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# Oral health in older adults: current insights and tips

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The aging process intricately intersects with oral health, necessitating a meticulous focus on the preservation and augmentation of well-being in the elderly. This demographic frequently contends with dental issues such as dental caries, periodontal problems, tooth loss, and an escalated susceptibility to severe oral conditions, notably oral cancer. The compounding factors of cognitive impairments and chronic illnesses exacerbate oral health challenges, further complicated by the pharmacological interventions they undergo. The ongoing global demographic transition towards an aging populace engenders apprehensions, particularly in densely populated regions and emerging economies, where healthcare infrastructures may confront limitations.
The advent of the COVID-19 pandemic has exerted a profound impact on healthcare systems, permeating into oral health services. The elderly, disproportionately susceptible to severe manifestations of the virus, grapple with heightened apprehension and reluctance to pursue healthcare, encompassing oral care. Prolonged social isolation imposed by lockdown measures contributes to mental health ramifications, discouraging their engagement with oral healthcare services.
This discourse underscores the pivotal significance of oral health in the elderly, propounding the necessity for targeted interventions and meticulously recalibrated strategies tailored to their distinctive needs. In the trajectory of this imperative undertaking, collaborative alliances among healthcare practitioners, policymakers, and communities assume paramount importance. Sustained research endeavors, coupled with synergistic partnerships with academic institutions, are imperative for the continual refinement of oral health interventions for the aging demographic, thereby fostering enhancements in their holistic well-being.

**Key words**: oral health, elderly, aging, quality of life, COVID-19 pandemic

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## INTRODUCTION

Ageing is a natural and inevitable process characterized by a decline in physical and cognitive abilities resulting from biological changes occurring over time. However, the extent of decline is subject to various factors such as lifestyle, socioeconomic status, or access to healthcare. While chronological age, such as “60 years or older”, is commonly used to delineate the elderly population, individuals within this age bracket can exhibit significant disparities in health status, physical capacities, and overall well-being [1,2]. Oral health is critical for good overall health and quality of life. Regarding to World Health Organization’s definition of health as “complete state of

physical, mental, and social well-being and not just the absence of disease", quality of life has recently been included in the professional conceptual framework of oral health [3]. The World Health Organization's Global Oral Health Program particularly emphasizes this issue to raise awareness about oral health worldwide [4]. However, oral diseases remain a significant public health concern in many low- and middle-income countries, including high-income countries. The rapid increase in the proportion of older individuals compared to other age groups is leading to a global demographic shift [1,2-6]. The number of people aged 60 and over continues to rise worldwide, particularly in developing countries, and it is estimated that their numbers will reach 2 billion by 2050 [2,7,8]. (Fig. 1). As a result, a greater number of older individuals will face more diseases and disabilities, requiring an increasing amount of healthcare services [2,9]. This situation is becoming a major concern for countries with high population densities and developing economies [2,10]. Therefore, addressing oral health needs for older people should reflect continuity in care for older patients and should be readjusted to suit the stages of life appropriately [11,12].

The oral cavity is an important part of the body and is used in chewing, swallowing, speaking and forming facial expressions; it also plays a crucial role in maintaining nutritional status, systemic health and psychological self-esteem [6,13,14]. These functions are important for individuals of all ages; however, it gains more importance especially for older individuals who have increased susceptibility to malnutrition and infection [15]. The distinction between physiological aging and actual pathology is not always clear-cut. Thinning of the oral mucosa, reduction in masticatory muscle mass, tooth wear and enamel loss, and limited attachment loss serve as instances of physiological oral aging [8]. However, dental caries, substantial attachment loss, tooth mobility and/or loss, and a decline in masticatory efficiency represent pathological alterations that typically necessitate intervention to impede further progression, alleviate

