

Review

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

Wen-Yi Liu^{1,2,3}, Yen-Ching Chuang², Ching-Wen Chien^{3,*}, Tao-Hsin Tung^{4,5,6,*}

¹Department of Health Policy Management, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, Maryland, USA

²Shanghai Bluecross Medical Science Institute, Shanghai, P. R. China

³Institute for Hospital Management, Tsing Hua University, Shenzhen Campus, P. R. China

⁴Enze Medical Research Center, Affiliated Taizhou Hospital of Wenzhou Medical College, Taizhou, P. R. China

⁵Maoming People's Hospital, Maoming, Guangdong, P. R. China

⁶Department of Medical Research and Education, Cheng-Hsin General Hospital, Taipei, Taiwan, P. R. China

*Correspondence: ihca@sz.tsinghua.edu.cn (Ching-Wen Chien); ch2876@gmail.com (Tao-Hsin Tung)

Abstract

Background and purpose: 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. 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.

References

- [1] United Nations. World population ageing 1950-2050. New York: United Nations. 2002.
- [2] World Health Organization. Active ageing: a policy framework. Geneva: World Health Organization. 2002. Available at: https://www.who.int/ageing/publications/active_ageing/en/ (Accessed: September 30, 2020).
- [3] United Nations, Department of economic and social affairs, population division. The 2019 revision of world population prospects, 2019. Available at: <https://population.un.org/wpp/> (Accessed: September 2, 2020).
- [4] United Nations Population Division. World population prospects: the 2002 revision. New York: United Nations. 2003.
- [5] Kandelman D, Petersen PE, Ueda H. Oral health, general health, and quality of life in older people. *Special Care in Dentistry*. 2008; 28: 224-236.
- [6] Sheiham A. Oral health, general health and quality of life. *Bulletin of the World Health Organization*. 2005; 83: 644.
- [7] World Health Organization. WHO remains firmly committed to the principles set out in the preamble to the Constitution. Available at: <https://www.who.int/about/who-we-are/constitution> (Accessed September 30, 2020).
- [8] Engel GL. The clinical application of biopsychosocial model. *American Journal of Psychiatry*. 1980; 137: 535-544.
- [9] Kieffer JM, Hoogstraten J. Linking oral health, general health, and quality of life. *European Journal of Oral Sciences*. 2008; 116: 445-450.
- [10] Idahosa CN, Kerr AR. Clinical evaluation of oral diseases. *Contemporary Oral Medicine*. 2019; 137-171.
- [11] McGrath C, Bedi R. A review of the influences of oral health on quality of life. *International Journal of Health Promotion and Education*. 1999; 37: 116-119.
- [12] Chahar P, Mohanty VR, Aswini YB. Oral health-related quality of life among elderly patients visiting special clinics in public hospitals in Delhi, India: a cross-sectional study. *Indian Journal of Public Health*. 2019; 63: 15-20.
- [13] Onyejaka NK, Lawal BN, Okechukwu RA, Osayande MO, Alamba IC. Pattern of patients' attendance to the dental clinic of federal college of dental technology and therapy, Enugu, Nigeria. *The Pan African Medical Journal*. 2018; 29: 151.
- [14] Joseph BK, Kullman L, Sharma PN. The oral-systemic disease connection: a retrospective study. *Clinical Oral Investigations*. 2016; 20: 2267-2273.
- [15] Zucoloto ML, Maroco J, Campos JADB. Impact of oral health on health-related quality of life: a cross-sectional study. *BMC Oral Health*. 2016; 16: 55.
- [16] Petersen PE. The world oral health report 2003: continuous improvement of oral health in the 21st century—the approach of the who global oral health programme. *Community Dentistry and Oral Epidemiology*. 2003; 31: 3-23.
- [17] Aro T, Laitala M, Syrjälä AM, Laitala ML, Virtanen JI. Perceptions of older people's oral health care among nurses working in geriatric home care. *Acta Odontologica Scandinavica*. 2018; 76: 427-432.
- [18] Silva MEDSE, Villaça EL, Magalhães CSD, Ferreira EFE. Impact of tooth loss in quality of life. *Ciência & Saúde Coletiva*. 2010; 15: 841-850. (In Portuguese)
- [19] Johansson AK, Johansson A, Unell L, Ekbäck G, Ordell S, Carlsson GE. Self-reported dry mouth in 50- to 80-year-old Swedes: Longitudinal and cross-sectional population studies. *Journal of Oral Rehabilitation*. 2020; 47: 246-254.
