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Relationship Between Chewing and Swallowing Functions and Health-Related Quality of Life

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1. Introduction

Population aging has advanced rapidly in developed countries. In particular, Japan has already become a “Super Aging Society” (MHLW, 2010), and this trend exists in other Asian countries such as South Korea as well (Fig. 1). The increase in life expectancy has led to a decreased ratio between people of working-age and older individuals. At present, the aging problem is most common in developed and mid-developed countries.

During the last 6 decades, the types of diseases found in Japan have changed greatly with socio-economic development (Matsuda, 2008). For example, the present major causes of death in Japan are non-communicable diseases (NCD) such as malignant neoplasm, cardiovascular disease, and cerebrovascular disease (WHO, 2011). With an aging population, the need for geriatric dentistry has increased greatly in Japan. Oral health is important in the elderly; it helps maintain the ability to chew, swallow, and speak clearly, which are important for quality of life (QOL) (Pereira et al., 2006; Sonies et al., 1984).

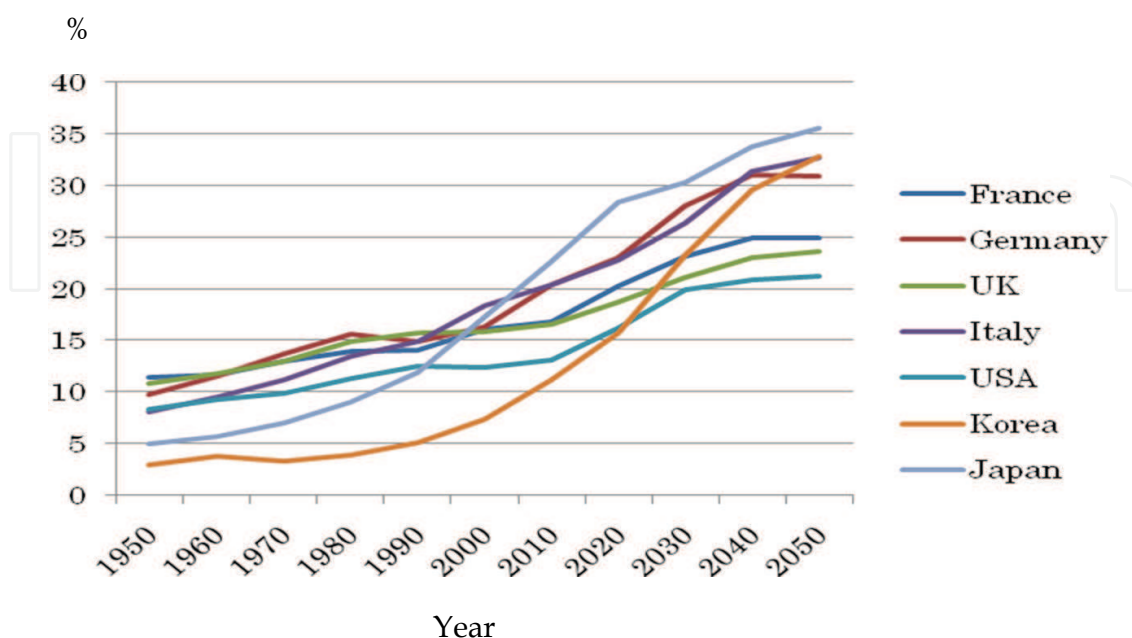


Fig. 1. Percentage of elderly people in the population of 7 countries, including Japan

1.1 QOL improvement and successful aging

Psychosocial approaches to successful aging focus on high social functioning and life satisfaction (Britton et al., 2008; Peel et al., 2005). In particular, sustaining good health is essential for maintaining QOL. Health-related QOL (HRQOL) refers to the perception of overall satisfaction with life and involves the measurement of functional status in the physical, mental, and social realms (Coons et al., 2000). Successful aging is a key concept for improving the quality of life. Application of this broader perspective helps to explain why dental treatment of elderly individuals is more likely to succeed if it addresses oral problems that disturb self-image and social interactions, rather than an approach based solely on function.

Previous studies have reported that QOL is closely related to health and financial status (Robert et al., 2009; Yamazaki et al., 2005), and maintaining satisfactory health, in particular, is essential to successful aging. Thus, HRQOL is a key issue for the elderly.

