2

Achieving oral health among older adults: Community and clinical approaches

CHAPTER MENU

Oral Health for an Ageing Population: Evidence, Policy, Practice and Evaluation, First Edition. Kakuhiro Fukai.

2.1 Introduction

Oral diseases have a higher prevalence than systemic diseases (Kassebaum et al. 2017; GBD 2017 Oral Disorders Collaborators 2020; WHO 2022) (Figures 2.1 and 2.2). The oral health of older people is particularly affected by tooth loss, which results from the accumulation of dental caries and worsening periodontal disease throughout one's life. Even when not accompanied by tooth loss, dental caries and periodontal disease themselves are also significant health risks that negatively affect the quality of life of older people (Naito 2015). In addition, age-related decline in the muscle strength of the tongue, orbicularis oculus, and the masticatory and swallowing muscles, together with reduced saliva, leads to a gradual decline in oral function (Fukai et al. 2022). Prevention of such oral functional decline is important in its own right, and it is also important for frailty prevention, as frailty is associated with undernutrition in the elderly.

Assessment of oral health status in older people requires community-wide screening in addition to full dental examinations at dental clinics. If examinations at dental clinics are the only approach utilized, it is difficult to catch the early stages of reduced oral function in healthy people and take appropriate community and individual measures.

This chapter, therefore, focuses on the importance of cooperation between local communities and dental institutions within the larger national healthcare system, which itself must be built around a stable medical insurance system and accompanying long-term care insurance system.

In addition, cognitive function decline has become a major health challenge for ageing societies, so it is essential to consider how dental treatment and dental health guidance can be adapted specifically for people with dementia (Livingston et al. 2017). This chapter therefore describes how dental treatment can be integrated into national dementia policies, with a particular focus on the emerging role of dental care in preventing cognitive decline.

2.2 Oral health in older adults

The increasing percentage of older adults in the global population will have implications for nearly all sectors of society, including health and oral health in particular. An important implication of the United Nations 2030 Agenda for Sustainable Development is that, as populations

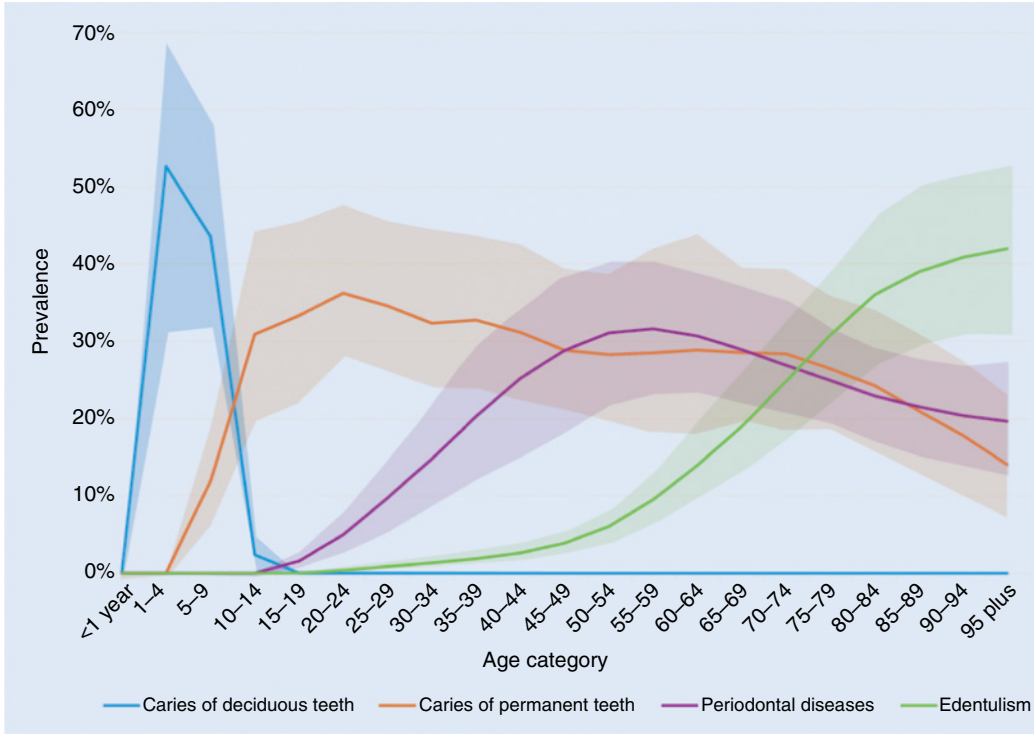


Figure 2.1 Prevalence rates of four major oral diseases over the life course. *Source:* World Health Organization (2022)/with permission of World Health Organization.

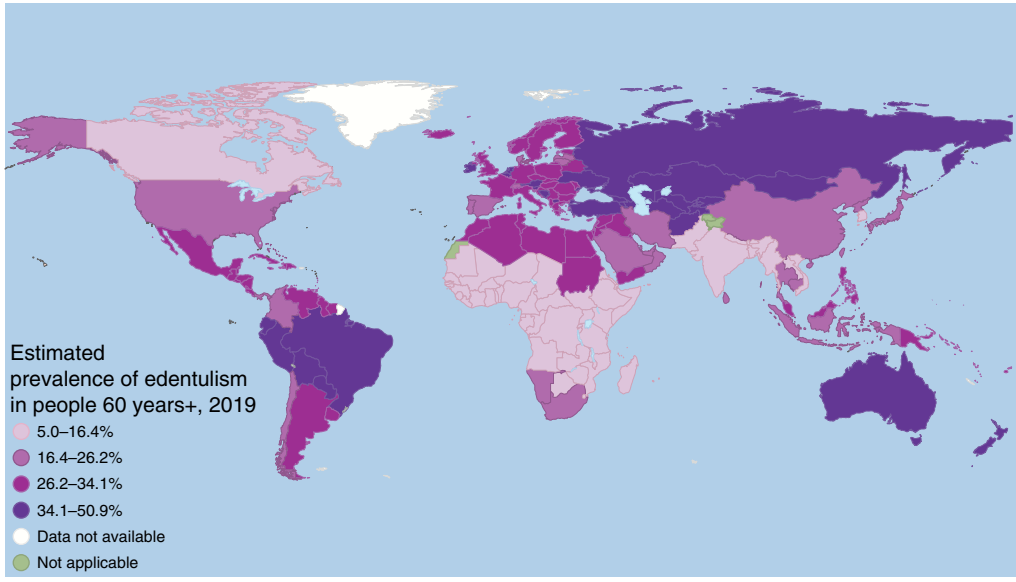


Figure 2.2 Estimated prevalence of edentulism. *Source:* World Health Organization (2022)/with permission of World Health Organization.

age, the goal of ensuring healthy lives and well-being at all ages becomes more urgent than ever (UN 2015). If oral healthcare systems are to contribute to reaching this ambitious goal, they must adapt accordingly.

The emergence of a 'society of longevity' is the result of human progress. On the other hand, the decline of vital functions and health with age is a biological process that cannot be halted. Oral health is no different. Older adults, therefore, often have complicated clinical conditions. Chronic diseases such as diabetes and respiratory diseases, polypharmacy, frailty and dependence on care often accompany physiological ageing (WHO 2015). Impaired vision, lower tactile thresholds, reduced dexterity, cognitive impairment and dementia often complicate daily oral hygiene routines (Fukai et al. 2019).

According to the Global Burden of Disease (GBD) study, oral disease in older adults accounted for 3.5 million disability-adjusted life years (DALYs), primarily due to edentulism, followed by severe periodontitis and untreated caries (Kassebaum et al. 2014a, 2015).

Edentulism impairs chewing ability and often leads to a change in diet and limited food choices. It can also affect social interactions and, more generally, quality of life. Edentulism drastically increases with age, and its prevalence strongly varies according to geographic location, ranging from 30% of those over 65 in certain regions of Latin America to only 9% in East Asia (Kassebaum et al. 2017). The prevalence of periodontal disease also gradually increases with age, and there are clear geographic differences in prevalence here as well, ranging from 51% of older adults in east Sub-Saharan Africa to 10% in Oceania (Kassebaum et al. 2015). Untreated caries also increase with age, peaking at 70 years as the risk of root caries suddenly increases (Kassebaum et al. 2014b).

2.3 Frailty and level of dependency in older adults

In 2001, Fried et al. (2001) proposed the 'frailty cycle', a vicious circle model involving decreasing muscle strength and mass (sarcopenia), fatigue and decreasing energy consumption. The model demonstrates that nutritional factors such as loss of appetite, weight loss and low nutrition are accelerators of frailty (Figure 2.3).