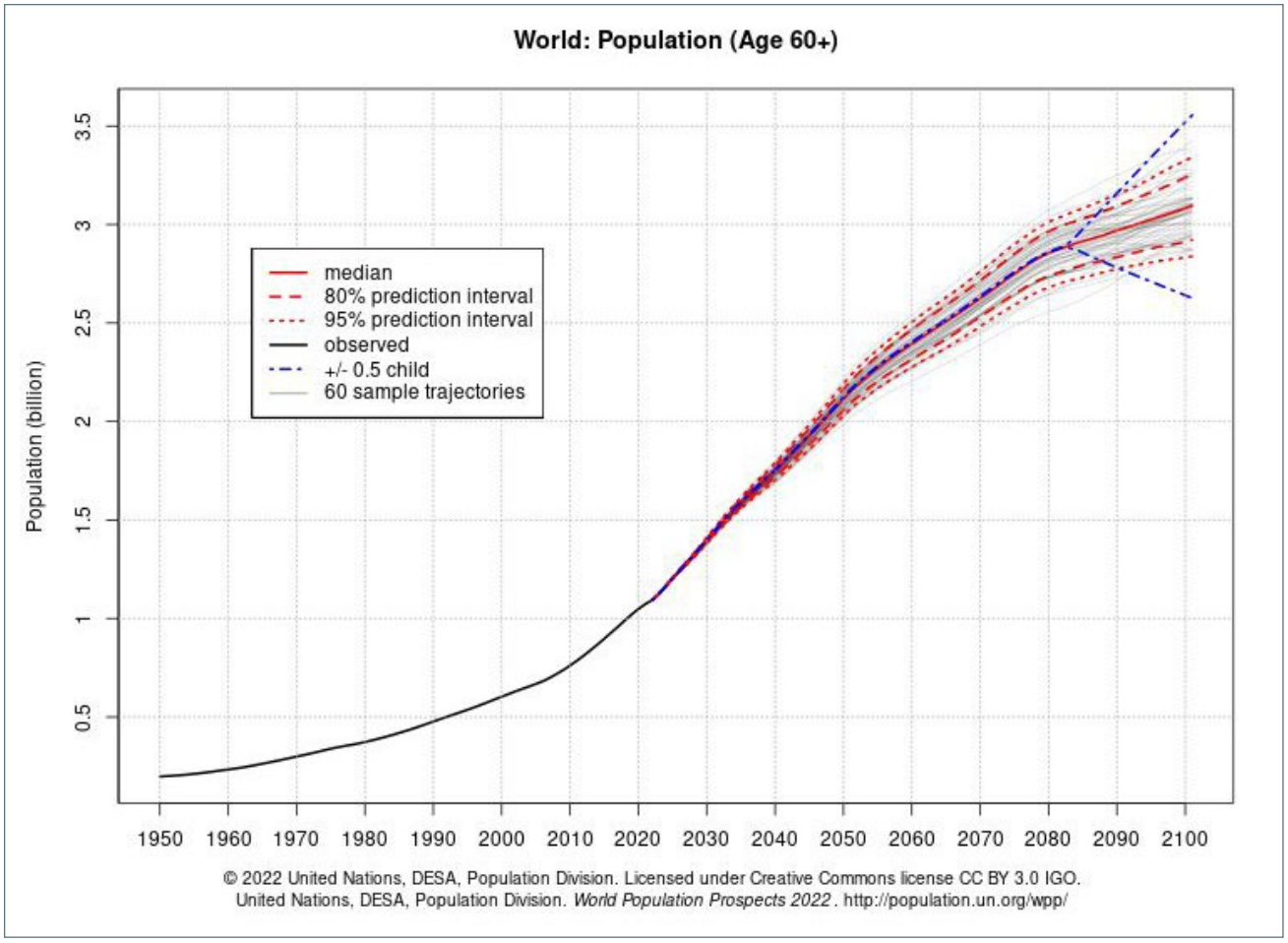


**Figure 1.** The graph depicts the projected increase in the percentage of the world's population aged 60 years and older from 1950 to 2100. (United Nations World Population Prospects report, 2022.) (https://population.un.org/wpp/Graphs/Probabilistic/POP/60plus/900).

discomfort, and reinstate function [8]. Oral diseases have the potential to influence overall health through various pathways; conversely, general health conditions can impact oral health, given their mutual association with shared risk factors [16]. Oral hygiene directly linked to systemic infections, autoimmune disorders, chronic cardiovascular diseases, diabetes, cancer and many other diseases [11,13,17]. In conducted research, a strong relationship has been established between periodontal disease and diabetes [12,18-20], as well as between inadequate nutrition and tooth loss [7]. In addition, it has been determined that estrogen deficiency seen in menopausal or postmenopausal women may create a high risk for severe periodontal disease and tooth loss. Hormonal changes seen in older women can also cause various oral disorders such as dry mouth, burning in the gums, and changes in the sense of taste [13]. These diseases can cause severe pain and psychological sensitivity, which significantly reduces an older people's quality of life. However, there is still no international consensus on a guideline to improve oral hygiene, especially in racially, ethnically and culturally diverse, low-income and older populations with an increased likelihood of chronic diseases [7,21]. It is observed that the effects of the COVID-19 pandemic on the oral hygiene habits of older individuals, especially, cannot be clearly determined.