- [20] Kossioni AE, Hajto-Bryk J, Maggi S, McKenna G, Petrovic M, Roller-Wirnsberger RE, *et al.* An expert opinion from the european college of gerodontology and the european geriatric medicine society: european policy recommendations on oral health in older adults. *Journal of the American Geriatrics Society*. 2018; 66: 609-613.
- [21] Baker SR, Pankhurst CL, Robinson PG. Utility of two oral health-related quality-of-life measures in patients with xerostomia. *Community Dentistry and Oral Epidemiology*. 2006; 34: 351-362.
- [22] Sáez-Prado B, Haya-Fernández M, Sanz-García M. Oral health and quality of life in the municipal senior citizen's social clubs for people over 65 of Valencia, Spain. *Medicina Oral, Patología Oral Y cirugía Bucal*. 2016; 21: e672-e678.
- [23] Tanaka T, Takahashi K, Hirano H, Kikutani T, Watanabe Y, Ohara Y, *et al.* Oral frailty as a risk factor for physical frailty and mortality in community-dwelling elderly. *the journals of gerontology. Series A, Biological Sciences and Medical Sciences*. 2018; 73: 1661-1667.
- [24] Saintrain MVDL, Saintrain SV, Sampaio EGM, Ferreira BSP, Nepomuceno TC, Frota MA, *et al.* Older adults' dependence in activities of daily living: implications for oral health. *Public Health Nursing*. 2018; 35: 473-481.
- [25] Petersen PE, Ogawa H. Promoting oral health and quality of life of older people - the need for public health action. *Oral Health and Preventive Dentistry*. 2018; 16: 113-124.
- [26] Alhadj MN, Halboub E, Amran AG, Alkheraif AA, Al-Sanabani AF, Al-Makramani MB, *et al.* Link between perceived oral and general health status among Yemeni adult dental patients. *BMC Oral Health*. 2019; 19: 93.
- [27] Gondivkar SM, Bhowate RR, Gadail AR, Sarode SC, Gondivkar RS, Yuwanati M, *et al.* Quality of life-related "patient-reported outcome measures" in oral submucous fibrosis patients. *Journal of Contemporary Dental Practice*. 2018; 19: 331-338.
- [28] Bramantoro T, Hariyani N, Setyowati D, Purwanto B, AyuZulfiana A, RatihIrmalia W. The impact of oral health on physical fitness: a systematic review. *Heliyon*. 2020; 6: e03774.
- [29] Wong FMF, Ng YTY, Leung WK. Oral health and its associated factors among older institutionalized residents—a systematic review. *International Journal of Environmental Research and Public Health*. 2019; 16: 4132.
- [30] Rozas NS, Sadowsky JM, Stanek JA, Jeter CB. Oral health assessment by lay personnel for older adults. *Journal of Visualized Experiments*. 2020; 156.
- [31] Atchison KA, Dolan TA. Development of the geriatric oral health assessment index. *Journal of Dental Education*. 1990; 54: 680-687.
- [32] Riggs S, Blue C, Golden J. The oral health quality of life for seniors in residential facilities who have direct access to care as compared to those without access. *Geriatric Nursing*. 2020; 41: 406-410.
- [33] Slade GD. Derivation and validation of a short-form oral health impact profile. *Community Dentistry and Oral Epidemiology*. 1997; 25: 284-290.
- [34] Mehta SB, Loomans BAC, Banerji S, Bronkhorst EM, Bartlett D. An investigation into the impact of tooth wear on the oral health related quality of life amongst adult dental patients in the United Kingdom, Malta and Australia. *Journal of Dentistry*. 2020; 99: 103409.
- [35] Montes-Cruz C, Juárez-Cedillo T, Cárdenas-Bahena Á, Rabay-Gánem C, Heredia-Ponce E, García-Peña C, *et al.* Comportamiento del Geriatric/General Oral Health Assessment Index (GOHAI) Oral Impacts on Daily Performances (OIDP) en una población de adultos mayores de la Ciudad de México. *Revista Odontológica Mexicana*. 2014; 18: 111-119. (In Mexican)
- [36] de Andrade FB, Lebrão ML, Santos JLF, Duarte YADO. Correlates of change in self-perceived oral health among older adults in Brazil: findings from the health, well-being and aging study. *Journal of the American Dental Association*. 2012; 143: 488-495.
- [37] Gkavela G, Kossioni A, Lyraikos G, Karkazis H, Volikas K. Oral health related quality of life in older people: preliminary validation of the Greek version of the Geriatric Oral Health Assessment Index (GOHAI). *European Geriatric Medicine*. 2015; 6: 245-250.
- [38] Ribeiro GR, Costa JLR, Ambrosano GMB, Garcia RCMR. Oral health of the elderly with alzheimer's disease. *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*. 2012; 114: 338-343.
- [39] El Hérou M, Boulos C, Adib SM, Tabbal N. Relationship between oral health and nutritional status in the elderly: a pilot study in Lebanon. *Journal of Clinical Gerontology and Geriatrics*. 2014; 5: 91-95.