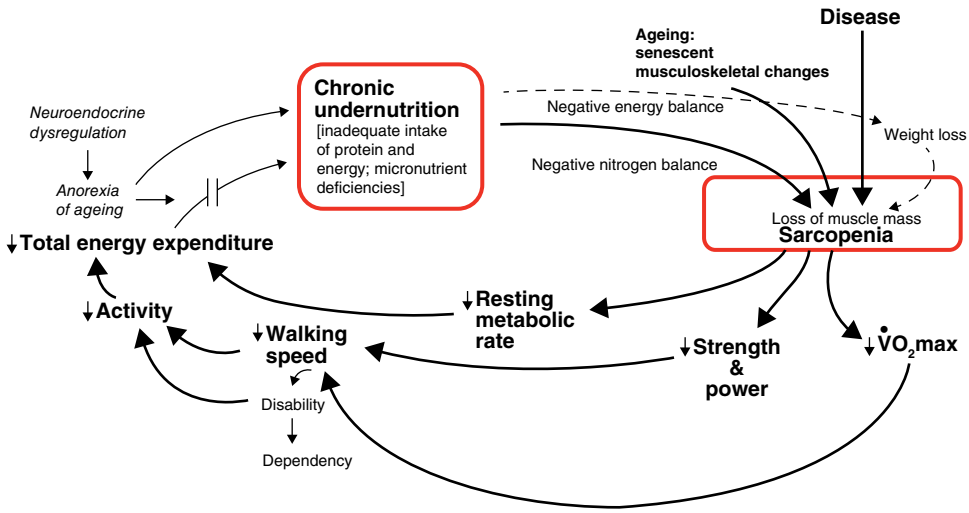
Frailty can be defined as a 'state of increased vulnerability to stressors due to age related decline in physiological reserve across neuromuscular, metabolic and immune systems' (Pretty et al. 2014).

The levels of dependency described in Table 2.1 are based on the Lucerne Care Pathway, which in turn is derived from the Seattle Care Pathway for maintaining oral health in older patients (Fukai et al. 2018). Recommended interventions may vary depending on the older adult's pre-assessed level of dependency for dental care teams.

Frailty and vulnerability need to be assessed at various levels: government, policy, population and individual. Figure 2.4 can be used to implement a life-course approach to oral health and to implement service delivery strategies which avoid under- and overtreatment.

2.4 Deterioration of oral health function

Healthy longevity and health equity are the right goals, and they resonate with people in all walks of life and of all races and cultures. They therefore have the potential to unite humanity across our multitudinous divisions. The factors contributing to healthy longevity are numerous, complex and interrelated, requiring creative, interdisciplinary, intergenerational and global approaches.



Definition of frailty

1. Weight loss
2. Exhaustion
3. Physical activity
4. Walk time
5. Grip strength

Positive for frailty phenotype: 3 criteria present

Intermediate or pre-frail: 1 or 2 criteria present

Figure 2.3 Frailty in older adults: evidence for a phenotype. *Source:* Fried L.P. et al. 2001/Oxford University Press.

Table 2.1 A definition of levels of dependency.

Level of Dependency	Definition
No dependency CSHA level 1 & 2	Robust people who exercise regularly and are the most fit group for their age.
Pre-dependency CSHA level 3	People with chronic systemic conditions that could impact oral health but, at the point of presentation, are not currently impacting oral health. A comorbidity whose symptoms are well controlled.
Low dependency CSHA level 4	People with identified chronic conditions that are affecting oral health but who currently receive or do not require help to access dental services or maintain oral health. These patients are not entirely dependent, but their disease symptoms are affecting them.
Medium dependency CSHA level 5	People with an identified chronic systemic condition that currently impacts their oral health and who receive or do not require help to access dental services or maintain oral health. This category includes patients who demand to be seen at home or who do not have transport to a dental clinic.
High dependency CSHA level 6 & 7	People who have complex medical problems preventing them from moving to receive dental care at a dental clinic. They differ from patients categorized in medium dependency because they cannot be moved and must be seen at home.

CSHA, Canadian Study of Health and Aging.
Source: FDI. Older adults chair side guide, 2019.

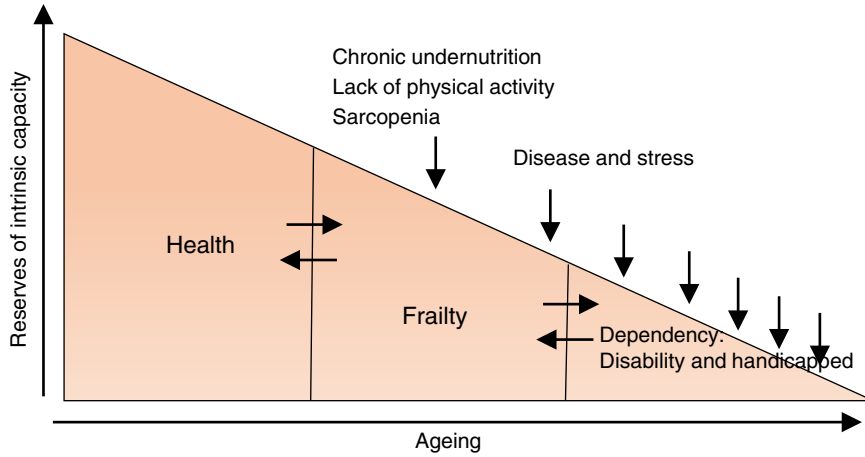


Figure 2.4 Frailty and dependency by age. *Source:* Adapted from MHLW of Japan, Guidelines for health services based on the characteristics of older people (in Japanese), 3rd ed., 2024, https://www.mhlw.go.jp/content/001240315.pdf

Prevention of oral function decline is an important part of that picture, and person-centred approaches such as community-based, muti-sectoral screening programmes are practical, effective and pose a low economic burden on society.

Ageing has become a major health challenge confronting all countries in the world at the same time, regardless of socioeconomic status. Humans have long wanted to live longer lives, but having achieved longevity, we are confronted by the reality that this celebrated achievement brings with it great challenges. Ageing causes individuals to become more susceptible to disease, leading to a decline in the essential functions of living (including both intrinsic capacity and functional ability).

According to the 2015 World Report on Ageing and Health, the goal of healthy ageing is to ensure that people can maintain the degree of functional ability required for well-being (WHO 2015). Functional ability refers to the 'health-related attributes that enable people to be and to do what they have reason to value'. Functional ability is determined by the intrinsic capacity of the individual as well as the environment of the individual and the interaction between those two factors. Intrinsic capacity is 'the composite of all the physical and mental capacities 'that an individual can draw on'. To delay functional decline and maintain health and well-being, we must provide medical care and long-term care for all, and we must also integrate those systems into a social infrastructure that encourages healthy behaviour and improves accessibility to care.

Eating, talking and smiling are essential life functions that are directly linked to oral health (Glick et al. 2016). Therefore, oral healthcare access must be viewed as a core, universal human right. This implies that communities and governments are obligated to provide a healthcare system that ensures that all people have access to the information, prevention and care needed to maintain oral health throughout their life.

Oral function is a complex system of interacting anatomical parts and movements. Most prominent are the higher-order functions needed for daily life and survival, such as eating, talking and smiling. These functions are, in turn, supported by a number of interacting lower-order physiological and functional components: teeth, saliva, lips, the tongue and other oral-facial

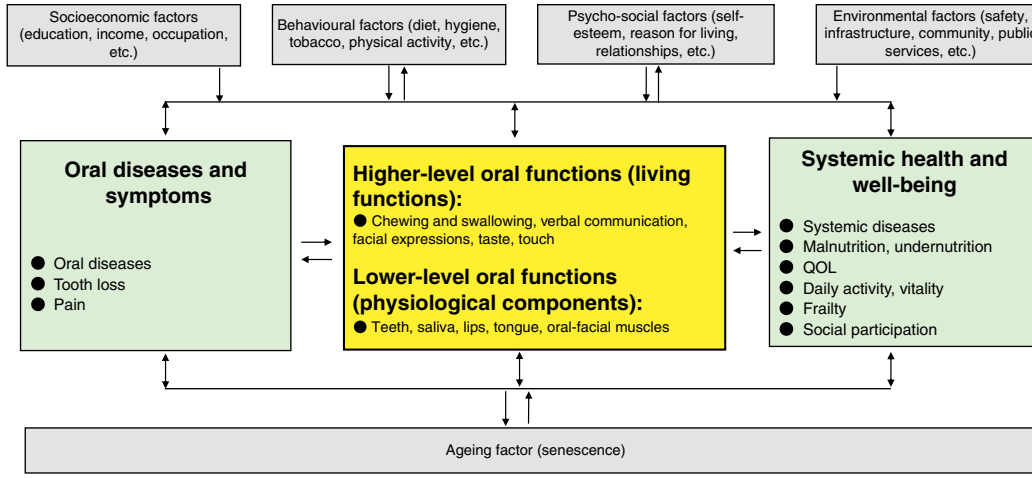
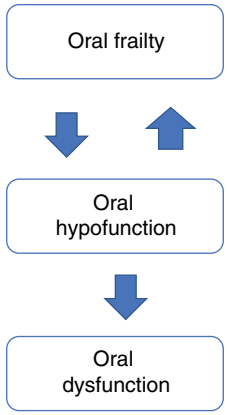


Figure 2.5 Conceptual pathway of oral function decline. *Source:* Fukai K. et al. 2002/with permission of Elsevier.

muscles. As people get older, the oral environment undergoes changes and they experience a decline in oral functions, such as motor function (lips and tongue movement) as well as chewing and swallowing function. Figure 2.5 presents a novel conceptual pathway that incorporates the complex array of factors involved in oral function decline (Fukai et al. 2022). This pathway places oral function in the centre and shows how various factors contribute to it and are affected by it. The main risk factors of oral function decline are well known: oral diseases and symptoms such as caries, periodontal disease, tooth loss and pain. However, this figure emphasizes the fact that a variety of factors related to general health and well-being also contribute in important ways to oral function decline. This figure also shows the complex reciprocal relationships between the various factors and oral function. It should further be noted that the three central elements of the pathway (oral diseases, oral functions and systemic health) are themselves constantly interacting with social and psychological factors such as economic status, behaviour and environment (including health services). Finally, the pathway indicates that all of this exists within the overarching context of the ageing process, and indeed it is an integral part of the ageing process.