In general, poor oral health among older individuals has been associated with various factors, including high levels of tooth loss, difficulties in accepting prosthetics due to tooth loss-related alveolar bone atrophy, periodontal disease, dental caries, dry mouth (xerostomia), and oral cancer [2,10,12,13,15,22]. The majority of older individuals use medications due to chronic illnesses, which can impact their oral health and dental treatment. Common medications, including antihistamines, diuretics, pain relievers, antihypertensives, and antidepressants, can lead to side effects such as dry mouth, soft tissue changes, loss of taste and gum enlargement [13,15]. This makes older people more susceptible to oral problems than younger age groups, especially those who are cognitively impaired [9,11,23]. Furthermore, individuals over the age of 75 tend to visit dentists less frequently compared to other age groups, due to physical and cognitive impairment, transportation difficulties, past negative experiences, fear and anxiety towards dental services [13]. The view among older people and their families, as well as among health professionals, that oral diseases are naturally associated with aging, leads older people to visit dentists only when they have painful and urgent issues [2,12].

In this review, the impact of oral health on the quality of life, the challenges faced by older individuals in terms of oral health, the barriers encountered by professionals providing these services, and opportunities to optimize dental care in this demographic will be addressed. In this context, the gaps in international guidance on oral health for older individuals, proposing a framework for more cohesive and globally applicable recommendations will be addressed. The unprecedented challenges posed by the COVID-19 pandemic and its specific impact on the oral hygiene habits of older individuals will be presented, providing insights into potential adaptations and innovations in oral health strategies. In conclusion, this review aims not only to provide a broad perspective on the oral health of older individuals but also to serve as a catalyst for further research, collaboration, and transformative approaches in geriatric oral care.

## TOOTH LOSS AND EDENTULISM

In the past, oral health in old age was mostly associated with edentulism [24], and as a result, the dental needs of older individuals were mostly confined to the maintenance of partial or full dentures [12]. However, due to the strong social tendency to preserve natural teeth in old age [5,10,28], the proportion of people aged 75 and overusing full dentures has significantly decreased from 78.6% in 1979 to 35.7% in 2005 [12].

Epidemiological studies indicate that individuals with lower social class or income and minimal or no education have a higher likelihood of tooth loss compared to those with higher social class, income and education levels [7,10,25]. Relatively fewer epidemiological studies on older people tooth loss have been conducted in developing countries [7]. However, data related to geriatric populations demonstrate significant disparities in the prevalence of edentulism among countries based on varying trends in dental service utilization, provision of public financial support, and implementation of oral health policies. Nonetheless, most studies conducted in both developed and developing countries report a peak in severe tooth loss incidence around the age of 65 [19]. Various degrees of tooth loss have been found to be higher in older individuals with conditions such as arthritis, cardiovascular disease, chronic obstructive pulmonary disease, diabetes and partial or complete vision loss, compared to systemically healthy individuals [14]. According to the results of the study conducted by Zhang et al., having fewer than 20 teeth, regardless of denture use, was found to be associated with frailty [26], defined as "a clinical state in which there is an increase in an individual's risk of dependence and/or mortality when exposed to a stressor that can be reduced by taking appropriate measures" [27]. Nevertheless the connection between the number of teeth and frailty is still not fully understood. A potential explanation

for the association between having fewer teeth and frailty could be attributed to nutritional pathways [26]. More research is needed to evaluate the extent of tooth loss, chewing ability, and the functionality of any prosthetics used, if present.

In older people, edentulism has been associated with both weight loss [7] and obesity [8,14,24,26]. Poor oral health is among the most common causes of malnutrition due to its impact on energy and nutrient intake caused by chewing and swallowing difficulties [12,19,22]. Tooth loss reduces chewing performance and indirectly affects the person's food choice by impairing the perception of the taste of food [14,22,28]. It has been shown that edentulous people mostly avoid fibrous foods, tend to prefer foods rich in saturated fat and cholesterol, and are more likely to have an atherogenic diet [7,14,15,29]. The use of dentures can be considered as an effective compensation for the adverse effects of tooth loss; therefore, it may help reduce the risk of musculoskeletal frailty in individuals with fewer teeth [30]. Untreated tooth loss can lead to the tilting and over-eruption of other teeth, resulting in food impaction, susceptibility to dental caries and periodontal diseases, and subsequently more tooth loss [15]. Alveolar bone loss, especially in long-term edentulous individuals, persists for years after natural tooth extraction. Alveolar bone resorption that occurs leads to reduced denture stability, causing difficulties in tolerating dentures and a decrease in biting force. Stomatitis and traumatic ulcers resulting from the use of ill-fitting and unhygienic partial or full dentures are among the most common oral conditions in the older population [19,31], with a reported prevalence rate ranging from 11 to 67% [7,32]. Both lesions were observed more frequently in full denture wearers than in removable partial dentures [31]. Factors such as low education level, tobacco smoking and alcohol use and infrequent dental visits are associated with an increased occurrence of denture-related oral lesions. The prevalence of denture stomatitis was strongly associated with denture hygiene or the amount of denture plate [32]. In many cases of denture stomatitis, fungal colonization was observed on the seating surface of the denture [7]. In this context, the maintenance, hygiene, and regular dental visits for dentures are crucial in preventing oral health-related issues [12,19].