- [40] Niesten D, Witter D, Bronkhorst E, Creugers N. Oral health-related quality of life and associated factors in a care-dependent and a care-independent older population. *Journal of Dentistry*. 2016; 55: 33-39.
- [41] Kuo H, Wang R, Wang J, Yang Y. Assessing a conceptual model with both oral health and health related quality of life in community-dwelling elders. *Archives of Gerontology and Geriatrics*. 2018; 79: 27-31.
- [42] Thomson WM, Ma S. An ageing population poses dental challenges. *Singapore Dental Journal*. 2014; 35C: 3-8.
- [43] Puturidze S, Margvelashvili M, Bilder L, Kalandadze M, Margvelashvili V. Relationship between general health, oral health and healthy lifestyle in elderly population (review). *Georgian Medical News*. 2018; 17-21.
- [44] Fotedar S, Sharma KR, Fotedar V, Bhardwaj V, Chauhan A, Manchanda K. Relationship between oral health status and oral health related quality of life in adults attending H.P Government Dental College, Shimla, Himachal Pradesh-India. *Oral Health and Dental Management*. 2014; 13: 661-665.
- [45] Peres MA, Macpherson LMD, Weyant RJ, Daly B, Venturelli R, Mathur MR, *et al*. Oral diseases: a global public health challenge. *The Lancet*. 2019; 394: 249-260.
- [46] Ástvaldsdóttir Á, Boström A, Davidson T, Gabre P, Gahnberg L, Sandborgh Englund G, *et al*. Oral health and dental care of older persons-a systematic map of systematic reviews. *Gerodontology*. 2018; 35: 290-304.
- [47] Hand JS, Hunt RJ, Beck JD. Coronal and root caries in older iowans: 36-month incidence. *Gerodontics*. 1988; 4: 136-139.
- [48] Gilbert GH, Miller MK, Duncan RP, Ringelberg ML, Dolan TA, Foerster U. Tooth-specific and person-level predictors of 24-month tooth loss among older adults. *Community Dentistry and Oral Epidemiology*. 1999; 27: 372-385.
- [49] Thomson WM, Spencer AJ, Slade GD, Chalmers JM. Is medication a risk factor for dental caries among older people? *Community Dentistry and Oral Epidemiology*. 2002; 30: 224-232.
- [50] Hawkins RJ, Jutai DK, Brothwell DJ, Locker D. Three-year coronal caries incidence in older canadian adults. *Caries Research*. 1997; 31: 405-410.
- [51] Thomson WM. Dental caries experience in older people over time: what can the large cohort studies tell us? *British Dental Journal*. 2004; 196: 89-92.
- [52] Griffin SO, Griffin PM, Swann JL, Zlobin N. Estimating rates of new root caries in older adults. *Journal of Dental Research*. 2004; 83: 634-638.
- [53] Broadbent JM, Thomson WM, Poulton R. Trajectory patterns of dental caries experience in the permanent dentition to the fourth decade of life. *Journal of Dental Research*. 2008; 87: 69-72.
- [54] Kossioni AE, Hajto-Bryk J, Janssens B, Maggi S, Marchini L, McKenna G, *et al*. Practical guidelines for physicians in promoting oral health in frail older adults. *Journal of the American Medical Directors Association*. 2018; 19: 1039-1046.
- [55] Fejerskov O, Nyvad, B, Kidd, E. *Dental caries: the disease and its clinical management*. 3rd edn. Wiley Blackwell. 2003.
- [56] Selwitz RH, Ismail AI, Pitts NB. Dental caries. *The Lancet*. 2007; 369: 51-59.
- [57] Ekstrand KR. High fluoride dentifrices for elderly and vulnerable adults: does it work and if so, then why? *Caries Research*. 2016; 50: 15-21.
- [58] Wierichs RJ, Meyer-Lueckel H. Systematic review on noninvasive treatment of root caries lesions. *Journal of Dental Research*. 2015; 94: 261-271.
- [59] Srinivasan M, Schimmel M, Riesen M, Ilgner A, Wicht MJ, Warncke M, *et al*. High-fluoride toothpaste: a multicenter randomized controlled trial in adults. *Community Dentistry and Oral Epidemiology*. 2014; 42: 333-340.
- [60] Yeung CA. Some beneficial effect on root caries from use of higher concentration fluoride toothpaste (5000ppm F) Evidence-based Dentistry. 2014; 15: 8-9.
- [61] Gupta S, Maharjan A, Dhama B, Amgain P, Katwal S, Adhikari B, *et al*. Status of tobacco smoking and diabetes with periodontal disease. *Journal of the Nepal Medical Association*. 2018; 56: 818-824.
