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Readily Identifiable Risk Factors of Nursing Home Residents' Oral Hygiene: Dementia, Hospice, and Length of Stay

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Abstract

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CONFLICT OF INTEREST CHECKLIST

Elements of Financial/Personal Conflicts	SZ		SA		LC		DR		PP		KW		PS	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Employment/Affiliation		√		√		√		√		√		√		√
Grants/Funds		√		√		√		√		√		√		√
Honoraria		√		√		√		√		√		√		√
Speaker Forum		√		√		√		√		√		√		√
Consultant		√		√		√		√		√		√		√
Stocks		√		√		√		√		√		√		√
Royalties		√		√		√		√		√		√		√
Expert Testimony		√		√		√		√		√		√		√
Board Member		√		√		√		√		√		√		√
Patents		√		√		√		√		√		√		√
Personal Relationship		√		√		√		√		√		√		√

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Background/Objectives—The poor oral hygiene of nursing home (NH) residents is a matter of increasing concern, especially due to its relationship to pneumonia and other health events. Because details and related risk factors in this area are scant, and providers need to be able to easily identify those residents at most risk, this study comprehensively examined the plaque, gingival, and denture status of NH residents, as well as readily available correlates of those indicators of oral hygiene, including items from the Minimum Data Set (MDS).

Design—An oral hygiene assessment and chart abstract conducted on a cross-section of NH residents

Setting—Fourteen NHs in North Carolina

Participants—506 NH residents

Measurements—Descriptive data from the MDS and assessments using three standardized measures: the Plaque Index for Long-Term Care (PI-LTC), the Gingival Index for Long-Term Care (GI-LTC), and the Denture Plaque Index (DPI)

Results—Oral hygiene scores averaged 1.7 (of 3) for the PI-LTC, 1.5 (of 4) for the GI-LTC, and 2.2 (of 4) for the DPI. Factors most strongly associated with poor oral hygiene scores included having dementia, being on hospice care, and longer length of stay. MDS ratings of gingivitis differed significantly from oral hygiene assessments.

Conclusions—Findings identify resident subgroups that are at especially high risk of poor oral health who can be targeted in quality improvement efforts related to oral hygiene; they also indicate need to improve the accuracy of how MDS items are completed.

Keywords

Mouth care; oral hygiene; risk factors; long-term care; nursing homes; Minimum Data Set

INTRODUCTION

The oral hygiene of nursing home (NH) residents has become of concern following numerous studies documenting poor care and outcomes – such that only 16% of NH residents receive mouth care[1] and only 15% have very good or better oral hygiene.[2] Common reasons for poor care and outcomes are that NH residents, especially those with dementia, resist mouth care,[1] and that staff are not aware of the health benefits of good hygiene.[3] It is now known that poor oral hygiene increases the risk of aspiration pneumonia,[4,5] pain, malnutrition, exacerbation of chronic disease, and lower quality of life.[6,7]

The increasing attention paid to oral hygiene in NHs has resulted in the development of efficacious mouth care programs.[3,8–12] One challenge of such programs, however, is the additional time it takes to provide sufficient care to dependent NH residents. For example, when mouth care *is* provided, care staff spend on average only 1¼ minutes brushing a resident's teeth,[1] yet one program found it required more than 6 minutes to adequately brush teeth, clean gums and between teeth, and apply products such as fluoride.[12] Given lingering perceptions that mouth care is an omissible grooming activity when staff are burdened,[13,14] it is necessary to consider how it might be targeted to the neediest residents.

An efficient way for NH providers to determine residents' oral health needs is to use existing data. Since 1987, federal regulation has mandated that all NHs receiving Medicare or Medicaid screen residents at admission, quarterly, annually, and when a significant change in status occurs; this information is recorded in the Minimum Data Set (MDS).[15] The MDS records data on some of the risk factors for poor oral health, including dementia[16,17] and select medications.[18] It also records screening information related to broken/loosely fitting dentures, absence of teeth/tooth fragments, abnormal mouth tissue, cavity/broken natural teeth, inflamed/bleeding gums or loose teeth, and mouth/facial pain/discomfort or difficulty chewing, which are intended to guide further assessment and care.

