



Original Article

Investigation of Changes in Oral Conditions and Body Weight of Older Residents in an Aged Care Nursing Home

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SUMMARY

Background: Older people experience reduced food intake and undernutrition due to masticatory and swallowing dysfunctions and cognitive disorders. Studies on the association between oral condition and nutrition in older people are difficult to conduct because of the participant's advanced age and co-existing medical conditions. This study aimed to investigate the changes in oral conditions and body weight loss of older people in an aged care nursing home.

Methods: Fifty-two residents of an aged care nursing home were included in this study and assessed twice between 2014 and 2020. A number of parameters were evaluated by dental care professionals of the nursing home. The association between oral conditions and body weight was statistically analyzed.

Results: This study included 12 men and 40 women. The mean ages of the participants at the first and second assessments were 86.7 and 88.6 years, respectively. The median interval between assessments was 27 months. At the second assessment, there were 25 and 27 participants without and with weight loss, respectively. There were statistically significant differences in the rate of removable denture use and refusal of oral care and daily total calories between first and second assessments. There were no statistically significant differences of all parameters at the first assessment between the weight loss and no weight loss groups.

Conclusion: The rate of removable denture use and daily total calories reduced, and the rate of refusal of oral care increased over time in the older residents. There was no statistical difference in weight loss between twice assessments.

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1. Introduction

According to the World Health Organization, dementia is estimated to afflict 47 million people in 2015, with nearly 10 million new cases being reported annually. It is one of the major causes of inability of older people to live independently.¹ The worsening status of dementia often compels the patient to be admitted to a nursing home. The older people in nursing home experience reduced food intake and undernutrition due to masticatory and swallowing dysfunction, sarcopenia, and frailty.^{2–5} These conditions may lower the quality of life and increase the burden of cost⁶ on the caregiver of the older adults and shorten their life expectancy.^{7,8}

The causes of undernutrition include cognitive disorders, such as dementia,⁹ depressive symptoms,¹⁰ or medication,¹¹ and decreased swallowing and oral function.¹² Oral dysfunction is a factor leading to weight loss and frailty, and it is essential for older people to avoid worsening of oral function.¹³ Untreated dental caries,¹⁴ edentulousness,¹⁵ and the number or distribution of teeth are other factors associated with food consumption and nutritional intake.¹⁵

Thus, intervention by dentists and dental hygienists in cooperation with caregivers and dietitians is indispensable.

Studies on the association between oral condition and nutrition have been reported, and most of them were cross-sectional studies.^{12,14,15} The reason may be the difficulty of conducting a survey over an extended period of time because of the participant's advanced age, the progression of dementia, or development of other diseases. The present study examined the oral and nutritional conditions of the residents at a nursing home associated with a hospital to examine the changes over time in as many older people as possible. This is because many of them return to the same nursing home after hospitalization, making the follow-up easier. In addition, the same dentists and dental hygienists work in both the nursing home and hospital; thus, the status of the residents of the nursing home can be constantly kept under check. The information on oral management and dental intervention in a nursing home may be obtained by examining the changes in oral conditions of the same residents over time. Here, we designed a study on older people residing in a nursing home affiliated to a hospital to investigate the longitudinal changes in oral and nutritional conditions with the assistance of a dentist and a dental hygienist. This study aimed to investigate the changes in oral conditions and body weight of older people in an aged care nursing home.

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2. Materials and methods

2.1. Study design and participants

This was a longitudinal study conducted in a single nursing home. From June 2016 to June 2019, 114 residents admitted to an aged care nursing home underwent the oral and nutritional assessments. Of these, 52 who were successfully evaluated for the second time were included in the present analysis. The other 62 residents who could not be evaluated for a second time due to dementia progression, hospitalization, or death were excluded. The comparison of follow-up and lost groups is shown in Table 1. There were no statistically significant differences in age, sex, degree of requiring long-term care, degree of dementia, body weight, and body mass index (BMI) between the two groups. The following parameters were investigated in the included group: age, sex, interval between the first and second assessments, degree of requiring long-term care,^{16,17} daily life independence level of patients with dementia (degree of dementia),^{18,19} degree of independence in oral care, presence or absence of refusal of oral care, oral hygiene, number of teeth, presence or absence of a removable denture, presence or absence of molar occlusion, repetitive saliva swallowing test (RSST), oral diadochokinesis, amount of saliva secretion, oral wetness, dietary forms, total daily calories (rice and other foods, including supplementary nutrition), body weight, and BMI as a measure of nutritional status. The degree of oral self-care was assessed on the following three levels: self, partial help needed, and total help needed. Oral hygiene was assessed based on the following two levels: good or poor. Oral hygiene was classified as good when there was little or no food residue or dental plaque and poor when moderate to high amounts of food residue or dental plaque were found. The oral hygiene status was assessed by a dentist.

