REVIEW



Epidemiology of oral health in older adults aged 65 or over: prevalence, risk factors and prevention

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Abstract

Oral diseases have emerged as one of the most prevalent non-communicable diseases (NCDs) worldwide, with a high global average prevalence of 45%, affecting an estimated 3.5 billion people globally. With the acceleration of global aging, oral health issues among the older adults have become increasingly prominent. According to the global multi-country epidemiological survey and the WHO report, the prevalence of oral diseases in the elderly aged 65 and above showed a significant increase, and the burden of disease was concentrated on dental caries, periodontal disease and tooth loss. This article synthesizes recent epidemiological data on the rising prevalence of oral health problems in older adults(aged \geq 65), including inflammatory or non-inflammatory oral diseases, such as dental caries, periodontal disease, tooth loss, oral cancer, dry mouth and dysphagia, illustrates their multidirectional connections with systemic health, their risk factors and prevention, finally advocates for integrating oral health into holistic geriatric care frameworks.

Keywords Epidemiology · Oral health · Risk factor · Prevention · Older adult

Population ageing is a global phenomenon. The United Nations stated that the population of persons aged 65 years or over stands at 703 million globally in 2019, with this number expected to double to1.5 billion in 2050 [1]. The World Health Organization (WHO) highlighted the critical deterioration of oral health conditions worldwide. Oral diseases have emerged as one of the most prevalent noncommunicable diseases (NCDs) worldwide, with a high global average prevalence of 45%, affecting an estimated 3.5 billion people [2]. According to the 2021 Global Burden of Disease study, oral disorders ranked 11th among Level 3 causes of global disability, with a 3.69 billion (3.4-4.0)prevalent cases and 3.74 billion (3.31-4.22) incident cases globally, causing 23.2 million (95% UI 13.8-35.0) Years Lived with Disability(YLDs) [3]. With the acceleration of global aging, oral health issues among the older adults have become increasingly prominent. In 2019, oral disorders accounted for 8.9 million disability-adjusted life-years

Lin Kang kangl@pumch.cn in individuals older than 60 years [4]. According to the global multi-country epidemiological survey and the WHO report, the prevalence of oral diseases in the elderly aged 65 and above showed a significant increase, and the burden of disease was concentrated on dental caries, periodontal disease and tooth loss [2, 5]. For example, China's fourth national oral health survey revealed a high prevalence of dental caries as 98% among the people aged 65–74 years, while 87.2% of the caries remained untreated [6]. Despite their high prevalence and heavy disease burden, oral health issues often receive insufficient attention in clinical practice. Therefore, in alignment with its Sustainable Development Goals framework, WHO make a goal to implement comprehensive oral healthcare coverage in all member nations by 2030 [7].

Poor oral health can cause malnutrition, undermine communication, decrease self-esteem and quality of life, especially in aging populations [2]. As people age, their oral health often deteriorates, leading to a host of other health issues. Tooth loss, for example, make it difficult to chew and digest food properly, leading to malnutrition. This, in turn, can weaken the immune system and increase the risk of chronic diseases. Moreover, oral health problems can affect a person's ability to speak clearly, which may lead to social isolation and depression. Poor oral health can also

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impact self-esteem, as missing teeth or bad breath can make a person feel self-conscious. Research has revealed that older adults frequently experience oral health problems, such as dental caries, periodontal disease, oral cancer, dry mouth, subjective difficulties in eating and swallowing, etc [8–10]. These issues can contribute to frailty, sarcopenia, cognitive decline, reduced physical and social functioning, diminished quality of life, and increased mortality among older adults [11–14]. Recent research have identified the multifaceted links between oral health and general health. Systemic diseases affect oral health either directly through pathological pathways or indirectly through behavioral changes associated with diseases or treatments. Poor oral health also have an impact on general health [15]. A recent study published in The Lancet Healthy Longevity revealed that poor oral health in older adults is associated with an elevated risk of functional impairment and mortality, with the role of chewing ability being particularly highlighted [16]. Improved oral health through disease prevention and health promotion not only supports better general health in older adults but also significantly boosts their quality of life.