The link between ageing and oral function decline, as well as the effect of oral function decline on general physical health, are based on a growing body of evidence. For example, the percentage of older Japanese people with dysphagia is reported to be 25.1% (Igarashi et al. 2019). The decline in oral function that accompanies ageing reduces the diversity of food intake, resulting in nutritional deficiency. Furthermore, a large-scale longitudinal study of Japanese older people revealed that minor oral dysfunction increases the risk of muscle loss, dependence on long-term care and death (Tanaka et al. 2018).

In order to delay the decline of oral function, the Japanese Geriatric Dental Association proposed an expanded dental screening and assessment programme that would identify even small changes in tongue and lip function, saliva production and eating functions (Minakuchi et al. 2018; Tanaka et al. 2021) (Figure 2.6). While the reliability and validity of the assessment instruments need further improvement, it is clear that there is a great need for person-centred assessment of oral function. In order to maintain oral health in the later stages of life, such assessments need to be implemented on the basis of multi-sectoral cooperation and information-sharing.



JSG defines oral hypofunction based on the presentation of 7 oral signs or symptoms.
The criteria for each symptom were determined based on data from previous studies, and oral hypofunction is diagnosed if the criteria for 3 or more of these signs or symptoms are met.

Poor oral hygiene	The total number of microorganisms (CFU/mL) is $10^{6.5}$ or more
Oral dryness	The measured value obtained by a recommended moisture checker is less than 27.0
Reduced occlusal force	The occlusal force is less than 200 N
Decreased tongue-lip motor function	The number of /pa/, /ta/ or /ka/ syllables produced per second is less than 6
Decreased tongue pressure	The maximum tongue pressure is less than 30 kPa
Decreased masticatory function	The glucose concentration obtained by chewing gelatin gummies is less than 100 mg/dL
Deterioration of swallowing function	The total score of EAT-10 is 3 or higher

Figure 2.6 Definition and criteria of oral hypofunction. JSG, Japanese Society of Gerodontology.
Source: Adapted from Minakuchi S. et al., 2018.

There has already been some research on the types of interventions (for improvement of oral function) that should be implemented in tandem with such screening programmes. Types of intervention include: health education (e.g. how the oral cavity and saliva support our daily life, or how to prevent aspiration pneumonia); oral hygiene instruction; and exercises to maintain oral function (e.g. tongue and face exercises, saliva gland massage, pronunciation training and breathing exercises) (Sakayori et al. 2013; Ohara et al. 2015; Iwao et al. 2019). These interventions can be undertaken by healthcare professionals in various fields, including dental hygienists.

Evaluating the effectiveness of oral function improvement interventions for older people is an increasingly active area of research. However, systematic reviews and meta-analyses of this evidence have not yet been conducted, so establishing the effectiveness of these interventions requires further research (Dent et al. 2019).

The goals of health equity and healthy longevity resonate with people all over the world regardless of race, culture or socioeconomic status. These goals, therefore, have the potential to unite us around a common mission and vision, overcoming our divisions. There are numerous interrelated factors contributing in complex ways to healthy longevity, so we need creative, interdisciplinary, intergenerational and global approaches. Maintenance of oral function is an essential part of the solution and this requires practical, effective, low-cost, person-centred approaches such as community-based, multi-sectoral screening.

2.5 Nutrition and oral health for older adults

Many studies on frailty prevention have reported a relationship between protein intake and frailty. In the elderly, decreasing muscle mass and decline in functional ability often occur. This is partly caused by anabolic resistance, which occurs with ageing, and which in turn causes a weakening of the assimilation suppression reaction of skeletal muscle (Cruz-Jentoft et al. 2010; Chen et al. 2020).

It is important for older people to consume enough protein. It is particularly important that protein intake exceed the recommended level where nitrogen equilibrium, which is an

indicator of protein metabolism, has been lost and output is greater than intake. For example, in one study, when a woman over 65 years old with frailty was put on a high-protein diet (1.23 g/kg per day), her anabolic response and nitrogen equilibrium improved, demonstrating the effectiveness of a high-protein diet. This has been confirmed in many other studies as well (Motokawa et al. 2021).

In addition, it has been shown that consuming a diverse variety of food and nutrients, rather than a limited variety, is effective in preventing frailty and sarcopenia (Kimura et al. 2103). In order to improve the diversity of food intake in daily life, it is recommended that older people be encouraged to: (1) not skip meals, (2) snack on dairy products and fruits between meals, and (3) make use of commercially prepared meals such as frozen foods. Regarding the importance of not skipping meals, Motokawa et al. (2021) reported that people who eat only twice a day have poorer food diversity and lower energy intake (by 100 kcal) than those eating three times a day. Regarding the benefit of between-meal consumption, when people experience decreased appetite and are unable to consume the recommended amount of food during meals, snacking between meals is an easy way to increase intake. When incorporating snacks, diversity of food intake can be improved by incorporating milk, other dairy products, and fruits, which tend to be insufficient in ordinary meals (Motokawa et al. 2021).

Inadequate and poor-quality diet, as well as malnutrition, are commonly associated with adverse health outcomes, including morbidity and mortality, among older people. Additionally, a large number of studies have produced a great deal of evidence on the association between nutrition and oral health. Overall, it is clear that number of teeth and dentition influence food and nutrient intake, including food diversity. For example, one study showed that the intake of vegetables and meat decreases along with the number of remaining teeth. On the other hand, intake of carbohydrates and rice increases with tooth loss (Yoshihara et al. 2005). Another study found that individuals with impaired dentition demonstrated a significantly greater degree of decline in the intake of multiple nutrients (protein, sodium, potassium, calcium, vitamin A, vitamin E and dietary fibre) than those without impaired dentition (Iwasaki et al. 2021). In yet another study, patients receiving new complete dentures were divided into two groups. The intervention group received denture care advice along with simple dietary advice from a nutritionist using a uniform pamphlet, while the control group received only denture care advice. Protein intake in the intervention group increased significantly compared with the control group (Suzuki et al. 2017).

Wakai et al. (2010) found that intake of carotene, vitamins A and C, milk and dairy products, and vegetables (including green-yellow vegetables) decreased as number of teeth decreased (p for trend < 0.05). On the other hand, mean intake of carbohydrates, rice and confectioneries increased as the number of teeth decreased (p for trend < 0.05) (Wakai et al. 2010).

Kimura et al. (2013) conducted an evaluation of chewing ability and its relationship with activities of daily living, depression, cognitive status and food intake in community-dwelling elderly people. Participants with low chewing ability consumed a lower variety of food ($p < 0.001$) and had less frequent intake of beans, vegetables, seaweed and nuts than those with high chewing ability (Kimura et al. 2013).

Iwasaki et al. (2016) found a longitudinal association of dentition status with dietary intake in Japanese adults aged 75–80 years. Individuals with impaired dentition demonstrated a significantly ($p < 0.05$) greater degree of decline in the intake of multiple nutrients (protein, sodium, potassium, calcium, vitamin A, vitamin E and dietary fibre) and food groups (vegetables and meat) than those without impaired dentition, after adjusting for potential confounding factors (Iwasaki et al. 2016).

These research findings indicate a likely bidirectional relationship between poor oral function and low number of teeth, on the one hand, and inadequate and poor-quality diet and malnutrition, on the other. Older adults with poor oral function are likely to have a less nutritious diet and poor nutritional status, and the reverse is also true: malnourished older adults are likely to have poor oral function.

Maintaining good oral function is therefore an essential key to longevity. However, there is currently insufficient evidence from longitudinal studies, and in most studies oral function has not been assessed comprehensively enough, so there is a need for additional high-quality studies to further our understanding of this connection.

Recently, the concept of 'oral frailty' has been introduced by Tanaka et al. (2017). According to the Japan Dental Association (JDA), oral frailty presents as a series of phenomena and processes characterized by vulnerable oral health status due to age-related changes in oral health indicators (number of teeth, oral hygiene, oral functions). It is accompanied by a decreased interest in oral health and decreased physical and mental reserve capacity, which can lead to deterioration in eating function, potentially resulting in physical and mental disorders (JDA 2019).

2.6 Assessment of oral health of older adults

2.6.1 Nutrition and diet

Nutrition assessment of older people can be implemented in dental settings by measuring body weight and body mass index (BMI) in order to monitor weight loss rate. Weight loss of 5% in a month or 10% in 6 months is considered to be a sign of possible undernutrition. Calf circumference is another useful measure (Kubo et al. 2009). Dental professionals can also monitor the nutrient (particularly energy and protein) and water consumption of patients. They can also ask about patients' appetite and the reasons for loss of appetite. Protein intake usually decreases in the later stages of life, and protein deficiency is a primary cause of frailty and sarcopenia. Therefore, it is important to maintain and restore appetite and food diversity by maintaining and restoring oral function. Assessment of food diversity is usually performed via the dietary variety score (DVS). The DVS assesses the daily intake of 10 different foods, and a higher score is thought to indicate a higher intake of protein and other nutrients. Nutrition screening of hospital inpatients can be performed using the subject global assessment (SGA) as a subjective evaluation method. The SGA consists of simple interview questions and physical assessments, making it practical to implement with a wide range of age groups and on an ongoing basis. In addition, the Mini Nutritional Assessment® (MNA®) is a subjective evaluation tool for use with older people aged 65 and over, and there is also a short form (MNA®-SF) that is commonly used (Rubenstein et al. 2001).