1.2 Evaluation of HRQOL

Previous studies reported different methods for evaluating HRQOL. Representative evaluation methods are SF-36 (Brazier et al., 1992), SF-8 (Ware et al., 2001), Sickness Impact Profile (Berger, 1981), WHOQOL-BREF (WHO, 2011), and EuroQOL (EuroQOL Group, 1990). In particular, SF-36 and SF-8 have been translated into many languages, including Japanese. More specific evaluations, for example, are EROTC QLQ for cancer (Asronzon et al., 1993), KDQOL (Hays, 1994) for kidney disease, and GOHAI for oral health (Atchinson et al., 1990). These methods are also very useful for assessing comprehensive health status among the elderly.

1.3 Geriatric oral health in Japan

In Health Japan 21, a national health campaign to improve the population's health status, the followings were identified as focus areas: nutrition, physical activity, mental health, tobacco control, alcohol control, oral health, diabetes control, prevention of heart diseases, and prevention of cancer (MHLW, 2011). Oral health goals in Health Japan 21 were as follows: (1) prevention of dental caries among infants, (2) prevention of dental caries at school age, (3) prevention of periodontal disease, and (4) prevention of tooth loss. The "prevention of tooth loss" is particularly important for the oral health of aging people.

Table 1 shows baseline and intermediate oral health results after 5 years of the Health Japan 21 initiative. The goals relevant to the elderly are to increase the percentage of: 80-year-olds retaining 20 or more teeth; 60-year-olds retaining 24 or more teeth; the increased numbers of people receiving tooth scaling and cleaning; and the increased number of individuals receiving a periodontal checkup. According to the intermediate report (Ministry of Health, Labour, and Welfare, 2007), the dentition of the elderly has greatly improved. Figure 2 shows the national data regarding the percentage of individuals retaining more than 20 teeth. In Japan, the "8020 movement," which means to keep 20 teeth at 80 years, has already been a very popular oral health initiative (Shinsho 2001).

1.4 Oral health and overall health

The oral cavity is important for its eating and speaking functions; eating is necessary for survival, and speaking is essential for satisfactory verbal communication. Many epidemiological studies have shown that good oral health contributes to greatly improving

the physical health of community-dwelling elderly individuals in Japan (Miura et al., 1997; Miura et al., 1998; Miura et al., 2005; Moriya et al., 2011). The scientific evidence contained in these studies provides a useful guidance to other mid-developed countries.

Goals	Age of target population	Percent of population		
		Baseline	Mid-term	Final target
Increase of the proportion of persons with 20 or more teeth	80	11.5%	25.0%	>20%
Increase of the proportion of persons with 24 or more teeth	60	44.1%	60.2%	>50%
Increase of the proportion of persons with dental scaling each year	60	15.9%	43.2%	>30%
Increase of the proportion of persons with periodontal checkup each year	60	16.4%	35.7%	>30%

Table 1. Mid-term evaluation of the oral health initiative goals in 2006 from Health Japan 21 for the prevention of tooth loss