Occlusal support of the molars was evaluated as being present when the occlusion was maintained on at least one side. Oral wetness was measured using an oral moisture meter (MUCUSTM, Yoshida, Tokyo). Dietary forms were classified into (a) normal, gruel, and blended with rice and (b) normal, soft, chopped, blended with other foods. Dentists and dental hygienists regularly assessed the dental condition and oral function of nursing home residents and provided them with dental care. They examined the mouth of the participants and advised facility staff and nutritionists about the advisable dietary forms depending on the condition of the teeth and removable dentures of the participants. This study was approved by the Ethics Committee of Hiroshima University (E-227). According to the guidelines set by the local institutional ethics committee, informed consent was obtained in the form of opt-out.

2.2. Degree of dementia and daily life dependency

The daily life independence level of patients with dementia was

determined according to the following five grades: Grade I, has mild dementia, but is almost independent in daily life with participation in domestic and social activities; Grade II, has some degree of behavior-related symptoms or difficulty in communication that interferes with daily life, but can live independently if someone looks after them; Grade III, has occasional behavior-related symptoms or difficulty in communication that interferes with daily life and requires care; Grade IV, frequent behavior-related symptoms or difficulty in communication that interferes with daily life and requires constant care; and Grade M, has significant psychotic manifestations, behavioral problems, or severe physical disease and requires specialized medical care.¹⁹

2.3. Statistical analyses

Comparisons using univariate analysis were made between the first assessment (baseline) of the included and excluded group and between the first and second assessments. Univariate analysis at first assessment between the no weight loss and weight loss groups was performed. Body weight changes were investigated according to the BMI and categorized as follows: low (BMI < 18.5 kg/m²), normal (18.5 ≤ BMI < 25 kg/m²), and high (BMI ≥ 25 kg/m²) BMI groups according to the Japan Society for the Study of Obesity.²⁰ Because it is possible that aged people with a BMI ≥ 25 kg/m², which corresponds to obesity, may decrease their weight to a standard weight after admission to the nursing home if they are provided with an appropriate amount and calory of food, weight change by BMI level was also examined. The Wilcoxon rank-sum test or Wilcoxon signed-rank test or Kruskal-Wallis test for quantitative data and chi-squared test and Fisher's exact test (two-sided test) for categorical data were used for statistical analyses to compare the two groups. The Jonckheere trend test was used for ordinal data. Statistical significance was set at $p < 0.05$. All statistical analyses were performed using JMP Pro version 15.0 for Windows (SAS Institute, Cary, NC, USA) and EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria).

3. Results

The first and second assessments of included participants are shown in Table 2. The mean ages of the participants at the first and second assessments were 86.7 and 88.6 years, respectively, and the median interval between the assessments was 27 (range, 6–31) months. There were no statistically significant differences between the first and second assessments in the degree of requiring long-term care (chi square = 1.86, $p = 0.60$), degree of dementia (chi square = 0.85, $p = 0.86$), presence or absence of molar occlusion (chi square = 0.06, $p = 0.80$), oral care independence (chi square = 3.43, p

Table 1
Comparison of baseline characteristics of 114 older residents at first assessment.

	Follow-up group (n = 52)					Lost group (n = 62)					<i>p</i> value
Age (mean ± S.D.)	86.7 ± 8.9					88.3 ± 8.4					0.48
Sex											0.21
Male/female	12/40					21/41					
Degree of requiring long-term care											0.33
Degree	1	2	3	4	5	1	2	3	4	5	
Number	0	4	26	17	5	0	2	24	26	10	
Degree of dementia											0.20
Degree	I	II	III	IV	M	I	II	III	IV	M	
Number	10	15	18	9	0	4	16	30	10	2	
Body weight (kg, mean ± S.D.)	48.0 ± 8.9					46.0 ± 11.0					0.15
BMI (mean ± S.D.)	21.0 ± 4.7					20.1 ± 4.0					0.085

BMI, body mass index.

