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Author(s)	Kaneko, Nobuko; Nohara, Kanji; Tanaka, Nobukazu et al.
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BRIEF COMMUNICATION

Olfactory and gustatory functions, appetite, and nutritional status in Alzheimer's disease in a care facility

Nobuko Kaneko¹  | Kanji Nohara²  | Nobukazu Tanaka³  |
Makoto Mitsuyama⁴ | Takayoshi Sakai² 

¹Naniwa College of Dental Hygiene, Osaka, Japan

²Department of Oral-facial Disorders, Osaka University Graduate School of Dentistry, Suita, Japan

³Division of Oral-facial Disorders, Osaka University Dental Hospital, Suita, Japan

⁴Keieikai Medical Corporation, Osaka, Japan

Correspondence

Kanji Nohara, Department of Oral-facial Disorders, Osaka University Graduate School of Dentistry, 1-8 Yamada-Oka, Suita, Osaka 565-0871, Japan.

Email: nohara.kanji.dent@osaka-u.ac.jp

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1 | BACKGROUND

The older adult population requiring nursing care has dramatically grown in Japan. Dementia is the most frequent cause of nursing care, with Alzheimer's disease (AD) being the leading type. Decreased appetite and weight loss among older adults with AD have become severe medical problems.¹ Decreased appetite in older adults with AD is thought to be caused by a lack of oral health self-care, disease, medications, and aging changes. Weight loss in older adults with AD may be caused by various factors, but they have not been identified as yet.

Interestingly, neuropathy in AD can affect the conduction pathways of olfaction and gustation, potentially impairing the olfactory and gustatory senses in older adults with AD.^{2,3} In other words, older adults with AD face hindrances in perceiving the smell and taste of food placed in the oral cavity, and the decreased appetite and weight loss in these older adults may be attributed to their olfactory and gustatory functions. However, research concerning these relationships are limited, and thus the nature of their associations remain unclear.

Clarifying the association between olfactory and gustatory functions, appetite, and nutritional status in older adults with AD enables meal support/assistance focusing on olfaction and gustation. This study compared the olfactory and gustatory functions, appetite, nutritional status, and medication usage among older adults with AD in care facilities to those without AD.

2 | MATERIALS AND METHODS

Table 1 displays information on the study individuals; this study included 57 older adults who had been diagnosed with AD by a psychiatrist, who were in an older adults care facility, and who were able to communicate, excluding those with a history of nasal disease and COVID-19. The mean age of the 57 older adults was 88.1 (SD 5.3) years, the mean level of nursing care (Table 2) was 2.6 (SD 1.2), and the mean Functional Assessment Staging of Alzheimer's Disease (FAST) score was 5.1 (SD 0.6) (the "AD group"). The control group comprised 39 adults aged 65 or older who lived in the community and did not require nursing care; their mean age was 81.2 (SD 6.1) years. The assessment of cognitive function revealed a mean score of 25.7 points (SD 4.0) on the Revised Hasegawa's Dementia Scale for individuals scoring 21 points or higher (the "non-AD group").

The survey included items regarding olfaction (Odor Stick Identification Test for Japanese [OSIT-J], standard score 9 points), gustation (the whole mouth test and using a SALSAVE, standard score 0.6 mg/cm²), appetite (questionnaire survey method using the Council of Nutrition Appetite Questionnaire [CNAQ], standard score 16 points), nutritional state (body mass index [BMI]), and the amount of medication being taken.

The mean ages of the AD versus non-AD groups significantly differed according to the *t*-test results. Therefore, age was used as a

TABLE 1 Individuals' data.

	AD (n = 57) mean (SD)	Non-AD (n = 39) mean (SD)	p-value
Age (years old)	88.1 (5.3)	81.2 (6.1)	$t(94) = 5.9$ $p < 0.001^*$
Nursing care level	2.6 (1.2)	-	-
FAST (score)	5.1 (0.6)	-	-
HDS-R (points)	-	25.7 (4.0)	-

Note: A *t*-test was conducted for age.

* $p < 0.01$: significant difference present.

Abbreviations: AD, Alzheimer's disease; SD, standard deviation; n, sample size; FAST, Functional Assessment Staging of Alzheimer's Disease; HDS-R, Revised Hasegawa's Dementia Scale.

TABLE 2 Level of nursing care in nursing care insurance service of Japan.

Nursing care level	State	Reference time of care
1	Decreased abilities to perform activities of daily living, and partial nursing care needed.	≥ 32 min <50 min
2	In addition to the conditions for nursing care level 1, partial nursing care needed for activities of daily living.	≥ 50 min <70 min
3	Both activities of daily living and instrumental activities of daily living are worse than in nursing care level 2, and nursing care is needed for almost all aspects.	≥ 70 min <90 min
4	In addition to the conditions for nursing care level 2, the ability to move has further decreased, and daily life is difficult without nursing care.	≥ 90 min <110 min
5	Further decreased ability to move than in nursing care level 4, and it is almost impossible to live daily life without nursing care.	≥ 110 min

covariate for the survey items, and we made comparisons using analysis of covariance, which allows for analyses without considering age differences (confidence interval: 95%). A normality test was conducted on the survey items, and no normality was observed for OSIT-J and SALSARE in the AD group and for SALSARE in the non-AD group. Therefore, these were log-transformed and compared between the two groups. This study was approved by the Ethical Review Board of the Osaka University/Hospital.