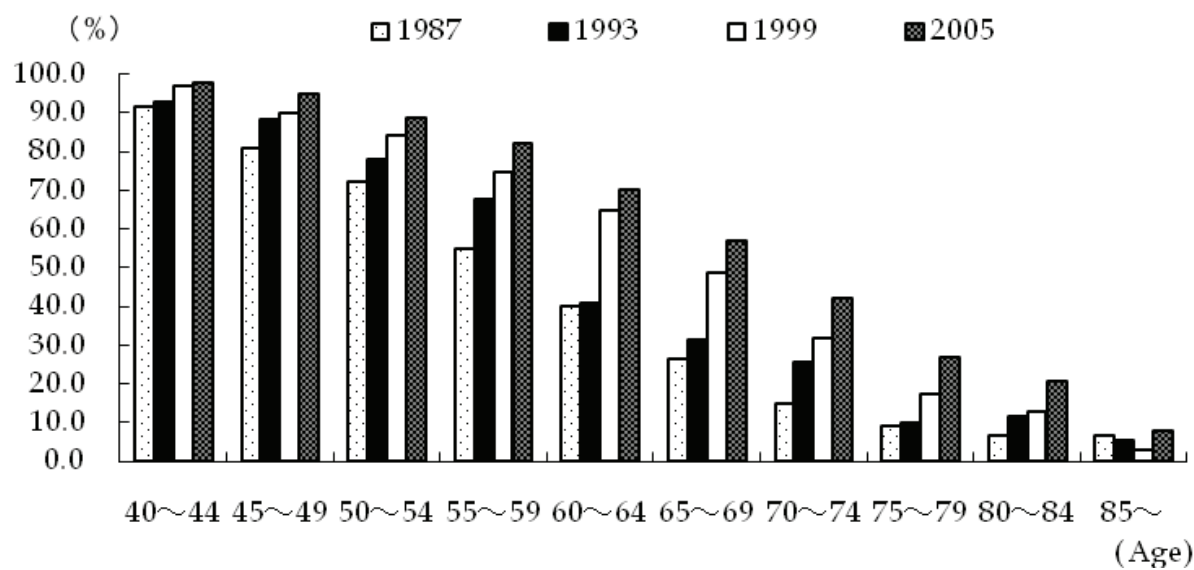


Fig. 2. Persons retaining 20 or more teeth from 1987 to 2005 in Japan (MHLW, 2006)

Chewing and swallowing disorders are prevalent in frail elderly people. In particular, masticatory problems in the disabled elderly are frequently related to tooth loss and ill-fitting dentures. Mastication is necessary for the reduction of food mass, and therefore, inadequate chewing may cause dysphagia symptoms, particularly in the elderly. Several cross-sectional studies revealed that preservation of a person’s ability to chew contributed

greatly, not only to physical health, but to QOL as well (Miura et al., 2000; Mori et al., 2010). Furthermore, subsequent studies provided a new perspective for assessing the HRQOL of subjects who suffer from systemic disease with oral symptoms or dysfunction; whereas dysphagia may be the functional focus, patients with dysphagia often have inadequate diets that also produce systemic problems (Foley et al., 2009).

Eating is a pleasure for most people in daily life; therefore, the relationship between improvement in dysphagia and QOL, especially for the elderly, is an important issue. Because consumption of food and drinks form integral to social events and symbolize acceptance, friendship, and community, it is not surprising that swallowing problems evoke a host of distressing psychosocial responses, such as anxiety, shame, embarrassment, fear, and lowered self-esteem (McHorney et al., 2000).

1.5 Purpose of the present study

A decline in chewing and swallowing functions among the elderly is closely related to an increase in overall health risks, such as malnutrition and aspiration pneumonia. Insufficient chewing and swallowing functions could result in a lower HRQOL. In this chapter, we report on our field survey on the relationship between chewing, swallowing, and HRQOL in the elderly.

2. Subjects and methods

2.1 Subjects

The cross-sectional survey was conducted from September 2010 to January 2011 in the northern area of Miyazaki Prefecture, located in Southern Japan. Our initial target sample was 675 community-dwelling individuals who were older than 65 years. Before the survey, we explained in detail the intent of the present survey and obtained informed consent from 541 persons (response rate = 80.1%). The present study was approved by the Institutional Review Board of National Institute of Public Health of Japan.

2.2 Measurements

The respondents were asked to complete a structured questionnaire regarding the following items: (i) demographic variables, (ii) dysphagia risk, (iii) HRQOL, and (iv) overall satisfaction with diet. The decline in the ability to chew and swallow was assessed using the dysphagia risk assessment for the community-dwelling elderly (DRACE), which was developed by Miura et al. (2006). Table 2 shows the assessment items of DRACE. Dysphagia risk was determined according to the criteria of our previous study (Miura et al., 2007); thus, subjects who had >2 positive scores on DRACE were classified as at risk for dysphagia.

HRQOL among community-dwelling elderly people was evaluated using the Japanese version of the SF-8 Health Survey (Fukuhara et al., 2004). The SF-8 represents a major advance in the application of SF technology for purposes of achieving both brevity and comprehensiveness in population health surveys. The SF-8 is widely used to assess QOL, including health status, and comprises the following 8 health subsets: physical functioning (PF), role physical (RP), body pain (BP), general health (GH), vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH). Levels of subjective satisfaction with diet were measured by the question: "Are you satisfied with your present diet?" Subjects categorized themselves by using the 5 Likert scale.