The alternative method that can be preferred for replacing missing teeth is osseointegrated implants, which serve as a substitute to traditional fixed or removable partial dentures [33]. Implants are increasingly and successfully being utilized, and with the increase in life expectancy, they have also become a reason for older individuals to seek dental care. According to the current literature, advanced age does not appear to be a factor influencing the success of implants. In a retrospective study conducted by Park et al., evaluating the success of implants in individuals aged 65 and older, a total of 902 implants were assessed in 346 patients. The study revealed that the failure rate of implants placed in individuals over the age of 65 was 4.61% at the implant level and 0.02% at the patient level. An interesting finding in the same study was that the majority of implant failures occurred in individuals aged 65-69, while patients aged 70 and older exhibited a notably high implant survival rate [34].

The introduction of new implant developments with various macroscopic and microscopic designs, improved implant surface treatment techniques, and enhanced surgical procedures significantly contribute to the success rates of dental implant treatments. It is noteworthy that advancements in implant technology and surgical techniques are enhancing the overall success of dental implant treatments, but a thorough preoperative assessment remains crucial due to the substantial impact of aging on bone quality and quantity [34].

Systemic diseases commonly associated with aging, such as diabetes and osteoporosis, can be considered relative contraindications for implant procedures due to weakened immune system and low bone density [33]. However, when the primary factors that could lead to implant failure are managed and proper patient preparation and follow-up are conducted, implant treatment can offer a viable therapeutic alternative for the elderly population. In the future, not only medical professionals but also care staffs and patients should have a comprehensive understanding of implant treatments for the elderly to better manage these treatments and enable early detection of implant-related issues [35,36].

Alongside these considerations, it should be noted that complete or partial tooth loss affects a person's appearance, self-esteem, self-confidence, as well as speech and effective communication skills, thus impacting social well-being and interpersonal relationships [12,14,17,28]. These factors may encourage the adoption of an unhealthy lifestyle and contribute to the onset of stress and anxiety [37]. Long-term follow-up studies have indicated that elderly individuals with tooth loss tend to exhibit more depressive symptoms [37]. Economic constraints, aesthetic concerns, discomfort during the adaptation period, underlying health conditions, lack of awareness regarding the benefits of dentures, and limited access to dental care are among the factors that may influence elderly individuals' preference against getting dentures. Further comprehensive research, encompassing longitudinal studies with larger sample sizes and diverse demographic representation, is imperative to delve deeper into the multifaceted dynamics surrounding elderly individuals' reluctance towards opting for dentures. Such investigations should aim to elucidate the intricate

interplay of socioeconomic factors, cultural influences, psychological perceptions, and healthcare accessibility, thus providing a holistic understanding of the barriers and facilitators impacting this decision-making process within the elderly population.

In certain industrialized countries, there has been a positive trend towards decreased tooth loss among adults, including the older people, in recent years. However, social inequalities in accessing dental services persist even in countries with well-established public oral health programs [7]. Severe periodontal disease and dental caries still remain the primary causes of tooth loss among the older adults [7,10,14,38].