2.6.2 Assessment of residential environment, family, exercise, health literacy, social activity and economic situation

Older people are more likely to be affected by psychological problems and their social environment, so they need to be evaluated from the perspective of psychological and social frailty. Therefore, in addition to the physical functions of daily living, it is important for oral health professionals to be aware of patients' living environment. Specifically, living environment information that is relevant to oral function management includes: the residential environment, the presence or absence of family members, daily exercise habits, health literacy (access to and ability

to make use of health-related information), social connectedness and participation, economic status, and geographical distance and accessibility of oral health services. For older people requiring long-term care, oral health professionals need to coordinate and cooperate with care managers, counsellors, and family caregivers to ensure that sufficient daily oral care can be continuously provided.

2.6.3 Assessment of oral function

When evaluating oral function, it is important to consider the purpose of the evaluation based on the general health condition and daily activities of the subject, to select the appropriate evaluation methods and to conduct the evaluation using standardized, evidence-based techniques. In addition, it is important not to rely on the results of a single evaluation, but to obtain a comprehensive picture of the overall decline of oral function by considering multiple test results in the aggregate.

The oral function of older people is closely related to general health condition and lifestyle (Fukai et al. 2022). Therefore, when evaluating oral function, it is important to take these factors into consideration. This section will provide an outline of oral function evaluation methods that can be used either during dental checkups or in other settings such as outpatient care, elderly care homes or home dental care. From the viewpoint of oral function management, all of these settings are part of an integrated and ongoing process, so a variety of evaluation methods must be integrated into a comprehensive assessment that is tailored to each patient (JDA 2019).

2.6.4 General health and lifestyle factors

In order to develop and select appropriate evaluation methods and interpret the results, it is important to understand the general health and lifestyle factors that are relevant to oral functions. For example, as the elderly often have multiple morbidities, it is important to review the case history and be aware of which diseases the patient has and which medications they are on. Some diseases (e.g. cerebrovascular disease and dementia) and drugs (e.g. for hypertension and depression) may affect oral functions in specific ways. It is also important to be aware of the patient's consciousness level and cognitive function, as patients with cognitive decline often experience a reduction in masticatory function as well as difficulty eating and communicating their thoughts and feelings. Vital signs must be assessed before oral function evaluations begin, and in some cases during the evaluation. For example, if blood oxygen levels are low, there may be a risk of aspiration during the swallowing function test. A patient's posture and physical mobility may also have a limiting effect on some oral functions, so these factors should be observed and noted before beginning the evaluation. Muscle strength (as measured by grip strength) is another factor that is closely related to oral functions, particularly swallowing. Respiratory disease is common among the elderly, and those with declining respiratory function and weakened cough reflex are likely also to experience oral function symptoms such as dysphagia. It is especially important to be aware of the patient's diet and nutrition, which have a strong bidirectional relationship with oral function. Declining oral function is one of the causes of low nutrition, which in turn causes reduced body weight, sarcopenia and frailty. These in turn cause declining oral function, completing the vicious cycle. Finally, the living environment of the patient should also be noted, as family members, daily routines and location of residence can all have an effect on oral function and care. Of particular importance is whether the person lives alone and whether sufficient care can be provided by family members or other professional or non-professional caregivers.

2.6.5 Diseases and medications

As older people often have multiple diseases, dental professionals should check patients' general medical history, including the current status of any ongoing conditions or diseases. When treating patients with cardiovascular or respiratory diseases, care must be taken when extracting teeth and/or performing other procedures involving bleeding. Diseases such as cerebrovascular disease and dementia are known to cause loss of oral function, so it is useful for dentists to be aware of these conditions. Furthermore, when dental care is performed on such patients, it is necessary to communicate and cooperate with the patient's physician. Dentists must also be aware of their patients' medications, as older people are likely to be taking multiple medications. If it is difficult elicit accurate medical information directly from the patient, reviewing the patients' medications usually provides a good indication of the diseases for which they are being treated. Additionally, some drugs affect oral function by causing dry mouth or involuntary movements. In particular, antipsychotic medications may contribute to dysphagia by weakening the swallowing and cough reflexes. The method and frequency of medication administration should also be noted.

2.6.6 Level of consciousness and cognitive function

Consciousness refers to alertness and cognition, with the brain stem controlling the former and the cerebral cortex controlling the latter. If either one or both of them declines, there will be a loss of consciousness. The Glasgow Coma Scale (GCS) is the most commonly used assessment of consciousness level. In dental settings, however, professionals are more likely to use the Mini Mental State Examination (MMSE), which assesses cognitive function when dementia is suspected. In general, dementia is suspected if the MMSE score is 23 points or lower. If the MMSE score is between 24 and 27, mild cognitive impairment (MCI) is suspected. However, the MMSE score alone is not a sufficient basis for a diagnosis. Diagnosis of dementia and MCI requires a comprehensive judgment by a physician based on interviews, physical examination and imaging, along with a number of cognitive function tests. Another assessment tool used to determine the severity of dementia is the Clinical Dementia Rating (CDR). The CDR provides a multi-faceted assessment of cognitive function based on behavioural observations and information from caregivers. Alzheimer's disease is progressive, so the functional assessment staging (FAST) method, a classification system used to assess the stage of cognitive decline, is also useful. It is important for dental professionals to notice the connection between oral function decline and cognitive decline (Naito 2015; Motokawa et al. 2021).

2.6.7 Vital signs

Vital signs are indicators of the body's most important life-sustaining functions that can be measured and monitored. They include blood pressure, heart rate, respiratory rate, body temperature and consciousness. In particular, breathing and circulation, which are the essential requirements of life, are often monitored by blood oxygen saturation (SpO2), blood pressure, heart rate and electrocardiogram. Older people generally have low reserve capacity, so monitoring vital signs is one way for oral health professionals to be aware of how the treatment can inflict stress on these patients. In this sense, monitoring vital signs can be seen as a type of risk management activity to prevent the onset of systemic side-effects that can occur during dental examinations.

2.6.8 Activities of daily living and posture

Activities of daily living (ADLs) and posture retention, such as head position and trunk posture, also affect diet and quality of life (QOL), which are related to oral function evaluation. ADLs are largely separated into basic activities and instrumental activities. The Barthel Index and the Functional Independence Measure (FIM) are used to evaluate basic activities of daily living. The former evaluates whether a person *can do* certain activities, and the latter evaluates whether a person *actually does* certain activities. These measures can be used to determine the level of care needed. The Instrumental Activities of Daily Living (IADL) scale measures more complex and labour-requiring activities, such as using the telephone, shopping and doing housework. On all of these scales, a higher score indicates greater independence. These measures can be important in oral function evaluation because they are related to walking, movement, posture, oral health behaviour and diet.

2.6.9 Muscle strength and paralysis

Knowing the muscle strength of older patients, as well as whether or not they have paralysis, is very important because this aspect of the patient's physical condition are related not only to the prevention of frailty and sarcopenia, but also to oral function. For example, in order to assess swallowing function, it is important to be aware of differences between the left and right sides of the body, particularly in terms of trunk muscle strength, neck muscle strength, and facial and tongue muscle movement, which are important for spitting and swallowing. The simplest and most practical strength assessment is grip strength. In general, a grip strength assessment is conducted twice with each hand, and the better result is recorded. In Japan, low muscle strength is suspected when the grip strength is lower than 26 kg in men or 18 kg in women (Chen et al. 2014). If grip strength measuring equipment is not available, a rough assessment can be obtained by shaking the patient's hand.

2.6.10 Breathing and vocal capacity

Respiratory function and cough reflexes generally decline with age, often in conjunction with respiratory diseases such as chronic obstructive pulmonary disease. Therefore, from the viewpoint of preventing aspiration pneumonia, oral health professionals should assess the breathing of older patients. Particular attention is warranted with patients who have previously developed aspiration pneumonia. In addition, pneumonia is often asymptomatic in older people, so dental professionals should pay attention even to less obvious symptoms such as slight fever, increased sputum production, anorexia and a decrease in ADLs.

Respiratory function can be evaluated by assessing maximum phonation time (MPT) of vowel sounds. There is a gender difference, but in healthy elderly people, normal MPT is considered to be in the range of 10–15 seconds (Hagio 2004). Another sign of respiratory function decline is chronic hoarseness, which may take a variety of forms and be caused by glottal or nasal closure, so dental professionals should take notice if patients present with abnormal vocal characteristics.

2.6.11 Assessment of the oral environment

Assessment of the oral environment involves assessing the state of a patient's oral hygiene, saliva, teeth, gums, mucous membrane, etc. These aspects of the oral environment influence and are influenced by the various movements and forces of the oral components (jaws, tongue, etc.) The

vital oral functions of chewing and swallowing are the result of the integration of these components, movements and forces.

Assessing the oral environment requires two different types of assessment: one for oral hygiene and saliva, and another for teeth, gums and the oral mucous membrane. An oral assessment tool that can be used to comprehensively assess the oral environment is also useful.

2.6.11.1 Dental plaque and tongue coating

Poor oral hygiene in older patients can cause aspiration pneumonia and oral infections due to an abnormal increase in microorganisms in the oral cavity, which can also cause bad breath. Oral hygiene is assessed by measuring the degree of plaque adhesion and tongue coating.

There are three measurements commonly used to assess the degree of plaque adhesion, all of which rely on dyeing: Plaque Control Record (PCR), Debris Index, and Plaque Index. However, there is a greater degree of tooth loss in older people, and plaque may accumulate on the mucous membrane as well as dentures, so it is difficult to obtain an accurate measurement via dyeing procedures alone, especially in long-term care recipients.