- [62] Preshaw PM, Alba AL, Herrera D, Jepsen S, Konstantinidis A, Makrilakis K, *et al*. Periodontitis and diabetes: a two-way relationship. *Diabetologia*. 2012; 55: 21-31.
- [63] Chapple ILC. Time to take periodontitis seriously. *British Medical Journal*. 2014; 348: g2645.
- [64] Harald Löe DDS, Else Theilade DDS, Börglum Jensen DDS. Experimental Gingivitis in Man. *Journal of Periodontology*. 1965; 36: 177-187.
- [65] Tonetti MS, Jepsen S, Jin L, Otomo-Corgel J. Impact of the global burden of periodontal diseases on health, nutrition and wellbeing of mankind: a call for global action. *Journal of Clinical Periodontology*. 2017; 44: 456-462.
- [66] Tonetti MS, Bottenberg P, Conrads G, Eickholz P, Heasman P, Huysmans MC, *et al*. Dental caries and periodontal diseases in the ageing population: call to action to protect and enhance oral health and well-being as an essential component of healthy ageing - Consensus report of group 4 of the joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases. *Journal of Clinical Periodontology*. 2017; 44: S135-S44.
- [67] Pihlstrom BL, Michalowicz BS, Johnson NW. Periodontal diseases. *The Lancet*. 2005; 366: 1809-1820.
- [68] Grossi SG, Genco RJ, Machtei EE, Ho AW, Koch G, Dunford R, *et al*. Assessment of risk for periodontal disease II. risk indicators for alveolar bone loss. *Journal of Periodontology*. 1995; 66: 23-29.
- [69] Locker D, Ford J, Leake JL. Incidence of and risk factors for tooth loss in a population of older Canadians. *Journal of Dental Research*. 1996; 75: 783-789.
- [70] Drake CW, Hunt RJ, Koch GG. Three-year tooth loss among black and white older adults in North Carolina. *Journal of Dental Research*. 1995; 74: 675-680.
- [71] Slade GD, Gansky SA, Spencer AJ. Two-year incidence of tooth loss among south Australians aged 60+ years. *Community Dentistry and Oral Epidemiology*. 1997; 25: 429-437.
- [72] Warren JJ, Watkins CA, Cowen HJ, Hand JS, Levy SM, Kuthy RA. Tooth loss in the very old: 13-15-year incidence among elderly Iowans. *Community Dentistry and Oral Epidemiology*. 2002; 30: 29-37.
- [73] Paulander J, Axelsson P, Lindhe J, Wennström J. Intra-oral pattern of tooth and periodontal bone loss between the age of 50 and 60 years. a longitudinal prospective study. *Acta Odontologica Scandinavica*. 2004; 62: 214-222.
- [74] De Marchi RJ, Hilgert JB, Hugo FN, Santos CMD, Martins AB, Padilha DM. Four-year incidence and predictors of tooth loss among older adults in a southern brazilian city. *Community Dentistry and Oral Epidemiology*. 2012; 40: 396-405.
- [75] Fagundes NCF, Couto RSDA, Brandão APT, Lima LAO, Bittencourt LO, Souza-Rodrigues RD, *et al*. Association between tooth loss and stroke: a systematic review. *Journal of Stroke & Cerebrovascular*. 2020; 29: 104873.
- [76] Chestnutt IG, Binnie VI, Taylor MM. Reasons for tooth extraction in scotland. *Journal of Dentistry*. 2000; 28: 295-297.
- [77] Haworth S, Shungin D, Kwak SY, Kim HY, West NX, Thomas SJ, *et al*. Tooth loss is a complex measure of oral disease: Determinants and methodological considerations. *Community Dentistry and Oral Epidemiology*. 2018; 46: 555-562.
- [78] Haag DG, Peres KG, Balasubramanian M, Brennan DS. Oral conditions and health-related quality of life: a systematic review. *Journal of Dental Research*. 2017; 96: 864-874.
- [79] Alvarenga MOP, Ferreira RDO, Magno MB, Fagundes NCF, Maia LC, Lima RR. Masticatory dysfunction by extensive tooth loss as a risk factor for cognitive deficit: a systematic review and meta-analysis. *Frontiers in Physiology*. 2019; 10: 832.
- [80] Slade GD, Akinkugbe AA, Sanders AE. Projections of U.S. edentulism prevalence following 5 decades of decline. *Journal of Dental Research*. 2014; 93: 959-965.
- [81] Lee GY, Koh SB, Kim NH. Regular dental scaling associated with decreased tooth loss in the middle-aged and elderly in korea: a 3-year prospective longitudinal study. *Indian Journal of Dental Research*.