## PERIODONTAL DISEASES

Periodontitis is defined as a chronic infectious disease that affects the supporting tissues of the teeth, including the gums and alveolar bone. In the elderly population, prevalent observations concerning periodontal tissues predominantly encompass inadequate oral hygiene practices, accumulation of bacterial plaque leading to gingival inflammation, and varying degrees of alveolar bone resorption ranging from mild to moderate levels [2,19]. Studies indicate that the prevalence and severity of periodontal diseases increase with age [2,8,39] and over half (53%) of older adults experience moderate to severe periodontal disease [28]. Low education level, irregular visits to the dentist, partial tooth loss and smoking contribute to a higher occurrence and progression of periodontal diseases in older adults [7,18]. Untreated periodontitis can lead to tooth loss, thereby adversely impacting both masticatory function and nutritional intake. Considering the widespread prevalence of suboptimal oral health and its correlation with heightened mortality risks, the imperative of conducting population-based studies to inform targeted public health interventions cannot be overstated [17]. In their investigation involving 4,880 individuals aged 60 and above, Yu et al. tracked participants over a span of 326 months, during which 85% of the cohort deceased. Notably, a discernible trend emerged indicating a higher mortality rate among those self-reporting poor oral health. The augmentation of accessibility to dental screening and treatment services for elderly community-dwellers holds promise in mitigating disparities in mortality risks associated with oral health [17]. While the data is not conclusive, scientific evidence suggests that local periodontal infection may be an independent risk factor for certain diseases like diabetes [18], cardiovascular disease, dementia, lung infections, some types of cancer, erectile dysfunction, premature low-weight birth and kidney disease [19,28,40]. Therefore, more attention should be given to preventive practices in older individuals to reduce plaque and gingivitis [41].

The recommended brushing method for the older patients are often the sulcular brushing method using a soft toothbrush (Bass method) [2,42]. Patients with significant gingival recession may be advised to use an extra soft brush and apply gentle pressure. However, ensuring adequate oral hygiene can pose challenges among the older people due to factors such as reduced manual dexterity, cognitive decline, diminished vision and systemic illnesses or social isolation [11,41]. In such cases, electric toothbrushes with rotating heads or custom-designed manual brushes could be utilized as alternatives to conventional mechanical toothbrushes. Furthermore, the adoption of strategies such as professional dental cleanings or chemical plaque control, alongside mechanical oral hygiene practices, has been advocated to uphold oral health among the elderly population [43]. It is reported that especially mouthwashes containing chlorhexidine reduce gingivitis and pocket depth [44] and reduce the incidence of oral mucositis and candidiasis in immunocompromised individuals such as chemotherapy patients [2]. Additionally, chewing chlorhexidine acetate/xylitol gums may reduce the prevalence of denture stomatitis and angular cheilitis in the older patients [45].

## DENTAL CARIES AND XEROSTOMIA IN GERIATRIC PATIENTS

Dental caries is one of the main oral diseases that cause pain and infection and affect the social life of people due to impaired chewing and speaking skills [46]. Bacteria (such as streptococci, actinomycetes, and lactobacilli) in an adherent microbial colony (dental plaque) on tooth surfaces produce lactic acid when exposed to sucrose and other simple sugars. This leads to the demineralization of dental hard tissues and eventually irreversible destruction of tooth structure.

Research indicates that untreated dental caries represent a predominant concern among adults worldwide [8,40], closely intertwined with social and behavioral determinants [7,10,19]. In older patients, the risk of dental caries, particularly root surface caries, is heightened by factors such as compromised salivary gland functions, generalized periodontitis leading to gingival recession, and diminished motor skills, which collectively impede the maintenance of oral hygiene [8,15,23,47]. A recent systematic review revealed that nearly half of older adults experience dental caries [46]. The risk of caries is elevated by aging-related systemic conditions and the medications prescribed for their management [46,47]. An important side effect of many drugs is xerostomia,

which is defined as reduced salivary flow and a subjective sensation of dry mouth [48]. Xerostomia, which affects approximately 30% of individuals aged 65 and older [49], results in various discomforts including mouth burning, changes in soft tissue, halitosis, sensitivity to spicy and hard foods, decreased retention of dentures, consequently affecting chewing, altering taste perception, causing excessive thirst, difficulty swallowing, hoarseness, and candidiasis [9,19,37]. Although xerostomia in older adults is typically linked with polypharmacy, systemic conditions have also been implicated in its cause. These include dehydration, endocrine factors such as diabetes mellitus, autoimmune conditions like Sjögren's syndrome, systemic lupus erythematosus, scleroderma, and rheumatoid arthritis, as well as local factors such as head and neck radiotherapy, mouth breathing, and infectious conditions like Actinomycosis, HIV, among others [20] (Tab. I). Many of these conditions that can cause dry mouth are common among older adults. Therefore, it is important for dentists to be informed about these factors to make the best treatment decisions [20]. Examining medication usage and reducing polypharmacy will provide significant benefits not only for elderly individuals but also for the broader healthcare system. Various strategies have been employed in the management of xerostomia, encompassing interventions such as augmenting water intake frequency and incorporating citrus fruits into the diet, as well as utilizing salivary stimulants like sugar-free chewing gums or lozenges [49]. In cases of severe xerostomia, the utilization of salivary substitutes may become necessary. Indeed, the increasing worldwide elderly population and the simultaneous rise in individuals affected by xerostomia underscore the critical need for additional scholarly investigation into the causes and treatment options for this condition [49].