To enhance public awareness regarding oral health in the elderly population, this article synthesizes recent epidemiological data on the rising prevalence of oral health problems in older adults(aged \geq 65), including inflammatory or non-inflammatory oral diseases, such as dental caries, periodontal disease, tooth loss, oral cancer, dry mouth and dysphagia, illustrates their multidirectional connections with systemic health, their risk factors and prevention, finally advocates for integrating oral health into holistic geriatric care frameworks.

Method

The literature search was conducted utilizing medical journal database as PubMed, from 2015 to 2025 February 23, covering the past 10 years. Search strategies is detailed in Appendix 1. Read the article title and abstract to confirm whether the article is relevant to the topic. If relevant, the full article text was downloaded for further reading. The Only studies published in English or translated into English were reviewed. More than 6000 articles were reviewed, among which,165 full-text were read.

Definition of oral health

In 2016, the FDI World Dental Federation expanded the definition of oral health, shifting from a sole focus on disease status to a more comprehensive perspective. This new definition includes the capacity to speak, smile, smell, taste, touch, chew, swallow, and express a spectrum of emotions

through facial expressions with self-assurance and free from pain or discomfort [17]. Oral health is linked to adverse outcomes, which fall into four categories: worsening oral health status; reduced oral motor function; disorders related to chewing, swallowing, and saliva; and oral pain [10].

Prevalence of global oral health in older adults

Dental caries

Oral diseases impact billions globally, and untreated dental caries is the most prevalent problem worldwide. According to the 2022 the estimated global average prevalence of permanent teeth caries is 29%, translating to over 2 billion cases. It is expected that low-middle-income countries (816 million) and high-middle-income countries (690 million) have the highest number of cases, and middle-income countries accounts for 75%. Prevalence varies from different regions, with an estimated 25% in the Western Pacific Region and as high as 34% in the European Region [2]. The DMFT index (Decayed, Missing, and Filled Teeth) is the most widely used system for assessing the status of dental caries in individuals [18]. Population-based surveys demonstrate a high caries experience among older adults, with DMFT \geq 20 [19–25]. Emerging evidence highlights a transition in the burden of untreated dental caries shifting from pediatric to adult populations, with tri-modal prevalence peaks observed at ages 6, 25, and 70 years [26]. A recent multinational meta-analysis by R. Borg-Bartolo's team synthesizes epidemiological evidence on the prevalence of dental caries among middle-aged and older adults $(\geq 45 \text{ years})$ in community settings. It revealed a prevalence estimate of 45%, demonstrating significant intercontinental variation: Europe (17%), North America (29%), South America (42%), Africa (48%), and Asia-Oceania (53%). Peak caries burden was observed in the 65-74 age cohort [27]. Longitudinal surveillance data from the National Institutes of Health (NIH), showed a decline of the incidence of dental caries among adults ≥ 65 years from the early 1970s up to 1999-2004, encompassing both restored and active lesions. However, the prevalence remains significant despite this decrease, with 93% of seniors ($\geq 65y$) and 92% of adults (20-64y) exhibiting decay experience, regardless of treatment status [28]. From 1990 to 2019, the global agestandardized prevalence of untreated caries in permanent and deciduous teeth decreased by 3.6% (2.6-4.5%) and 3.0% (1.3–4.9%), respectively [29]. Root caries prevalence among older adults remains underreported in the current literature, with the lowest value being 14.4% in Spain, followed by 24.0% in Belgium, 28% in Germany, 28.4% in Turkey, and 38.3% in Greece [21]. The prevalence of root caries among community-dwelling older adults ranges from

53.3 to 62.0%. Furthermore, root caries incidence per person is 35.9% per year and 52.3% per six years [30].