- 2019; 30: 231-237.
- [82] Kassebaum NJ, Smith AGC, Bernabé E, Fleming TD, Reynolds AE, Vos T, *et al.* Global, regional, and national prevalence, incidence, and disability-adjusted life years for oral conditions for 195 countries, 1990-2015: a systematic analysis for the global burden of diseases, injuries, and risk factors. *Journal of Dental Research*. 2017; 96: 380-387.
- [83] Seerig LM, Nascimento GG, Peres MA, Horta BL, Demarco FF. Tooth loss in adults and income: systematic review and meta-analysis. *Journal of Dentistry*. 2015; 43: 1051-1059.
- [84] Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NHJ. Tooth loss and oral health-related quality of life: a systematic review and meta-analysis. *Health and Quality of Life Outcomes*. 2010; 8: 126.
- [85] Peres MA, Tsakos G, Barbato PR, Silva DAS, Peres KG. Tooth loss is associated with increased blood pressure in adults—a multidisciplinary population-based study. *Journal of Clinical Periodontology*. 2012; 39: 824-833.
- [86] Ribeiro CG, Cascaes AM, Silva AER, Seerig LM, Nascimento GG, Demarco FF. Edentulism, severe tooth loss and lack of functional dentition in elders: a study in southern brazil. *Brazilian Dental Journal*. 2016; 27: 345-352.
- [87] Sanders AE, Slade GD, Carter KD, Stewart JF. Trends in prevalence of complete tooth loss among australians, 1979-2002. *Australian and New Zealand Journal of Public Health*. 2004; 28: 549-554.
- [88] Emami E, de Souza RF, Kabawat M, Feine JS. The impact of edentulism on oral and general health. *International Journal of Dentistry*. 2013; 2013: 498305.
- [89] Fox PC. Xerostomia: recognition and management. *Dental Assistant*. 2008; 77: 18, 20, 44-48.
- [90] Calin AM, Debita M, Ciurcanu OE, Scutariu MM, Szalontay AS. Xerostomia and Hyposalivation in Patients with Physical and Psychological Disabilities. *Revista de Chimie*. 2017; 68: 2443-2447.
- [91] Tabak LA. Structure and function of human salivary mucins. *Critical Reviews in Oral Biology and Medicine*. 1990; 1: 229-234.
- [92] Barbe AG. Medication-induced xerostomia and hyposalivation in the elderly: culprits, complications, and management. *Drugs & Aging*. 2018; 35: 877-885.
- [93] Villa A, Wolff A, Aframian D, Vissink A, Ekström J, Proctor G, *et al.* World Workshop on Oral Medicine VI: a systematic review of medication-induced salivary gland dysfunction: prevalence, diagnosis, and treatment. *Clinical Oral Investigations*. 2015; 19: 1563-1580.
- [94] Furness S, Worthington HV, Bryan G, Birchenough S, McMillan R. Interventions for the management of dry mouth: topical therapies. the Cochrane database of systematic reviews. 2011; CD008934.
- [95] Turner MD. Hyposalivation and xerostomia: etiology, complications, and medical management. *Dental Clinics of North America*. 2016; 60: 435-443.
- [96] Potulska A, Friedman A. Controlling sialorrhoea: a review of available treatment options. *Expert Opinion on Pharmacotherapy*. 2005; 6: 1551-1554.
- [97] Orellana MF, Lagravère MO, Boychuk DGJ, Major PW, Flores-Mir C. Prevalence of xerostomia in population-based samples: a systematic review. *Journal of Public Health Dentistry*. 2006; 66: 152-158.
- [98] Närhi TO. Prevalence of subjective feelings of dry mouth in the elderly. *Journal of Dental Research*. 1994; 73: 20-25.
- [99] Fox PC, van der Ven PF, Sonies BC, Weiffenbach JM, Baum BJ. Xerostomia: evaluation of a symptom with increasing significance. *Journal of the American Dental Association*. 1985; 110: 519-525.
- [100] Sreebny LM. Saliva in health and disease: an appraisal and update. *International Dental Journal*. 2000; 50: 140-161.
- [101] Guggenheimer J, Moore PA. Xerostomia: etiology, recognition and treatment. *Journal of the American Dental Association*. 2003; 134: 61-69.
- [102] Atkinson JC, Wu AJ. Salivary gland dysfunction: causes, symptoms, treatment. *Journal of the American Dental Association*. 1994; 125: 409-416.
- [103] Fischer D, Ship JA. The effect of dehydration on parotid salivary gland function. *Special Care in Dentistry*. 1997; 17: 58-64.
- [104] Locker D. Dental status, xerostomia and the oral health-related quality of life of an elderly institutionalized population. *Special Care in Dentistry*. 2003; 23: 86-93.