The purpose of this study was to comprehensively characterize the oral hygiene status of NH residents and examine correlates of risk readily available from the MDS. In addition to examining resident-level characteristics, it examined NH-level characteristics, to determine whether some NHs house residents with poorer oral hygiene. Results are useful not only to target care provision, but also to guide future quality improvement efforts.

METHODS

Sample

Data were collected as part of a larger study aimed at improving mouth care in NHs. Fourteen NHs were selected to participate, all located in counties with proportionately high rehospitalization rates for pneumonia (an outcome of interest in the larger study) and that provided care for high proportions of long-term care (as opposed to rehabilitation) residents. In each NH, the oral hygiene of up to 60 residents was assessed by a dental hygienist. Eligibility included being 21 years of age or older, having natural teeth or having and using a denture, not requiring antibiotic prophylaxis prior to dental assessment, and not receiving only short-term rehabilitation. In NHs with more than 60 eligible residents, eligible residents were randomly selected using a random number list; in NHs with 60 or fewer residents, all eligible residents were approached. All residents or their legally authorized representative provided written informed consent. Resident charts also were reviewed, and NH administrators provided information about NH characteristics. All procedures were approved by the University of North Carolina at Chapel Hill Biomedical Institutional Review Board (IRB #13-2072).

Measures

Data related to oral hygiene as well as resident and NH characteristics.

Oral hygiene—Oral hygiene was accessed using modifications of three indices: the Plaque Index for Long-Term Care (PI-LTC),[19] the Gingival Index for Long-Term Care (GI-LTC),[20] and the Denture Plaque Index (DPI).[21] For all indices, a higher score indicates worse oral health. To derive the PI-LTC score, the dental hygienist scratched the surface of the tooth that had the most plaque in twelve areas of the mouth, first on the outside (buccal) surface of the teeth, and then on the inside (lingual) surface; each segment was assigned a score of 0 (no plaque or stain), 1 (plaque covers ≤ 1/3 of the tooth surface), 2 (plaque covers > 1/3 but ≤ 2/3 of the tooth surface), or 3 (plaque covers > 2/3 of the tooth surface). The derive the GI-

LTC score, the hygienist swept the most inflamed gingival area in each sextant of the mouth and assigned a score of 0 (no inflammation), 1 (mild inflammation with a slight change in color or texture), 2 (mild inflammation involving the entire marginal or gingival unit), 3 (moderate inflammation with glazing, redness, edema, and/or hypertrophy with bleeding on pressure), or 4 (severe inflammation with spontaneous bleeding). The GI-LTC has good intra- and inter-rater reproducibility (average kappa values 0.59 ± 0.06 to 0.72 ± 0.05).[22] The DPI was assessed on residents who used a full or partial denture; for this, the hygienist immersed the denture into disclosing solution, and gave each of eight segments of the dentures (including both the facial [exposed] surface and the basal [unexposed] surface), a score of 0 (no plaque), 1 (light plaque covering 1% – 25% of the quadrant), 2 (moderate plaque covering 26% – 50% of the quadrant), 3 (heavy plaque covering 51% – 75% of the quadrant), or 4 (very heavy plaque covering 76% – 100% of the quadrant). The DPI evidences good reliability (intra-class correlation coefficient 0.96 [95% CI: 0.92 – 0.99], weighted kappa reliability 0.50 – 0.67).[23]

Resident-level characteristics—Resident-level characteristics were those readily available in the NH chart and associated with oral hygiene in previous research: age, gender, race, payment source,[24] diagnosis of Alzheimer's disease or another dementia, resisting/refusing care at least one day a week,[16] receiving antipsychotic or antianxiety medications in the last week,[18] and being on hospice.[25] Length of stay also was examined, to determine whether hygiene varied based on an individual's tenure in the NH. In addition, the most recent MDS oral status items appropriate for comparison with the standardized oral hygiene assessment were obtained: absence of teeth/tooth fragments and inflamed/bleeding gums.

