

Table 3. Model fitting result

	-2log likelihood	Difference degree of freedom	Akaike information criterion	<i>P</i>
(1) Total number of remaining teeth				
Full saturated	1812	NA	1304	
Full ACE	1817	6	1297	0.55
Full ADE	1822	6	1302	0.12
Full AE	1822	1	1300	<0.01
Full CE	1817	1	1295	0.99
E	1809	2	1366	<0.01
(2) Occult blood test				
Full saturated	631	NA	161.5	
Full ACE	638	6	155.7	0.41
Full ADE	638	6	156.4	0.33
Full AE	638	1	154.4	0.40
Full CE	638	1	153.7	1.00
E	651	2	164.5	<0.01
(3) Maximum probing depth				
Full saturated	886.0878	NA	490.0878	
Full ACE	888.4528	6	480.4528	0.88
Full ADE	888.4523	6	480.4523	0.88
Full AE	888.4528	1	478.4528	0.98
Full CE				
E	889.2907	2	477.2907	0.66
(4) Score of bone resorption				
Full saturated	515.8	NA	115.8	
Full ACE	521.5	6	109.5	0.46
Full ADE	524.4	6	112.4	0.20
Full AE	524.4	1	110.4	0.09
Full CE	521.5	1	107.5	0.96
E	574.1	2	158.1	<0.01
(5) Decayed, filled and missing teeth				
Full saturated	515.8	NA	115.8	
Full ACE	-42.9	40	-523.0	1
Full ADE	-43.4	40	-523.4	1
Full AE	-42.9	1	-525.0	0.54
Full CE				
E	7.8	2	-476.2	<0.01
(6) Occlusal force				
Full saturated	3544.3	NA	3056.3	
Full ACE	3551.5	6	3051.5	0.31
Full ADE	3551.3	6	3051.3	0.32
Full AE	3551.5	1	3049.5	0.68
Full CE				
E	3580.0	2	3075.9	<0.01
(7) Masticatory performance				
Full saturated	2852.3	NA	2388.3	
Full ACE	2862.3	6	2386.3	0.12
Full ADE	2862.5	6	2386.5	0.11
Full AE	2862.5	1	2384.5	0.61
Full CE	2865.4	1	2387.4	0.08
E	2912.3	2	2432.3	<0.01

Table 3. (continued)

	-2log likelihood	Difference degree of freedom	Akaike information criterion	<i>P</i>
(8) Stimulated salivary flow rate				
Full saturated	998.9	NA	498.9	
Full ACE	1011.7	6	499.7	0.05
Full ADE	1010.5	6	498.5	0.07
Full AE	1011.8	1	497.7	0.27
Full CE				
E	1046.1	2	530.1	<0.01
(9) Width of upper dental arch				
Full saturated	-703.5	NA	635.8461	
Full ACE	-716.9	6	634.5315	0.10
Full ADE	-620.3	6	634.3749	0.21
Full AE	-620.5	1	632.5315	0.69
Full CE				
E	-620.9	2	638.7	<0.01
(10) Width of lower dental arch				
Full saturated	719.5	NA	463.47	
Full ACE	725.7	6	457.7296	0.40
Full ADE	725.7	6	457.7281	0.40
Full AE	725.7296	1	455.7296	0.97
Full CE				
E	730.7952	2	458.7942	0.08

Table 4. Percentage of variance of additive genetic (*A*), common environmental (*C*) and unique environmental (*E*) variances for mean clinical scores

	Model	<i>A</i> (95% CI)	<i>C</i> (95% CI)	<i>E</i> (95% CI)
Total number of remaining teeth	CE		0.65 (0.46, 0.93)	0.35 (0.28, 0.46)
Occult blood test	CE		0.32 (0.14, 0.68)	0.68 (0.52, 0.88)
Maximum probing depth	E			1.00 (0.83, 1.21)
Score of bone resorption	CE		0.63 (0.43, 0.90)	0.37 (0.28, 0.49)
Decayed, Filled and missing teeth	AE	0.52 (0.38, 0.66)		0.48 (0.34, 0.62)
Occlusal force	AE	0.45 (0.30, 0.60)		0.55 (0.40, 0.70)
Masticatory performance	AE	0.63 (0.54, 0.99)		0.37 (0.22, 0.41)
Stimulated salivary flow rate	AE	0.51 (0.35, 0.63)		0.49 (0.37, 0.65)
Width of upper dental arch	AE	0.28 (0.04, 0.52)		0.72 (0.48, 0.96)
Width of lower dental arch	AE	0.29 (0.02, 0.46)		0.71 (0.54, 0.98)

CI, Confidence Interval.

The structural equation modelling was used, and the fittest model was estimated with Akaike information criteria, log likelihood, degree of freedom and *P*-value.

factors contributed significantly to salivary flow rate, occlusal force and masticatory performance but not to the number of teeth and periodontal status. These findings regarding the genetic contribution, particularly to oral function, would help improve awareness among both dental practitioners and patients and would play an important role in treatment planning.

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Conflicts of interest

The authors declare no potential conflict of interest.

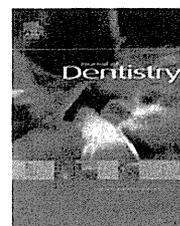
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Association of personality traits with oral health-related quality of life independently of objective oral health status: A study of community-dwelling elderly Japanese

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ABSTRACT

Objectives: Oral health-related quality of life (OHRQoL) is being increasingly used in epidemiologic studies of dentistry. However, patient-reported OHRQoL does not always coincide with clinical measures. Previous studies have shown a relationship between OHRQoL and personality, but did not concomitantly investigate oral function. We aimed to examine the association among personality traits, oral function, and OHRQoL using a large sample of community-dwelling Japanese elderly.

Methods: The participants ($n = 938$; age, 69–71 years) were drawn from a complete enumeration of an urban area and a rural area of both the Tokyo metropolitan area and Hyogo Prefecture. The self-perceived impact of OHRQoL was measured using the Geriatric Oral Health Assessment Index (GOHAI). The oral status and socioeconomic characteristics were recorded in each participant, and personality traits (neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness) were assessed with the NEO-five-factor inventory. Multiple linear regression analysis was performed to examine the relationships between OHRQoL and other factors, with $p < 0.05$ considered to be statistically significant. **Results:** Neuroticism was negatively associated with the GOHAI score in bivariate analyses (Spearman rank-order correlation coefficient (r_s) = -0.20), whereas extraversion was positively associated ($r_s = 0.17$). In the regression analyses, neuroticism (standardized partial regression coefficient (β) = -0.179) and extraversion ($\beta = 0.094$) were significantly associated with the GOHAI scores independently of the number of teeth, maximal occlusal force, and financial status.

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Conclusions: Personality traits are associated with OHRQoL independently of objective measures of oral health status in community-dwelling elderly Japanese.

