

Oral function and its association with nutrition and quality of life in nursing home residents with and without dementia: A cross-sectional study

Liza J. M. van de Rijt¹  | Alexandra R. Feast² | Victoria Vickerstaff^{2,3} | Elizabeth L. Sampson^{2,4} | Frank Lobbezoo¹

¹Department of Orofacial Pain and Dysfunction, Faculty of Dentistry, Academic Centre of Dentistry Amsterdam (ACTA), University of Amsterdam and Vrije Universiteit Amsterdam, Amsterdam, The Netherlands

²Marie Curie Palliative Care Research Department, Division of Psychiatry, University College London, London, UK

³The Research Department of Primary Care and Population Health, University College London, London, UK

⁴Barnet Enfield and Haringey Mental Health Trust Liaison Psychiatry Team, North Middlesex University Hospital, London, UK

Correspondence

Liza J. M. van de Rijt, Department of Orofacial Pain and Dysfunction, Academic Centre of Dentistry Amsterdam (ACTA), Gustav Mahlerlaan 3004, 1081 LA Amsterdam, The Netherlands.
Email: l.j.m.vande.rijt@acta.nl

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Abstract

Background: Oral health problems increase with age, and are common in nursing home residents, especially in those with dementia. These problems can lead to tooth loss, diminished oral function and malnutrition.

Objectives: To compare oral function, nutritional status and quality of life (QoL) between residents with and without dementia, and to examine associations between these variables.

Methods: Cross-sectional study conducted in four UK nursing homes. Residents aged 65 + with and without dementia were included. Information was collected on demographics, dental status, quality of swallowing and chewing, xerostomia and orofacial pain. During oral examination, information was collected on number of teeth and occlusal units (OU), and functional categories (eg, OU combined with dentures). Multiple linear regression was used for statistical analysis.

Results: Of 84 residents with and 27 without dementia participated. Residents with dementia had significantly fewer teeth (Dementia median (IQR) = 14 (6-21), vs No dementia 22 (12.75-24.25); $P = .021$), fewer OU (Dementia median (IQR) = 0 (0-3), vs No dementia 4 (0-7); $P = .001$) and poorer functional categories ($Z = -3.283$; $P = .001$), and nutritional status was significantly poorer than those without (Dementia Mean (SD) = 8.3 (2.7), vs No dementia 10.4 (2.0); $P = .002$). In the regression model, quality of chewing (Coef (95% CI) = -1.27 ($-2.22, -0.31$); $P = .010$) was significantly correlated with nutritional status.

Conclusion: Oral function and nutritional status of residents with dementia was poorer than those without. Almost half of all residents had insufficient oral function, which was negatively associated with QoL and nutritional status.

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KEYWORDS

dementia, nursing home, nutrition, oral function, oral health, quality of life

1 | INTRODUCTION

Oral health problems are common in older people, and are even more common in nursing home residents, especially in those with dementia.¹⁻⁵ Although the number of edentate persons increases with age, many nursing home residents have remaining natural teeth.⁶ When admitted to a nursing home, oral hygiene becomes challenging, due to physical or cognitive disabilities, and residents may be dependent on care home staff.² Oral health problems, like caries and periodontal diseases, can lead to the loss of teeth and therefore diminish oral function.⁷ Besides the number of natural teeth, the distribution of remaining teeth is critical.⁷ The number of occlusal units (OU), namely the number of contacts between upper- and lower (pre)molars, can be used as an indicator of objective chewing ability.^{7,8} Previous studies reported that shortened dental arches of 3-5 OU are sufficient to maintain proper chewing ability.⁹⁻¹¹ Oral function can also be influenced by swallowing difficulties, xerostomia, and orofacial pain.¹²⁻¹⁴ In older people, having a functional dentition (either natural or prosthetic) is important for a good oral health-related quality of life (OHQoL), whereas pain in the orofacial area or functional complaints can lead to impaired OHQoL.¹⁵

An adequate diet is necessary to maintain a healthy nutritional status.¹⁶ Reduced oral function can lead to nursing home residents avoiding food, due to difficulty in chewing and swallowing.¹⁷ Dementia itself has been described as a risk factor for malnutrition.¹⁸ Decreased food intake and diminished nutritional status can increase mortality and morbidity risk.¹⁹ Furthermore, decreased chewing ability and a poor nutritional status are both associated with poor quality of life.^{15,20}

Diminished chewing ability is also associated with impaired cognition.²¹ This association can partly be explained by the negative influence of nutritional deficiencies on cognitive function.²² Another possible link is the increased middle cerebral arterial blood flow velocity during masticatory activity.²³ Sufficient oral function may restore cognitive functioning after cerebrovascular damage.²⁴