Periodontal disease

Periodontitis is an inflammatory disease, manifests as a hostmicrobe dysregulation syndrome with an adverse impact on systemic health. Severe periodontitis has emerged as a growing global health challenge, with its disease burden demonstrating a marked escalation in recent decades. Among the prevalent oral diseases, global prevalence data reveals that untreated caries in permanent teeth tops the list, affecting approximately 2 billion individuals, closely followed by severe periodontal disease, which affects around 1 billion people [2]. Even though dental caries accounts for the most cases among oral diseases, periodontal disease results in a greater number of DALYs (Disability-Adjusted Life Years) compared to dental caries, indicating a significant rise in the incidence of severe periodontal conditions [3]. NHANES 2009-2012 estimated that about 70% of the U.S. adults aged 65 years and older had periodontitis [31]. In 2019, there were 1.1 billion (95% UI: 0.8-1.4 billion) prevalent cases of severe periodontitis worldwide. The age-standardized prevalence rate was 13,109 (9993-16,385) per 100,000 persons. The largest percentage increase in the number of prevalent cases of severe periodontitis was noted among population aged 70-74 years (female: 129.72% [124.42-136.50%], male: 145.97% [142.16-150.80%]).From 1990 to 2019, the global age-standardized prevalence of severe periodontitis increased by 8.44% (range: 6.62-10.59%), with disproportionately higher rates observed in less developed countries and regions [32].

Tooth loss

Tooth loss is an important marker indicating the oral health status of a community, and reveals the history of oral and dental conditions during one's lifespan. Nevertheless, the incidence of tooth loss rises with advancing age. The 2018 Adult Dental Health Survey indicated that the average number of natural teeth declines with increasing age. The proportion of having functional dentition (commonly defined as \geq 21 teeth) decreases from 50% in adults aged 75–84 years to 32% aged 85 or over [33]. Globally, tooth loss is widespread and exhibits significant differences across various countries, age groups, and socioeconomic statuses. From 1999 to 2000 through 2017-2018, the age-adjusted prevalence of complete tooth loss in United States decreased from 29.9 to 13.1%. The prevalence of complete tooth loss among adults aged 65 and over was 12.9% in 2015–2018 [34]. In 2019, nearly half of the elderly people were complete edentulism in Iran [35]. Recently, the Singapore Longitudinal Aging Study (2009–2015) with 4990 samples shows that incidence of functional dentition loss demonstrated a significant absolute increase from 74.6 to 89.9% in the past 6 years [36].

Oral cancer

Oral malignancies (ICD-10 C00-C06) predominantly manifest as squamous cell carcinomas originating from the stratified epithelium of specific anatomical sites: labial mucosa (C00), lingual epithelium (C01-C02), gingival surfaces (C03), oropharyngeal floor (C04), and palatal structures (C05), with C06 encompassing other specified oral cavity subsites [37]. There were estimated 377,713 new numbers and 177,757 deaths from lip and oral cavity cancers globally according to the Global Cancer Statistics 2020. Lip and oral cavity cancer was estimated to rank the 16th most common type of cancer [38]. Based on the data from Global Burden of Disease study 2021, there were 422,000 incident cases (95% UI 390000-450000), 208,000 deaths (190000-224000), and 5.87 million (5.32-6.35) DALYs due to lip and oral cavity cancer globally [3]. The incidence and mortality rates of oral malignancies differ from geographic region, age, and gender. The South-East Asia Region rank most compared with other WHO regions, with incidence rates of 26.1 per 100,000 in men/9.0 per 100,000 in women and mortality rates of 14.4 per 100,000 in men/5.1 per 100,000 in women, which almost double the global average. Age-standardized incidence rates (ASIR) demonstrate a 2.62-fold male predominance (13.1 vs. 5.0 per 100000 person-years), paralleled by a double mortality rate ratios (MRR), persisting across WHO subregions [2]. Globally, there were estimated 389,800 oral cancer cases in 2022, 30.8% (95% UI 29.6-31.9) of which were attributable to smokeless tobacco or areca nut consumption [39]. Trends vary, with incidence rates of lip cancer continuing to decline for both men and women. Similarly, mouth cancer rates are on the decline for males, but in certain populations, an increase in rates among females has been noted [40].