Clinical significance: This study showed personality traits are associated with OHRQoL independently of dental status and oral function in old Japanese people. As elderly patients undergo increasingly complex dental treatments, there is a need to evaluate patient personality traits prior to dental treatment and predict patient expectations and responses to planned treatment. This is advantageous in determining the most appropriate therapy.

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1. Introduction

Oral health-related quality of life (OHRQoL) measures are increasingly being used in epidemiological studies of dentistry, and previous studies have identified a relationship between oral status and OHRQoL.¹⁻⁶ In clinical practice, however, a gap is present between treatment outcomes and patient satisfaction, especially among elderly patients.^{7,8} Distinction between objective assessment (by the clinician) and subjective assessment (by the patient) is important. Objective measures are measures of stages of disease processes, not measures of health. Subjective measures deal with health and the impact of disease on health. The correlation between subjective and objective measures is often moderate to weak.

Wilson and Cleary developed a conceptual model of the relationship between general health and measures of patient health-related QoL. They concluded that characteristics of the individual and environment affect QoL both directly and indirectly.⁹

Specifically, personality has been related to the functional status of the patient. In the field of medicine, one study showed that personality had a greater impact on QoL after colorectal surgery for malignant disease than did common clinical variables such as underlying disease and the presence of a stoma.¹⁰ In another study, the QoL scores among patients with head and neck cancer were partly predicted by treatment-related factors (e.g., TNM stage and treatment level), but were 2.5 to 10.0 times more closely associated with psychological factors.¹¹

Several studies in the field of dentistry have demonstrated a relationship between QoL and patient personality. More than 20 years ago, van Waas et al. described a relationship between patient satisfaction and psychological factors in wearers of complete dentures.¹² Kressin et al. concluded that negative affectivity, which is a general disposition to experience subjective distress, was significantly associated with OHRQoL ratings in a study of older men.¹³ Another study found that neuroticism, extraversion, and openness may influence dental perceptions and play a significant role in shaping satisfaction with dentition in younger people.¹⁴ Thomson et al. suggested that personality may be related to oral health by affecting patients' self-reported health, increasing the risk of oral disease and altering their attitudes to disease.¹⁵

However, no consensus regarding the association between personality and OHRQoL has yet been reached. Furthermore, our previous studies illustrated a significant association among number of teeth, masticatory performance, occlusal

force, and OHRQoL.^{3,16} Thus, both oral status and personality have been individually associated with OHRQoL, but no study has concurrently examined the association among personality traits, oral function, and OHRQoL. Although one study examined the number of remaining teeth in their study participants,¹³ we do not consider this to be an adequate objective assessment of oral function.

We hypothesized that personality traits are associated with OHRQoL independently of oral status and function. Thus, the aim of this study was to examine the association of personality traits, dental status, and oral function with OHRQoL in a large sample of community-dwelling elderly Japanese.

2. Methods

2.1. Study population and procedure

This was a cross-sectional examination of data collected during the baseline assessment of a prospective study of health and longevity called Septuagenarians, Octogenarians, Nonagenarians Investigation with Centenarians (SONIC). The research data were collected from two main regions of eastern and western Japan (the Tokyo metropolitan area and Hyogo Prefecture, respectively). Two additional areas (an urban area and a rural area of each region) were included in each of the main regions: Itami City, Hyogo (western, urban); Asago City, Hyogo (western, rural); Itabashi ward, Tokyo (eastern, urban); and Nishitama County, Tokyo (eastern, rural). Our sample of study participants was drawn from a complete enumeration of the district. The study participants and procedure are detailed elsewhere.¹⁷

The study protocol was approved by the Institutional Review Board of Osaka University Graduate School of Dentistry (approval number H22-E9). Participants with no occlusal contact with their own teeth or prostheses were excluded because of the inability to measure their bite force. This was the only exclusion criterion. All participants in this study gave written informed consent to participate.

2.2. Numbers of remaining and carious teeth, denture use, and maximal occlusal force

Registered dentists performed all dental examinations with a dental mirror and an explorer without X-rays, and the numbers of remaining and carious teeth and use of removable dentures were recorded. The presence of crown and root caries requiring restorative treatment was detected by means

of visual and tactile examination. In this study, a crown lesion reaching the dentin layer or a root lesion with a softened surface was defined as a dental caries. Teeth with initial and arrested lesions were not considered to be carious teeth.

Evaluation of masticatory performance involves a comprehensive evaluation of oral function with respect to eating, but such evaluation is impractical in a large number of elderly people because it is very time-intensive. Therefore, we used the maximal occlusal force as a proxy measurement because it is highly correlated with the objectively measured masticatory performance¹³⁻²² and can be tested in just a few seconds. The bilateral maximal occlusal force was measured with pressure-sensitive sheets of 97- μm thickness (Dental Prescale 50H R type; Fuji Film Co., Tokyo, Japan).²³ The participants performed maximal clenching in the intercuspal position with the pressure-sensitive film placed between the maxillary and mandibular dental arches. Participants with removable partial dentures kept their dentures in place during measurement. The inter-examiner and intra-examiner reliability of this type of measurement is described elsewhere.¹⁷

2.3. Subjective measures

2.3.1. OHRQoL measures

OHRQoL was measured with the 12-item Japanese version¹⁶ of the Geriatric Oral Health Assessment Index (GOHAI).²⁴ Among several measures of OHRQoL, the Oral Health Impact Profile (OHIP)²⁵ and the GOHAI are currently the most comprehensive. In this study, we used the GOHAI because it gives greater weight to functional limitation and pain/discomfort and has a weaker "ceiling effect" than does the OHIP-14.^{16,26} The GOHAI has demonstrated high reliability and validity, and the 12 questions are designed to assess functional limitations, pain and discomfort, psychological impacts, and behavioural impacts. Responses were based on a six-point Likert-type scale for each item (all the time = 0, very often = 1, fairly often = 2, sometimes = 3, seldom = 4, and never = 5). The total GOHAI score was derived by summing the scores for each item, and thus ranged from 0 to 60, with higher scores indicating better OHRQoL.

The validity and reliability of the GOHAI had been confirmed. The internal reliability of the GOHAI in this study population was calculated with Cronbach's α for all items and found to be high (0.86). The test-retest reliability of the instrument was previously calculated for a similar population using the intraclass correlation coefficient, which was 0.77 for the GOHAI.³

2.3.2. Personality traits

We administered the Japanese version of the NEO-five-factor inventory^{27,28} to measure the major personality traits.

The big-five model is the predominant model of personality in psychology. The NEO Personality Inventory measures five main personality traits: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. The test used in the present study comprised 60 questions that analysed these five major personality dimensions: neuroticism (including anxiety, angry hostility, depression, self-consciousness, impulsiveness, and vulnerability), extraversion (including warmth, gregariousness, assertiveness,

activity, excitement-seeking, and positive emotions), openness (including fantasy, aesthetics, feelings, actions, ideas, and values), agreeableness (including trust, straightforwardness, altruism, compliance, modesty, and tender-mindedness), and conscientiousness (including competence, order, dutifulness, achievement striving, self-discipline, and deliberation). Each dimension was assessed using 12 questions, and the participants were asked to indicate on a five-point scale how much each parameter applied to them. This test is a comprehensive method for measuring personality, has good reliability and validity, and is the gold standard for personality assessment.

