



Original Article

Association between salivary alpha-amylase and subjective and objective oral parafunctions in community-dwelling elderly individuals



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KEYWORDS

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Background/purpose: Stress in the elderly is caused by loss of physical and psychological health. Although there have been many reports on the intraoral environment affecting physical health, few reports exist on stress and the intraoral environment in the elderly. The aim of this study was to investigate the relationship between salivary α -amylase as an index of stress value and the intraoral environment.

Materials and methods: Three hundred and nineteen participants were community-dwelling independent individuals over 65 years old. The outcome variable was salivary α -amylase. After measurement, salivary α -amylase was classified into four groups (0 = 0–30, 1 = 31–45, 2 = 46–60, 3 = 61–200). The predictor variables were physical status (which includes age and male body-mass index) and subjective and objective symptoms (which include present teeth, torus palatinus, torus mandibularis, temporomandibular joint noise, bruxism, and dental attrition). These variables were compared among participants using univariate analysis and multiple logistic regression analysis.

Results: The participants included 77 men and 242 women, with a mean age of 75.8 ± 5.4 years (65–94 years). Although temporomandibular joint noise and dental attrition were significantly positively correlated with salivary α -amylase, bruxism was significantly negatively correlated with salivary α -amylase ($p < 0.05$). Stepwise regression analysis revealed a significant relationship between salivary α -amylase and temporomandibular joint noise, bruxism, and dental attrition.

Conclusion: High salivary α -amylase is associated with a high rate of temporomandibular joint noise and dental attrition, and a low rate of bruxism among elderly participants.

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Introduction

Stress, which is a reaction that occurs in a living body when stimulation is applied from the outside world, affects health.¹ It has been reported that the mortality rate significantly increases among people who are stressed.² Currently, questionnaires, blood tests, and salivary α -amylase are available as methods for measuring stress values.^{3–5} Salivary α -amylase is a useful tool for evaluating the sympathetic activity of the sympathetic nervous-adrenomedullary system so that it is a good evaluation method for stress detecting.⁶ Salivary α -amylase of these tests provides a means of collecting salivary α -amylase without subjecting participants to psychological and physical stress. Additionally, no special pretreatment is required.⁷ Salivary α -amylase is highly correlated with plasma norepinephrine concentration and is used as an indicator of stress in the sympathetic nerve system during assessment.^{8,9} Furthermore, the advantage of salivary α -amylase is that it is less affected by aging.¹⁰

The causes of stress in the elderly are primarily loss of physical and psychological health owing to aging.¹¹ Excessive stress during old age has also been reported to cause brain and physical function impairment.^{12,13} In addition, elderly people often have decreased immune function, and it has also been reported that immune function is markedly reduced by stress.¹⁴ Furthermore, the immune function is affected by infections and allergies.¹⁵ Therefore, it is important to identify the causes of stress and how they can be alleviated in order to extend the healthy life span of the elderly, whose population is rapidly increasing. However, there are few reports comparing intraoral environment affecting physical health and stress in the elderly. Therefore, we conducted this survey on the assumption that the increase in salivary α -amylase in the elderly is related to the presence of oral parafunctions. The purpose of this study is to investigate the relationship between salivary α -amylase as an index of stress value and the intraoral environment.

Materials and methods

Study design and sample population

This study is a cross-sectional study and it was conducted in compliance with the 1964 Helsinki Declaration and the guidelines for the Strengthening the Reporting of Observational Studies in Epidemiology.¹⁶ This study was approved by the Medical Ethics Committee of Kyoto Gakuen University (No. 27-2). The sample population consisted of 319 subjects who were participants in the Elders Physical Fitness Measurement Research Project as at June 2018 and 2019. The participants in this study were community-

dwelling independent individuals who were over 65 years old. All participants understood the content of this study and submitted signed consent forms to us before data collection.

Study variables and data collection methods

The outcome variable is salivary α -amylase. The salivary α -amylase monitor (NIPRO, Osaka, Japan) was used to assess stress. It was confirmed that participants did not engage in moderate physical activity, tooth brushing, smoking, eating, and drinking within 1 h before measurement. Subsequently, subjects were instructed to take two deep breaths. Before measurement, a dedicated chip was inserted under the tongue to absorb saliva. This chip was inserted into the salivary α -amylase monitor and after 60 s, the amylase activity in the saliva was obtained. After measurement, salivary α -amylase was classified into four groups (No stress: 0 = 0 to 30, Mild stress: 1 = 31 to 45, Moderate stress: 2 = 46 to 60, Severe stress: 3 = 61 to 200) according to the manufacturer's instructions.¹⁷ The strength of α -amylase is defined to classify into four groups, because the normalized salivary amylase activity correlated with the mental and physical fatigue states.³ Saliva sample collection was performed from 12:00 to 15:00 to minimize the influence of circadian change.