There has been little research on the association between oral function, nutritional status and quality of life in nursing home residents with dementia, a population at increased risk of diminished oral function and malnutrition. Therefore, the aim of this study was to compare the oral function, nutritional status and quality of life between nursing home residents with and without dementia. Moreover, the association between oral function, nutritional status and quality of life was examined. The present study concerns a secondary analysis of another cross-sectional study.²⁵

2 | METHODS

2.1 | Study design, setting and participants

This study was conducted in four nursing homes across London, UK. Three out of four nursing homes had a 'Good' quality rating according to the Care Quality Commission (CQC), while one nursing home had an 'Excellent' quality rating. All data were collected cross-sectionally during one single assessment. Nursing home residents with and without a clinical diagnosis of dementia in their file, aged 65 years or above, were included. Residents who indicated that they did not wish to participate, either verbally or non-verbally were excluded. Residents with clinical concerns or delirium were excluded as well. The study protocol was reviewed and approved by the London Queen Square Research Ethical Committee (19/LO/0100). Before approaching a resident, eligibility was discussed with the nursing staff. From all participants, informed consent was obtained. If they did not have capacity, a personal or professional consultee was asked to give agreement for the person's participation, and sign his/her agreement. This procedure complied with capacity legislation governing England and Wales (Mental Capacity Act 2005, Sections 30-34).

2.2 | Measurement instruments

Demographic information on age, gender, ethnicity, marital status, number of years in schooling in general education and highest completed level of education was collected of all participants. For participants with dementia, the severity of dementia was determined by the researcher using the clinical dementia rating (CDR) score.²⁶ For all participants, the following information was collected; Charlson comorbidity index (CCI), Barthel Index, 5-level EQ-5D (EQ-5D-5L), Oral Health Impact Profile 14 (OHIP-14), and medication usage.²⁷⁻³¹ The OHIP-14 was only used in participants who were still able to self-report. The validated EQ-5D for proxy was used in participants who were not able to self-report. Test questions were used to assess the ability to self-report.

2.3 | Oral function

Subjective oral function was assessed via interview. Depending on whether the residents with dementia were still able to communicate, residents or their carers were asked about the residents' dental status (eg, dentate or edentate, denture usage), quality of

swallowing, quality of chewing, and whether the resident was on a normal or soft diet. To determine xerostomia in participants who were still able to self-report, the summated xerostomia inventory (SXI) was used.³²

During a brief oral examination, performed by a dentist (LR), information was collected on objective oral function. The number of teeth present and the number of occlusal units (ie, number of contacts between upper- and lower (pre)molars) were counted. We used the orofacial-pain scale for non-verbal individuals (OPS-NVI) to identify orofacial pain in residents with dementia.³³ To identify orofacial pain in residents without dementia, the numeric rating scale (NRS) was used.³⁴ Methods regarding identification of orofacial pain are reported in full in a previous paper.²⁵

2.4 | Nutritional status

We used the Mini Nutritional Assessment Short Form (MNA-SF) to determine residents' nutritional status.³⁵ The MNA-SF consists of six categories:

- A decline in food intake
- B weight loss in the last 3 months
- C mobility
- D psychological stress or acute disease in the past three months
- E neuropsychological problems
- F body mass index (BMI) (weight in kg/height in m²)

The complete MNA-SF is shown in Appendix 1. We calculated the MNA-SF score using the outcome of these six categories (max. 14 points). Based on the total score, we determined a screening score; normal nutritional status (12-14 points), at risk of malnutrition (8-11 points), or malnourished (0-7 points).

2.5 | Data analysis

To analyse data, we used IBM Statistics SPSS 25 (SPSS Inc.). We used descriptive statistics to report the demographic features of the cohort. We used chi-square tests, independent sample *t* tests, and Mann-Whitney *U* tests (depending on the distribution of data) to compare outcomes between the dementia and non-dementia groups. To determine the correlation between oral function, nutritional status and quality of life, we used the Spearman correlation coefficients, independent sample *t* tests, chi-square tests, and Mann-Whitney *U* tests, depending on type of variable and distribution of data. We used univariate and multiple linear regression to evaluate the relationship between nutritional status and multiple oral function factors. Oral function factors that were significantly associated with nutritional status ($P < .10$) in the univariate regression, were included in the final multivariable regression model.

3 | RESULTS

In total, 111 nursing home residents participated in this study, of which 84 had dementia and 27 were without dementia. The recruitment flowchart is reported in Figure 1. Descriptive characteristics of all participants and of residents with and without dementia separately are given in Table 1. Of the total sample, 62.2% were female and the average age was 83.9 (SD 7.95) years old.