2.4. Sociodemographic characteristics

The sociodemographic characteristics measured in the present study were selected from among the variables previously reported to be associated with OHRQoL. Each participant also was interviewed regarding their sociodemographic characteristics by one of the psychologists using a standardized questionnaire. Gender, self-rated financial status (dissatisfied, moderate, or satisfied), highest education level (junior high school, higher school/technical school, or university degree), and family structure (living alone or living with spouse or child's family) were recorded because they are reportedly associated with OHRQoL.^{1,24,29}

2.5. Statistical analysis

Data analysis was conducted using SPSS Version 19.0 for Windows software (SPSS Inc., Chicago, IL, USA). Spearman's rank-order correlation coefficient was calculated to determine the association between the GOHAI score and the number of teeth, number of carious teeth, maximal occlusal force, and personality traits. The Mann-Whitney U test was used to compare the GOHAI scores for different genders, education levels, financial status, family structures, and denture use. A multiple linear regression analysis was carried out to test the association between each explanatory variable and the GOHAI score after controlling for the other factors. We used multiple regression analysis in three stages: the first included control variables only (gender, financial status, education level, and family structure), the second added the number of remaining teeth and occlusal force, and the third added personality traits. The GOHAI score was square-root-transformed to prevent violation of the normal distribution of the standardized residual value of the model.^{16,26} The aforementioned explanatory variables were introduced into three models using the enter method. In all cases, $p < 0.05$ was considered to denote a statistically significant difference.

3. Results

We collected complete data from 938 participants (443 men, 495 women). The mean \pm standard deviation of the number of remaining teeth was 20.3 ± 8.6 . These data showed that 762 (81.2%) participants had at least one missing tooth, while 73 participants (7.8%) were edentulous in a single arch and 43 (4.6%) were completely edentulous. In contrast, 176 participants

Table 1 – Median GOHAI score, by sociodemographic characteristics.

Variables	n	%	Median GOHAI score (25–75%)	p-Value
Gender				
Male	443	47.2	52 (46–56)	0.508
Female	495	52.8	52 (48–57)	
Educational level				
High school and more	698	74.4	53 (47–57)	0.031
Junior high school	240	25.6	51 (46–56)	
Financial status				
Moderate/satisfied	729	77.5	53 (48–57)	<0.001
Dissatisfied	209	22.5	50 (45–55)	
Family structure				
Living alone	116	12.4	51 (45–57)	0.418
Living with family	822	87.6	52 (47–56)	
Removable denture use				
Non-wearer	573	61.1	54 (50–58)	<0.001
Wearer	365	58.9	49 (44–54)	

Statistical analysis performed using Mann–Whitney *U* test. Significance was accepted at $p < 0.05$.

(18.8%) had ≥ 28 teeth. The mean number of carious teeth was 0.57. The mean maximal occlusal force was 515 ± 320 N.

The mean and median GOHAI scores were 50.83 and 52, respectively. The median GOHAI scores subgrouped by socio-demographic characteristics are presented in Table 1. Bivariate analyses using the Mann–Whitney *U* test showed no significant difference in the GOHAI score according to gender and family structure. In contrast, participants who graduated from high school, who were in good financial condition, and/or did not wear a removable denture had better GOHAI scores than did participants who did/were not (Table 1).

The number of teeth (Spearman rank-order correlation coefficient (r_s) = 0.427), number of carious teeth (r_s = -0.092), occlusal force (r_s = 0.401), neuroticism (r_s = -0.204), extraversion (r_s = 0.170), openness (r_s = 0.070), agreeableness (r_s = 0.121), and conscientiousness (r_s = 0.162) were each significantly correlated with the GOHAI score (Table 2).

In the incremental regression analysis (Table 3), we defined three models in which various factors were gradually added to assess their impact, both in isolation and in combination, on OHRQoL. In the first regression model, which included only possible confounding factors (gender, education level, financial status, and family structure), the independent variables explained only 2.5% of the variance, and only financial status was significantly associated with OHRQoL (standardized partial regression coefficient (β) = 0.125). In the second model,

Table 2 – Correlation between GOHAI score with oral status, maximal occlusal force and personality traits.

Variables	r_s	p-Value
Number of teeth	0.427	<0.001
Number of caries teeth	-0.092	0.005
Occlusal force	0.401	<0.001
Personal traits		
Neuroticism	-0.204	<0.001
Extraversion	0.170	<0.001
Openness	0.070	0.032
Agreeableness	0.121	<0.001
Conscientiousness	0.162	<0.001

$n = 938$. ' r_s ' denotes the Spearman rank-order correlation coefficient.

which included oral status, the R^2 value was 0.186 (greater than that in the first model). Both the number of teeth (β = 0.176) and maximal occlusal force (β = 0.236) were significant variables. In the final model, in which personality traits were added to the second model, R^2 was 0.249 (highest value of the three models). In this model, in addition to the factors already identified as being significantly linked to OHRQoL, we showed that neuroticism (β = -0.179) and extraversion (β = 0.094) were significantly related to OHRQoL after controlling for other variables. The maximal occlusal force (β = 0.237), number of teeth (β = 0.155), and denture use (β = -0.095) remained significant variables and had comparable standardized partial regression coefficients. Financial status was still significantly associated with OHRQoL. Occlusal force, the number of teeth, and each personality trait were independent of one another because the variance inflation factors for these independent variables were <2.5.

4. Discussion

In the present study, personality traits were associated with OHRQoL independently of dental status and objective measures of oral function in independent elderly Japanese. Neuroticism and extraversion were, respectively, negatively and positively correlated with OHRQoL.

In this study, dental, medical, and psychological professionals comprehensively evaluated health and longevity in the same individuals. Because of the numerous measurements and statistical methods used, the sample size needed to reflect power considerations. We estimated the total sample size to be about 904 by G*Power software when the defined effect size was small, α error was 0.05, power = $1 - \beta$ error was 0.8, and number of predictors was 13 in the multiple linear regression. Therefore, a sample of 938 subjects was sufficient for our study.

We recruited community-dwelling Japanese in the 69- to 71-year age range and conducted an oral examination on each subject. According to the most recent Japanese national survey in 2011,³⁰ the mean number of teeth in 65- to 69-year-olds was 21.2 and that in 70- to 74-year-olds was 17.3.

Table 3 – Multiple regression analysis models for assessing correlation between GOHAI scores and number of teeth, maximal occlusal force, personality traits and confounding factors as independent variables.

