Cross-sectional study of age-specific differences in salivary occult blood test results in older adults

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Abstract: This study aimed to identify factors associated with poor oral health status, as indicated by salivary occult blood (SOB) level, in community-dwelling older adults. A total of 592 community-dwelling participants aged 70 to 84 years with 20 to 28 teeth participated in the survey and SOB evaluation. Survey items included behaviors during dental visits, systemic diseases, smoking habit, cognitive function, and findings of intraoral examination. To identify factors associated with high SOB levels, binomial logistic regression analysis was performed after classifying participants as having high and low SOB on the basis of 75th-percentile SOB measurements. Presence of dental plaque (odds ratio [OR]: 2.26), poor subjective oral health (OR: 2.99) for the age group 70 to 74 years, fewer remaining teeth (OR: 0.80), no dental visits during the previous year (OR: 2.80) for the age group 75 to 79 years, and no dental visits during the previous year (OR: 3.93) for the age group 80 to 84 years were significantly associated with high SOB levels. The factors associated with high SOB, which indicates poor oral health status, differed by age group in community-dwelling older adults. Therefore, oral health management may improve oral health by providing different age groups with care that accounts for their physical and social functional abilities.

Keywords: community-dwelling older adults, occult blood, oral health, saliva

Introduction

Oral health care is critical for overall health, and the effects of oral disease on systemic health are clear [1]. Management of oral health in older adults must account for age-related changes in the oral cavity, as well as for several systemic diseases [2], physical function, and social background [3,4]. These factors often vary in older age groups; therefore, varied approaches may be necessary to ensure appropriate management of oral health in older adults of different ages. However, apart from a previous report on adults older than 65 years examined as a single population [2], no studies have assessed management of oral health in different geriatric age subgroups.

According to the 2016 National Survey in Japan, more than 50% of people aged ≥80 years had ≥20 remaining teeth, which suggests that the number of older adults with periodontal disease may be increasing. Therefore, oral health management involving periodontal disease management is increasingly important for elders. Salivary occult blood (SOB) testing has recently been used as a simple method for evaluating oral health status involving periodontal disease [5] and was significantly correlated with probing pocket depth, bleeding on probing, and the community periodontal index, making it a useful tool for conducting mass dental examinations [6-8]. SOB is especially useful for a population approach because it is a straightforward method to detect poor oral health and encourage elders to go to dental clinics [6-8]. However, previous studies of SOB in older adults have been limited to comparisons of general health status between dependent older adults [9]. No studies have used SOB to examine management of oral health, including oral health behaviors.

The objectives of this study were to identify factors associated with poor oral health status, as indicated by SOB, in relation to age group.

Materials and Methods

Participants

This study used data from a survey that was part of a longitudinal cohort study for older adults—the Takashimadaira study—which aimed to identify dementia-friendly communities in a metropolitan area. Self-administered questionnaires were mailed through the postal service to 7614 individuals aged ≥70 years who were living in the Takashimadaira district, Itabashi, Tokyo, from August through September 2016. In total, 5430 respondents (recovery rate: 71.3%) were asked to participate in a visit-type survey in the vicinity of the target area during the period from October through December 2016. In total, 1,248 participants (16.4% of all inhabitants) who visited the study site were included. Of these, 1142 dentate individuals who gave informed consent for saliva examination were included in the analysis. Participants with a Mini-Mental State Examination-Japanese (MMSE-J) score of <23, which corresponds to suspected cognitive decline (n = 92) [10], and those with missing data (n = 8) were excluded because of concerns regarding data reliability.

Because of the effect of number of teeth, presence of SOB differed between patients with ≥20 teeth and those with <19 teeth [7]; therefore, only participants with ≥20 teeth were analyzed. In total, 592 patients with 20 to 28 teeth were included in the analysis. The effect of periodontitis on wisdom teeth was considered, and participants with ≥29 teeth were excluded because many had third molars. Because only 28 patients were ≥85 years of age, they were excluded from the analysis. In total, 564 patients aged 70 to 84 years (7.4% of the total population) were included in the final analysis, because age-related changes may have occurred in this age group.