The following questions are related to your ability to swallow food and beverages. Please select the option that best describes your experience in the last year.		
(1) Have you had at least one episode of fever?		
2 Frequently	1 Occasionally	0 Never
(2) Have you felt that you take a longer time to eat than before?		
2 Much longer	1 Slightly longer	0 Not at all
(3) Have you had difficulties with swallowing beverages?		
2 Frequently	1 Occasionally	0 Never
(4) Have you had difficulties with chewing hard food?		
2 Frequently	1 Occasionally	0 Never
(5) Have you experienced food spilling out of your mouth?		
2 Frequently	1 Occasionally	0 Never
(6) Have you ever choked while eating?		
2 Frequently	1 Occasionally	0 Never
(7) Have you ever choked while drinking beverages?		
2 Frequently	1 Occasionally	0 Never
(8) Have you ever swallowed food and had it go up your nose?		
2 Frequently	1 Occasionally	0 Never
(9) Have you ever had a change in your voice after a meal?		
2 Frequently	1 Occasionally	0 Never
(10) Have you ever produced sputum during a meal?		
2 Frequently	1 Occasionally	0 Never
(11) Have you ever felt like you had a lump in your throat while swallowing?		
2 Frequently	1 Occasionally	0 Never
(12) Have you ever had food or liquid from your stomach come back up into your throat?		
2 Frequently	1 Occasionally	0 Never

Table 2. Dysphagia risk assessment for community-dwelling elderly (DRACE)

2.3 Analyses

Bivariate analyses were performed using Pearson correlation coefficients, and partial correlation coefficients were determined to control typical demographic variables such as age and gender. Then, a stepwise multiple regression was performed with the DRACE score treated as the dependent variable for each independent variable ($F = 2.5$) in order to detect the factors with the largest influence on the risk of dysphagia among the elderly. All statistical procedures were performed using SPSS ver.18.0 (Chicago, IL, USA).

3. Results

3.1 Univariate analysis

Table 3 shows the characteristics of the elderly subjects, DRACE scores, and SF-8 mean value and standard deviation. Each of the SF-8 sub-scores was similar to the standardized

value of Japanese elderly population. The distribution of DRACE scores among the respondents is shown in Figure. 3. In the present survey, 45.0% of individuals had dysphagia risk.

Satisfaction with diet		Frequency (%)	
Very satisfied		59.9	
Satisfied		33.4	
Fair		5.1	
Unsatisfied		0.9	
Very unsatisfied		0.3	

(a)

Variable		Mean	SD	Median
Age		76.06	6.75	75.00
DRACE score		3.02	2.09	2.00
SF-8 sub scores				
PF		48.48	6.32	48.52
RP		48.06	7.36	48.47
BP		46.43	7.97	46.19
GH		49.41	6.71	50.71
VT		49.87	6.48	54.48
SF		48.30	7.80	54.74
RE		49.64	7.48	49.07
MH		50.22	6.63	50.28

(b)

Table 3. Univariate analyses on characteristics of the elderly subjects (N = 541)

