue similar to dry mouth, common among the older people. Researchers have determined that no clear correlation exists between the subjective feeling of dryness and the objective decrease of saliva. From a prevention perspective, their incidence of oral and other diseases can be reduced by maintaining good oral health. In addition, adequate nutrition is closely related to oral health, and diet and nutrition should be regarded as an integral part of oral health assessment and management for the older people [166]. Therefore, oral health care gradually shifts from disease management to integrated treatment, further reducing the incidence of oral and other diseases, including lifestyle, psychology, and oral health care methods [167].

At present, the GOHAI and OHIP are the tools primarily used to elucidate the impact of oral health on the quality of life among the older people. Note however that these questions are interrelated rather than independent. Practitioners must view these results within the context of their clinical experience in order to identify the factors of greatest significance. Furthermore, the oral health research among male elderly people mainly involves different aspects of influence and is based on population cohort or cross-sectional research, such as masticatory function, oral prevention, weakness problems, cardiovascular disease risk and cognitive status.

This review provides a brief summary of the relationship between common oral diseases and general health based on a review of the literature. This review is meant to function as a guide for non-clinical professional readers to understand the complex relationship between oral health and general health. In the future, researchers could combine the results of meta-analysis with the clinical experience of doctors to provide a more in-depth and broader discussion on oral health research topics concerning the older people.

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## Conflict of interest

The authors declare no conflict of interest.

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