Salivary occult blood

A SpotChem ST salivary testing device (Arkray, Inc., Kyoto, Japan) was used to measure SOB; peroxidase activity was detected by hemoglobin [8]. The examination protocol consisted of oral rinsing with 3 mL purified water for 10 seconds and collection of expectorated fluid as a saliva sample. Saliva samples were measured on test papers by using Samco Scientific 1.5-mL #231 Transfer Pipettes (Samco Scientific Corporation, San Fernando, CA, USA), and color changes of the SOB specimens were measured by the SpotChem ST as reflectance (%). Scores were reported on a scale of 0 to 100 points. Higher scores indicated higher SOB levels.

Participant characteristics

Basic information on sex, age, history of systemic diseases, smoking habit, presence of cohabitants, subjective economic distress, and years of education was collected with the self-administered questionnaire. Participants

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Participant characteristics

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were asked if they had a history of systemic diseases (i.e. hypertension, diabetes, cerebrovascular disease, heart disease, or cancer) because these conditions are reportedly associated with oral health, particularly periodontal disease [1], which could influence SOB.

**Physical function**

The JST Activity Performance Index (Japan Science and Technology Agency Index of Competence; JST-IC) [1] was used to assess functional capacity. Handgrip strength was used as an indicator of activities of daily living (ADL) function [12] and was measured with a Smedley dynamometer (T.K.K.5401; Takei Scientific Instruments Co., Ltd., Niigata, Japan). The measurement was performed twice with the dominant hand, and the higher value was used in the analysis.

**Cognitive function**

Trained nurses and psychologists performed the MMSE-J examination, to evaluate cognitive function [10].

**Oral characteristics**

Oral examinations to determine the number of remaining teeth, excluding retained roots and dental implants, and presence of dental plaque, were performed by dentists and dental hygienists after adequate training. A questionnaire was administered to determine subjective oral health (SOH) status, if oral hygiene instruction had been received, and if a dental visit had been made during the previous year.

The presence of dental plaque was visually assessed by using a pre-scored plaque indicator. SOB status was assessed by asking participants to respond as follows: 1) current smoker, 2) previous smoker, or 3) never smoked; answers were classified as present smoker (1) or nonsmoker (2 or 3). Presence of dental plaque was visually assessed by using a pre-scored plaque indicator.

**Statistical analysis**

Participants were classified by age group as 70 to 74, 75 to 79, and 80 to 84 years of age. To analyze the characteristics of participants in each age group, the Kruskal-Wallis test was used for continuous variables and the χ² test was used for categorical variables. Results in the highest 75th percentile of SOB measurements (≥56.0 points) were classified as the high-SOB group; all other results classified as the low-SOB group, in accordance with a previous study [9] and the present frequency distribution. The two groups were compared in relation to age group by using the χ² test for categorical variables and Mann-Whitney U test for continuous variables. Binary logistic regression analysis was performed to identify factors associated with high SOB, while controlling for potential confounders. The dependent variable was associated with high or low SOB, and independent variables were selected while considering multiple collinearity. All statistical analyses were performed with IBM SPSS Statistics Version 21 (IBM Corp., Armonk, NY, USA) with significance set at 5%.

**Results**

**Participant characteristics**

Of the 564 participants, 210 (37.2%) were male and 354 (62.8%) were female. Mean age was 76.0 ± 3.8 years, and mean SOB was 41.9 ± 21.8 points; there were no significant differences in SOB in relation to age group (Table 1). There were significant differences in age, smoking habit, subjective economic distress, JST-IC, maximal handgrip strength, MMSE-J, history of hypertension, and cardiac disease (all P < 0.05).