Tongue coating is also a useful indicator because it can be assessed even in toothless jaws, and it is, like plaque, a measure of oral hygiene. The Tongue Coating Index (TCI) is used for this purpose. The TCI involves dividing the dorsal surface of the tongue into several small areas and evaluating the degree of coating on each area with a three-step scale (0, no coating; 1, thin coating; 2, thick coating). The scores can then be added together to arrive at a total TCI score. Another method is Shimizu's method (Shimizu et al. 2007), which involves dividing the dorsum of the tongue into nine parts and then assessing the degree of coating in a more fine-grained manner. When assessing tongue coating, the clinician must also pay attention to the colour of the coating. It is usually white, so care should be taken to distinguish it from pseudomembranous candidiasis (thrush). The coating may also appear yellow depending on the thickness of the coating or the patient's diet. If the colour is black, it is often due to black hairy tongue, a condition caused by microbial substitution due to the long-term administration of antibacterial drugs and adrenocortical hormones.

2.6.11.2 Dry mouth and saliva flow

Saliva is normally secreted at a rate of 1–1.5 L/day, and it plays an important role in the preservation of the oral environment. For this, reason, it is important to assess the amount and quality of elderly patients' saliva, as well as the degree of dryness and flow.

Oral dryness is diagnosed on the basis of subjective symptoms such as abnormal dryness in the oral cavity, declining fit and stability of dentures, discomfort when using dentures, and weakening of the mucous membrane. Due to a decrease in the amount of saliva, the movement of the tongue, lips and cheeks becomes restricted; chewing, swallowing and conversation become difficult; and the sense of taste becomes dull. As a result, the enjoyment of eating decreases. Causes of dry mouth include systemic diseases, medication side-effects, ageing and decreased oral motor function.

2.6.11.3 Halitosis

Halitosis (bad breath) can be caused by plaque in the oral cavity, coated tongue, or decreased saliva flow. When the patient's mouth cannot be opened due to clenching or resistance to care, bad breath can be a useful sign of poor oral conditions such as plaque and coated tongue.

2.6.11.4 Level of independence in performance of daily oral cleaning

When evaluating oral hygiene behaviour, caregivers should assess the extent to which patients can independently perform daily oral cleaning (oral care-related ADLs). In other words, there is a need

to assess whether patients are self-supporting or require partial or full assistance with regard to oral hygiene, gargling, dentures, and so on.

2.6.11.5 Assessment of teeth, dentures, gums, mucous membranes, jawbones and jaw joints

Dentists should conduct regular assessment of dental caries, periodontal disease and oral mucosal diseases, and they should also record the number of remaining functional teeth and the presence and type of dentures.

Dentists should also examine patients for dental diseases that are prevalent among the elderly, such as tooth fractures, cracked or chipped teeth, root caries, dental implants, oral candidiasis, stomatitis, bisphosphonate-related osteonecrosis of the jaw (BRONJ) and need of urgent dental treatment.

2.6.11.6 Comprehensive assessment of the oral environment

The two most commonly used comprehensive oral assessments tools are the Revised Oral Assessment Guide (ROAG) (Andersson et al. 2002) and the Oral Health Assessment Tool (OHAT) (Chalmers et al. 2005). ROAG is used to assess oral hygiene status in order to prevent stomatitis in cancer patients. OHAT is used evaluate the oral environment, including denture fit, of older patients. These assessment tools are useful for sharing information about patients' oral condition among multiple professionals who are responsible for day-to-day oral care, such as nurses and speech therapists.

2.6.11.7 Assessment of integrated oral function

Integrated oral function refers not to the function of individual oral organs, but to the integrated set of functions that occur in the oral cavity, such as chewing, swallowing, conversation and non-verbal communication (facial expression). Healthy oral function depends not only on a healthy oral environment and individual oral functions, but also on integrated oral function. The following sections outline methods for evaluating integrated oral function, with a particular focus on chewing and swallowing functions, because these two functions are most closely related to dental care. Chewing function and swallowing function are explained separately in the following sections, but it is important to be aware that they are actually integrated as a single process: eating. However, it is possible to have normal chewing function while also having difficulty swallowing.

2.6.11.8 Assessment of mastication

Older people often experience a decline in chewing and swallowing function due to senescence and/or various diseases. Declining chewing and swallowing function can, in turn, lead to aspiration pneumonia. Therefore, healthy eating habits and the maintenance of chewing function are essential elements of elderly health and well-being. To that end, oral health professionals need to be proficient in using a variety of assessment methods to assess and monitor patients' masticatory and swallowing function.

2.6.11.9 Observation of the act of eating

The chewing process begins when food is brought into the oral cavity and ends with the act of swallowing. The act of chewing itself involves formation and transport of a mass of food material suitable for swallowing by repeatedly biting and grinding the food while mixing it with saliva. Chewing function can be assessed by observing people in the act of eating. Once normal chewing has been observed, chewing function problems can be identified by visual comparison.

The eating process can be divided into five stages. The first three stages are the cognitive, preparatory and oral cavity (chewing) stages. The last two stages are the pharyngeal and oesophageal stages of swallowing.

2.6.11.10 Assessment of consumable foods

The simplest way to assess chewing function is to ask a patient which foods he or she is able to eat. With older patients, in particular, it is important to ask them on a daily basis which foods and food states (whole, cut, mashed, etc.) they are able to eat, and to record and notice how their responses change over time. Another method is to ask patients to fill out a daily questionnaire in which they identify the types of food they are able to ingest. Several such ingestible food questionnaires have been developed (Sato et al. 1988).

2.6.11.11 Chewing and grinding ability

A quantitative method of chewing function assessment is to measure the concentration of glucose extracted from chewing gummy candies.

2.6.11.12 Food mixing ability

Another assessment of chewing ability focuses on the ability to mix bits of food with saliva in the mouth. In this assessment, the patient chews a piece of gum 60 times (one bite per second) and then discharges it from the oral cavity. The colour of the gum is then observed and recorded visually (using a colour scale), or it can be assessed with a spectrophotometer.

2.6.11.13 Ability to form boluses (salivary masses)

Recent studies have shown that the ability to form boluses can be assessed by using a video endoscope to directly observe the state of the bolus in the pharynx during swallowing (Abe et al. 2011; Fukatsu et al. 2015).

2.6.11.14 Assessment of swallowing function

2.6.11.14.1 Observe the act of eating Like chewing, the most basic form of swallowing assessment is observing a person while they are eating. Once an expert knows what the normal mechanism of swallowing looks like, they can then look for abnormalities in the swallowing function of a patient. Of the five stages of eating mentioned earlier, the practitioner will focus primarily on visual assessment of the oral (chewing) and pharyngeal (swallowing) stages. They will check not only the swallowing function, but also the breathing function.

2.6.11.14.2 Subjective assessment Decreased swallowing function refers to the pre-dysphagia stage, where swallowing function has begun to decrease with age. EAT-10 (the 10-item Eating Assessment Tool) (Belafsky et al. 2008) is a screening tool used to subjectively evaluate swallowing function. EAT-10 consists of 10 questions and a score of 3 or more signifies that swallowing function is impaired.

2.6.11.14.3 Screening tests Screening tests are often performed for the purpose of obtaining information before a more thorough examination such as an endoscopy, or for the purpose of establishing standards of normal function. Note that in patients who are currently able to eat, the information obtained from observation of eating is often more useful than screening tests. However, in patients who are unable to eat, screening tests can be invaluable in order to determine the necessity of a thorough examination or whether oral intake can be resumed. Simple screening tests

for swallowing function include the Repetitive Saliva Swallowing Test (RSST), the Modified Water Swallowing Test (MWST), the Food Test (FT) and cervical auscultation.

The RSST is a test in which the patient is asked to swallow as many times as possible in 30 seconds, and the result is recorded. If the patient is able to swallow fewer than three times, dysphagia (aspiration) is suspected. It is easier and safer than other tests because the patient is just swallowing their own saliva. However, it may be difficult to conduct this test if the patient is unable to follow instructions or if the patient has a dry mouth.

The MWST is a test in which 3 ml of cold water is placed in the oral cavity and swallowed, and the swallowing function of the pharynx is assessed by noting the presence or absence of the swallowing reflex, the presence or absence of a coughing response, the respiratory condition, and presence or absence of a wet-hoarse voice. These criteria are used to record the result, which is on a five-point scale. This test is easy to conduct even if the patient cannot understand the dentist's instructions well.

The FT involves having the patient swallow 3–4 g of pudding and then assessing the swallowing function in the same way as the MWST and also noting any pudding remaining in the oral cavity. It is easier to detect oral disorders with this test than with the MWST. A disadvantage of using the MWST and FT to detect swallowing function disorders is that they rely heavily on the presence or absence of coughing, but it is possible to have swallowing problems that are not accompanied by coughing.

Cervical auscultation assesses the swallowing function in the pharynx by using a stethoscope to listen to the patient's breathing and swallowing sounds before and after swallowing. This is an easy and non-invasive auxiliary method that is often used in conjunction with other tests. Multiple screening tests should be used in order to improve the accuracy of the assessment.