= 0.18), and oral hygiene status (chi square = 0.04, $p = 0.84$) and number of teeth ($Z = -0.34, p = 0.73$). The rate of removable denture use was significantly lower in the second assessment than in the first assessment (chi square = 6.62, $p = 0.02$). The rate of refusal of oral care increased significantly during the second assessment (chi square = 21.77, $p < 0.01$). There were no statistically significant differences in dietary forms between the first and second assessments for both rice and other foods (chi square = 5.98 and 5.89, $p = 0.06$ and 0.12). The total daily calories at the first and second assessments

were 1439.8 ± 176.2 kcal (mean \pm S.D.) and 1313.7 ± 193.5 kcal (mean \pm S.D.); this difference was statistically significant ($p < 0.01$). Comparisons between the first and second assessments regarding RSST, oral diadochokinesis, amount of saliva secretion, and oral wetness are shown in Table 3. The findings were observed only in those who underwent successful examinations. There were no statistically significant differences in RSST ($Z = 0.64, p = 0.52$), oral diadochokinesis ("Pa"; $Z = -0.00, p = 0.99$, "Ta"; $Z = 0.56, p = 0.57$, "Ka"; $Z = -0.35, p = 0.72$), amount of saliva secretion ($Z = 0.08, p = 0.93$), and

Table 2
Comparisons between the first and the second assessments (n = 52).

	First					Second					<i>p</i> value
Age (mean \pm S.D.)	86.7 \pm 8.9					88.6 \pm 8.8					-
Sex											-
Male						12					
Female						40					
Degree of requiring long-term care											0.60
Degree	1	2	3	4	5	1	2	3	4	5	
Number	0	4	26	17	5	0	2	25	16	9	
Degree of dementia											0.86
Degree	I	II	III	IV	M	I	II	III	IV	M	
Number	10	15	18	9	0	7	14	21	10	0	
Number of teeth (mean \pm S.D.) (min.–max.)	7.3 \pm 9.7 (0–29)					6.9 \pm 6.9 (0–29)					0.73
Occlusion of molar region (with only own teeth)											0.80
Presence	10					9					
Absence	42					43					
Use rate of removable denture (%)	100 (32/32)					81.3 (26/32)					0.02*
Oral care											0.18
Self	20					12					
Partial help needed	14					21					
Total help needed	18					19					
Refusal of oral care											< 0.01*
Presence	0					18					
Absence	52					34					
Oral hygiene											0.84
Good	28					27					
Poor	24					25					
Dietary forms											
Rice											0.06
Normal	31					20					
Texture-modified	21					32					
Gruel	18					23					
Blended	3					9					
Other foods											0.12
Normal	22					13					
Texture-modified	30					39					
Soft	13					17					
Chopped	14					13					
Blended	3					9					
Total daily calorie (kcal, mean \pm S.D.)	1439.8 \pm 176.2					1313.7 \pm 193.5					< 0.01*
Body weight (kg, mean \pm S.D.)	48.0 \pm 8.9					46.7 \pm 8.4					0.56
BMI (mean \pm S.D.)	21.4 \pm 3.7					20.8 \pm 3.6					0.41

BMI, body mass index. * Statistically significant.

Table 3
Comparisons between the first and the second assessments regarding RSST, oral diadochokinesis, amount of saliva secretion, and oral wetness.

	First	Second	<i>p</i> value
RSST (times/30 minutes) (mean \pm S.D.)	2.0 \pm 1.5 (n = 34)	2.1 \pm 1.3 (n = 27)	0.52
Oral diadochokinesis (times/sec)			
Pa	3.5 \pm 1.4 (n = 35)	3.5 \pm 1.4 (n = 25)	0.99
Ta	3.6 \pm 1.6 (n = 32)	3.6 \pm 1.3 (n = 25)	0.57
Ka	3.3 \pm 1.4 (n = 32)	3.0 \pm 1.2 (n = 25)	0.72
Amount of saliva secretion (g/min)	0.4 \pm 0.3 (n = 41)	0.4 \pm 0.2 (n = 45)	0.93
Oral wetness*	27.3 \pm 1.8 (n = 40)	27.2 \pm 2.8 (n = 45)	0.64

RSST, repetitive saliva swallowing test. Oral wetness < 27: suspicion of dryness of the mouth. The findings were observed only in those who underwent successful examinations.

oral wetness ($Z = -0.47$, $p = 0.64$) between the first and second assessments. Comparisons between the without and with weight loss groups at first assessment are shown in Table 4. There were no statistically significant differences in all variables. Comparisons of RSST, oral diadochokinesis, amount of saliva secretion, and oral wetness with and without the weight loss group at the first assessments

are shown in Table 5. The frequency of oral diadochokinesis, "Ta," in the weight loss group was significantly higher than that in the no weight loss group ($Z = -2.57$, $p < 0.01$). These findings were observed only in those who underwent successful examinations. The mean body weight changes for the three categories of BMI were as follows: -0.13 (range, -3.7 to $+4.2$), -1.3 (range, -13.6 to $+6.9$), and -3.1

Table 4
Statistical analysis between the with weight loss and without weight loss groups at first assessment.