- [105] Liu B, Dion MR, Jurassic MM, Gibson G, Jones JA. Xerostomia and salivary hypofunction in vulnerable elders: prevalence and etiology. *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*. 2012; 114: 52-60.
- [106] Thomson WM. Dry mouth and older people. *Australian Dental Journal*. 2015; 60: 54-63.
- [107] Ship JA, Pillemer SR, Baum BJ. Xerostomia and the geriatric patient. *Journal of the American Geriatrics Society*. 2002; 50: 535-543.
- [108] Sreebny LM, Schwartz SS. A reference guide to drugs and dry mouth—2nd edition. *Gerodontology*. 1997; 14: 33-47.
- [109] Smith RG, Burtner AP. Oral side-effects of the most frequently prescribed drugs. *Special Care in Dentistry*. 1994; 14: 96-102.
- [110] Smidt D, Torpet LA, Nauntofte B, Heegaard KM, Pedersen AML. Associations between labial and whole salivary flow rates, systemic diseases and medications in a sample of older people. *Community Dentistry and Oral Epidemiology*. 2010; 38: 422-435.
- [111] Smidt D, Torpet LA, Nauntofte B, Heegaard KM, Pedersen AML. Associations between oral and ocular dryness, labial and whole salivary flow rates, systemic diseases and medications in a sample of older people. *Community Dentistry and Oral Epidemiology*. 2011; 39: 276-288.
- [112] Sreebny LM. Salivary flow in health and disease. *Compendium Supplement*. 1989; S461-S469
- [113] Avşar A, Elli M, Darka O, Pinarli G. Long-term effects of chemotherapy on caries formation, dental development, and salivary factors in childhood cancer survivors. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics*. 2007; 104: 781-789.
- [114] Turner MD. Hyposalivation and xerostomia: etiology, complications, and medical management. *Dental Clinics of North America*. 2016; 60: 435-443.
- [115] Singh ML, Papas A. Oral implications of polypharmacy in the elderly. *Dental clinics of North America*. 2014; 58: 783-796.
- [116] Rothen M, Cunha-Cruz J, Zhou L, Mandl L, Jones JS, Berg J. Oral hygiene behaviors and caries experience in northwest precedent patients. *Community Dentistry and Oral Epidemiology*. 2014; 42: 526-535.
- [117] Almståhl A, Wikström M. Oral microflora in subjects with reduced salivary secretion. *Journal of Dental Research*. 1999; 78: 1410-1416.
- [118] Gift HC, Reford M. Oral health and the quality of life. *Clinics in Geriatric Medicine*. 1992; 8: 673-684.
- [119] Chávez EM, Hendre A. Clinical care for an aging population. *Compendium of continuing education in Dentistry*. 2017; 38: 595-602.
- [120] Barboza-Solis C, Porras-Chaverri M, Fantin R. Is tooth loss important when evaluating perceived general health? Findings from a nationally representative study of Costa Rican adults. *Community Dentistry and Oral Epidemiology*. 2019; 47: 358-365.
- [121] van der Putten GJ. The relationship between oral health and general health in the elderly. *Ned Tijdschr Tandheelkd*. 2019; 126: 653-656.
- [122] Dörfer C, Benz C, Aida J, Campard G. The relationship of oral health with general health and ncds: a brief review. *International Dental Journal*. 2017; 67: 14-18.
- [123] Poudel P, Griffiths R, Wong VW, Arora A, Flack JR, Khoo CL, *et al.* Oral health knowledge, attitudes and care practices of people with diabetes: a systematic review. *BMC Public Health*. 2018; 18: 577.
- [124] Torales J, Barrios I, González I. Oral and dental health issues in people with mental disorders. *Medwave*. 2017; 17: e7045.
- [125] Yang M, Chen P, He M, Lu M, Wang H, Soares JC, *et al.* Poor oral health in patients with schizophrenia: a systematic review and meta-analysis. *Schizophrenia Research*. 2018; 201: 3-9.
- [126] Mallineni SK, Yiu CKY. Dental treatment under general anesthesia for special-needs patients: analysis of the literature. *Journal of Investigative and Clinical Dentistry*. 2016; 7: 325-331.
- [127] Schnabl D, Guarda A, Guarda M, von Spreckelsen LMI, Riedmann M, Steiner R, *et al.* Dental treatment under general anesthesia in adults with special needs at the University Hospital of Dental Prosthetics and Restorative Dentistry of Innsbruck, Austria: a retrospective study of