When examining older populations, the generally high prevalence of tooth loss due to dental caries reflects the fact that the predominant treatment approach historically has been extraction of significantly affected teeth [10,19]. This is attributed to the majority of individuals over 60 not having been acquainted with the concept of preventive dentistry at a younger age, consequently lacking inclinations in that direction [2]. Contemporary treatment procedures aim to preserve as many natural teeth as possible through early detection of dental caries and restoration with appropriate dental materials, thereby eliminating or minimizing the need for removable or fixed prosthetics and enhancing the quality of life [19]. Additionally, routine fluoride treatment can be applied to prevent dental caries in individuals at high risk. Toothpaste is the most convenient and readily available form of fluoride. The World Dental Federation (FDI) recommends the use of fluoride toothpastes with a concentration of 1000-1500 ppm twice daily [46]. For older adults with reduced dexterity or cognitive impairment, professional application of fluoride at regular intervals is advised [46]. A meta-analysis has shown that regardless of the method – self-applied (toothpaste) or professionally applied (gel, varnish, etc.), or even through community water systems – fluorides can reduce the incidence of coronal caries in adults by approximately 25% without dependence on the specific application technique [14].

## ORAL MUCOSAL DISEASES AND CANCER IN GERIATRIC PATIENTS

Alongside dental caries and periodontal diseases, oral mucosal diseases are also prevalent conditions in the older population. It has been reported that aging alone does not have a significant effect on the oral mucosa and its protective defense mechanisms if the individuals are in good health [31,50]. However, the decline in the oral mucosa's protective functions due to systemic diseases, malnutrition, medication use, or inadequate oral hygiene renders a person susceptible to various pathogens and chemicals entering the oral cavity [2,31]. Over time, the cumulative effects of numerous exogenous and endogenous factors lead to chromosomal anomalies and subsequent cellular structural deterioration. This initiates histological and clinical changes, causing the normal epithelium to transform into dysplastic epithelium with varying degrees of cellular damage and eventually progressing to cancer [51].

Oral cancer which ranks sixth among the most common cancer types all over the world [52,53], is a disease that causes severe damage on oral and facial structures before and after treatment and adversely impact patients' nutrition, social lives, and overall quality of life [54]. Although advanced age, male gender, tobacco smoking and alcohol use, human papillomavirus (HPV) infection, fungal infections, and various genetic disorders are the primary risk factors, recent studies have indicated that poor oral hygiene and chronic inflammatory conditions stemming from periodontitis may also act as co-factors in the development of oral cancer [55-57].

Despite the advances in cancer treatment in the last 30 years, the survival rate after treatment has remained around fifty percent [58]. Hence, early diagnosis and treatment is crucial in managing the global burden of oral cancer [54,59]. Regular oral examinations and oral hygiene education, particularly for high-risk individuals (such as those with advanced age, smoking and alcohol use), are vital. Suspicious cases warrant prompt referral for further examination.

**Table I.** Possible etiological factors that may cause xerostomia (from Storbeck et al. 2022; Coll et al., 2020; Anil et al., 2016, mod.) [20,40,49].