		β	p-Value	Adjusted R ²	VIF
Model 1	Gender	0.003	0.917	0.020	1.037
	Educational level	0.063	0.054		1.014
	Financial status	0.125	<0.001		1.027
Model 2	Family structure	-0.045	0.171	0.186	1.041
	Gender	0.030	0.329		1.078
	Educational level	0.000	0.996		1.042
	Financial status	0.098	0.001		1.047
	Family structure	-0.042	0.166		1.043
	Number of teeth	0.176	<0.001		2.395
	Number of caries	-0.046	0.129		1.041
	Denture use	-0.064	0.128		2.039
Model 3	Occlusal force	0.236	<0.001	0.249	1.583
	Gender	0.047	0.133		1.189
	Educational level	-0.012	0.692		1.087
	Financial status	0.071	0.015		1.065
	Family structure	-0.046	0.115		1.060
	Number of teeth	0.155	<0.001		2.412
	Number of caries	-0.035	0.227		1.046
	Denture use	-0.095	0.020		2.056
	Occlusal force	0.237	<0.001		1.594
	Neuroticism	-0.179	<0.001		1.202
	Extraversion	0.094	0.004		1.318
	Openness	-0.014	0.645		1.217
	Agreeableness	0.022	0.512		1.387
Conscientiousness	0.065	0.049	1.334		

Dependent variable: GOHAI score; β : standardized partial regression coefficient; gender: male = 0, female = 1; education level: junior high school = 0, high school and more = 1; financial status: dissatisfied = 0, moderate/satisfied = 1; family structure: living with family = 0, living alone = 1. Denture use: non-wearer = 0, wearer = 1. 'VIF' denotes the variance inflation factor.

The mean number of teeth in this study was 20.3, and we considered this group to be an accurate reflection of the national average for similarly aged Japanese. Regarding education level, 27.6%, 48.1%, and 24.3% of our subjects had ≤ 9 years, 10 to 12 years, and ≥ 13 years of education, respectively, while 35.9%, 48.7%, and 15.4% of individuals in the Japanese census of 2010 had reached these respective education levels.³¹ In terms of family structure, 12.7%, 48.2%, and 39.1% of our subjects lived alone, lived with a spouse, and lived with a child's family, respectively, while 13.7%, 43.5%, and 42.7% of individuals in the Japanese census of 2010 reported these respective family structures. The family structures of our study population were comparable with those reported in the national data; however, the overall education level was relatively higher than that reported in the national data.

The narrow age range in this study is a disadvantage to generalizability. However, the narrow age range is also an advantage because health consciousness and oral health strongly reflect one's social situation and the era in which one has grown up, neither of which can be adjusted by statistical procedures. For example, whereas 24.1% of 80-year-old Japanese people had ≥ 20 teeth in 2005, 38.3% of Japanese people in the same age group had ≥ 20 teeth only 6 years later in 2011.³⁰ One of the advantages of this study is that the participants were homogeneous in age, and a generation gap was thus avoided.

Spearman rank-order tests showed that all personality traits were correlated with the GOHAI score. However, the correlation coefficients, excluding that for neuroticism, were

small. The negative relationship between neuroticism and OHRQoL is consistent with previously reported findings.³²

The incremental regression analysis results partially support our hypothesis. The number of teeth and maximal occlusal force were associated with the GOHAI score, and neuroticism and extraversion were independently associated with the GOHAI score. The association between the GOHAI score and both education level and financial status is consistent with previous studies demonstrating a role of education²⁹ and financial condition³³ in the prediction of OHRQoL.

In many medical conditions, the patient's personality is a major factor related to QoL. Such conditions include Parkinson's disease³⁴; cancers of the stomach,³⁵ breast,³⁶⁻³⁸ colorectum,³⁹ and head and neck⁴¹; menopause⁴⁰; and a history of receiving a kidney⁴¹ or bone marrow transplant.⁴² However, the relationship between personality and QoL has been rarely investigated in the field of oral health. Almost all previous studies have shown profound effects of neuroticism on reported QoL in patients with a variety of malignant diseases, but the mechanism by which this effect occurs requires further consideration. Costa and McCrae stated that symptom reporting may be biased by neuroticism,⁴³ and we hypothesize that highly neurotic individuals tend to perceive and/or complain more about health concerns.¹³ Neuroticism, a fundamental personality trait, is defined as a disposition to experiencing subjective distress and aversive mood states. Neurotic individuals consistently report worse self-perceived health.⁴⁴

Conversely, extraversion is associated with an outgoing nature and less severe feelings of stress. Extraverts tend to perceive their health status more positively.⁴⁵ The effect of

extraversion on OHRQoL, which was positive in our study, differs across existing studies but is hypothesized to improve coping resources for dealing with troublesome symptoms.^{36,42} After adding personality traits, the partial correlation coefficients for the number of remaining teeth and occlusal force showed little change from those determined in Model 2, whereas the personality traits themselves showed some correlation with OHRQoL. These results suggest that personality traits must be taken into consideration when assessing OHRQoL. Elderly people with high neuroticism and low extraversion were more likely to have a low OHRQoL score, irrespective of oral status. Indeed, Watson and Pennebaker stated that "individuals high in neuroticism are more likely to over-report physical symptoms and to experience negative emotions in response to difficult circumstances and consequently report a lower QoL."¹⁶ Several studies that performed objective health assessments demonstrated associations between self-rated QoL and not only objective assessment measures, but also personality in patients with head and neck cancer^{11,47} and colorectal disease.¹⁰ However, until now there has been no evidence of an association among objective oral function, personality traits, and QoL. As stated in previous studies, personality traits seem to be related to the oral health status and self-rated oral function.

In the present study, we did not identify any associations between treatment results and patient satisfaction. However, almost all elderly people have a history of oral disease and dental treatment. Therefore, self-assessment of an individual's present oral health status may be related to satisfaction with previous treatment. The demands of elderly patients for dental treatment are becoming increasingly complex, so it is worth evaluating patient personality traits prior to dental treatment and predicting patient expectations and responses to planned treatment. This may be advantageous in determining the most appropriate therapy (i.e., that which is most likely to be tolerated) for a given patient.

Several aspects of our study design limit our conclusions. The first point of concern is the narrow range of our study population, which included only nonclinical, noninstitutionalized, 70-year-old community-dwelling Japanese people, most of whom were physically and cognitively healthy despite the sample being drawn from a complete enumeration of the resident record. All study participants came to the research venue voluntarily by referring to the map and were considered cognitively eligible. As a result, persons with dementia were spontaneously excluded from this study. Consequently, our results cannot be generalized to younger, older, or less healthy people. Unfortunately, calibration of the dental examination among the examiners could not be performed. However, all of the examiners were registered prosthodontists of the Japan Prosthodontic Society; therefore, the results of the examinations are expected to be reliable.

Another point of limitation is that along with most other studies in this area, our study was cross-sectional rather than longitudinal in nature, rendering it difficult to identify any causal relationships. However, we are following up the participants every 3 years in an effort to establish causal connections among personality traits, changes in oral status, and QoL. Numerous possible confounders of OHRQoL exist; however, a considerable number of them are unknown, and

we could not address the full range of confounders in the present study.

In conclusion, personality traits are associated with OHRQoL independently of dental status and oral function in community-dwelling 70-year-old Japanese people.

Conflict of interest statement

There is no conflict of interest in relation to this research.