Dry mouth(Xerostomia)

Saliva serves as a critical biological regulator of oropharyngeal homeostasis, functioning as a viscoelastic secretion, containing a variety of electrolytes, peptides, glycoproteins, enzymes, immunoglobulin A, amines, and leucocytes. It maintains mucosal hydration, provides mechanical protection against abrasive/erosive challenges and lubricates during mastication, deglutition, and phonation. The buffering effect of saliva, which is crucial, effectively prevents tooth demineralization [41]. Xerostomia, the subjective feeling of dry mouth, is a symptom associated with alterations in the quality and quantity of saliva. It is related to poorer oral health related quality [42]. The prevalence of xerostomia is rising due to the increasing aging population, the effects of some systemic diseases (such as rheumatoid arthritis, uncontrolled HIV disease, Sjögren's syndrome, and diabetes mellitus), clinical treatment(such as radiotherapy-induced), and commonly-prescribed medications that reduce saliva production [8, 41]. The Newcastle 85+Study with the 853 participants reports that 57% experienced dry mouth symptoms [11]. A cross-sectional study of 1226 long-term care residents (mean age 83.9 years) founds that the greater number of medications, the higher the overall risk of medicationrelated dry mouth [43]. Aging-related degeneration of oral mucosa and salivary gland function has been studied extensively [44]. Polypharmacy emerges as a primary etiologic driver of hyposalivation in older adults. A cross-sectional study consisted of 1226 nursing home residents with a mean age of 83.9 years (SD 8.5) shows a high level of medication use. The mean number of medications per person was 9.0 (SD 3.6, range 0-23, median 9.0). Notably, 49.6% of prescribed drugs exhibited hyposalivatory potential, averaging 4.5 medications per resident (SD 2.2, range 0-15, median 4.0) [43]. Similarity, a national population-based survey of older adults in New Zealand revealed widespread polypharmacy, with over 50% participants prescribed 5-9 medications and 20% receiving≥10 medications. Xerostomia prevalence (29.4%; 95%CI 26.5-32.5) was higher among the latter. After controlling for age and sex, xerostomia prevalence was higher among people who taking any antidepressant (1.45%;95%CI 1.14-1.86), taking a tricyclic antidepressant and either a steroid(2.33%;95%CI 1.65-3.29) or an anticholinergic(1.67%; 95%CI 1.15-2.43),taking a bronchodilator without taking prophylactic aspirin (1.67%;95%CI 1.05–2.65) [45].

Dysphagia

The incidence of dysphagia differs with the type of information source (selfreported or formal assessments) and the underlying cause, age, setting (such as hospital, institution or community). In general, the prevalence of oropharyngeal dysphagia falls between 6% and 50% [46]. Dysphagia is a common symptom in older adults with a prevalence of 9-33% [47, 48]. A national representative longitudinal population study, which tracks 51,338 Canadians over the age of 45, reports an 10.6% overall prevalence of self-reported swallowing difficulties, and this rate increased to 13.7% after 3 years [49]. Christopher Adkins et al. performed a population-based survey of more than 31,000 adults (median age 46.5±15.7) in USA, 4998 respondents (16.1%) reported experiencing dysphagia [50]. Another epidemiological Survey from China, includes 5943 persons aged 65 years older, finding that 2341 (39.4%) were identified with dysphagia [51].