2.6.11.14.4 Detailed examination Swallowing is a function that occurs inside the oral cavity and the pharynx, so it is difficult to observe from the outside. Therefore, in cases where a more precise assessment is required for final diagnosis, it is necessary to perform an image inspection using videofluoroscopy (VF) or videoendoscopy (VE). In VF, a series of swallows are indirectly observed by X-ray. The first stages of the swallowing process, from introduction of food into the oral cavity to transportation of food material to the stomach, can be observed by lateral and frontal X-ray images, and aspiration and gastro-oesophageal reflux during swallowing can also be observed. However, VF requires the use of simulated food containing barium, which may not necessarily reflect daily eating function. VE, on the other hand, involves direct observation of the pharynx using a nasopharyngeal endoscope. This device is highly portable and can therefore be carried out by the bedside or even at the patient's home or a nursing care facility, so the advantage of using this method is that the patient's normal daily eating and swallowing habits can be accurately observed. VF and VE are mutually complementary imaging methods that must be used with a full understanding of their respective characteristics.

2.6.11.14.5 Comprehensive evaluation When considering how to proceed with treatment of dysphagia in older patients, it is useful to make a comprehensive determination of the level of clinical severity based on the results of the various observations, screening tests and detailed examinations of swallowing function described earlier. Determining the overall level of swallowing function disorder in this way would allow for easy dissemination to and understanding by all healthcare professionals involved in caring for a given patient. It would also make it easy for all involved to see whether the patient's condition is stable or changing. For example, Saito's dysphagia clinical severity scale (Dysphagia Severity Scale, DSS) (Nishimura et al. 2015) allows for comprehensive evaluation of a patient's ability to swallow based on a seven-level system.

2.7 Dementia and oral healthcare in dental clinics

Dementia is the leading cause of dependency and it is inevitable that the burden of dementia will increase in an ageing society. Dental patients often visit their dentist for a long period of time. It is therefore important that dentists and dental team are concerned with the prevention of cognitive decline. This section describes some evidence for the prevention of cognitive decline, based on Japanese guidelines for the dental treatment of people with dementia (Fukai et al. 2019).

2.7.1 The effect of dental maintenance on the delay and prevention of dementia onset

It is likely that regular dental maintenance has an indirect effect on the delay and prevention of the onset of dementia. Regular and continuous dental maintenance is effective in preventing oral diseases and maintaining oral function. This, in turn, supports healthy social functioning, which likely contributes to delaying the onset of dementia. However, few studies have investigated this relationship over the long term, so there is currently insufficient evidence to make a strong claim of effectiveness.

Dental visitation gives people living with dementia a reason and opportunity to leave home and interact with others. In addition, maintaining good oral health through regular dental intervention supports nutrition intake, which itself contributes to prevention of cognitive decline.

A great deal of research has been conducted on the relationship between diet and dementia, revealing that regular dietary guidance is probably effective in delaying or preventing the onset of dementia. A large portion of the population receives regular and continuing dietary guidance at their local dental clinic, so this represents a significant and effective public health approach to dementia prevention.

Older people often experience a decline in chewing and swallowing function, but for people living with dementia, there are many additional factors that negatively affect food intake and nutrition. Factors include the type and stage of dementia, the specific behavioural and psychological symptoms being experienced, the severity of interruption of ADLs, the side-effects of medication, and other environmental factors. Moreover, the diversity of food consumed by older people tends to be limited, and this phenomenon is particularly pronounced among those living alone.

Recent studies have reported that diet and nutrition are highly associated with cognitive decline and dementia. Therefore, dental professionals who have been well trained in dental clinics have great potential to contribute to the maintenance of cognitive function of older patients by providing regular and high-quality dietary instruction.

In developed countries, the rate and frequency of dental visitation are higher than those of medical check-ups and treatment. In Japan, for example, half of the population reports having visited a dentist in the past year (Fukai 2019) and most people have easy access to dental care. Therefore, providing dietary guidance in dental clinics has the potential to be a powerful public health approach to reducing cognitive decline among the population at large. For this reason, dental clinics should make greater effort to develop and enhance their dietary instruction content and procedures.

2.7.2 Does tooth loss prevention and prevention of oral function decline at dental clinics help delay or prevent the onset of dementia?

There is evidence that tooth loss prevention and prevention of oral function decline are highly likely to delay or prevent dementia.

Preventing tooth loss prevents cognitive decline and the onset of dementia, and the reverse is also likely true. The evidence reviewed in this chapter consists only of observational research, which is considered weaker than interventional research. However, there are serious ethical limitations on conducting interventional research on tooth loss (it would involve extracting teeth), so the best way to strengthen the evidence of this relationship is to accumulate and analyse evidence from a wide variety of countries and regions with differing socioeconomic status, healthcare systems, and so on.

Severe periodontal disease leads to loss of teeth, resulting in a decrease in oral function, including chewing function. The reviews described in this chapter have investigated the relationship between oral health and dementia. In particular, in recent years, many reports have revealed a link between periodontal disease and tooth loss, on the one hand, and the onset of cognitive decline and dementia on the other. Therefore, oral hygiene care and treatment for the prevention of tooth loss and periodontal disease is likely to contribute to preventing and delaying the onset of dementia and reducing its severity.

In addition, given that periodontal disease is also a major cause of tooth loss, there are likely two pathways by which oral health prevention contributes to the prevention and delay of cognitive decline. The first is a direct path, whereby periodontal disease prevention itself delays/prevents the onset of cognitive decline and dementia, and the second is an indirect path, whereby periodontal disease prevention activities prevent tooth loss, which in turn delays or prevents cognitive decline.

2.7.3 What barriers must be overcome in order to prevent dental disease and decline of oral health function in people with cognitive decline?

A limited amount of research shows that the effectiveness of dental disease prevention in people with dementia depends on the continuing and dedicated support of the person's family or other caregivers, but further research in this area is needed.

When cognitive function decreases, it becomes difficult to learn new things, but it is possible to continue performing the oral cleaning habits that have been previously acquired and practised throughout the person's life. However, sufficient dental plaque removal becomes gradually more difficult, which leads to worsening oral hygiene status. The onset and progression of cognitive decline often require the daily support of family members and/or caregivers in order to maintain oral health behaviours.

It has been suggested that the implementation of long-term oral care interventions can help to prevent the need for long-term nursing care among elderly people, and that it is also effective in improving their enthusiasm for life while maintaining and improving oral functions.

In addition to establishing good oral health behaviours while still healthy (before the onset of dementia), it is also necessary to involve family members and/or professional caregivers (ideally dental health professionals) in the maintenance of oral health during the early stages of dementia (Sumi et al. 2012). This means that screening and early detection can have a great effect on maintenance of oral health.

There is still a relative scarcity of research in this area, so much more research is needed before consensus can be reached on the importance of dental health support for those living with dementia.

2.7.4 How should dental treatment and maintenance plans be adjusted for people with different levels of cognitive decline?

As dementia progresses, it becomes more and more difficult to adapt to changes in the surrounding environment. Because the oral cavity is a sensitive part of the body, dental patients with dementia

often show strong resistance to dental care or oral care. In order to create an environment in which dental care is easier to accept, it is useful to begin by providing opportunities for the patient to experience short, low-pressure, low-pain experiences with dental professionals and dental intervention (Fiske et al. 2006).

As cognitive decline progresses, it becomes more and more difficult for people with dementia to manage their own complex oral healthcare routines. It is important for dentists to understand this and explain to the family or caregivers that dental treatment plans may have to be adjusted in consideration of the patient's ability to maintain the necessary daily care routine.

Dental professionals must consider how to effectively and safely administer dental care to patients with cognitive impairment, and they must also be aware of the progressive nature of this condition (Gordon 1988). They must collect and assimilate information from medical personnel, nursing care workers and family members in order to determine whether cognitive decline is present or not (Gordon 1988). Dentists also can and should contribute to the prevention and control of dementia and cognitive decline as part of a cooperative, multi-professional team.

Comprehensive reviews and government guidelines in both Japan (Fukai et al. 2019) and the UK (National Health Service England 2016; Batchelor 2017) have recommended that dental care should be tailored to each patient's cognitive function level. In order to do this, dental professionals must first identify the patient's current stage of cognitive decline (mild, moderate or severe) and then adjust their dental treatment plan accordingly. This is extremely important, as the dental care provided at the earlier stages can slow the progression of cognitive decline itself (due to influencing the patient's eating function and behaviour).

2.7.4.1 Mild

At this stage there are few obstacles to regular dental care and treatment, as patients are still relatively aware of their own oral status and can voice their complaints (Gordon 1988). However, dental professionals must recognize that treatment will become progressively more difficult in the future. Complex prosthetic procedures can also be conducted, assuming the patient's family and/or caregivers can assist with the patient's daily oral hygiene. Considering the progressive nature of dementia, prevention of subsequent periodontal disease becomes particularly important at this stage, so dental professionals need to move beyond the treatment-only paradigm and provide advice and information on the prevention of oral disease to these patients, their families and their caregivers.

2.7.4.2 Moderate

At this stage, patients are more likely to reject dental treatment due to difficulty understanding the explanation provided by the dental professional. Special consideration and/or arrangements may be needed, particularly for treatments that inflict a psychological burden, such as procedures that are extremely painful or take a long time to complete. For example, the patient may need to be given more breaks than usual, or more anaesthesia. When deciding on a treatment plan, the patient often has trouble making decisions independently, so the course of treatment may be determined by considering how cooperative the patient is, the dental care needs of the patient, other existing health conditions, and the social support system available to the patient (Batchelor 2017). If possible, the treatment plan should be carefully explained to the patient's family and informed consent obtained.