Nursing home-level characteristics—NH-level characteristics were those associated with NH quality (not necessarily specific to oral hygiene) in previous research: size, ownership, percent of residents on Medicaid,[26] monthly rate, percent of rooms that are private, overall rating of quality (scored 1–5, derived from the MDS),[27] and dental services (the availability of dentist and dental hygienist services in the NH, and frequency of visits).[28]

Analyses

Descriptive statistics of NHs and residents were computed, and plaque and gingival scores were calculated for the buccal (outside) and lingual (inside) surface of the upper and lower teeth, as were denture scores for the facial (exposed) and basal (unexposed) surface of the upper and lower denture. Bivariate associations between measures of oral hygiene and resident and NH characteristics were examined using mixed models, which adjust for resident clustering within NHs. Because many of the continuous variables were skewed, means for oral hygiene measures were constructed at the 25th and 75th percentile values for these variables. Multivariate mixed models included all variables that had a p value <.10 in bivariate relationships. Comparisons of oral hygiene assessments to MDS oral status items examined (1) agreement regarding total absence of teeth/tooth fragments, recognizing that to be eligible for this study, residents had to have teeth and/or dentures (meaning analyses could only validly compare "no teeth" on the MDS to observed teeth on the oral hygiene evaluation), and (2) inflamed/bleeding gums, recognizing that because the MDS groups this

item with “loose natural teeth,” analyses could only validly compare a “no” on the MDS item to a score of any inflammation on the oral hygiene evaluation. All analyses were completed using SPSS for Windows, version 18.

RESULTS

Study NHs averaged 114 beds; 11 of the 14 (77%) were for-profit. On average, Medicaid was the primary payer for 62% of the residents, and the overall quality rating on *Nursing Home Compare* was 4.2 (standard deviation [SD] 1.2 on a scale of 1–5; see Table 1). Only two NHs had services provided by dentists or dental hygienists at least once per quarter.

A total of 506 residents received oral hygiene assessments. Participants were primarily female (72%), white (64%), and receiving Medicaid (69%), and half (51%) had a diagnosis of Alzheimer’s disease or another dementia; 6% were on hospice. Mean length of stay was 2.5 years (SD 2.3). Nearly two-thirds (65%) had teeth without appliances; 14% had teeth and partial dentures; and 21% had dentures only.

Oral Hygiene

Of the 400 residents with at least some teeth, plaque data were collected for all 400, and gingival data for 397. Plaque scores on the PI-LTC averaged 1.7 (of 3; SD 0.8) and gingival scores on the GI-LTC averaged 1.5 (of 4; SD 0.9; see Table 2). The lingual (inside) surface of the upper teeth scored significantly better in terms of plaque and gingivitis, as did the lower teeth for gingivitis. Denture hygiene among the 176 residents with full or partial appliances averaged 2.2 (of 4, SD 1.2), with the lower denture evidencing better hygiene, especially on the facial (exposed) surface.

Relationship of Oral Hygiene to NH and Resident Characteristics

Four NH characteristics and six resident characteristics were associated with at least one measure of oral hygiene at levels that reached or approached statistical significance ($p<.10$; see Table 3). One or more measures of oral hygiene was worse in NHs that were for-profit, had more residents on Medicaid, were of lower overall quality, and did not provide at least monthly visits by a dental hygienist. Among resident characteristics, having Alzheimer’s/dementia was significantly related to worse scores on all three oral hygiene measures. Other resident characteristics associated with worse scores on one or more oral hygiene measures included African American race, male gender, longer length of stay, being on hospice, and insurance status.