Pulp and periapical diseases

Untreated dental caries has been consistently associated with dental infections [52]. The pulp tissue responds to bacteria via an inflammatory process. The intensity and duration of the irritant, along with the host's resistance, determines whether the pulp tissue pathology results in reversible inflammation or progresses to severe, irreversible inflammation that can lead to necrosis. The acute or chronic inflammatory response observed in periapical tissues is typically attributed to bacterial toxins and bacteria infiltrating these areas via the apical foramen. Irreversible pulpitis and chronic apical periodontitis proved to be the most prevalent pulp and periapical pathologies, accounting for 34.58% and 34.89% respectively [53]. However, the prevalence of pulp and periapical diseases in older adults is less reported.

Association with general health

Oral health is closely related to general health.

Systemic disease

Research has found the relationship between oral disease and chronic diseases such as cardiovascular, diabetes, cerebrovascular, and respiratory diseases, sharing some common biological pathogenesis [54]. Several studies show that professional oral care significantly lower the risk of aspiration pneumonia and reduce the likelihood of morbidity and mortality associated with it by up to 67% in hospitals and community settings [55, 56]. Evidences show there is a bidirectional link between type 2 diabetes and periodontitis [57, 58]. Numerous epidemiological studies have consistently demonstrated a link between periodontitis, metabolic syndrome, and obesity [59]. In a recent review, a total of 294 meta-analyses were evaluated, encompassing 856 comparisons. Out of these, 59 associations were identified as having strong evidence, supporting a bidirectional association of oral diseases with systemic non-communicable diseases (NCDs). Periodontitis contributed most significantly to the associations with NCDs and markers, followed by tooth loss and edentulism [60]. A population-based study conducted in Korea analyzed data from 247,696 healthy adults aged 40 years or older who had participated in an oral health screening program and had no history of major cardiovascular events. With a median follow-up of 9.5 years, the research revealed that individuals with periodontal disease, more dental caries, or greater tooth loss had an increased risk of cardiovascular events. Brushing teeth one more time per day was linked to a 9% lower risk of cardiovascular events after adjusting for multiple variables. Additionally, regular dental visits for professional cleaning (once a year or more) were found to reduce cardiovascular risk by 14% [61].

Emotion and cognition

A longitudinal Study in Older Japanese finds that oral health issues predict an increase in risk of depressive symptoms [62]. Another cross-sectional and prospective cohort study including 305,188 participants from the UK Biobank, showed that periodontal disease was associated with depression and/or anxiety (OR: 1.79, 95% CI: 1.73-1.86) [63]. Emerging evidence support the link between oral health and cognitive impairment or dementia [64, 65]. Recently, Professor Wu Bei's team published a commentary in The Lancet discussing oral health as a modifiable risk factor in dementia prevention, exploring the association between oral health and dementia risk, as well as its potential in prevention strategies [66]. In a meta-analysis of 14 longitudinal studies covering 34,074 adults aged 60 and older, researchers found a remarkable dose-response relationship: for every additional missing tooth, the risk of cognitive impairment increased by 1.4%, and the risk of a dementia diagnosis rose by 1.1% [67].

Geriatric syndrome

Oral health issues also have been confirmed to be associated with geriatric syndromes such as malnutrition, sarcopenia, and physical frailty [68–70]. Vittorio Dibello et al. conducted a systematic review focusing on the relationship between oral health factors and frailty in the elderly population (>60 years). The study revealed that deteriorating oral health, particularly having few remaining teeth, was most closely linked to frailty. Other factors, such as diminished oral motor skills (including chewing function, oral diadochokinesis, and occlusal force) and disorders related to chewing, swallowing, and saliva production (especially chewing difficulties), were less common but still considered associated with frailty [71]. Among the 7,557 participants in a English longitudinal study of aging, compared to individuals with 20 or more teeth, change in frailty over time was significantly higher among those with less than 20 teeth: 10–19 teeth (β: 0.249, 95%CI:0.116–0.382), and 1–9 teeth (β : 0.238, 95%CI:0.053–0.423) and being edentate (β : 0.286, 95%CI:0.106–0.465) when adjusting for co-variates. Individuals with fewer than 20 teeth, including denture users, experienced a significantly higher rise in frailty over time [72]. What's more, emerging studies have shed light on the mutual influence between bone mineral density disorders and oral health [73]. Vittorio Dibello et al. founds that having fewer teeth is linked to an increased risk of fractures and lower bone mineral density, while periodontal disease is associated with a higher likelihood of osteoporosis and reduced bone mineral density [74].