The EQ-5D for proxy was used in 63 participants with dementia. There were no significant differences between people with and without dementia regarding demographics, comorbidity (CCI), quality of life (EQ-5D), and oral-health related quality of life (OHIP-14). Functional ability (Barthel Index) was significantly poorer in the dementia group (median (IQR) dementia group: 10 (10-30) vs non-dementia group: 30 (15-40); $P = .003$).

3.1 | Oral function

Factors regarding oral function of all participants and of residents with and without dementia separately are given in Table 2. Of all participants, 69.4% were dentate and the median number of OU was 0. Regarding functional categories, 48.6% had 0-2 OU without dentures, and only 23.4% had 3 OU or more. Residents with dementia had significantly fewer natural teeth (in dentate participants) ($P = .021$), less OU ($P = .009$), and poorer outcome regarding functional categories ($P = .001$). Subjective swallowing quality was indicated as good by 73% of the participants, while 52.3% indicated the subjective chewing quality as good. Orofacial pain was significantly more prevalent in residents with dementia (48.8%), than those without dementia (14.8%) ($P = .002$).

3.2 | Nutritional status

Information on nutritional status of all participants and of residents with and without dementia separately are shown in Table 2. Significantly more residents with dementia (42.7%) were on a soft diet, compared with residents without dementia (14.8%) ($P = .009$). The mean outcome of the total score of the MNA-SF for residents with dementia was 8.3 (SD 2.7) and was significantly lower than the mean of 10.4 (SD 2.0) of residents without dementia ($P = .002$). Residents with dementia scored significantly poorer on the screening score of the MNA-SF ($P = .015$). According to the MNA-SF, of the residents with dementia, 41.7% were malnourished and 44.0% were at risk of malnutrition. In residents without dementia, 51.9% were at risk of malnutrition and 14.8% were malnourished.

In Tables 3 and 4, the associations between oral function factors, nutritional status and quality of life in nursing home residents are shown. Being dentate ($P = .015$), lower number of teeth ($P = .020$), lower number of OU ($P = .007$), poorer functional category