Acknowledgments

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特集

患者中心医療のための糖尿病患者評価—合併症

歯周病*

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Key Words: periodontal disease, periodontopathic bacteria, inflammatory response, diabetes mellitus

歯と歯周組織の特徴

歯は、軟組織である歯髄(いわゆる歯の神経)を硬組織である象牙質とエナメル質が取り囲む構造を有し、その歯冠部が歯肉(歯ぐき)から口腔内に萌出している。一方、歯周組織は、硬組織である歯槽骨およびセメント質と、軟組織である歯肉および歯根膜の4つの組織から構成され、歯の歯根部分を、セメント質、歯根膜、歯槽骨が順に積層し、歯肉がそれらを被覆し歯を支持している(図1)。このように、歯と歯周組織は、体表面近傍で硬組織と軟組織が隣接して存在する身体の中でも特にユニークな解剖学的および組織学的特徴を有している¹⁾²⁾。

歯周病とその進行

歯周病は、歯と歯肉の境界部に存在するデンタルプラーク(歯周病細菌により形成された細菌バイオフィルム)³⁾が原因となり歯周組織が破壊される慢性炎症性疾患である⁴⁾。歯周病は大きく分けると、その初期段階の歯肉炎と進行した歯周炎に分類される。歯肉炎は、乳歯列期を含め

若年層から発症するが、歯周炎は通常35歳以上に好発する(慢性歯周炎)。また、罹患率は低いが、35歳以下で発症し急速に進行する侵襲性歯周炎や遺伝性疾患(表1)の合併症として歯周病が発症することもある。そして、歯周病の大きな特徴は、その罹患率が非常に高いことで、軽症の人まで含めるとわが国の成人の80%以上が罹患している⁴⁾。

歯周病に罹患していない健康な状態では、歯と歯肉の接合部には1~2mmの歯肉溝と呼ばれる陥凹が存在する。そして、歯肉溝の底部で、ヘミデスマゾーム(hemidesmosome)と呼ばれる特殊な接着様式で歯肉上皮とエナメル質が付着することにより歯と歯肉が接合している。この歯肉溝付近に、口腔清掃不良によりプラークが付着した状態が持続すると、炎症反応が惹起されまず歯肉の発赤や歯冠方向への歯肉の腫脹が生じ、歯肉溝が深くなりポケット(歯肉ポケット)が形成される。このような状態を、歯周病の初期段階である歯肉炎と呼ぶ。歯肉炎が未治療のまま長期間放置されると、歯と歯肉の接合部の付着が傷害され、接合部が根の先端(根尖)方向へ移動し、歯の周囲にさらに深いポケット(歯周ポケット)が形成される。このような状態になると、歯肉だけではなく歯根膜などの深部歯周組織に炎症が波及し歯槽骨にも破壊や吸収が生じ、歯周病の中でも進行した歯周

* Periodontal disease.

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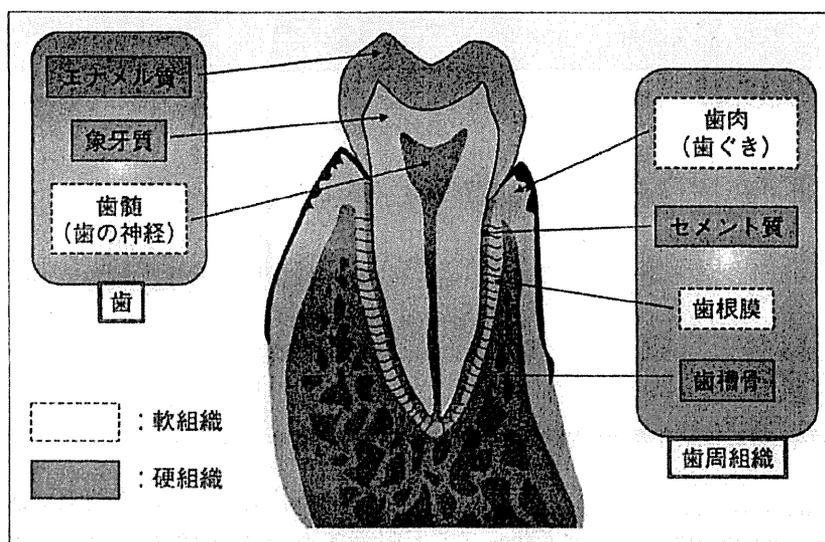
図1 健康な歯と歯周組織の構造(文献⁹⁾より引用改変)

表1 歯周炎を随伴する遺伝疾患

1. 家族制周期性好中球減少症
2. Down症候群
3. 白血球接着能不全症候群
4. Papillon-Lefevre症候群
5. Chediak-Higashi症候群
6. 組織球症候群
7. 小児遺伝性無顆粒球症
8. グリコーゲン代謝疾患
9. Cohen症候群
10. Ehlers-Danlos症候群(III, VIII型)
11. 低アルカリフォスファターゼ血症
12. その他

(文献⁹⁾より引用)

炎と呼ばれるようになる。そして、歯周炎がさらに進行し重症化すると、歯槽骨の吸収が進み歯が動揺するようになり、最終的には歯が脱落することとなる(図2)。

感染症としての歯周病の特徴

歯周病は、歯周病細菌が原因となり発症する細菌感染症である。しかしながら、原因菌の多様性や感染様式等の点で通常の感染症とは大きく異なっている。すなわち、歯周病では特定の細菌が単独で感染源となるのではなく、歯周炎の発症や進行に関与する可能性が特に高いとされる *Porphyromonas gingivalis*, *Tannerella forsythia*, *Treponema denticola* の3菌種をはじめ、

侵襲性歯周炎と密接に関連すると考えられている *Aggregatibacter actinomycetemcomitans* など10数種類以上の嫌気性グラム陰性菌が有力な歯周病原菌として歯周病の発症・進行に関与していると考えられている⁹⁾。そして、歯周病では、その原因となる歯周病細菌が厳密には生体外と考えられる外界と交通した口腔内に存在する歯や歯肉の表面に付着したり、あるいはポケット内に浮遊して存在することから、原因菌が生体の免疫系の働きによる排除機構を十分受けない。そのため、多くの細菌感染症と異なり、感染源を人為的に除去しない限り、歯周病が自然治癒することはない。また、これらの歯周病細菌の多くは口腔内の常在菌で、細菌自らが産生した菌体外多糖(glycocalyx)に被覆され共生・集合した細菌バイオフィーム³⁾を形成している。この細菌バイオフィームが生体の免疫系や抗菌薬に対するバリアとして機能し、歯周病の難治化の要因になっている。

歯周病の発症メカニズム

歯周病は、歯周病細菌の持続的感染により歯周組織が障害され発症・進行する(図3)。すなわち、ポケット近傍に存在する歯周病細菌の産生する酵素(コラゲナーゼ、プロテアーゼなど)、毒素および代謝産物が歯周組織に直接作用して障害を与える。一方、歯周病細菌に対する宿主の感染防御機