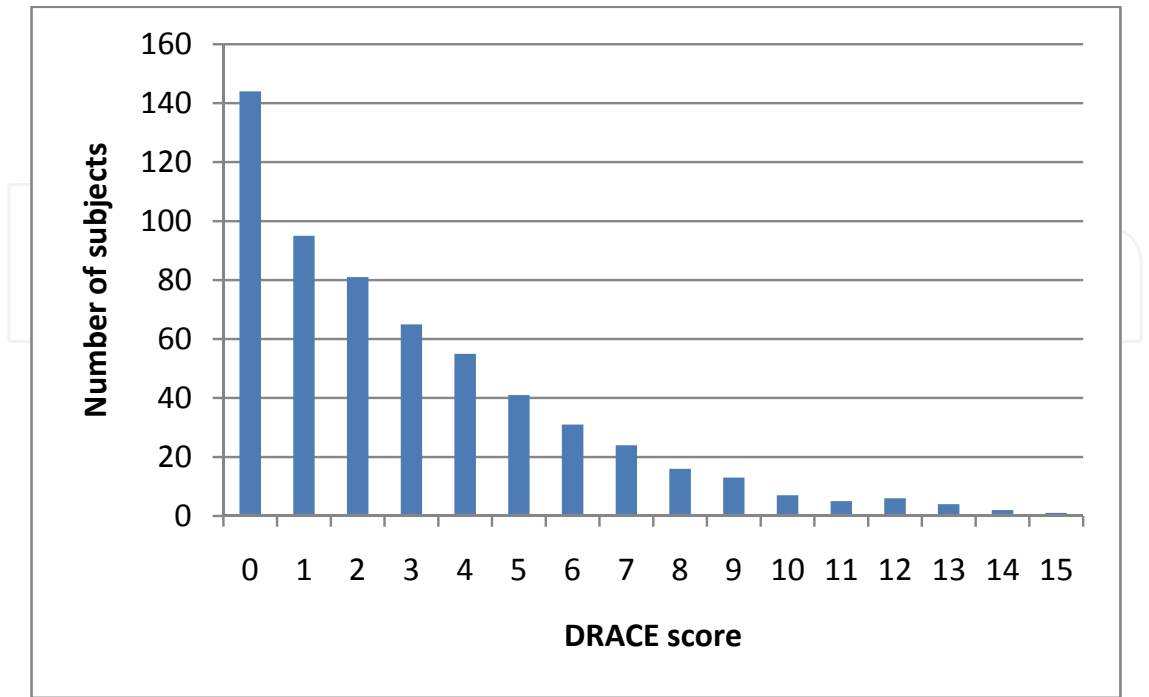


Fig. 3. Distribution of DRACE scores among the survey respondents

3.2 Bivariate analysis

Table 4 shows the matrix of Pearson correlation coefficients among DRACE, SF-8 sub-scores, and subjective satisfaction with diet. DRACE scores significantly related to all sub-scores of SF-8 and subjective satisfaction on diet ($p < 0.001$). In particular, sub-scores of SF-8 regarding mental health status closely associated with DRACE scores. Table 4 also shows the partial correlation coefficients controlled for age and gender between DRACE and the other variables. In the analyses of partial correlation coefficients, DRACE also significantly related to all sub-scores of SF-8 and subjective satisfaction with diet ($p < 0.001$). In particular, MH of SF-8 revealed higher correlation coefficients to DRACE score.

Pearson correlation coefficients			Partial correlation coefficients controlled for age and gender		
DRACE score versus:	Pearson correlation	P value	DRACE score versus:	Partial correlation	P value
Age	0.262	<0.001			
Satisfaction with diet	0.295	<0.001	Satisfaction with diet	0.238	<0.001
SF-8 sub-score			SF-8 sub-score		
PF	-0.304	<0.001	PF	-0.219	<0.001
RP	-0.374	<0.001	RP	-0.270	<0.001
BP	-0.260	<0.001	BP	-0.237	<0.001
GH	-0.310	<0.001	GH	-0.244	<0.001
VT	-0.356	<0.001	VT	-0.284	<0.001
SF	-0.373	<0.001	SF	-0.272	<0.001
RE	-0.388	<0.001	RE	-0.274	<0.001
MH	-0.374	<0.001	MH	-0.350	<0.001

Table 4. Matrix of correlation coefficients among DRACE score, SF-8 sub-scores, and subjective satisfaction with diet

3.3 Multivariate analysis

Table 5 shows the results of a stepwise multiple regression analysis to find the most influential factor on the DRACE score. Finally, we determined that the 4 most influential factors were as follows: mental health (MH), age, role physical (RP), and subjective satisfaction with diet. The final regression coefficient was 0.445 ($p < 0.01$), and the adjusted coefficient of determination was 0.192 ($p < 0.01$).

Variable	Beta	T value	P value
SF-8 MH	-0.225	-4.711	<0.001
Age	0.184	4.184	<0.001
SF-8 RP	-0.123	-2.432	0.015
Satisfaction with diet	0.102	2.247	0.025

Multiple correlation coefficient (R) = 0.445.
Adjusted coefficient of determination (R^2) = 0.192.