**Two-group comparison of SOB in relation to age group**

The participants were classified as having high and low SOB for each age group, namely, 70 to 74, 75 to 79, and 80 to 84 years of age (Tables 2-4). In the age group 70 to 74 years, 51.5% had dental plaque and 34.8% had poor SOH status; both percentage values were significantly higher in the high-SOB group (P = 0.017 and P = 0.012, respectively) than in the low-SOB group (Table 2). In the age group 75 to 79 years, participants with a high SOB had 23.9 ± 2.5 remaining teeth, which was significantly lower than the 25.2 ± 2.5 remaining teeth in the low-SOB group (P = 0.001). Furthermore, 67.4% of participants with a high SOB had visited dental clinics during the previous year, which was significantly lower than the 82.2% of low-SOB group participants who had visited dental clinics during the previous year.
The percentage of participants with poor SOH was significantly higher in the high-SOB group than in the low-SOB group (7.4% vs. 9.5%, respectively; \( P = 0.013 \) (Table 3). In the age group 80 to 84 years, there were significantly more men in the high-SOB group (37.0% vs. 19.5%, respectively; \( P = 0.013 \)) (Table 3). In the age group 70 to 74 years, there were significantly more men in the high-SOB group (37.0% vs. 19.5%, respectively; \( P = 0.013 \)) (Table 3).

Factors associated with high SOB

Factors potentially associated with high SOB were analyzed by using binomial logistic regression (Table 5). Presence of dental plaque (\( P = 0.022 \), odds ratio [OR] = 2.26, 95% confidence interval [CI] = 1.13-4.52) and SOH status (\( P = 0.007 \), OR = 2.99, 95% CI = 1.34-6.66) were significantly associated with high SOB in the age group 70 to 74 years. Number of remaining teeth (\( P = 0.007 \), OR = 0.80, 95% CI = 0.69-0.92) and dental visits during the previous year (\( P = 0.042 \), OR = 2.80, 95% CI = 1.34-5.70) were significantly associated with high SOB in the age group 75 to 79 years. Dental visits during the previous year (\( P = 0.032 \), OR = 3.93, 95% CI = 1.13-13.70) was significantly associated with high SOB among adults aged 80 to 84 years.

### Discussion

There is an increasing need for effective oral health management as the number of remaining teeth increases in older adults. Furthermore, the impact of age-related physical, mental, and social changes must be considered in the management of oral health. These factors should be assessed in age subgroups of older adults, as oral health is readily affected by age-related changes, particularly as compared with younger people. This is the first study to investigate age-related differences in factors associated with SOB—a non-invasive method of evaluating oral health of elders in less than 5 minutes.

Comparisons of high and low SOB levels by age group revealed differences. Among adults aged 70 to 74 years, the high-SOB group had more dental plaque and poorer SOH status, and both these factors were associated with high SOB on multivariate analysis. The association between SOH status and SOB is consistent with the findings of a previous study.
Among those aged 80 to 84 years, the proportion of males was significantly higher, and the rate of dental visits during the previous year was significantly lower, in the high-SOB group. There were no significant differences in the rates of smoking or living alone, both of which are risk factors for periodontal disease. Gender is also a reported risk factor, as periodontal disease is more common among males [19]. The detailed factors associated with sex differences are unknown; however, the present findings support those of a previous study, which reported that poor oral hygiene and more-severe periodontal disease were more frequent in males than in females [19]. Multivariate analysis showed that lack of dental visits during the previous year was associated with high SOB. Thus, regular dental visits may be important for managing poor oral health in adults aged 80 to 84 years.

This study shows that factors associated with high SOB differ by age group, suggesting that it is important to manage oral health in accordance with these changes. Specifically, age group-specific differences were observed in the pattern of dental visits and SOH status, which may be influenced by age-related changes in physical and social function. Dental visits during the previous year were not associated with high SOB in those aged 70 to 74 years but were associated with high SOB after age 75 years. Factors that interfere with regular dental visits in older adults include decreased ADL, decreased cognitive function, and lower economic status and education level [20]. However, the following factors were not significantly associated with high SOB in the present study: handgrip strength,
Conflict of interest

With the exception of the funding detailed above, the authors report no conflict of interest related to this study.

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