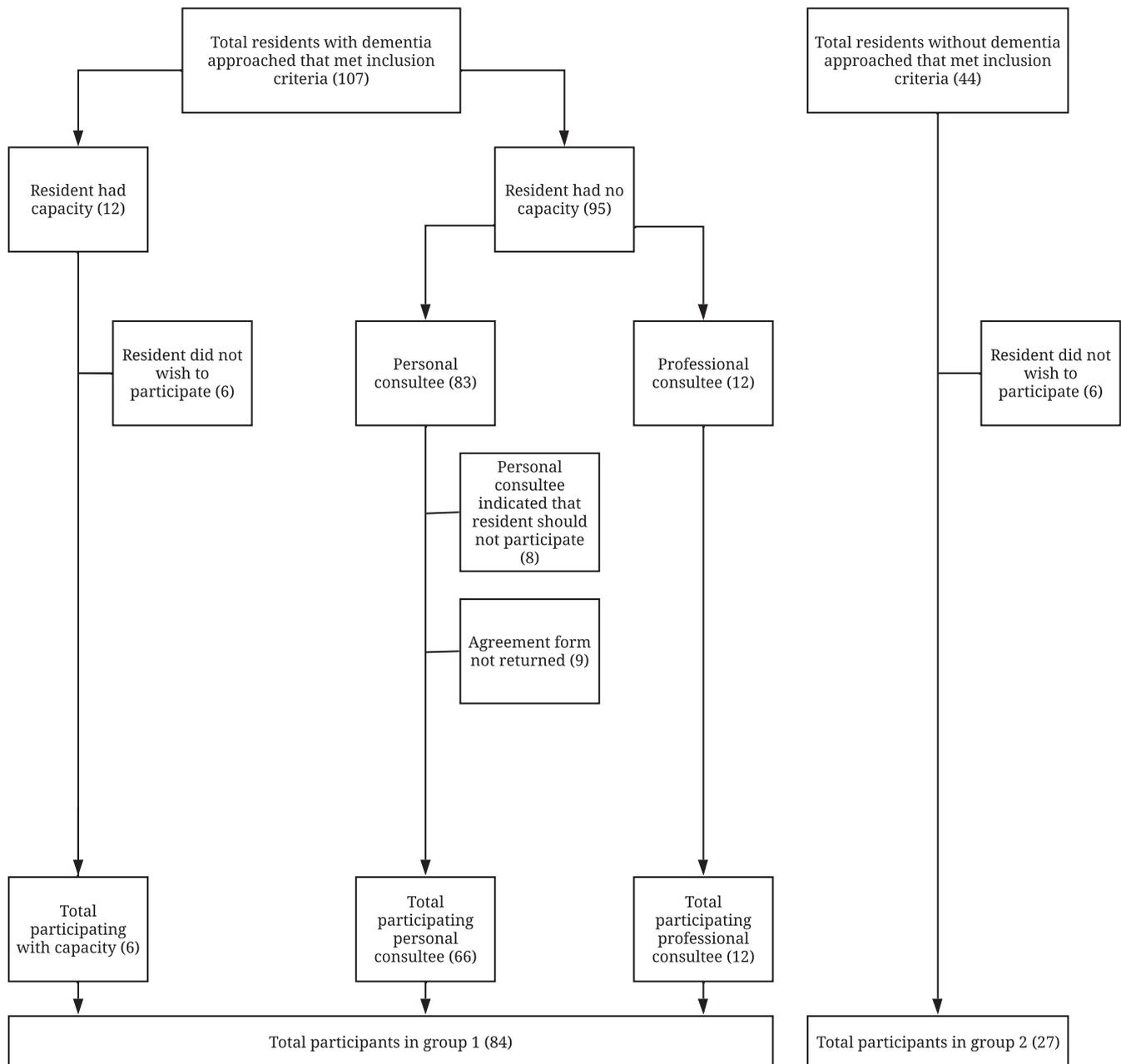


FIGURE 1 Recruitment flowchart residents with and without dementia. Note. Recruitment flowchart has been reported in a previous paper³⁹

($P = .012$), poorer swallowing quality ($P < .001$), and poorer chewing quality ($P < .001$) were significantly associated with the presence of orofacial pain.

Lower number of teeth ($P < .001$), lower number of OU ($P < .001$), poorer functional category ($P < .001$), poorer swallowing quality ($P < .001$), poorer chewing quality ($P < .001$), presence of orofacial pain ($P = .001$), xerostomia ($P = .005$) and being on a soft diet ($P < .001$) were significantly associated with a poorer nutritional status. A poorer quality of life, according to the EQ-5D, was significantly associated with poorer swallowing quality ($P < .001$), poorer chewing quality ($P < .001$), presence of orofacial pain ($P = .003$), xerostomia ($P < .001$), being on a soft diet ($P < .001$), and poorer nutritional status ($P < .001$). A poorer oral

health-related quality of life, according to the OHIP-14, was significantly associated with poorer chewing quality ($P = .005$), presence of orofacial pain ($P = .001$), xerostomia ($P = .014$), and poorer nutritional status ($P = .039$).

In Table 5, the univariate and multiple linear regression between oral function factors and nutritional status (MNA-SF) are reported. Functional categories, quality of swallowing, quality of chewing, orofacial pain, SXI and being on a soft diet were eligible for the multivariable regression model ($P < .10$). After adjusting for the other oral function factors, only quality of chewing ($P = .010$) remained significantly associated with nutritional status. This model explained 28% ($R^2 = 0.28$) of the variance in nutritional status.

TABLE 1 Descriptive characteristics of all participants and of residents with and without dementia separately