| | | | |
|---|---|---|---|
| Etiological factors | Salivary gland agenesis | | |
| | Injury to the salivary gland | | |
| | Radiotherapy of the head and neck | | |
| | Autoimmune diseases | Sjögren's syndrome | |
| | | Systemic lupus erythematosus | |
| | | Rheumatoid arthritis | |
| | | Scleroderma | |
| | | Graft-versus-host disease | |
| | Viral infections | Paramyxovirus | |
| | | Cytomegalovirus | |
| | | HIV | |
| | | Hepatotropic viruses | |
| | Bacterial infections | Staphylococcus aureus | |
| | | Streptococcus pyogens | |
| | | Escherichia coli | |
| | Dehydration | | |
| | Sialolithiasis | | |
| | Diabetes mellitus | | |
| | Aging | | |
| | Mechanical peripheral nerve injuries | | |
| | Autonomic system dysfunctions | | |
| | Psychogenic factors or mental illness | Anorexia | |
| | | Depression | |
| | | Schizophrenia | |
| | Side-effect of medications | Antihistamines-sedating only | Diphenhydramine, doxylamine, chlorpheniramine, promethazine |
| | | Decongestant | Pseudoephedrine |
| | | Antidepressants | Tricyclics (e.g., amitriptyline), SSRIs and SNRIs |
| | | Antipsychotics | Haloperidol, olanzapine, clozapine, amisulpiride |
| | | Diuretic | Hydrochlorothiazide, furosemide |
| | | Muscle relaxants | Cyclobenzaprine, orphenadrine |
| | | Benzodiazepines | Alprazolam, lorazepam |
| | | Gastrointestinal agents | Hyoscine, hyoscyamine, belladonna alkaloids, atropine |
| | | Cardiovascular agents | Atenolol, metoprolol, prazosin, clonidine |
| | | Analgesics | Tramadol, codeine, opioids, gabapentin, pregabalin |
| | | Bronchodilators | Ipratropium, tiotropium, salbutamol, salmeterol, eformoterol, umeclidinium |
| | | Anticonvulsants | Carbamazepine |
| | | CNS Stimulants | Caffeine, pseudoephedrine, amphetamines |

## IMPACT OF COVID-19 ON GERIATRIC ORAL HEALTH

Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus, which mainly affects the respiratory tract and can lead to serious complications. The rapid global spread of the disease led the World Health Organization to declare it a pandemic in March 2020. With the discovery that the virus is spread by small particles of fluid from the mouth or nose of an infected person when coughing, sneezing, talking or breathing [59], governments worldwide have

**Table II.** An overview table of the specific actions and roles of stakeholder groups in contributing to the oral health of older adults.

| Stakeholder group | Specific actions | Roles |
|---|---|---|
| Government | Implement policies that prioritize elderly oral health | Provide regulatory framework, funding, and policy direction for oral healthcare systems |
| | Allocate funding for geriatric oral healthcare programs | |
| | Establish regulations to ensure quality care for older adults | |
| Healthcare providers | Provide routine dental check-ups for elderly patients | Deliver direct care, education, and collaborate with interdisciplinary teams for comprehensive care |
| | Offer education on oral hygiene practices and disease prevention to older adults | |
| | Collaborate with other healthcare professionals to address systemic health issues impacting oral health | |
| Community organizations | Organize oral health education workshops for older adults | Engage in outreach, education, and advocacy efforts within the community |
| | Facilitate access to dental care through outreach programs | |
| | Advocate for policies that support elderly oral health | |
| Insurance providers | Develop insurance plans that cover geriatric dental care | Offer financial support and incentives for preventive care and treatment |
| | Encourage preventive care and routine check-ups through coverage incentives | |
| | Partner with dental professionals to promote oral health among older beneficiaries | |
| Research institutions | -Conduct studies on oral health issues specific to older adults | Generate knowledge, guidelines, and innovations to improve geriatric oral healthcare |
| | Develop evidence-based guidelines for geriatric oral care | |
| | Explore innovative treatments and technologies tailored to elderly patients | |
| Caregivers and family | Assist elderly relatives in scheduling and attending dental appointments | Provide support, encouragement, and advocacy at the individual level |
| | Encourage good oral hygiene practices and healthy eating habits | |
| | Advocate for the importance of oral health within family discussions and decision-making | |
| Industry partners | Develop oral care products specifically designed for elderly needs | Innovate and produce products, technologies, and solutions tailored to geriatric oral health needs |
| | Collaborate with healthcare providers to integrate oral health technology into geriatric care settings | |
| | Support research and development efforts aimed at improving oral health outcomes in older adults | |

been compelled to implement various precautionary measures such as mandatory mask usage in public places, maintaining physical distance, restricting social activities, and enforcing quarantines [60-62]. Determining that the corona virus disease is more severe especially in older patients with chronic diseases such as hypertension and diabetes [63-65], led to changes in daily routines and activities among the older population, driven by fear and anxiety. Global crises that threaten people's lives can have negative consequences on both mental and oral health. It is predicted that the COVID-19 pandemic also has similar effects on oral hygiene habits. Anxiety during the pandemic has been associated with bruxism, periodontal diseases, and poor oral hygiene [65]. The COVID-19 pandemic has particularly led to a decrease in physical activity among older adults. Studies have shown that the presence of both stress and decreased physical activity is associated with poor oral health-related quality of life in older adults [65].