Key risk factors

The WHO Global Oral Health Status Report states that oral health and other noncommunicable diseases share a set of key modifiable risk factors, such as all forms of tobacco use, harmful alcohol use, unhealthy diets, physical inactivity and environmental pollution [2]. Here, we aim to conduct an in-depth analysis of risk factors for oral health from the perspective of aging, focusing on two major dimensions: biological and sociobehavioral perspectives.

Biological factors

Age-related changes, such as immunosenescence, deterioration of oral mucosa/salivary gland function, and oral microbiota imbalance, play a critical role in the development of dental caries and periodontal disease among older adults. Aging is characterized by systemic chronic inflammation, coupled with cellular senescence, immunosenescence, organ dysfunction, and age-related diseases [78]. Senescent cells secrete the senescence-associated secretory phenotype (SASP), which fuels chronic inflammation and causes neighboring normal cells to become senescent. Meanwhile, chronic inflammation speeds up the aging of immune cells, weakening their function and ability to remove senescent cells and inflammatory mediators. This interplay establishes a detrimental feedback loop, perpetuating both inflammation and senescence [79]. Immune senescence refers to the process of altered immune functioning that accompanies increasing age. It is considered that immune senescence results in increased susceptibility of older adults to infections. There is evidence that immune senescence plays a role in the pathogenesis of periodontitis and dental caries [80]. A.P. Colombo et al. introduces the aging-associated molecular mechanisms in oral tissues and cells in their recent article, providing a better understanding of oral tissue/cell homeostasis and immune responses during our life span [81]. Dysbiotic oral microbial communities have been shown by recent studies to emerge and persist, mediating inflammatory pathology not only locally but also at distant sites [82]. With aging, the oral mucosa demonstrates a loss of elastic fibers and thickening and disorganization of collagen bundles in the connective tissue. The mucosa becomes less resilient, and this, accompanied by a reduction in the microvasculature, leads to impaired wound healing [83].

Sociobehavioral factors

Loneliness and social isolation have been recently recognized as an important social determinants of health that can potentially negatively affect health and quality of life among older adults [26]. For older adults living in congregate long term care settings, loneliness is a common phenomenon, while loneliness among community-dwelling older adults ranges from 19 to 29% [84]. Recent research reports that loneliness was associated with more risk factors and poorer oral health outcomes [85]. Older adults exhibit heightened vulnerability to micronutrient deficiencies, impacting both their physical capabilities and social integration. Polypharmacy amplifies this susceptibility by disrupting drug-nutrient-microbiome crosstalk-particularly through pharmacokinetic interactions affecting nutrient absorption and microbial ecology. This dysregulation predisposes to complex comorbidities, including systemic inflammatory cascades and accelerated oral pathologies such as caries progression [86]. Meanwhile, lifestyle patterns compound oral biological vulnerabilities, such as oral hygiene neglect, tobacco/alcohol use and unhealthy dietary. Dental enamel, the outermost mineralized layer of teeth composed predominantly of hydroxyapatite, is inherently prone to demineralization under acidic conditions. Oral hygiene interventions target the suppression of cariogenic biofilms by disrupting acidogenic bacteria-primarily Streptococcus mutans and Lactobacilli-that metabolize fermentable carbohydrates into organic acids, thereby initiating enamel breakdown [83]. The Dehgolan prospective cohort study (DehPCS) includes a total of 3,996 individuals aged 35-70 years, showing suboptimal oral hygiene with only 13.21% reported flossing regularly and 43.17% brushed less than daily [87]. Half of Salvadoran older adults have "Poor or Very Poor" hygiene,