| | Total (n = 111) | Dementia (n = 84) | No dementia (n = 27) | Test value | P-value |
|--|--------------------------------|--------------------------------|--------------------------------|---------------------|---------|
| Gender [n (%)] | | | | | |
| Female | 69 (62.2%) | 52 (61.9%) | 17 (63.0%) | $\chi^2(1) = 0.010$ | .921 |
| Male | 42 (37.8%) | 32 (38.1%) | 10 (37.0%) | | |
| Age M, SD (range) | 83.9, 7.95 (65-101) | 84.5, 7.62 (65-101) | 82.3, 8.86 (66-99) | $t(109) = 1.229$ | .222 |
| Ethnicity [n (%)] | | | | | |
| White | 70 (63.1%) | 54 (64.3%) | 16 (59.3%) | $\chi^2(3) = 4.195$ | .241 |
| Asian/Asian British | 9 (8.1%) | 8 (9.5%) | 1 (3.7%) | | |
| Black/African/ Caribbean/Black British | 28 (25.2%) | 18 (21.4%) | 10 (37.0%) | | |
| Other ethnic group | 4 (3.6%) | 4 (4.8%) | 0 (0.0%) | | |
| Marital status [n (%)] | | | | | |
| Married | 28 (25.7%) | 21 (25.3%) | 7 (26.9%) | $\chi^2(3) = 2.827$ | .419 |
| Divorced | 9 (8.3%) | 5 (6.0%) | 4 (15.4%) | | |
| Widowed | 48 (44.0%) | 37 (44.6%) | 11 (42.3%) | | |
| Single | 24 (22.0%) | 20 (24.1%) | 4 (15.4%) | | |
| Years in general education M, SD (range) | 9.69, 3.78 (0-18) | 9.12, 3.61 (0-16) | 10.6, 3.94 (0-18) | $t(52) = -1.388$ | .171 |
| Highest completed level of education [n (%)] | | | | | |
| Degree | 1 (0.9%) | 1 (1.2%) | 0 (0.0%) | $\chi^2(4) = 4.133$ | .388 |
| GCSE (or equivalent) | 9 (8.2%) | 5 (6.0%) | 4 (14.8%) | | |
| No qualification | 50 (45.5%) | 36 (43.4%) | 14 (51.9%) | | |
| Other | 3 (2.7%) | 2 (2.4%) | 1 (3.7%) | | |
| Unknown | 47 (42.7%) | 39 (47.0%) | 8 (29.6%) | | |
| CDR [n (%)] | | | | | |
| None | 0 (0%) | 0 (0%) | - | N/A | N/A |
| Questionable | 1 (1.2%) | 1 (1.2%) | | | |
| Mild | 8 (9.5%) | 8 (9.5%) | | | |
| Moderate | 22 (26.2%) | 22 (26.2%) | | | |
| Severe | 53 (63.1%) | 53 (63.1%) | | | |
| CCI median (IQR) | 4 (3-5) | 4 (3-5) | 4 (2-5) | $Z = -0.807$ | .42 |
| Barthel index median (IQR) | 15 (10-35) | 10 (10-30) | 30 (15-40) | $Z = -2.936$ | .003* |
| EQ-5D index M, SD (range) | 0.105, 0.299 (-0.352-0.906) | 0.075, 0.279 (-0.352-0.806) | 0.199, 0.344 (-0.256-0.906) | $t(109) = -1.899$ | .06 |
| OHIP-14 median (IQR) | 1 (0-5) | 1 (0-4) | 2 (0-5.5) | $Z = -0.969$ | .333 |
| Medication [n (%)] | | | | | |
| Analgesics | 92 (82.9%) | 69 (82.1%) | 23 (85.2%) | $\chi^2(1) = 1.33$ | .715 |
| Regular | 54 (58.1%) | 36 (51.4%) | 18 (78.3%) | $\chi^2(2) = 5.625$ | .06 |
| PRN | 34 (36.6%) | 29 (41.4%) | 5 (21.7%) | | |
| Regular + PRN | 5 (5.4%) | 5 (7.1%) | 0 (0.0%) | | |
| Anti-depressants | 29 (26.1%) | 20 (23.8%) | 9 (33.3%) | $\chi^2(1) = 0.960$ | .327 |
| Anti-epileptics | 19 (17.1%) | 11 (13.1%) | 8 (29.6%) | $\chi^2(1) = 3.937$ | .047* |
| Anti-psychotics | 18 (16.2%) | 14 (16.7%) | 4 (14.8%) | $\chi^2(1) = 0.052$ | .82 |

Abbreviations: M, mean; SD, standard deviation; IQR, interquartile range; CDR, clinical dementia rating; CCI, Charlson comorbidity index; EQ-5D, euroqol 5 dimension; OHIP, oral health impact profile; PRN, pro re nata; χ^2 , chi square test, t , independent sample t test; Z , Mann-Whitney U test; N/A, not applicable.

* $P < .05$.

TABLE 2 Oral function and nutritional status of all participants and of residents with and without dementia separately