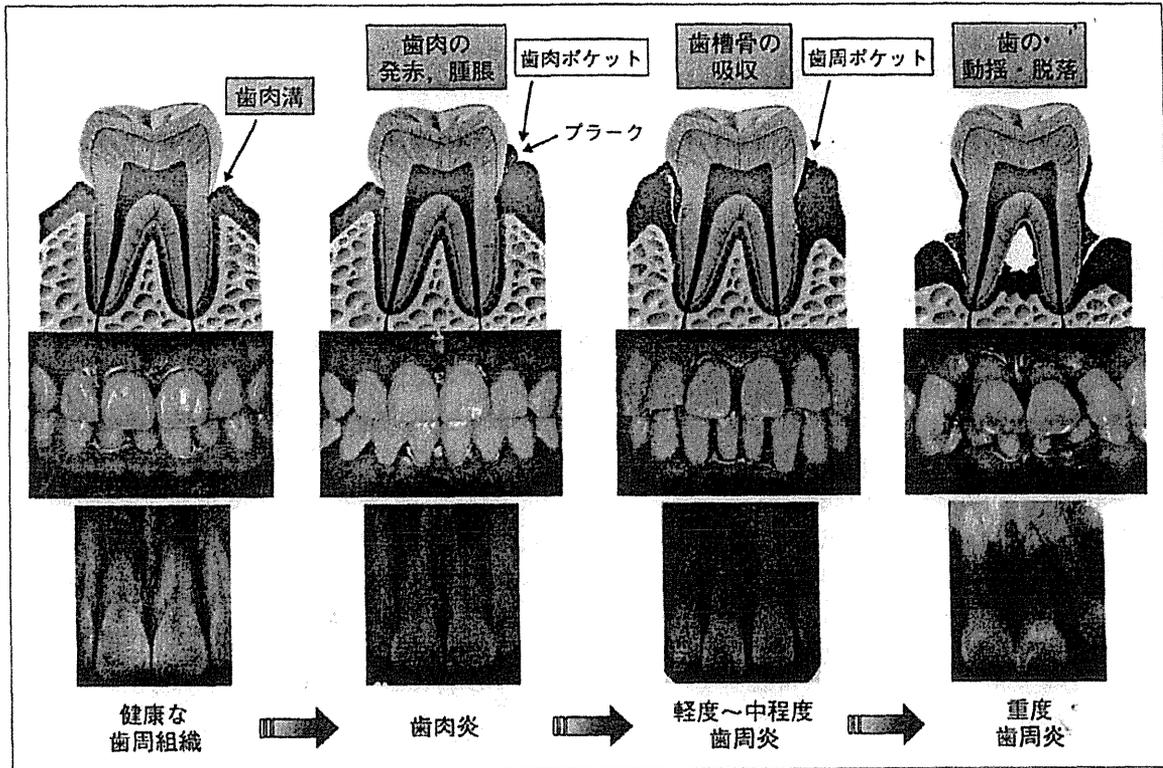


図2 歯周病の進行(文献²⁾より引用改変)

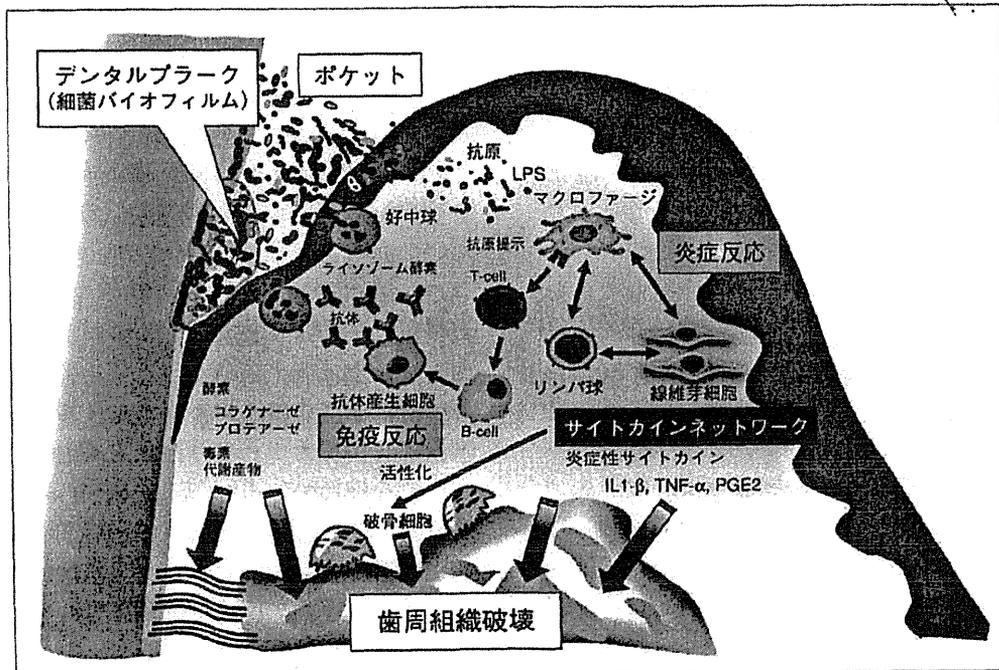


図3 歯周病の発症メカニズム(文献²⁾より引用改変)

構として生じる免疫反応や炎症反応が、結果として歯周組織に障害的に働き歯周組織破壊を惹起する。たとえば、好中球は、ポケットに接する歯肉

上皮直下で、あるいは歯肉溝滲出液とともにポケット内に遊走して歯周病細菌を食食・融解し、ライソゾーム酵素を放出し歯周組織のコラーゲン線維

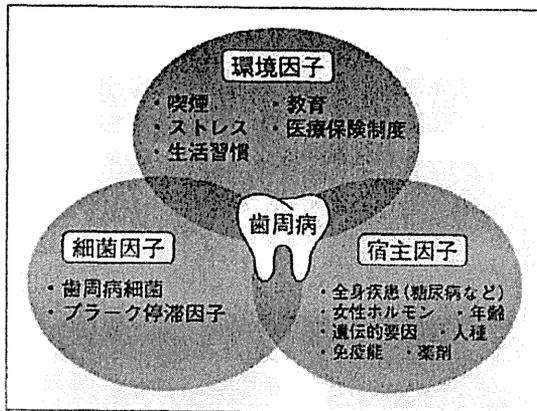


図4 歯周病のリスクファクター
(文献²⁾より引用改変)

の分解を亢進させ結合組織の脆弱化を招く。また、歯周病細菌を貪食・処理するために歯周組織に集積したマクロファージや好中球などの食細胞は、貪食後、インターロイキン1- β (IL-1 β)や腫瘍壊死因子- α (TNF- α)などのさまざまなサイトカインやプロスタグランジンE₂ (PGE₂)などの生理活性物質を放出し、サイトカインネットワークを形成し、線維芽細胞などの歯周組織構成細胞を障害したり、破骨細胞を活性化させ歯槽骨吸収を惹起する。一方、リポ多糖などの歯周病細菌由来の抗原を貪食・処理したマクロファージは、ヘルパーT細胞にその情報を伝え、B細胞を抗原特異的抗体を産生する抗体産生細胞(形質細胞)へ分化させて、歯周病細菌の排除を図る。