The predictor variables in this study were grouped into two categories: physical status (which includes age and male body-mass index) and subjective and objective symptoms of oral parafunctions (which include present teeth, torus palatinus, torus mandibularis, temporomandibular joint noise, bruxism, and dental attrition). Although drinking and smoking habits of subjects were also measured as factors related to stress, they were excluded from the predictive variables in this study because their habits differ greatly in their drinking and smoking habits between subjects. The torus palatinus status was grouped into two categories: class 0 (<2 cm) and class 1 (>2 cm), where a class 0 status indicates the absence of torus palatinus and a class 1 status indicates the presence of torus palatinus, in accordance with the Gorsky Torus Index.¹⁸ The torus mandibularis status was also grouped into two categories: class 0 (<0 cm) and class 1 (>0 cm), where a class 0 status indicates the absence of torus mandibularis and a class 1 status indicates the presence of torus mandibularis, in accordance with the Igarashi Torus Index.¹⁹ The dental attrition status was scored on a scale of 0–5 in accordance with the Smith and Knight Clinical Tooth Wear Index.²⁰ Class 0 was defined as the absence of dental attrition and classes 1 to 5 indicate the presence of dental attrition. Each participant was interviewed on their oral status including the presence of temporomandibular joint noise and bruxism, using an original questionnaire. The temporomandibular joint noise status was grouped into two

categories (class 0 and class 1) based on the response to the question "Have you or has anyone ever detected clicking or popping sounds over the past three months when you opened or closed your jaw?"²¹ Bruxism status was grouped into two categories (class 0 and class 1) based on the response to the question "Have you or has your partner ever detected your teeth clenching or grinding over the past three months?"²² (Table 1).

Data analyses

A Spearman's rank correlation coefficient test was used to compare each variable for salivary amylase among participants. Statistical significance was set at $P < 0.05$. In addition, the Spearman's rank correlation coefficient was used to detect confounding factors related to the salivary α -amylase on the condition that $P < 0.05$ of statistical significance. After adjusting for these confounding factors, the odds ratios and 95% confidence intervals using stepwise regression analysis were calculated to determine the association between the predictor variables and the variable outcome. All statistical analyses were performed using a statistical software (BellCurve for Excel, Social Survey Research Information Co, Ltd., Tokyo, Japan).

Results

The participants comprised of 77 men and 242 women, with a mean age of 75.8 ± 5.4 years (65–94 years). The means and standard deviations or n (%) for the outcomes and the predictor variables of physical status and

Table 1 Evaluation method list for variable name.

Variable name	Evaluation method
Saliva α -amylase	Assessment for amylase activity in saliva
0	No stress (0–30)
1	Mild stress (31–45)
2	Moderate stress (46–60)
3	Severe stress (61–200)
Age	Interview of age
Male	Interview of sex
Body-mass index	Assessment for body height and weight
Present teeth	Assessment for number of present teeth
Denture wearer	Assessment for absence or presence of denture wearer
Torus palatinus	Assessment for absence (<2 cm) or presence (>2 cm)
Torus mandibularis	Assessment for absence (<0 cm) or presence (>0 cm)
Temporomandibular joint noise	Interview on sound clicks or pops over the past three months
Bruxism	Interview on teeth clenching or grinding over the past three months
Dental attrition	Assessment for absence or presence of dental attrition

Table 2 Average values and standard deviation for each variable.

Variable name	Average values \pm standard deviation or n (%)
Saliva α -amylase	
0, n (%)	277 (86.8)
1, n (%)	12 (3.8)
2, n (%)	12 (3.8)
3, n (%)	18 (5.6)
Age (yr)	75.8 ± 5.4
Male, n (%)	77 (24.1)
Body-mass index	22.1 ± 2.8
Present teeth	22.0 ± 7.7
Denture wearer, n (%)	127 (39.8)
Torus palatinus, n (%)	64 (20.1)
Torus mandibularis, n (%)	193 (60.5)
Temporomandibular joint noise, n (%)	22 (6.9)
Bruxism, n (%)	28 (8.8)
Dental attrition, n (%)	263 (82.4)

subjective and objective symptoms of oral parafunctions are shown in Table 2. Results of the Spearman's rank correlation coefficient test between salivary α -amylase as an outcome variable and all the predictor variables are shown in Table 3. Temporomandibular joint noise and dental attrition were significantly positively correlated with salivary α -amylase ($p < 0.05$). On the other hand, bruxism was significantly negatively correlated with salivary α -amylase ($p < 0.05$). Based on the Spearman's rank correlation coefficient test for all of predictor variables, there was no multicollinearity for salivary α -amylase. Stepwise regression analysis revealed a significant relationship between salivary α -amylase and temporomandibular joint noise, bruxism, and dental attrition ($p < 0.05$; Table 4).