| | Total (n = 111) | Dementia (n = 84) | No dementia (n = 27) | Test value | P-value |
|--|--------------------------|-----------------------|------------------------|---------------------|--------------------|
| Dental status, dentate [n (%)] | 77 (69.4%) | 59 (70.2%) | 18 (66.7%) | $\chi^2(1) = 0.123$ | .726 |
| Present teeth (in dentate P) median (IQR) | 16 (7-22) | 14 (6-21) | 22 (12.75-24.25) | $Z = -2.302$ | .021 [*] |
| OU median (IQR) | 0 (0-4) | 0 (0-3) | 4 (0-7) | $Z = -2.625$ | .009 ^{**} |
| Functional categories [n (%)] | | | | | |
| 0-2 OU no dentures | 54 (48.6%) | 48 (57.1%) | 6 (22.2%) | $Z = -3.283$ | .001 ^{**} |
| 0-2 OU + dentures | 31 (27.9%) | 21 (25.0%) | 10 (37.0%) | | |
| 3-5 OU | 13 (11.7%) | 8 (9.5%) | 5 (18.5%) | | |
| ≥ 6 OU | 13 (11.7%) | 7 (8.3%) | 6 (22.2%) | | |
| Subjective swallowing quality [n (%)] | | | | | |
| Good | 81 (73.0%) | 59 (70.2%) | 22 (81.5%) | $\chi^2(2) = 3.084$ | .214 |
| Moderate | 25 (22.5%) | 22 (26.2%) | 3 (11.1%) | | |
| Bad | 5 (4.5%) | 3 (3.6%) | 2 (7.4%) | | |
| Subjective chewing quality [n (%)] | | | | | |
| Good | 58 (52.3%) | 40 (47.6%) | 18 (66.7%) | $\chi^2(2) = 4.180$ | .124 |
| Moderate | 38 (34.2%) | 30 (35.7%) | 8 (29.6%) | | |
| Bad | 15 (13.5%) | 14 (16.7%) | 1 (3.7%) | | |
| Orofacial pain [n (%)] | 45 (40.5%) | 41 (48.8%) | 4 (14.8%) | $\chi^2(1) = 9.796$ | .002 ^{**} |
| SXI median (IQR) | 6 (5-11.75) | 7 (5.5-13) | 6 (5-10) | $Z = -1.220$ | .222 |
| Soft diet [n (%)] | 39 (35.8%) | 35 (42.7%) | 4 (14.8%) | $\chi^2(1) = 6.865$ | .009 ^{**} |
| Weight in kg M, SD (range) | 61.5, 16.9 (31.4-114) | 59.9, 16.5 (31.4-114) | 66.5, 17.3 (38.9-99.1) | $t(109) = -1.805$ | .074 |
| BMI M, SD (range) | 22.5, 5.2 (12-37) | 22.0, 5.0 (12-37) | 24.0, 5.6 (14-37) | $t(109) = -1.787$ | .077 |
| Decline in food intake [n (%)] | | | | | |
| Severe decrease | 2 (1.8%) | 2 (2.4%) | 0 (0.0%) | $Z = -1.651$ | .099 |
| Moderate decrease | 37 (33.3%) | 31 (36.9%) | 6 (22.2%) | | |
| No decrease | 72 (64.9%) | 51 (60.7%) | 21 (77.8%) | | |
| Weight loss last 3 months [n (%)] | | | | | |
| >3 kg | 8 (7.2%) | 5 (6.0%) | 3 (11.1%) | $Z = -0.303$ | .762 |
| 1-3 kg | 28 (25.2%) | 22 (26.2%) | 6 (22.2%) | | |
| No weight loss | 63 (56.8%) | 48 (57.1%) | 15 (55.6%) | | |
| Unknown | 12 (10.8%) | 9 (10.7%) | 3 (11.1%) | | |
| MNA-SF total score M, SD (range) | 8.7, 2.7 (2-14) | 8.3, 2.7 (2-13) | 10.4, 2.0 (6-14) | $t(109) = -3.128$ | .002 ^{**} |
| MNA-SF [n (%)] | | | | | |
| Normal nutritional status | 21 (18.9%) | 12 (14.3%) | 9 (33.3%) | $\chi^2(1) = 8.382$ | .015 [*] |
| At risk of malnutrition | 51 (45.9%) | 37 (44.0%) | 14 (51.9%) | | |
| Malnourished | 39 (35.1%) | 35 (41.7%) | 4 (14.8%) | | |

Abbreviations: P, participants; IQR, interquartile range; M, mean; SD, standard deviation; OU, occlusal units; SXI, summated xerostomia inventory; BMI, body mass index in kg/m²; MNA-SF, mini nutritional assessment short form; χ^2 , chi square test; t , independent sample t test, Z , Mann-Whitney U test; N/A, not applicable.

* $P < .05$,

** $P < .01$.

4 | DISCUSSION

Our aims were to compare the oral function, nutritional status and quality of life between nursing home residents with and without

dementia, and to examine the association between oral function, nutritional status and quality of life. Almost half of nursing home residents had insufficient oral function, which was negatively associated with quality of life and nutritional status. The oral function

TABLE 3 Spearman correlation between oral function, nutritional status and quality of life in nursing home residents

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-------------------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|----------------|--------------|---|
| 1 Present teeth | - | | | | | | | | |
| 2 OU | $r = .78^{**}$ | - | | | | | | | |
| 3 Functional categories | $r = .60^{**}$ | $r = .80^{**}$ | - | | | | | | |
| 4 Swallowing quality | $r = -.13$ | $r = -.14$ | $r = -.11$ | - | | | | | |
| 5 Chewing quality | $r = -.18$ | $r = -.18$ | $r = -.20^*$ | $r = .41^{**}$ | - | | | | |
| 6 SXI | $r = -.05$ | $r = -.15$ | $r = -.22$ | $r = .41^{**}$ | $r = .37^{**}$ | - | | | |
| 7 MNA-SF | $r = .42^{**}$ | $r = .44^{**}$ | $r = .35^{**}$ | $r = -.41^{**}$ | $r = -.54^{**}$ | $r = -.35^{**}$ | - | | |
| 8 EQ-5D | $r = .00$ | $r = .02$ | $r = .13$ | $r = -.43^{**}$ | $r = -.43^{**}$ | $r = -.44^{**}$ | $r = .45^{**}$ | - | |
| 9 OHIP-14 | $r = -.22$ | $r = -.23$ | $r = -.26$ | $r = .17$ | $r = .42^{**}$ | $r = .37^*$ | $r = -.32^*$ | $r = -.31^*$ | - |