歯周病の病態決定とそのリスク因子

歯周病では歯周病細菌による持続的な感染が生じるため、その病態は、原因である歯周病細菌と宿主の生体防御機能とのバランスに影響される¹²⁾。そのため、白血病やAIDSなどの免疫不全を伴う疾患などを有する患者では、歯周病の発症や進行のリスクが高くなると考えられる。また、副作用として歯肉肥大を発症するカルシウム拮抗薬・抗てんかん薬(フェニトイン)・免疫抑制薬(サイクロスポリン)などの薬も、歯周病の病態に影響を及ぼす。そして、歯周病は喫煙やストレスなどの生活習慣に影響を受けることも疫学調査で明らかにされている。このように、現在では、細菌因子だけではなく、年齢、免疫能、全身疾患、遺伝的要因、薬物、人種な

どの宿主因子、そして喫煙、ストレス、口腔環境への関心度、生活習慣、医療保険制度などの環境因子などのリスク因子が複雑にからみ合い、歯周病が発症したり進行したりすると考えられている^{4)~6)}(図4)。

歯周病の治療⁴⁾

歯周病の原因はデンタルプラークであることから、デンタルプラークを除去し、プラークが付着しにくい口腔環境を作り出すこと(プラークコントロール)が歯周病の治療の基本となる⁴⁾。プラークコントロールには、歯ブラシなどの清掃器具を用いて患者自らプラーク除去を行うセルフコントロールが不可欠である。そして、患者自身では除去できないポケット内などのプラークコントロールには、歯科受診が必要である。すなわち、歯周病に罹患した歯の歯根面に付着したプラーク、歯石などの沈着物を機械的に除去するスケーリング(scaling)と細菌により汚染された粗造なセメント質の除去を行うルートプレーニング(root planing)が、通常まず行われる。そして、これらの処置を行っても十分に病状が改善しない場合には、歯周外科処置が行われることもある。しかしながら、これら治療により歯周病の感染源を除去し、その進行をくい止めることができても、歯周組織が罹患前の健康な状態に回復することは通常期待できない。一方近年、人工膜を用いる歯周組織再生誘導法(GTR法)や歯周組織再生誘導材料(エムドゲイン®ゲル)を用いた歯周組織再生療法が開発され、歯根膜、歯槽骨、セメント質などの歯周組織の部分的な再生が可能となっている。また、歯周病は口腔内の常在菌が原因となり発症するため再発しやすい。そのため、再発防止のために定期的にプラーク除去を行う歯周組織維持療法(SPT)が不可欠である。その他、徐放性を有する局所抗菌薬が、歯周病が急性化したケースやSPTにおいてスケーリングなどによる機械的なプラーク除去が困難なケースに対して臨床応用されている。

歯周病と糖尿病との関連

糖尿病と歯周病との関連性が以前から強く指摘されている^{1)4)~8)}。糖尿病患者は、1型、2型



図5 1型糖尿病患者(26歳)にみられた重度歯周炎

X線検査の約1か月後に口腔内写真を撮影した。この間に自然脱落した歯があり、口腔内写真(A)とX線写真(B)の残存歯に不一致がみられる。(文献⁵⁾より引用)

にかかわらず、健常者と比較して有意に歯周病を発症する頻度が高い。そして、糖尿病における血糖コントロールの状態と歯周病との関連性について、糖尿病で血糖コントロールが不良な患者は、血糖コントロールの良好な患者と比較して、歯周組織破壊や歯周炎の罹患率が高いことが示されている。図5は、26歳の重度歯周炎に罹患した1型糖尿病患者の口腔内およびX線写真である。1型糖尿病に伴う好中球の機能異常があり、口腔清掃などのプラークコントロールが十分行われなかったため、このような著しい炎症所見を示す重度の歯周炎に罹患し、多数歯の喪失に至ったものと考えられる⁵⁾。このように、糖尿病患者には、好中球機能異常、コラーゲンの代謝異常、微小循環障害による創傷治癒不全や易感染性などが認められることが多く、糖尿病に伴う宿主の免疫応答の低下や結合組織の代謝異常が、歯周病の重症化をもたらすものと考えられる。

歯周病による炎症やその原因となる細菌感染は、局所に限局した小規模なものと考えがちであるが、その細菌密度や炎症範囲から実際にはかなり大きな炎症巣や細菌感染源が存在する¹⁾²⁾⁶⁾。そのため、歯周病が原病巣となり全身性の二次的疾患を惹起する病巣感染の可能性が以前から示唆されている。近年、糖尿病と歯周病との関連においても、糖尿病から歯周病への方向とは逆に、糖尿病に対する歯周病の影響が検討されている。その結果、歯周病の治療を行うことによりヘモグロビンA1c(HbA1c)が低下することが報告され⁷⁾⁸⁾、2型糖尿病患者を対象にしたラン

ダム化比較試験を集積しメタ解析を行ったシステマティックレビュー⁹⁾¹⁰⁾で、歯周病の治療を受けた糖尿病患者は、治療を受けない患者と比較し、おおむね平均0.4%程度のHbA1c値の減少が認められることが示されている。一方、最近、歯周病の治療が糖尿病患者のHbA1c値を減少させないとする中規模のランダム化比較試験の結果が報告され¹¹⁾、期間を置かずそれに対する反証¹²⁾もなされている。また、わが国で行われた2型糖尿病患者を対象にした研究では、慢性炎症の指標となる高感度CRPと関連して、糖尿病患者のHbA1c値が減少することが報告されている¹³⁾。以上、これらを総合的に判断すると、現段階では、歯周治療を行うことにより糖尿病の病態が改善されることを示すエビデンスが多いが、異なった研究結果がも示されていることから、さらに検討が必要である。

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The Role of Public Health Nurses in Japanese Long-term Care Prevention Projects in the Community

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Abstract

As the frontrunner of ageing countries, we would like to introduce the role of public health nurses in Japanese long-term care prevention projects in the community and our research on healthy longevity in this review article. Previous studies in Japan reported that lack of participation in social activities was significantly related to an increased risk to suffer from disability and subsequently requiring the application of Japanese long-term care insurance. As for primary/secondary prevention for old populations, public health nurses are expected to develop and utilize the social capital in health promotion interventions at individual and community levels in Japan. Since 2006, long-term care insurance was revised focusing on preventive care by detecting people aged 65 years and older who are at high risk of needing future care or support. There will be increasing demand for health care professionals to promote a community's overall health status in cost-effective ways, and public health nurses should play an important role to make it.