In multivariate analyses, more plaque remained significantly associated with resident characteristics of having Alzheimer’s/dementia ($p=.05$), longer length of stay ($p=.02$), being on hospice ($p<.01$), and being Black/African American ($p=.04$), as well as with NH-level characteristic of not having a hygienist visiting monthly ($p=.02$). Poorer gingival scores remained significantly associated with resident characteristics of Alzheimer’s/dementia ($p<.01$), longer length of stay ($p<.01$), and being on hospice ($p<.02$) or Medicaid ($p=.05$), and with the NH characteristic of for-profit status ($p=.04$). Worse denture hygiene remained significantly associated with Alzheimer’s/dementia ($p=.03$) and private pay status ($p = .04$), but not with any NH-level characteristics.

Relationship of Oral Hygiene to MDS Items

Of the 400 residents who had teeth or a combination of teeth and dentures, 7 (2%) were indicated on the MDS to have “no natural teeth or tooth fragments.” Of these, 2 had teeth only, and 5 had both dentures and teeth. Regarding gingivitis, MDS data indicated that none of the 397 residents assessed with the GI-LTC had “inflamed or bleeding gums or loose natural teeth;” however, 275 of these (69%) had a GI-LTC score greater than 1 (more than mild inflammation), a statistically significant discrepancy ($p<.001$). Among the NH characteristics noted in Table 1, failure to identify inflamed gums was more likely to occur in for-profit NHs ($p = .004$) and those with a higher percentage of residents on Medicaid ($p = .009$), and less likely to occur in NH where a hygienist visited monthly ($p = .049$).

DISCUSSION

The oral hygiene of this random sample of 506 residents from 14 NHs found that on average, plaque covered more than 1/3 of the tooth surface, mild gingival irritation was often present, and plaque typically covered 50% or more of denture surfaces. This is the first study to report on all three indices of oral hygiene, and also associations of all three indices with NH characteristics and MDS assessments. The findings are noteworthy because with daily mouth care, oral hygiene can be improved.[12]

If oral care is to be improved, special attention should be paid to the outside surfaces, the lower teeth, and the upper dentures (especially unexposed surfaces), because the hygiene of these is somewhat worse than other areas. It could be expected that the upper denture would have more plaque than the lower denture, given its generally larger surface size. In regard to teeth, however, contrary to our initial assumption that inside surfaces would exhibit poorer hygiene because they are more challenging to access during mouth care, it seems the tongue is beneficial in removing debris from the inside of the mouth, resulting in less plaque and healthier gingiva.

In adjusted models, risk factors for poor hygiene consistently implicated Alzheimer’s/dementia, and for plaque and gingiva, being on hospice and longer length of stay. Other variables were related to only one oral hygiene indicator. Dementia has been recognized as a risk factor in other studies;[16] reasons for this association may be poorer oral health prior to admission, unmeasured risk factors, or that their oral hygiene is simply being overlooked -- and for reasons other than behavior, given that resistance and psychotropic medication use were not significant even in bivariate analyses (although it must be acknowledged that the low prevalence of these characteristics – 11% and 17%, respectively, made it difficult to detect a difference if one existed).

Residents receiving hospice care exhibited the worst mean scores on both plaque and gingival indexes in unadjusted models (Table 3), and had significantly worse hygiene in adjusted models; the fact that hospice was a significant indicator even in a group that constituted only 6% of the overall sample is noteworthy. This finding echoes other studies indicating that basic mouth care is often neglected at the end of life, with caregivers failing to compensate for deteriorating self-care abilities.[25] In part, poor hygiene may result from the common misconception that swabbing the mouth with a small sponge on a stick is

appropriate for terminally ill patients, despite the fact that it does little to remove food debris, even less to remove plaque, and nothing to address interdental health.[29] Because better oral hygiene is a quality of life issue throughout life, focusing assessment and care on residents near the end of life, especially those on hospice, should not be neglected.