Abbreviations: n, 111; OU, occlusal units; SXI, summated xerostomia inventory; MNA-SF, mini Nutritional assessment short form; EQ-5D, euroqol 5 dimension; OHIP, oral health impact profile; r , spearman correlation coefficient.

* $P < .05$,

** $P < .01$.

TABLE 4 Association between dental status, orofacial pain and being on a soft diet and oral function, nutritional status and quality of life in nursing home residents

| | Dental status P-value | Orofacial pain P-value | Soft diet P-value |
|---------------------------|--------------------------|---------------------------|----------------------|
| Dental status [X^2] | - | - | - |
| Orofacial pain [X^2] | .015 [*] | - | - |
| Soft diet [X^2] | .068 | <.001 ^{**} | - |
| Present teeth [Z] | - | .020 [*] | .215 |
| OU [Z] | - | .007 ^{**} | .747 |
| Functional categories [Z] | .159 | .012 [*] | .051 |
| Swallowing quality [Z] | .591 | <.001 ^{**} | <.001 ^{**} |
| Chewing quality [Z] | .122 | <.001 ^{**} | <.001 ^{**} |
| SXI [Z] | .697 | .008 ^{**} | .002 ^{**} |
| MNA-SF [t] | .687 | .001 ^{**} | <.001 ^{**} |
| EQ-5D [t] | .802 | .003 ^{**} | <.001 ^{**} |
| OHIP-14 [t] | .100 | .001 ^{**} | .481 |

Abbreviations: n, 111; OU, occlusal units; SXI, summated xerostomia inventory; MNA-SF, mini nutritional assessment short form; EQ-5D, euroqol 5 dimension; OHIP, oral health impact profile; t , independent sample t test; X^2 , chi square test; Z , Mann-Whitney U test.

* $P < .05$,

** $P < .01$.

and nutritional status of residents with dementia was poorer than of those without.

A previous study from the Netherlands reported that 13% of older people with dementia had less than 3 OU and no dentures, and that older people with dementia had fewer teeth and OU than older people with mild cognitive impairment.³⁶ Poorer nutritional status in nursing home residents with dementia than in those without was reported previously.¹⁸ These authors also found an association

between malnutrition and edentulism.¹⁸ A significant association between quality of chewing and nutritional status was found in a study conducted in Dutch nursing homes.³⁷ Another study confirms the association between poor oral function and poor oral health-related quality of life.^{11,38}

4.1 | Strengths and limitations

This is the first study assessing the association between oral function and nutrition, including nursing home residents with dementia without capacity. Since some participants were no longer able to verbally communicate, several questions were answered by their carers. It is important to acknowledge the possibility of misinterpretation of subjective questions by the carers, which reduces the validity. However, without the use of information of carers we would have to exclude the very people, whose care we wish to improve. Furthermore, no sample size calculation was performed for these secondary analyses, since the analysed data were originally collected for other purposes. Moreover, we did not account for the number of tests performed and the adjustment for clustering the data of the four nursing homes, due to the limited sample size. The MNA-SF was used for the assessment of the nutritional status, which is a screening tool. To establish a comprehensive overview of the nutritional status, a more extended interview, including a food diary, is required. Since this study was cross-sectional with a single assessment on one day, this was not possible.

4.2 | Implications

Almost half of the nursing home residents had insufficient objective chewing ability (<3 OU and no dentures), and 47.4% indicated their subjective quality of chewing as moderate or bad. Of all participants, 81% were at risk of malnutrition or were malnourished. Strikingly,