similar to the results of other studies such as those conducted in India and Turkey in which deficient levels of oral hygiene were also reported [88]. A systematic review suggests that older adults with dementia have poor oral hygiene, result in high levels of gingival bleeding, periodontitis, plaque, and assistance for oral care [89]. Lip and oral cavity cancers rank as the third most common tobacco-related cancers, with approximately one quarter of oral cancer cases linked to harmful alcohol consumption. The combination of these two risk factors significantly heightens the risk of oral cavity cancers [2, 90, 91]. Globally, it is reported that approximately one-third of oral cancer cases are linked to the consumption of smokeless tobacco or areca nuts [39]. A study suggests redefining the non-communicable disease framework to a 6×6 approach, highlights the importance of sugar as a risk factors [92]. Restriction of free sugar was shown to be associated with reduced gingival inflammation and dental caries, national and international dietary guidelines advocate for reduced free sugar intake among the general population [93, 94]. Table 1.

Prevention and intervention strategies

Pubic health policy

The 8020 Campaign was launched in 1989 by Japan's Ministry of Health and Welfare and the Japan Dental Association, with a lifelong approach aimed at preventing tooth loss. The objective was to ensure that individuals retained at least 20 of their natural teeth by the age of 80, thereby maintaining their nutritional and social well-being [95]. In 2019, China launched the Healthy Mouth Action Program (2019–2025) to improve oral health, especially among older adults. It highlights the need to understand how oral health

Table 1 Summarizes the prevalence of dental caries, periodontal disease and tooth loss in older adults

Prevalence of Oral health in Older Adults		
	study	prevalence
Dental caries	R. Borg-Bartolo et al. [27]	45% in middle-aged and older adults (≥45 years); Europe (17%), North America (29%), South America (42%), Africa (48%), and Asia-Oceania (53%);Peak caries burden was observed in the 65–74 age cohort.
	China's fourth national oral health survey [6]	A high prevalence of 98% among the people aged 65–74 years, while 87.2% of the caries remained untreated.
	National Institutes of Health (NIH)(28)	93% of seniors (\geq 65years) exhibiting decay experience.
	Carvalho JC et al. [21]	Root caries prevalence: 14.4% in Spain, followed by 24.0% in Belgium, 28% in Germany, 28.4% in Turkey, and 38.3% in Greece.
Periodontal	NHANES 2009–2012 [31]	70% of the U.S. adults (\geq 65years) had periodontitis.
disease	Chen et al. [32]	From 1990 to 2019, the global age-standardized prevalence of severe periodontitis increased by 8.44%; the largest percentage increase was noted among population aged 70–74 years.
Tooth loss	2018 Adult Dental Health Survey [33]	The proportion of having functional dentition (commonly defined as ≥ 21 teeth) decreases from 50% in adults aged 75–84 years to 32% aged 85 or over.
	Fleming E et al. [34]	The prevalence of complete tooth loss among adults (≥65years) was 12.9% in 2015–2018.
	Singapore Longitudinal Aging Study (2009–2015) [36]	The incidence of functional dentition loss demonstrated a significant absolute increase from 74.6–89.9%.

impacts overall well-being and promotes efforts to increase public awareness of oral health [96]. In Australia, the Senior Smiles initiative facilitates the integration of skilled dental practitioners, encompassing dental hygienists and oral health therapists, into residential aged care facilities, to provide risk assessments, care plans and referral pathways for advanced treatment needs [97]. Recently, a study assessed the practicality and effectiveness of introducing an Oral Health Promotion Program (OHPP) in nursing homes. The results showed that the OHPP significantly boosted the oral health and daily functioning of the elderly, increasing the proportion of healthy mouths from 29.8 to 67.8%. It suggested that an oral health promotion program combining health education and behavioral interventions is an effective measure for nursing homes to improve the periodontal health of older adults [98].