3 | RESULTS

Table 3 displays the results. The OSIT-J showed that both groups obtained a below-standard score. A significant difference was found

between the two groups, with the AD group displaying considerably lower results ($p < 0.001$). Both groups obtained values below the standard SALSARE assessment. However, no significant difference was found between the two groups ($p = 0.05$). The CNAQ was maintained in both groups, with no significant difference between the two groups ($p = 0.20$). BMI was maintained in both groups, with no significant difference ($p = 0.22$). Moreover, the number of medications taken was significantly higher in the AD group ($p = 0.001$).

4 | DISCUSSION

Decreased appetite and weight loss in AD can also be caused by severe hyposmia.^{1,3} Therefore, in this study, older adults with AD admitted to a facility were surveyed and compared to non-AD older adults.

Olfactory function typically decreases with age. Moreover, AD severity and cognitive impairment are recognized as associated with olfactory impairment.⁴ Many of those in the AD group had a reduced sense of olfaction, even after adjusting for age.

The gustatory function between the AD and non-AD groups showed no significant differences. Thus, the potential for marked decreases in gustatory function due to AD is low.

A prior study found that olfactory and gustatory impairment leads to decreased appetite and weight loss.¹ However, in this study, the appetite and nutritional status were maintained in the AD group, even for individuals with impaired olfactory and gustatory functions. These results differed from the previous studies that targeted older adults. The surveyed facilities may reflect their efforts in nutritional management for the AD group, including considerations for appetite/nutritional status, dietary support, and meal forms tailored to the swallowing functions of older adults with AD. Nutritional management within a nursing care environment appeared to maintain their appetite and nutritional status.

The AD group was found to take a substantially greater number of medications. Older adults have many chronic diseases; these medications are administered separately for each disease. Hence, the number of medications taken tends to increase. In many cases, older adults with AD take both chronic diseases and anti-dementia medications. Therefore, the AD group can be inferred to have consumed more medications, leading to a noticeable disparity between the two groups.

The AD group had a reduced olfaction and a higher number of medications, even after adjusting for age, whereas there was no difference in appetite or weight.

As a limitation of this study, the maintenance of appetite and nutritional status in the AD group could reflect differences in the need for nutrition management by dietitians and the provision of support/assistance by caregivers for older adults in facilities. As the results are expected to differ depending on older adults' living environments and caregiving statuses, future studies must use more rigorous assessments.

TABLE 3 Survey item results.

	AD (n = 57) mean (SD)	Non-AD (n = 39) mean (SD)	p-value
OSIT-J (points)	1.9 (1.4) ^a	7.5 (3.3) ^a	<i>p</i> < 0.001*
SALSAVE (mg/cm ²)	0.9 (0.4) ^a	0.7 (0.3) ^a	0.05
CNAQ (points)	30.4 (3.0)	29.9 (3.4)	0.20
BMI (kg/m ²)	21.3 (3.3)	22.0 (2.8)	0.22
Medication being taken (type)	6.4 (3.1)	3.3 (2.9)	0.001*

Note: An analysis of covariance between age and survey items was conducted. Logarithmic transformation was conducted for OSIT-J and SALSAVE.

Abbreviations: AD, Alzheimer's disease; BMI, Body Mass Index; CNAQ, Council of Nutrition Appetite Questionnaire; n, sample size; OSIT-J, Odor Stick Identification Test for Japanese; SD, standard deviation.

^aGeometric mean.

**p* < 0.01: significant difference present.

AUTHOR CONTRIBUTIONS

Kanji Nohara conceived the idea of the study. Nobukazu Tanaka and Nobuko Kaneko developed the statistical analysis plan and conducted statistical analyses. Kanji Nohara, Takayoshi Sakai and Makoto Mitsuyama contributed to the interpretation of the results. Nobuko Kaneko drafted the original manuscript. Kanji Nohara supervised the conduct of this study. All authors read and approved the final manuscript.

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CONFLICT OF INTEREST STATEMENT

The author reports no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the author upon reasonable request.

ETHICS STATEMENT

This study was conducted in accordance with the current revision of the 1975 Declaration of Helsinki and the approval of the ethics review committee of the Osaka University Graduate School of Dentistry and Dental Hospital (approval number: H29-E24-1). The purpose and methods of this study were disclosed to potential participants before their participation along with recognition of their right to decline to participate in the study. Furthermore, an

anonymous ID number was generated for each participant for their participation in the study.

ORCID

Nobuko Kaneko  <https://orcid.org/0000-0003-1111-6933>

Kanji Nohara  <https://orcid.org/0000-0001-8254-4615>

Nobukazu Tanaka  <https://orcid.org/0000-0002-5877-0214>

Takayoshi Sakai  <https://orcid.org/0000-0003-4348-4896>

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