Discussion

The results of this study suggested that high salivary α -amylase was closely associated with a high rate of temporomandibular joint noise and dental attrition, and a low rate of bruxism, among elderly participants.

From this result, stress in the elderly was positively correlated with temporomandibular joint noise and attrition. It was reported that stress or psychological factors are associated with temporomandibular disorder, using a questionnaire.^{23,24} In addition, it was reported that temporomandibular disorder occurs due to occlusion, masticatory muscle abnormality, and mandibular dysfunction. Furthermore, temporomandibular disorder is further complicated by bruxism. It has been reported that temporomandibular disorder is positively associated with bruxism.²⁵ However, it was reported that although no difference in salivary stress was observed between children with and without temporomandibular disorder, children with temporomandibular disorder had higher anxiety scores.²⁶

Table 3 Spearman's rank correlation coefficient for the association with outcome variable and predictor variables.

Variable name	Saliva α -amylase	
	ρ	<i>P</i> value
Age	0.013	0.819
Male	-0.089	0.112
Body-mass index	0.044	0.432
Present teeth	0.047	0.406
Denture wearer	-0.060	0.289
Torus palatinus	-0.010	0.855
Torus mandibularis	0.086	0.125
Temporomandibular joint noise	0.117	0.037*
Bruxism	-0.120	0.032*
Dental attrition	0.129	0.021*

Data were presented as ρ or *P* value.

**P* < 0.05, Spearman rank correlation coefficient test.

Table 4 Summary of multiple regression model.

Outcome variable	Predictor variables	F	t	<i>P</i> value	VIF
Saliva α -amylase	Temporo mandibular joint noise	5.162	2.272	0.024*	1.003
	Bruxism	5.310	-2.304	0.022*	1.009
	Dental attrition	4.757	2.181	0.030*	1.008

**P* < 0.05, A stepwise multiple regression analysis.

F: F statistic, t: t-statistic, VIF: variance inflation factor.

On one hand, according to Spearman's rank correlation coefficient in this study, temporomandibular joint noise and bruxism were positively not related. The reason for the lack of association in this study may be because we assessed mild temporomandibular joint noise rather than severe temporomandibular disorders such as open mouth pain and open mouth restriction. In addition, it has been pointed out that depression and temporomandibular disorder are related.²⁷ A relationship between stress and attrition has also been identified in adolescents,²⁸ which is consistent with the results of this study. It has also been reported that salivary α -amylase in children undergoing long-term psychostimulant therapy compared to healthy children are low, although not significantly different.²⁹

On the other hand, salivary α -amylase was negatively associated with bruxism in this study. It was reported that stress is associated with bruxism,^{30,31} and in the event of stress, bruxism occurs to relieve stress and protect the mind and body.³² Control mice, compared with mice that cannot clench, exhibited reduced histidine decarboxylase activity in the stomach. This reduction was used as an indicator of stress in animal experiments. Additionally, since bruxism abuses the muscles of the jaw and head, adverse effects on the whole body and oral cavity such as migraine and temporomandibular disorder have been reported.^{33,34} Based on these findings, while bruxism reduces stress, it may adversely affect the whole body or the oral environment. The use of occlusal splint that can reduce stress and

at the same time prevent dental attrition and temporomandibular disorders may prevent unconscious bruxism, which will require further research.

This study has some limitations. Firstly, salivary α -amylase has been reported to be unsuitable for cross-sectional studies due to large differences among individuals.³⁵ Therefore, in this study, data collection was limited, as much as possible, to elderly (over 65 years old) who can function independently. Secondly, salivary α -amylase, secreted due to sympathetic action, shows diurnal variation.^{36,37} In this study, salivary amylase activity was measured by limiting time as much as possible in consideration of diurnal variation. Thirdly, low correlation of Spearman's rank correlation coefficient between salivary α -amylase and temporomandibular joint noise, bruxism, dental attrition may show low sample size in this study, and further longitudinal studies toward these factors must be evaluated to determine a cause-effect relationship. In conclusion, the results of this study suggested that high salivary α -amylase was associated with a high rate of temporomandibular joint noise and dental attrition, and a low rate of bruxism, among elderly participants.

Declaration of Competing Interest

All authors report no conflicts of interest.

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