- 12 years. *Clinical Oral Investigations*. 2019; 23: 4157-4162.
- [128] Matevosyan NR. Oral health of adults with serious mental illnesses: a review. *Community Mental Health Journal*. 2010; 46: 553-562.
- [129] Kisely S, Baghaie H, Lalloo R, Siskind D, Johnson NW. A systematic review and meta-analysis of the association between poor oral health and severe mental illness. *Psychosomatic Medicine*. 2015; 77: 83-92.
- [130] Kisely S, Quek L, Pais J, Lalloo R, Johnson NW, Lawrence D. Advanced dental disease in people with severe mental illness: systematic review and meta-analysis. *The British Journal of Psychiatry*. 2011; 199: 187-193.
- [131] Martins AMEDBL, Nascimento JE, Souza JGS, Sá MABD, Feres SDBL, Soares BP, *et al*. The association between common mental disorders and subjective health conditions among the elderly. *Ciencia & Saude Coletiva*. 2016; 21: 3387-3398. (In Portuguese)
- [132] Thomas C. Dental care in older adults. *British Journal of Community Nursing*. 2019; 24: 233-235.
- [133] Fiorillo L. Oral health: the first step to well-being. *Medicina*. 2019; 55: 676.
- [134] Jamieson L, Brennan D, Peres MA, Luzzi L, Miller C, Bowden J, *et al*. Having fewer than 21 teeth associated with poorer general health among south australians. *Journal of Public Health Dentistry*. 2017; 77: 216-224.
- [135] Griffin SO, Jones JA, Brunson D, Griffin PM, Bailey WD. Burden of oral disease among older adults and implications for public health priorities. *American Journal of Public Health*. 2012; 102: 411-418.
- [136] Samnieng P, Lekatana H. Oral health and quality of life among elderly in Thai. *Journal of Dentistry Indonesia*. 2016; 23: 40-47.
- [137] Shokry AAE, Adel MR, Rashad AEA. Educational program to improve quality of life among elderly regarding oral health. *Future Dental Journal*. 2018; 4: 211-215.
- [138] Gherunpong S, Tsakos G, Sheiham A. The prevalence and severity of oral impacts on daily performances in thai primary school children. *Health and Quality of Life Outcomes*. 2004; 2: 57.
- [139] Niesten D, Witter DJ, Bronkhorst EM, Creugers NHJ. Oral health care behavior and frailty-related factors in a care-dependent older population. *Journal of Dentistry*. 2017; 61: 39-47.
- [140] Naito M, Suzukamo Y, Nakayama T, Hamajima N, Fukuhara S. Linguistic adaptation and validation of the General Oral Health Assessment Index (GOHAI) in an elderly Japanese population. *Journal of Public Health Dentistry*. 2006; 66: 273-275.
- [141] Sánchez-García S, Heredia-Ponce E, Juárez-Cedillo T, Gallegos-Carrillo K, Espinel-Bermúdez C, de La Fuente-Hernández J, *et al*. Psychometric properties of the General Oral Health Assessment Index (GOHAI) and dental status of an elderly Mexican population. *Journal of Public Health Dentistry*. 2010; 70: 300-307.
- [142] Ting CC, Ko EC, Chen CC, Tu HP, Chang CS. Effectiveness of an oral function intervention for older Taiwanese people. *Gerodontology*. 2019; 36: 374-381.
- [143] Eguchi T, Tada M, Shiratori T, Imai M, Onose Y, Suzuki S, *et al*. Factors associated with undergoing regular dental check-ups in healthy elderly individuals. *The Bulletin of Tokyo Dental College*. 2018; 59: 229-236.
- [144] Mitri R, Sayegh NF, Boulos, C. Factors associated with oral health-related quality of life among Lebanese community-dwelling elderly. *Gerodontology*. 2020; 37: 200-207.
- [145] Echeverria MS, Wünsch IS, Langlois CO, Cascaes AM, Ribeiro Silva AE. Oral health-related quality of life in older adults-longitudinal study. *Gerodontology*. 2019; 36: 118-124.
- [146] Oliveira BH, Nadanovsky P. Psychometric properties of the brazilian version of the oral health impact profile-short form. *Community Dentistry and Oral Epidemiology*. 2005; 33: 307-314.
- [147] Sheng X, Xiao X, Song X, Qiao L, Zhang X, Zhong H. Correlation between oral health and quality of life among the elderly in southwest china from 2013 to 2015. *Medicine*. 2018; 97: e10777.
- [148] Kuo H, Chen J, Wu J, Chou T, Yang Y. Application of the oral health impact profile (OHIP) among Taiwanese elderly. *Quality of Life Research*. 2011; 20: 1707-1713.
- [149] Kireilytė M, Masiūnaitė V, Belickienė V, Žilinskas J, Sakalauskiene Ž. Testing of Lithuanian version of the Oral Health Impact Profile-14 among older adults. A pilot study. *Stomatologija*. 2019; 21: 67-71.