2.7.4.3 Severe

At the stage of severe cognitive decline, communication between patient and dental professional becomes very difficult or impossible, and the cognitive decline is very often accompanied by a

decline in physical function. When deciding on a dental treatment plan for these individuals, the dentist must obtain information about their daily life from their family or other caregivers and also listen to the family's preferences and consider their living arrangements and caregiving plans. In cases where complete and/or ideal treatment is deemed difficult, the dentist should implement a course of treatment that helps the patient maintain basic oral function but requires minimal intervention while prioritizing the patient's comfort and QOL (Batchelor 2017).

2.8 Oral healthcare systems: community-based and clinical-based approach

Central to confronting the challenges of healthy ageing is prevention of ageing-related functional decline. This means that the goal for healthy ageing is to maintain functional ability and prevent its decline as much as possible. In both community settings and individual contexts, it is necessary to take a person-centred approach, which involves a new emphasis on assessing and screening older people for decline in functional ability (motor ability, eating ability, cognitive ability, etc.) in addition to the current focus on disease detection.

In order to achieve a healthy ageing society, policies focusing on the assessment and maintenance of oral functions are needed. An approach centred on the assessment and screening of the oral function of older individuals and the subsequent multi-sectoral response would mark a shift towards a person-centred approach that is based on interprofessional cooperation (Fukai et al. 2022).

What challenges must be overcome to support the oral health needs of an ageing society? Oral healthcare systems (OHCSs) seek to maintain the oral health and oral function of a population via three methods: oral health promotion, prevention, and disease control and management. A country's national health agenda affects the degree of priority given to each of these three methods, and that distribution of priority in turn determines what services are provided, which population groups are served, funding and research priorities and data acquisition. OHCSs must adapt when confronted with demographic changes such as the increasingly ageing population, although they have traditionally been slow to adapt. Figure 2.7 identifies some of the challenges facing OHCSs around the world as they seek to adapt to demographic changes [World Dental Federation (FDI) OHAP Task Team 2018]. Some countries have already overcome some of the challenges, and the experiences of such countries show that effective solutions can be found and implemented if priorities are clarified and supported.

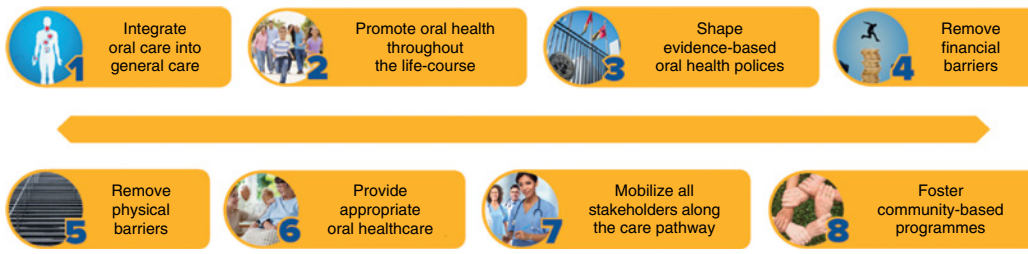


Figure 2.7 Eight different fields of action for stakeholders. *Source:* © FDI World Dental Federation / https://www.fdiworlddental.org/roadmap-healthy-ageing/ accessed 5 September 2023.

Table 2.2 Stakeholders for establishment of an oral healthcare system.

- Policymakers and governments
- FDI World Dental Federation
- National dental associations
- Dentists and dental teams
- Health professionals (e.g. physicians, nurses, nurse assistants)
- Public health professionals
- Research and academia
- Media (press, television, social media)
- Patients and their families

In order for countries to adapt their OHCSs to address the needs of ageing populations, a coalition of stakeholders is required. The roadmap in Table 2.2 lists the stakeholders who can be called upon to contribute to improving the OHCS, each based on their own area of expertise. The roadmap itself can be viewed on the OHAP Task Team project on the FDI website (https://www.fdiworlddental.org/roadmap-healthy-ageing). The challenges are policy and advocacy, provision of care, education and training, monitoring and surveillance, evidence and research, and communication and information.

According to FDI OHAP, these stakeholders can act via eight different fields of action (FDI OHAP Task Team 2018) in order to achieve the implementation of an OHCS that meets the needs of older adults. In Figure 2.7, the actions and roles of each stakeholder are presented. With this resource in hand, therefore, each stakeholder group can easily identify, in a concrete manner, how they can contribute to the maintenance and improvement of oral health in older adults. It also positions each stakeholder's role within the context of the contributions of other stakeholders, showing how each stakeholder group complements the contributions of others.

Oral healthcare systems need to be reformed to allow older people to lead lives of purpose and dignity. The most needed reforms are as follows: integrating oral health into overall health; employing a life-course approach that accounts for common risk factors; implementing a community-based approach; integrating and drawing on the strengths of all stakeholders; sharing of tasks and responsibilities among stakeholders; ensuring accessibility to care (both financial and physical); and establishing an enabling environment. To achieve this, the four-step approach recommended by Fukai et al. (2018) can be employed. This approach integrates and builds on the contributions of each stakeholder group to achieve the gradual adoption of oral healthcare systems that meet the needs of elderly populations and promote improvement in their oral health and oral health-related quality of life.

2.9 Conclusion

Restoring oral function in older people is important for the prevention of frailty and for preventing and reducing dependence on long-term care. In addition, the risk of oral diseases continues throughout all life stages, so dental professionals are likely to care for patients frequently, regularly and over a long period of time. This means that dental professionals are uniquely positioned to notice small, gradual changes in the physical and mental condition, including the oral function, of older patients.

In order to prevent non-communicable diseases and frailty, which are highly associated with oral health, there is a need for communities and dental institutions to collaborate to implement public health programmes which include assessment and screening and are based on the principle of inter-professional cooperation and driven by national policy.

References

Abe, R., Furuya, J., & Suzuki, T. (2011). Videoendoscopic measurement of food bolus formation for quantitative evaluation of masticatory function. *J Prosthodont Res*, 55(3), 171–178.

Andersson, P., Hallberg, I. R., & Renvert, S. (2002). Inter-rater reliability of an oral assessment guide for elderly patients residing in a rehabilitation ward. *Spec Care Dentist*, 22(5), 181–6.

Batchelor, P. (2017). *Dementia-Friendly Dentistry –Good Practice Guidelines*. London, UK: Faculty of General Dental Practice.

Belafsky, P. C., Mouadeb, D. A., Rees, C. J. et al. (2008). Validity and reliability of the Eating Assessment Tool EAT-1. *Ann Otol Rhinol Laryngol*, 117, 919–924.

Chalmers, J. M., King, P. L., Spencer, A. J., Wright, F. A., & Carter, K. D. (2005). The oral health assessment tool – Validity and reliability. *Aust Dent J*, 50, 191–199.

Chen, L. K., Liu, L. K., Woo, J. et al. (2014Feb). Sarcopenia in Asia: consensus report of the Asian Working Group for Sarcopenia. *J Am Med Dir Assoc*, 15(2), 95–101.

Chen, L. K., Woo, J., Assantachai, P. et al. (2020). 2019 Consensus update on sarcopenia diagnosis and treatment. *J Am Med Dir Assoc*, 21(3), 300–307.e2.

Cruz-Jentoft, A. J., Baeyens, J. P., Bauer, J. M. et al., European Working Group on Sarcopenia in Older People. (2010 July). Sarcopenia: European consensus on definition and diagnosis: Report of the European working group on sarcopenia in older people. *Age Ageing*, 39(4), 412–423.

Dent, E., Morley, J. E., Cruz-Jentoft, A. J. et al. (2019). Physical frailty: ICFSR International clinical practice guidelines for identification and management. *J Nutr Health Aging*, 23(9), 771–787.

FDI Oral Health for an Ageing Population Task Team. (2018). *Roadmap for Healthy Ageing*. Geneva: FDI. https://www.fdiworlddental.org/roadmap-healthy-ageing (accessed 13 May 2024).

Fiske, J., Frenkel, H., Griffiths, J., & Jones, V. (2006). Guidelines for the development of local standards of oral health care for people with dementia. *Gerodontology*, 23 Suppl 1, 5–32.

Fried, L.P., Tangen, C.M., Walston, J. et al. & Cardiovascular Health Study Collaborative Research Group. (2001). Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci*, 56(3), M146–156.

Fukai, K., Dartevelle, S., Jones, J. (2022). Oral health for healthy ageing: a people-centred and function-focused approach. *Int Dent*, 72(4S), S2–S4.

Fukai, K., Yoshihara, A., Ogawa, H. et al.(2019). *Ninchisho No Hitono Shikachiryo Guideline [The Dental-care Guideline for the Older People with Dementia]*. Tokyo: Ishiyaku Publishers Inc, 52–79 (in Japanese).

Fukai, K. (2019). Oral health for healthy aging society-evidence and health policy. *JJHEP*, 27(4), 360–368.

Fukai, K., Hori, K., Benz, C. et al. & FDI OHAP Task Team. (2018). Oral Health for Ageing Populations Roadmap For Healthy Ageing. Geneva: FDI. https://www.fdiworlddental.org/sites/default/files/2020–11/ohap-2018-roadmap_ageing.pdf (accessed 13 May 2024).

Fukatsu, H., Nohara, K., Kotani, Y. et al. (2015). Endoscopic evaluation of food bolus formation and its relationship with the number of chewing cycles. *J Oral Rehab*, 42(8), 580–587.