The third risk factor -- length of stay -- has not previously been studied. Given that it remained an independent risk factor even when considering dementia and hospice, there is a suggestion that ongoing poor care takes its toll on oral hygiene.

MDS documentation of gingivitis differed significantly from systematic assessment by the study's dental hygienist. This finding is consistent with previous studies showing that nurses identify few oral health problems using the MDS, including a study conducted with 18 residents in one NH that also used professional assessments.[30] Our study found lack of agreement across hundreds of residents in 14 NHs, further underscoring that staff require more training in the assessment of oral hygiene -- an actionable recommendation, given that such training can improve MDS accuracy, thereby better informing assessment and treatment.[8,30]

This study was limited to 14 NHs in one regional area, and generalizability may be a concern. However, associations with resident-level characteristics are not likely to be impacted by regional differences, suggesting that Alzheimer's/dementia, hospice, and length of stay -- which can be readily gleaned from NH records -- are worthy of attention regardless the locale. Another limitation is that not all potential correlates were examined, meaning that, for example, the importance of dementia, hospice, and length of stay may be explained by other variables; that said, they are highly useful to indicate need for better oral hygiene.

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References

1. Coleman P, Watson NM. Oral care provided by certified nursing assistants in nursing homes. J Am Geriatr Soc. 2006 Jan; 54(1):138–143. [PubMed: 16420211]
2. Gift HC, Cherry-Peppers G, Oldakowski RJ. Oral health status and related behaviors of U.S. nursing home residents, 1995. Gerodontology. 1997; 14:89–99. [PubMed: 10530173]
3. Zimmerman S, Sloane PD, Cohen LW, et al. Changing the culture of mouth care: Mouth Care Without a Battle. Gerontologist. 2014; 54(Supplement 1):25–34.
4. Adachi M, Ishihara K, Abe S, et al. Effect of professional oral health care on the elderly living in nursing homes. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2002 Aug; 94(2):191–195. [PubMed: 12221387]
5. El-Solh AA. Association between pneumonia and oral care in nursing home residents. Lung. 2011; 189:173–180. [PubMed: 21533635]
6. Langmore SE, Skarupski KA, Park PS, et al. Predictors of aspiration pneumonia in nursing home residents. Dysphagia. 2002; 17(4):298–307. [PubMed: 12355145]