Unfortunately, a significant proportion of COVID-19-related fatalities worldwide have occurred among elderly individuals with pre-existing systemic health issues. Long-term Care Facilities have been particularly affected, with significant mortality rates reported in many countries including Spain, Belgium, and Norway [64,65]. The restrictions implemented as a COVID-19 precaution have resulted in a significant reduction in oral healthcare services for dependent older adults. Given the importance of oral healthcare services for this patient group, this situation is anticipated to have significant and lasting impacts [64]. Despite all these risks, unfortunately, older adults have not been the focal point of the international health debate even during pandemic [65].

Studies conducted during social isolation and quarantine revealed changes in eating habits, with increased consumption of sugary foods that could compromise oral hygiene and lead to the emergence of dental caries and periodontal diseases [62,67]. Beyond shifts in eating habits, research has shown that mask usage also impacts oral hygiene, indicating that individuals across all age groups tend to brush their teeth less frequently and exhibit reduced concern about oral hygiene when using masks [61]. However, for many older adults with hearing and vision problems, maintaining social distance during communication and/or wearing masks can become an even bigger challenge [65].

On the other hand, there are also studies indicating that individuals with bad breath become more aware due to the use of masks and start brushing their teeth more frequently [62]. Consequently, it has been observed that individuals who change their daily routines and activities due to the COVID-19 pandemic exhibit different behavioral reactions, such as taking their oral care habits seriously or acting negligently [62,67]. In 2021, Sari et al.'s research involving 1227 participants who completed an online survey yielded similar results [67]. The study findings indicated that individuals exhibiting elevated levels of fear demonstrated heightened vigilance towards their oral hygiene practices, modified their dietary intake patterns, consumed specific foods in differing proportions, reported increased incidences of oral and dental health concerns. However, despite encountering dental issues, these individuals exhibited reluctance in seeking dental care and expressed concerns regarding the potential risk of COVID-19 transmission in dental settings. Especially during the pandemic, the role of the oral cavity as a potential reservoir for pathogens causing respiratory infections has been the subject of investigation, leading to the suggestion that increased complications and risks of death could be associated with oral biofilm and periodontal diseases. Enhanced oral hygiene practices may mitigate the risk of complications. Consequently, particularly in care homes for the elderly and individuals at high risk of contracting infectious diseases, the use of mouthwash in conjunction with brushing teeth and toothpaste twice a day is recommended to reduce viral load [67,68].

## CONCLUSIONS

In conclusion, the profound impact of the global COVID-19 pandemic on people's lives is undeniable, with older individuals experiencing notable changes in their social dynamics and habits. To gain a comprehensive understanding of how the pandemic has influenced the oral health and hygiene practices of the elderly, further in-depth research is imperative.

The current observations reveal a prevalent inadequacy in the oral health status of the geriatric population, characterized by a high incidence of dental caries, periodontal diseases, and tooth loss. These oral health issues directly contribute to a diminished quality of life for individuals in their later years. Notably, it is essential to recognize that the majority of these oral diseases are preventable, with their occurrence primarily attributed to factors beyond the natural aging process.

Given these circumstances, addressing and safeguarding the oral health conditions of older individuals necessitates a multidisciplinary approach. Collaboration among dentists, geriatric specialists, and care staff is crucial for developing effective strategies and interventions. By fostering interdisciplinary cooperation, tailored oral health plans can be established to meet the unique needs of the elderly population, enhancing their overall well-being. Implementing a comprehensive strategy over many years is crucial to meet the oral health needs of older adults. For this, it is necessary to acknowledge that oral health is an integral part of primary healthcare services and to eliminate the notion that poor oral health and tooth loss are normal aspects of aging. Adapting oral healthcare systems to meet the needs of elderly populations is indeed a complex task that requires collaboration among various stakeholders (Tab. II).

Each stakeholder group plays a crucial role in promoting oral health education, access to care, advocacy for policy changes, and innovation in oral healthcare products and services tailored to the unique needs of older individuals. By working together, these stakeholders can contribute to improving the overall oral health and quality of life for older adults around the world. Moreover, it is imperative to emphasize the importance of research in this field. A more extensive exploration of the oral health conditions of the elderly will not only deepen our understanding but also pave the way for translating accurate information on preventive measures into practical public health initiatives. This, in turn, can contribute significantly to promoting the oral health

of older individuals and improving their overall health outcomes. In the face of ongoing challenges, sustained efforts in research, education, and collaborative healthcare practices are crucial for ensuring the well-being of the aging population in a post-pandemic world.

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Not applicable.

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