Variables	No weight loss (n = 25)					Weight loss (n = 27)					p value
Age (mean \pm S.D.)	86.2 \pm 10.8					87.1 \pm 6.8					0.71
Sex											0.52
Male	7					5					
Female	18					22					
Interval of first and second assessments (months) (mean \pm S.D.) (min.–max.)	22.2 \pm 8.6 (6–31)					23.0 \pm 7.0 (6–29)					0.79
Degree of requiring long-term care											0.29
Degree	1	2	3	4	5	1	2	3	4	5	
Number	0	1	10	11	3	0	3	16	6	2	
Degree of dementia											0.78
Degree	I	II	III	IV	M	I	II	III	IV	M	
Number	6	6	8	5	0	4	9	10	4	0	
Number of teeth (mean \pm S.D.) (min.–max.)	6.6 \pm 9.6 (0–29)					8.0 \pm 10.0 (0–27)					0.67
Molar occlusion (with only own teeth)											0.73
Presence	4					6					
Absence	21					21					
Molar occlusion (including removable denture)											1.00
Presence	18					19					
Absence	7					8					
Oral care											0.23
Self	11					9					
Partial help needed	4					10					
Total help needed	10					8					
Refusal of oral care											1.00
Presence	0					0					
Absence	25					27					
Oral hygiene											0.18
Good	16					12					
Poor	9					15					
Dietary forms											0.91
Rice											
Normal	15					16					
Texture-modified	10					11					
Gruel	8					10					
Blended	2					1					
Other foods											0.15
Normal	7					15					
Texture-modified	18					12					
Soft	9					4					
Chopped	7					7					
Blended	2					1					
Total daily calorie (kcal, mean \pm S.D.)	1448.5 \pm 173.5					1431.8 \pm 181.6					0.80
Body weight (kg, mean \pm S.D.)	46.0 \pm 8.4					49.8 \pm 9.1					0.066
BMI (mean \pm S.D.)	20.8 \pm 3.6					22.0 \pm 3.8					0.33

BMI, body mass index. * Statistically significant.

Table 5
Comparisons between the with weight loss and without weight loss groups at first assessment.

Variables	No weight loss	Weight loss	p value
RSST (times/30 min) (mean \pm S.D.)	1.5 \pm 1.4 (n = 17)*	2.4 \pm 1.6 (n = 15)*	0.09
Oral diadochokinesis (times/s)			
Pa	3.2 \pm 1.4 (n = 15)*	3.8 \pm 1.5 (n = 17)*	0.17
Ta	2.8 \pm 1.2 (n = 15)*	4.2 \pm 1.6 (n = 17)*	< 0.01**
Ka	2.9 \pm 1.3 (n = 15)*	3.6 \pm 1.5 (n = 17)*	0.16
Amount of saliva secretion (g/min)	0.35 \pm 0.23 (n = 21)*	0.40 \pm 0.31 (n = 20)*	0.77
Oral wetness	27.6 \pm 1.8 (n = 20)*	26.9 \pm 1.9 (n = 20)*	0.20

RSST, repetitive saliva swallowing test.

* The findings were also observed only in those who underwent successful examinations.

** Statistically significant.

(range, -17.9 to +4.5) kg in the BMI < 18.5 (n = 13), 18.5 ≤ BMI < 25.0 (n = 31), and BMI ≥ 25 (n = 8) groups, respectively (Figure 1). There were no statistically significant differences among the three groups by the Jonckheere-Terpstra test ($p = 0.42$).

4. Discussion

The present study investigated the changes in oral conditions and body weight of older residents over time in a nursing home with regular dentist and dental hygienist interventions. Comparing the first and second assessment data of 52 patients, statistical analysis showed a significant decrease in denture use rate and total calorie intake and a significant increase in oral care refusal rate. However, there were no parameters that were statistically significantly lower in the weight loss group than in the no weight loss group in the first assessment results for degree of dementia, oral conditions, and dietary forms.