Table 5. Factors related to dysphagia risk in stepwise regression analyses

4. Discussion

The present findings indicate that a decline in chewing and swallowing functions are closely related to HRQOL. Multivariate analysis revealed that chewing and swallowing functions had a significantly higher correlation to mental health status than to physical status.

4.1 Evaluation of the risks of dysphagia

Dysphagia frequently occurs among frail elderly individuals (Siebens et al., 1986; Eliot et al., 1988) and enhances the risk of aspiration pneumonia, which are clinically-occult. Therefore, conducting appropriate screening to identify the potential for aspiration is important. DRACE is a useful assessment tool for detecting the risk of mastication and swallowing disorders among community-dwelling elderly people (Miura et al., 2007). Because there are only 12 items to assess, DRACE is a very simple survey compared to the other available options.

4.2 Evaluation of HRQOL

In order to assess HRQOL issues of the elderly, their health needs must be identified; maintaining HRQOL is directly associated with an extended healthy life expectancy. There are many methods for assessing HRQOL; however, SF-8 is an international scale of comprehensive HRQOL that has been widely used in Japan because the standard values for a cross section of Japanese residents have previously been reported (Fukuhara, 2004). The SF-8 is almost equivalent to SF-36; SF-8 is an 8-item version of the SF-36 that yields a comparable 8-dimension health profile and comparable estimates of summary scores for the physical and mental components of health. This study found that the SF-8 sub-scores were similar to the previously established values for the Japanese elderly.

4.3 Dysphagia and HRQOL

The ability to chew and swallow satisfactorily is necessary for maintaining a well-balanced diet for the elderly. Dysphagia affects physical health, including the nutrition status of senile individuals (Morris, 2006). Severe dysphagia can lead to reduced food selection, which can cause malnutrition. In addition, the ability to chew affects food selection and intake. The dietary data from the National Diet and Nutrition Survey showed that energy intake was lower in edentate people (Sheiham et al., 2001). Thus, a decline in chewing and swallowing function is significantly related to physical health.

In the present study, it was very interesting that there was a stronger correlation between DRACE and factors related to mental health than to factors related to physical health. A previous study has also shown a significant relationship between oral function and poor mental health (Friedlander and Norman, 2002). It was very interesting that the enhancement of chewing and swallowing function contributes not only physical health, but mental health as well.

The negative spiral caused by the decline of chewing and swallowing functions is illustrated in Fig. 4. A well-balanced diet would greatly improve a person's comprehensive QOL, including both physical and mental aspects.

4.4 Dysphagia and satisfaction with diet

Satisfaction with diet has been involved various aspects such as quality of diet, oral function and dietary environment. The present findings revealed the subjective evaluation on diet

closely related the risk of dysphasia among elderly community residents. Healthy chewing and swallowing function is connected to maintain healthy diet. A previous study regarding oral health-related QOL reported that Japanese elderly persons especially have developed a culture enjoying seasonal foods and a variety of foods (Naito, 2011), thus satisfaction with diet has been useful indicator to grasp the risk of dysphagia.