Individual intervention

Regular dental check-ups, proper brushing and flossing techniques, and a balanced diet rich in vitamins and minerals can all play a significant role in improving and preserving oral health in this vulnerable population. Consistent tooth brushing and professional dental cleanings have been demonstrated to lower the risk of periodontal diseases, dental caries, and tooth loss [99, 100]. There was widespread consensus that brushing one's teeth at least twice daily is essential, particularly before bedtime and at least once more in the daytime, to eliminate plaque and to sustain an optimal fluoride level during daylight hours. Keeping fluoride levels in the mouth elevated both during the day and night has been demonstrated to be crucial in preventing dental caries [101].

Challenges and prospects

With the rapid aging of the population, oral frailty as an emerging concept was introduced in Japan in 2013, which means "decline of oral function associated with aging" [102]. Oral frailty represents a transitional phase in oral function that lies between optimal "healthy mouth" conditions and the "decline of oral function". It is marked by the gradual accumulation of minor declines in oral function, such as tooth loss and difficulties in eating and communicating, thereby increasing the risk of impaired oral functional capacity [103]. Oral frailty can be assessed without the need for a dental health professional, defined as having at least two of the Oral Frailty 5-item Checklist (OF-5): (i) fewer teeth, (ii) difficulty chewing, (iii) difficulty swallowing, (iv) dry mouth, and (v) low articulatory oral motor skills [104]. The ICOPE (Integrated Care for Older People) guidelines emphasize the significance of regular oral health evaluations and regard oral health as a critical factor in determining the health status of the elderly [105]. As an upstream risk factor for malnutrition, ICOPE highlights the significance of oral health maintenance. By strengthening oral hygiene education, promoting proper brushing, regular use of dental floss and mouthwash, and routine dental check-ups, it is possible to prevent and manage oral frailty effectively, thereby enhancing the quality of life and overall health of older adults.

As a key factor to healthy longevity, oral health must be prioritize [7, 106]. Future efforts require interdisciplinary collaboration, integrating geriatrics and dental medicine, to optimize oral health management models in long-term care settings, particularly for frail older people with complex comorbidities (Figs. 1, 2, and 3)

Conclusion

Dental caries, periodontal disease, tooth loss, oral cancer, dry mouth and dysphagia are among the most common oral issues encountered by older adults. It showed a high prevalence of oral diseases in the elderly aged 65 and above. The oral health of older adults is susceptible to multiple influencing factors, encompassing age-related shifts like immunosenescence, the degeneration of oral mucosal tissue and salivary gland function, as well as disruptions in the equilibrium of the oral microbiome. Additionally, social and behavioral elements contribute significantly, including feelings of loneliness, the complexities of taking multiple medications, and alterations in lifestyle routines.

The main advantage of this article is that it provides valuable epidemiological data on the prevalence of oral health issues in older adults. It effectively illustrates the connection between oral and systemic health, highlighting the importance of this often overlooked aspect of geriatric care. Moreover, the article conducts a comprehensive analysis of the various risk factors affecting oral health in the elderly, offering a deeper understanding from an aging perspective. Finally, it advocates for the integration of oral health into more holistic geriatric care frameworks, emphasizing the need for a more comprehensive approach to elderly healthcare.

The article has shortcomings. It lacks a methodological framework, relying solely on one database with possibly insufficient literature review. In epidemiology, it omits comparative data across senior age groups and barely explores other relevant factors, which limits its depth of insight and analysis.



Fig. 1 Illustrates the bi-directional links between poor oral health and overall health

The mechanisms linking poor oral health to malnutrition, sarcopenia, and frailty



Fig. 2 Illustrates how poor oral health is connected to malnutrition, sarcopenia, and frailty [68-70, 75-77].



Fig. 3 Illustrates the connections between aging, oral microbiota dysbiosis, and systemic diseases

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Author contributions XH read the literature and wrote the manuscripts. LK revised the versions. JHB contributed to some of the mechanism maps.

Data availability No datasets were generated or analysed during the current study.

Declarations

Competing interests The authors declare no competing interests.

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