Keywords: Aged society; Community; Long-term care prevention; Public health nurse; Old-old; Young-old

Introduction

According to the Japanese national census, over the past 50 years the percentage of the older population has increased fourfold from 5.7% in 1960 to 23.1% in 2010 [1]. This increasing rate is the fastest in the world. As the frontrunner of ageing countries, we would like to introduce the role of public health nurses in Japanese long-term care prevention projects in the community in this article. In this article, the following definition applies to public health nursing according to American Public Health Association: "Public health nursing is the practice of promoting and protecting the health of populations using knowledge from nursing, social, and public health sciences" [2].

Primary prevention for long-term care

The percentage of the older population is estimated to continue increasing rapidly and reach up to 26.8% in 2015 as reported by the National Institute of Population and Social Security Research [3]. Japan will face a super-aged society in the near future, in which 40% of the population will be over 65years-of-age [3]. However, prolongation of life expectancy is inevitably associated with greater numbers of frail old people who need help in daily activities. The percentage of the old-old population (aged 75 years and over) in 2012, comprising more frail people compared to the young-old population, exceeded 11.9% of the nation's population in Japan [3].

In such a situation, many older Japanese wish to be healthy for their entire life and continue to live in their hometown with a sense of security until the end of their life. Under such circumstances, we should establish a society in which old people can enjoy a healthy, satisfying life through social participation and contribution. For an active ageing society, the World Organization (WHO) policy

framework requires action on the following three basic pillars: Health, Participation and Security. As for the policy framework, enhanced participation in social activities is required to attain the goal of active aging [4]. Also in Japan, the government started the Health Japan Project (the 2nd term) in April 2013, which is a 2nd version of a 10-year national campaign intended to prolong length of healthy life and to improve quality of life. As many older retired peoples are expected to have more time to participate in various activities in the community, participation in social activities would increasingly play a key role in contributing to the health of older adults in today's aging society in Japan [5].

Previous studies have investigated the association between participation in social activities and various health outcomes [6]. In a study in Sweden, it was found that social participation was the strongest predictor of low physical activity [7]. Also in a study conducted in Japan reported that lack of participation in social activities was significantly related to an increased risk to suffer from disability and subsequently requiring the application of Japanese long-term care insurance (LTCI) [8]. In addition, participation in social activities is supposed to be very important in the community, since it may develop social capital. Social capital refers to the quantity and quality of social relationships such as formal and informal social connections as well as norms of reciprocity and trust that exist in community [9]. Many recent studies have found that high levels of social capital are associated with better health [10,11].

Since public health nurses are the main community health practitioner who had been promoted and protected the health of populations, as for primary/secondary prevention (Figure 1) for old populations, public health nurses are now expected to develop and utilize the social capital in health promotion interventions at individual and community levels in Japan [12].

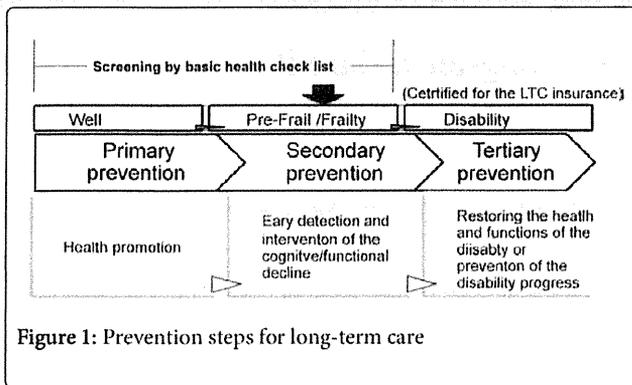


Figure 1: Prevention steps for long-term care

LTC; long term care

Secondary prevention for long-term care

An increase in long-term care expenses due to the increase of an aging population can affect the insurance premiums of both the old and the actively working generation [13]. With the comprehensive reform of social security and the tax system, establishing an integrated community care system and ensuring the sustainability of the Japanese long-term care insurance (LTCI) system is an essential topic [13]. LTCI in Japan was introduced in 2000 to cover social care for 2 million people aged 65 years and older, and the number of insured people under LTCI doubled by 2006 [14]. Since 2006, LTCI was revised focusing on preventive care by detecting people aged 65 years and older who are at high risk of needing future care or support [15]. The preventive care project provides community-based exercise programs and programs to improve cognitive function and malnutrition status. Many local governments are trying to detect community dwelling older people who are at high risk, using the basic health check list called "Kihon Checklist" (Table 1) [14]. The basic health check list consists of 25 items and seven categories (daily life, physical ability, nutrition, oral condition, seclusion, forgetfulness, and mind) for the screening of older people who have functionally or cognitively declined [16,17]. A subject is identified as showing "low physical strength" if they score three or more negative responses in questions 6-10. "Low nutritional status" is assessed by answers to both questions 11 and 12, with negative answer indicating lower status, and "low oral function" was defined as two or more negative responses in questions 13-15. A subject is identified as showing frailty if they answered at least 10 or more negative responses in questions 1-20 (interpreted "Overall low score on questions 1-20" in Table 1) [17]. The target people for the secondary preventive care project, who are at high risk of needing future care or support, are defined by the criteria of the Japan Ministry of Health, Labor and Welfare as those who show lower

function in at least physical strength, nutritional status, oral function and overall low score on questions 1-20. When we approach them, we also should refer the categories of "houseboundness", "low cognitive function" and "depression risk" to make preventive interventions more effective. "Houseboundness" referred people who answered "no" to question 16. "Low cognitive function" referred to people who had at least one or more negative conditions in questions 18-20, and "depression risk" referred to people who had two or more negative responses (questions 21-25)[16,17].

Various preventive intervention programs were provided in the community by the local government and have been proved to be effective for preventing functional or cognitive decline of older people. Public health nurses are playing an important role to perform these preventive intervention programs as the practitioner in the community. However, it is pointed out that there is a large gap between the number of people participating in preventive intervention programs and the people who are screened out as having any health problems to prevent further decline [14]. Though the preventive programs are effective for those who had participated in, it is not efficient considering the number of older people dwelling in the community. Therefore, many local governments are now trying to shift these preventive intervention programs by not only focusing on the people who are screened out as being functionally or cognitively declined (at the second prevention stage), but also on healthy older population (at the primary prevention stage) together, so as to promote the health status of the whole community. Designing long-term care prevention interventions to promote a community's overall health status in cost-effective ways is the key to establish a society where older people can live with a sense of security in their community. To realize it, a macroscopic integration and cooperation among industries, education institutions, administration and community through an interdisciplinary approach including medical science, nursing science, nursing care, study of gerontology, social welfare, social science, engineering, psychology, economics, religion and ethics should be made [5]. As the community health practitioner, public health nurses are expected to make the best use of their practice characteristics, "focusing on the health needs of an entire population", "conducting assessment of population health using a comprehensive, systematic approach", "developing and implementing community-wide health promotion programs", and "working in community partnerships and interdisciplinary teams" [18]. Although public health nurses have the advanced skills in population/community health management, their role has been underutilized and not well understood [19, 20]. Public health nurses should now play their emerging role to develop those primary and secondary prevention projects utilizing their skills and resources, especially in this world's most aged society Japan.