| | R | R ² | Coefficient | 95% CI | T | P-value |
|-----------------------|------|----------------|-------------|--------------|-------|--------------------|
| Univariate regression | | | | | | |
| Dental status | 0.04 | 0 | -0.22 | -1.32; 0.88 | -0.4 | .687 |
| Functional categories | 0.35 | 0.12 | 0.9 | 0.44; 1.36 | 3.85 | <.001 ^a |
| Quality of swallowing | 0.41 | 0.17 | -1.97 | -2.81; -1.14 | -4.67 | <.001 ^a |
| Quality of chewing | 0.54 | 0.29 | -2.02 | -2.62; -1.42 | -6.66 | <.001 ^a |
| Orofacial pain | 0.32 | 0.1 | -1.75 | -2.73; -0.77 | -3.55 | .001 ^a |
| SXI | 0.32 | 0.1 | -0.13 | -0.23; -0.03 | -2.63 | .011 ^a |
| Soft diet | 0.45 | 0.2 | -2.46 | -3.40; -1.52 | -5.17 | <.001 ^a |
| Multiple regression | | | | | | |
| Functional categories | 0.53 | 0.28 | 0.45 | -0.02; 0.92 | 1.93 | .059 |
| Quality of swallowing | | | -0.83 | -1.99; 0.33 | -1.43 | .159 |
| Quality of chewing | | | -1.27 | -2.22; -0.31 | -2.66 | .010 [*] |
| Orofacial pain | | | 0.68 | -0.59; 1.93 | 1.08 | .285 |
| SXI | | | -0.04 | -0.16; 0.08 | -0.67 | .508 |
| Soft diet | | | 0.39 | -1.17; 1.95 | 0.5 | .619 |

Abbreviations: n, 111; SXI, summated xerostomia inventory; MNA-SF, mini nutritional assessment short form; CI, confidence interval.

^ap < 0.10 and included in multivariable regression model.

*P < .05.

TABLE 5 Univariate and multiple linear regression of the relationship between oral function factors and nutritional status (MNA-SF) in nursing home residents

malnutrition increases the mortality and morbidity risk and decreases quality of life.^{19,20}

Orofacial pain was more prevalent in residents with dementia than those without, and it was significantly associated with poor OHQoL. In another paper, we elaborate more on these clinical results and we report on the validity testing of the observational tool.³⁹ Both oral function status and nutritional status were poorer in residents with dementia than in those without, and poor nutritional status was associated with poor oral function and orofacial pain. These results highlight the need for routine dental care in nursing home residents, to maintain sufficient chewing ability and treat possible pain causing oral health problems. In case of an insufficient number of OU (<3), properly fitting dentures should be provided. In dentate residents, the shortened dental arch (SDA) concept (eg, dentition with intact front teeth and a reduction of OU of posterior teeth, starting posteriorly), instead of removable partial dentures, could be considered.⁴⁰ Previous studies showed promising results of the SDA concept regarding nutritional status and quality of life.^{11,41} Furthermore, in case of a SDA, providing oral care for the resident or for care home staff becomes easier.

In our study, the model regarding oral function explained 28% of the variance in nutritional status. The remaining variance in nutritional status could be explained by other possible risk factors for malnutrition in older people (eg, excessive polypharmacy, poor appetite, institutionalisation, etc).⁴² We suggest future research should include those other possible risk factors for malnutrition and should use more extended information to determine nutritional status.

5 | CONCLUSION

Almost half of nursing home residents had insufficient oral function, which was negatively associated with quality of life and nutritional status. The oral function and nutritional status of residents with dementia was poorer than of those without. To improve oral function and nutritional status in care home residents with and without dementia, more research on clinical interventions in this topic is necessary.

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CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of conflicts of interest.

AUTHORS' CONTRIBUTIONS

LJM van de Rijt, EL Sampson and F. Lobbezoo were conceived and designed the study. AR Feast was involved in additional study planning and implementation. V. Vickerstaff, LJM van de Rijt and AR Feast were involved in the processing, analysis and the interpretation of data. LJM van de Rijt drafted the manuscript. All authors were involved in revising the manuscript critically and gave final approval of the manuscript.

DATA AVAILABILITY STATEMENT

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

ORCID

Liza J. M. van de Rijt  <https://orcid.org/0000-0003-1391-8622>

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APPENDIX 1

The mini nutritional assessment short form (MNA-SF)

| Category | Answers |
|--|---|
| A decline in food intake | Severe decrease in food intake (0 points) Moderate decrease in food intake (1 point) No decrease in food intake (2 points) |
| B weight loss in the last 3 mo | Weight loss greater than 3 kg (0 points) Does not know (1 point) Weight loss between 1 and 3 kg (2 points) No weight loss (3 points) |
| C mobility | Bed or chair bound (0 points) Able to get out of bed/chair, but does not go out (1 point) Goes out (2 points) |
| D psychological stress or acute disease in the past three months | Yes (0 points) No (2 points) |
| E neuropsychological problems | Severe dementia or depression (0 points) Mild dementia (1 point) No psychological problems (2 points) |
| F BMI | BMI less than 19 (0 points) BMI 19 to less than 21 (1 point) BMI 21 to less than 23 (2 points) BMI 23 or greater (3 points) |

Note. BMI = body mass index in kg/m².