Gatz, M., Mortimer, J. A., Fratiglioni, L. et al. (2006). Potentially modifiable risk factors for dementia in identical twins. *Alzheimers Dement*, 2(2), 110–117.

Glick, M., Williams, D.M., Kleinman, D.V. et al. (2016). A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. *Int Dent J*, 66(6), 322–324.

GBD 2017 Oral Disorders Collaborators, Bernabe, E., Marcenes, W., Hernandez, C.R. et al. (2020). Global, regional, and national levels and trends in burden of oral conditions from 1990 to 2017: a systematic analysis for the Global Burden of Disease 2017 study. *J Dent Res*, 99(4), 362–373.

Gordon, S. (1988). Argument in favour of providing dental care for the severely cognitively impaired patient. *Gerodontics*, 4(4), 170–171.

Hagio, Y. (2004). Investigation of the standard voice function value of the elderly. *Koutou*, 16, 111–121.

Igarashi, K., Kikutani, T., & Tamura, F. (2019, Jan 23;). Survey of suspected dysphagia prevalence in home-dwelling older people using the 10-Item Eating Assessment Tool (eAT-10). *PLoS One*, 14(1), e0211040.

Iwao, Y., Shigeishi, H., Takahashi, S. et al. (2019). Improvement of physical and oral function in community-dwelling older people after a 3-month 1ong-term care prevention program including physical exercise, ora1 health instruction, and nutritional guidance. *Clin Exp Dent Res*, 5(6), 611–619.

Iwasaki, M., Hirano, H., Ohara, Y., & Motokawa, K. (2021Nov). The association of oral function with dietary intake and nutritional status among older adults: latest evidence from epidemiological studies. *Jpn Dent Sci Rev*, 57, 128–137.

Iwasaki, M., Yoshihara, A., Kimura, Y. et al. (2016). Longitudinal relationship of severe periodontitis with cognitive decline in older Japanese. *J Periodontal Res*, 51(5), 681–688.

Japan Dental Association (JDA) (2019). Manual of oral frailty at dental clinics, Tokyo (in Japanese). https://www.jda.or.jp/dentist/oral_frail/pdf/manual_all.pdf (accessed 30 June 2024).

Kassebaum, N.J., Bernabé, E., Dahiya, M. et al. (2014a). Global burden of severe periodontitis in 1990–2010: a systematic review and meta-regression. *J Dent Res*, 93, 1045–1053.

Kassebaum, N.J., Bernabé, E., Dahiya, M. et al. (2014b). Global burden of severe tooth loss: a systematic review and meta-analysis. *J Dent Res*, 93, 20S–28S.

Kassebaum, N.J., Bernabé, E., Dahiya, M. et al. (2015). Global burden of untreated caries: a systematic review and metaregression. *J Dent Res*, 94, 650–658.

Kassebaum, N.J., Smith, A. G. C, Bernabé, E. et al. & GBD 2015 Oral Health Collaborators. (2017). 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. *J Dent Res*, 96(4), 380–387.

Kikutani, T., Yoneyama, T., Nishiwaki, K. et al. (2010). Effect of oral care on cognitive function in patients with dementia. *Geriatr Gerontol Int*, 10(4), 327–328.

Kimura, Y., Ogawa, H., Yoshihara, A. et al. (2013). Evaluation of chewing ability and its relationship with activities of daily living, depression, cognitive status and food intake in community-dwelling elderly people. *Geriatr Gerontol Int*, 13, 718–725.

Kubo, A., Yoshimatsu, T., Nishida, Y. (2009). Relation of the maximum calf circumference with albumin and body mass index in elderly cases of chronic hospitalization, *Nippon Ronen Igakkai Zasshi*, 46, 239–243.

Livingston, G., Sommerlad, A., Orgeta, V. et al. (2017). Dementia prevention, intervention, and care. *Lancet*, 390, 2673–2734.

Lourida, I., Soni, M., Thompson-Coon, J. et al. (2013). Mediterranean diet, cognitive function, and dementia: a systematic review. *Epidemiology*, 24(4), 479–489.

Minakuchi, S., Tsuga, K., Ikebe, K et al. (2018). Oral hypofunction in the older population: position paper of the Japanese Society of Gerodontology in 2016. *Gerodontology*, 35(4), 317–324.

Motokawa, K., Mikami, Y., Shirobe, M. et al. (2021). Relationship between chewing ability and nutritional status in Japanese older adults: a cross-sectional study. *Int J Environ Res Public Health*, 18(3), 1216.

MHLW of Japan (2024). Guidelines for health services based on the characteristics of older people (in Japanese). 3rd ed. 2024, Tokyo, MHLW. https://www.mhlw.go.jp/content/001240315.pdf (accessed 8 July 2024).

Naito, M. (2015). Rest/communication and QOL, Japan Dental Association (JDA) (Editor in chief: Fukai K) (2015). The current evidence of dental care and oral health for achieving healthy longevity in an aging society. Tokyo: JDA, pp. 204–213. https://www.jda.or.jp/dentist/program/pdf/world_concgress_2015_evidence_en.pdf (accessed 8 July 2024).

National Health Service England. (2024). *Working Towards Dementia Friendly Dental Practices. Health Education England South East.* https://thamesvalley.hee.nhs.uk/dental-directorate-thames-valley-and-wessex/dementia/ (accessed 8 July 2024).

Nishimura, K., Kagaya, H., Shibata, S. et al. (2015). Accuracy of Dysphagia Severity Scale rating without using videoendoscopic evaluation of swallowing. *Jpn J Compr Rehabil Sci*, 6, 124–128.

Ohara, Y., Yoshida, N., Kono, Y. et al. (2015). Effectiveness of an oral health educational program on community-dwe11ing older people with xerostomia. *Geriatr Gerontol Int*, l5(4), 48l–489.

Perneczky, R., Wagenpfeil, S., Komossa, K. et al. (2006). Mapping scores onto stages: mini-mental state examination and clinical dementia rating. *Am J Geriatr Psychiatry*,14(2), 139–144.

Pretty, I.A., Ellwood, R.P., Lo, E.C.M. et al. (2014). The Seattle Care Pathway for securing oral health in older patients. *Gerodontology*, 31(1), 77–87.

Rubenstein, L. Z., Harker, J. O, Salvà, A. et al. (2001). Screening for undernutrition in geriatric practice: developing the short-form mini-nutritional assessment (MNA®-SF). *J Gerontol A Biol Sci Med Sci.* 56(6), M366–372.

Sakayori, T., Maki, Y., Hirata, S. et al. (2013). Evaluation of a Japanese "Prevention of Long-term Care" project for the improvement in oral function in the high-risk elderly. *Geriatr Gerontol Int*, 13(2), 451–457.

Sato, Y., Ishida, E., Minagi, S. et al. (1988). The aspect of dietary intake of full denture wearers. *J Jpn Prosthodont Soc*, 32, 774–779.

Scarmeas, N., Stern, Y., Tang, M.X. et al. (2006). Mediterranean diet and risk for Alzheimer's disease. *Ann Neurol*, 59(6), 912–921.

Shimizu, T., Ueda, T., & Sakurai, K. (2007). New method for evaluation of tongue-coating status. *J Oral Rehab*, 34(6), 442–447.

Sumi, Y., Ozawa, N., Michiwaki, Y. et al. (2012). Oral conditions and oral management approaches in mild dementia patients. *Nippon Ronen Igakkai Zasshi*, 49, 90–98.

Suzuki, H., Kanazawa, M., Komagamine, Y. et al. (2017). The effect of new complete denture fabrication and simplified dietary advice on nutrient intake and masticatory function of edentulous elderly: a randomized-controlled trial. *Clin Nutr*, 37(5), 1441–1447.

Tanaka, T., Hirano, H., Ohara, Y et al. (2021). Oral Frailty Index-8 in the risk assessment of new-onset oral frailty and functional disability among community-dwelling older adults. *Arch Gerontol Geriatr*, 94, 104340.

Tanaka, T., Takahashi, K., Hirano, H. et al. (2018). Oral frailty as a risk factor for physical frailty and mortality in community-dwelling elderly. *J Gerontol A Biol Sci Med Sci*, 73(12), 1661–1667.

United Nations (2015). Transforming our World: The 2030 Agenda for Sustainable Development, New York UN. https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981 (accessed 30 June 2024).

Wakai, K., Naito, M., Naito, T. et al. (2010). Tooth loss and intake of nutrients and foods: A nationwide survey of Japanese dentists. *Community Dent Oral Epidemiol*, 38, 43–49.

World Health Organization (2015). *World Report on Ageing and Health*. Geneva: WHO. https://www.who.int/publications/i/item/9789241565042 (accessed 13 May 2024).

World Health Organization (2022). *Global Oral Health Status Report: Towards Universal Health Coverage for Oral Health by 2030*. Geneva: WHO. https://www.who.int/publications/i/item/9789240061484 (accessed 13 May 2024).

Yoneyama, T., Yoshida, M., Ohrui, T. et al. (2002). Oral Care Working Group. Oral care reduces pneumonia in older patients in nursing homes. *J Am Geriatr Soc*, 50(3), 430–433.

Yoshihara, A., Watanabe, R., Nishimuta, M et al. (2005). The relationship between dietary intake and the number of teeth in elderly Japanese subjects. *Gerodontology*, 22(4), 211–218. https://www.jda.or.jp/dentist/oral_frail/pdf/manual_all.pdf (accessed 13 May 2024).