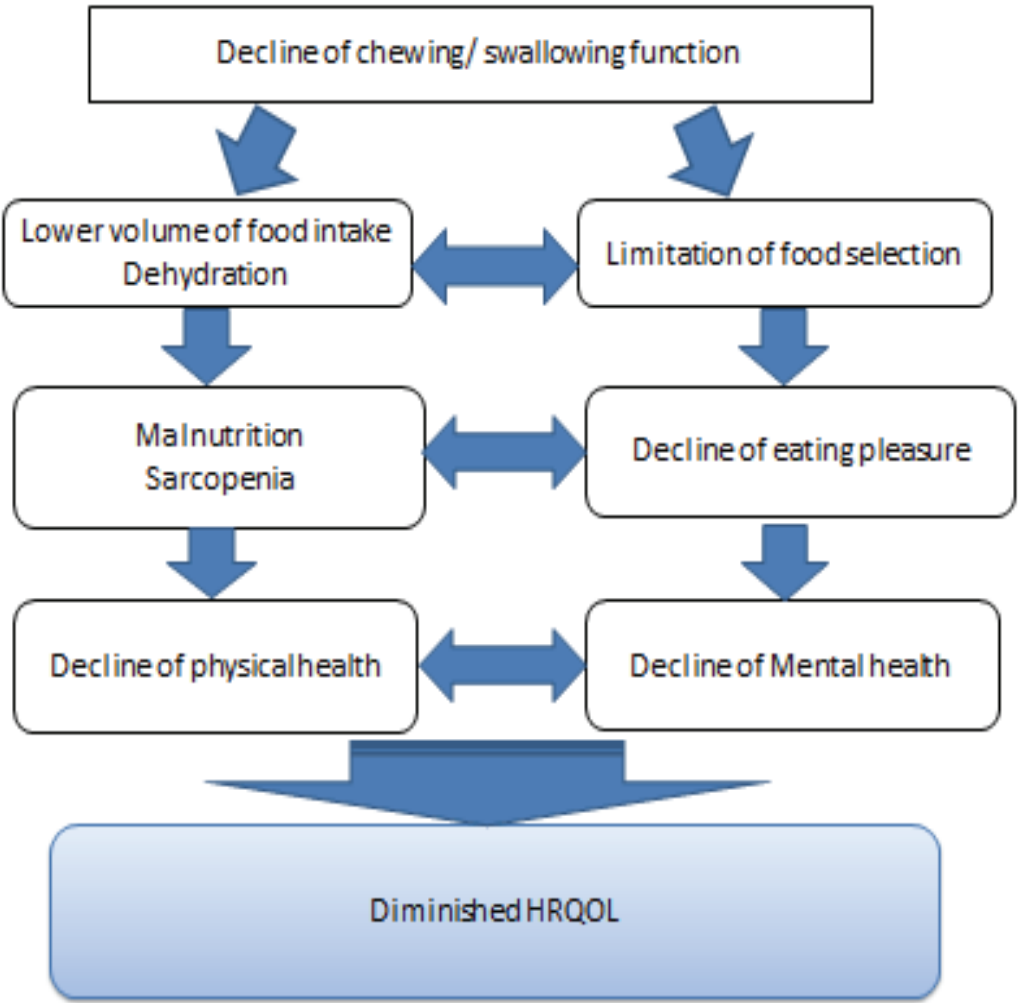


Fig. 4. Negative spiral caused by dysphagia in elderly people

4.5 Limitation of the present study

A limitation of the present study was the need to exclude elderly people with severe physical or mental disabilities in order to obtain reliable answers. Nevertheless, the present findings suggest that improvement of chewing and swallowing functions are very important for the maintenance of a healthy aging society.

5. Conclusion

Mastication and swallowing are essential functions for the maintenance of a healthy dietary life. A decline in these functions could induce not only the deterioration of physical health, but also mental health. To avoid the negative spiral caused by poor chewing and

swallowing, an oral function improvement program will be necessary as the population ages. The retention of the ability to chew and swallow is a key to a prolonged and healthy life. The creation of health programs that enhance the swallowing function, such as exercises to activate orofacial muscles, could improve QOL in elderly individuals.

In conclusion, the present findings suggest that the ability to chew and swallow is significantly related to HRQOL and subjective satisfaction with diet. These results will contribute to the creation of a conceptual model of QOL for the elderly and the impact of any decline in chewing and swallowing functions.

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Geriatric dentistry, or gerodontics, is the branch of dental care dealing with older adults involving the diagnosis, prevention, and treatment of problems associated with normal aging and age-related diseases as part of an interdisciplinary team with other healthcare professionals. Prosthodontics is the dental specialty pertaining to the diagnosis, treatment planning, rehabilitation, and maintenance of the oral function, comfort, appearance, and health of patients with clinical conditions associated with missing or deficient teeth and/or oral and maxillofacial tissues using biocompatible materials. Periodontology, or Periodontics, is the specialty of oral healthcare that concerns supporting structures of teeth, diseases, and conditions that affect them. The supporting tissues are known as the periodontium, which includes the gingiva (gums), alveolar bone, cementum, and the periodontal ligament. Oral biology deals with the microbiota and their interaction within the oral region. Research in oral health and systemic conditions concerns the effect of various systemic conditions on the oral cavity and conversely helps to diagnose various systemic conditions.

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