Previous studies have shown that as dementia worsens, the rate of removable denture use decreases and molar occlusion is lost, resulting in the consumption of a texture-modified diet and undernutrition. This is due to insufficient mastication caused by the absence of molar occlusion and insufficient nutrient intake from food.²¹ Normal food contains more calories per unit volume than texture-modified foods and has a better nutritional status.^{22–24} Moreover, Lee et al.'s systematic review reported an association between the masticatory function and sarcopenia.²⁵ The decrease in appetite due to the poor appearance of texture-modified foods is also considered the cause of undernutrition.²⁶ The rate of older participants unable to use the removable denture and without molar occlusion increased but was not associated with weight loss in the present study. In the present study, the results differed from those of previous studies in that a higher proportion of the weight loss group consumed texture-modified foods than the no weight loss group. Although there were no statistically significant differences, the weight loss group had higher initial weight and BMI and fewer total calories than the no weight loss group. This is probably because the appropriate nutrition quantity is taken after the nursing home admission.

Poor oral hygiene adversely affects food and nutrient intake.^{27,28} In our study, although the rate of refusal of oral care was significantly higher in the second assessment, there was no change in oral hygiene status. Therefore, appropriate oral care was provided, and oral hygiene status did not deteriorate.

Although there were no statistically significant differences in RSST, oral diadochokinesis, amount of saliva secretion, or oral wetness between the first and second assessments, when the first assessment data were compared between the weight loss and no weight loss groups, the frequency of oral diadochokinesis, "Ta," was significantly higher in the weight loss group than in the no weight loss group. Although there were no statistically significant differences in other parameters, such as "Pa," "Ka," and RSST, these parameters were higher in the weight loss group than in the no weight loss group. It is difficult to infer the reason for weight loss in the group with better oral function from the present study results. The suspected dysphagia value for RSST is less than 3 times/30 s,²⁹ and the suspected oral dysfunction value is less than 6 times/s for oral diadochokinesis.³⁰ The measurements in the present study were below the reference values in both groups with and without weight loss for all values of both oral diadochokinesis and RSST, suggesting that both groups may have impaired tongue and swallowing function. Therefore, we hypothesize that this may not have resulted in a decrease in oral function in the weight loss group.

This study has some limitations. First, since the study was con-

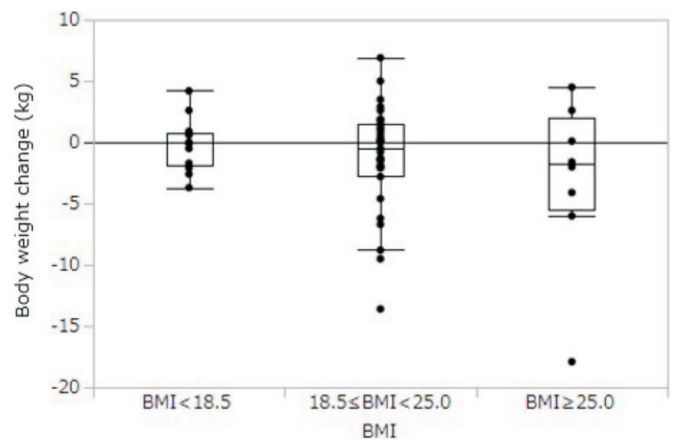


Figure 1. Box and whisker plot depicting the differences among weight changes by three categories of BMI. No statistically significant difference was noted among the three groups ($p = 0.42$). BMI, body mass index.

ducted at a single institution, the sample size was small and sufficient statistical analysis could not be performed. The median observation period was 27 (range, 6–31) months; there may have been negligible changes in most residents' oral status or body weight due to the short observation period. Second, as the average age at the time of the first assessment was 86.7 years, there were many participants who could not be followed up either because of hospitalization or death. Although the follow-up survey was considered to be conducted quickly after the first assessment, 62 out of the 114 patients who underwent the first assessment were unable to undergo the second assessment due to dementia progression, hospitalization, or death. Follow-up of institutionalized older people with dementia is a difficult task. Finally, to investigate the changes in body weight, it is important to accurately grasp the amount of food intake at each meal and to continuously keep a track of it for a long period of time. However, it is not feasible to investigate the amount of food consumed by each person in a study of several people in a nursing care setting, considering the burden on nursing care staff. Further studies with a larger sample size and conducted over an extended period of time are warranted on this participant.

In this study, we investigated the changes in oral conditions and body weight of older people in an aged care nursing home. Our findings show that the rate of using removable denture and daily total calories intaken have reduced, and the rate of refusal of oral care has decreased during observational period in the older residents. There was a trend toward weight loss between the first and second assessments, however, the loss was not statistically significant.

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Conflict of interests

The authors declare no conflict of interests.

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