- [150] Lu H, He FM. Reliability and validity of the Chinese version of the 5-item oral health impact profile. *Hua Xi Kou Qiang Yi Xue Za Zhi*. 2020; 38: 145-148. (In Chinese)
- [151] Takahashi M, Maeda K, Wakabayashi H. Prevalence of sarcopenia and association with oral health-related quality of life and oral health status in older dental clinic outpatients. *Geriatrics & Gerontology International*. 2018; 18: 915-921.
- [152] Ahmad MS, Bhayat A, Zafar MS, Al-Samadani KH. The impact of hyposalivation on quality of life (QOL) and oral health in the aging population of AL Madinah AL Munawarrah. *International Journal of Environmental Research and Public Health*. 2017; 14: 445.
- [153] Saxena A, Nagarajappa R, Naik D, Abid M, Ramesh G. Assessing the effect of oral diseases on oral health related quality of life of institutionalized elderly using Oral Health Impact Profile (OHIP-14) questionnaire: a pilot study. *Roczniki Państwowego Zakładu Higieny*. 2020; 71: 349-353.
- [154] Rodakowska E, Mierzyńska K, Bagińska J, Jamiolkowski J. Quality of life measured by OHIP-14 and GOHAI in elderly people from Białystok, north-east Poland. *BMC Oral Health*. 2014; 14: 106.
- [155] Gokturk O, Yarkac FU. Comparison of two measures to determine the oral health-related quality of life in elders with periodontal disease. *Community Dental Health*. 2019; 36: 143-149.
- [156] Osman SM, Khalifa N, Alhaji MN. Validation and comparison of the Arabic versions of GOHAI and OHIP-14 in patients with and without denture experience. *BMC Oral Health*. 2018; 18: 157.
- [157] Ikebe K, Hazeyama T, Enoki K, Murai S, Okada T, Kagawa R, *et al*. Comparison of gohai and ohip-14 measures in relation to objective values of oral function in elderly Japanese. *Community Dentistry and Oral Epidemiology*. 2012; 40: 406-414.
- [158] El Osta N, Tubert-Jeannin S, Hennequin M, Bou Abboud Naaman N, El Osta L, Geahchan N. Comparison of the OHIP-14 and GOHAI as measures of oral health among elderly in lebanon. *Health and Quality of Life Outcomes*. 2012; 10: 131.
- [159] Locker D, Matear D, Stephens M, Lawrence H, Payne B. Comparison of the GOHAI and OHIP-14 as measures of the oral health-related quality of life of the elderly. *Community Dentistry and Oral Epidemiology*. 2001; 29: 373-381.
- [160] Wright FAC, Law GG, Milledge KL, Chu SK, Hsu B, Valdez E, *et al*. Chewing function, general health and the dentition of older Australian men: the concord health and ageing in men project. *Community Dentistry and Oral Epidemiology*. 2019; 47: 134-141.
- [161] Wright F, Chu SKY, Milledge KL, Valdez E, Law G, Hsu B, *et al*. Oral health of community-dwelling older Australian men: the concord health and ageing in men project (champ) Australian Dental Journal. 2019; 63: 55-65.
- [162] Ramsay SE, Papachristou E, Watt RG, Tsakos G, Lennon LT, Papacosta AO, *et al*. Influence of poor oral health on physical frailty: a population-based cohort study of older British men. *Journal of the American Geriatrics Society*. 2018; 66: 473-479.
- [163] Valdez E, Wright FAC, Naganathan V, Milledge K, Blyth FM, Hirani V, *et al*. Frailty and oral health: findings from the concord health and ageing in men project. *Gerodontology*. 2020; 37: 28-37.
- [164] Haheim LL, Nafstad P, Schwarze PE, Olsen I, Rønningen KS, Thelle DS. Oral health and cardiovascular disease risk factors and mortality of cerebral haemorrhage, cerebral infarction and unspecified stroke in elderly men: a prospective cohort study. *Scandinavian Journal of Public Health*. 2020; 48: 762-769.
- [165] Takehara S, Clive Wright FA, Waite LM, Naganathan V, Hirani V, Blyth FM, *et al*. Oral health and cognitive status in the concord health and ageing in men project: a cross-sectional study in community-dwelling older Australian men. *Gerodontology*. 2020; 37: 353-360.
- [166] Razak PA, Richard KMJ, Thankachan RP, Hafiz KAA, Kumar KN, Sameer KM. Geriatric oral health: a review article. *Journal of International Oral Health*. 2014; 6: 110-116.
- [167] Antoniadou M, Varzakas T. Breaking the vicious circle of diet, malnutrition and oral health for the independent elderly. *Critical Reviews in Food Science and Nutrition*. 2020; 1-23.