7. Thorne SE, Kazanjian A, MacEntee MI. Oral health in long-term care: The implications of organizational culture. J Aging Stud. 2001; 15:271–283.
8. Arvidson-Bufano UB, Blank LW, Yellowitz JA. Nurses' oral health assessments of nursing home residents pre- and post-training: a pilot study. Spec Care Dentist. 1996 Mar-Apr;16(2):58–64. [PubMed: 9084337]
9. Boczko F, McKeon S, Sturkie D. Long-term care and oral health knowledge. J Am Med Dir Assoc. 2009; 10:204–206. [PubMed: 19233061]
10. Isaksson R, Paulsson G, Fridlund B, et al. Evaluation of an oral health education program for nursing personnel in special housing facilities for the elderly. Part II: Clinical aspects. Spec Care Dentist. 2000 May-Jun;20(3):109–13. [PubMed: 11203883]
11. Pyle MA, Massie M, Nelson S. A pilot study on improving oral care in long-term care settings. Part II: Procedures and outcomes. J Gerontol Nurs. 1998 Oct; 24(10):35–38.
12. Sloane PD, Zimmerman S, Chen X, et al. Effect of a person-centered mouth care intervention on care processes and outcomes in three nursing homes. J Am Geriatr Soc. 2013; 61(7):1158–1163. [PubMed: 23772769]
13. Chalmers JM, Levy SM, Buckwalter KC, et al. Factors influencing nurses' aides' provision of oral care for nursing facility residents. Spec Care Dentist. 1996 Mar-Apr;16(2):71–79. [PubMed: 9084339]
14. Pyle MA, Jasinevicius TR, Sawyer DR, et al. Nursing home executive directors' perception of oral care in long-term care facilities. Spec Care in Dentist. 2005 Mar-Apr;25(2):111–117.
15. National Citizens' Coalition for Nursing Home Reform (NCCNHR). Government policy: federal law and regulations on nurse staffing issues (as contained in the Nursing Home Reform Act of 1987). n.d. http://www.nccnhr.org/govpolicy/51_162_468.CFM
16. Chalmers J, Pearson A. Oral hygiene care for residents with dementia: a literature review. J Adv Nurs. 2005 Nov; 52(4):410–419. [PubMed: 16268845]
17. Ellefsen B, Holm-Pedersen P, Morse DE, et al. Caries prevalence in older persons with and without dementia. J Am Geriatr Soc. 2008 Jan; 56(1):59–67. [PubMed: 18028345]
18. Ciancio SG. Medications' impact on oral health. J Am Dent Assoc. 2004; 135:1440–1448. [PubMed: 15551986]
19. Greene JC, Vermillion JR. The simplified oral hygiene index. J Am Dent Assoc. 1964; 68:7–13. [PubMed: 14076341]
20. Lobene RR, Weatherford T, Ross NM. A modified gingival index for use in clinical trials. Clin Prev Dent. 1986; 8:3–6. 1986.
21. Augsburger RH, Elahi JM. Evaluation of seven proprietary denture cleansers. J Prosthet Dent. 1982; 47(4):356–359. [PubMed: 6951034]
22. Lorenz K, Bruhn G, Netuschil L, et al. How to select study designs and parameters to investigate the effect of mouthrinses? J Physiol Pharmacol. 2009; 60(8):77–83.
23. De Visschere LM, Grooten L, Theuniers G, et al. Oral hygiene of elderly people in long-term care institutions – a cross-sectional study. Gerodontology. 2006; 23(4):195–204. [PubMed: 17105500]
24. Friedman PK, Kaufman LB, Karpas SL. Oral health disparity in older adults: dental decay and tooth loss. Dent Clin North Am. 2014 Oct; 58(4):757–770. [PubMed: 25201540]
25. Chen X, Kistler CE. Oral health care for older adults with serious illness: when and how? J Am Geriatr Soc. 2015 Feb; 63(2):375–380. [PubMed: 25688608]
26. Harrington C, Zimmerman D, Karon S, et al. Nursing home staffing and its relationship to deficiencies. J Gerontol B Psychol Sci Soc Sci. 2000; 55(5):S278–S287. [PubMed: 10985299]
27. Shippee T, Henning-Smith C, Kane R, et al. Resident- and facility-level predictors of quality of life in long-term care. Gerontologist. 2015; 55(4):643–655. [PubMed: 24352532]
28. Macri D. Utilizing dental hygienists to improve health outcomes in long-term care. Ann Long-Term Care: Clinical Care and Aging. 2015; 23(9):21–24.
29. Dyck D, Bertone M, Knutson K, Campbell A. Improving oral care practice in long-term care. Can Nurse. 2012; 108(9):20–24.
30. Cohen-Mansfield J, Lipson S. The underdetection of pain of dental etiology in persons with dementia. Am J Alzheimers Dis Other Demen. 2002; 17(4):249–253. [PubMed: 12184515]

Table 1

Characteristics of Participating Nursing Homes and Residents

Characteristic	Mean (SD) or N (%)
Nursing Home Characteristics (N=14)	
Size (number of beds)	113.6 (23.5)
For profit ownership	11 (77%)
Monthly rate[a]	$6,000 ($1,805)
Percent of residents on Medicaid	62% (20)
Percent of rooms that are private	23% (28.1)
Overall quality rating[b]	4.2 (1.2)
Dentist services available inside the nursing home	6 (43%)
Dentist visits at least quarterly	2 (14%)
Dental hygienist available inside the nursing home	2 (14%)
Dental hygienist visits at least quarterly	2 (14%)
Resident Characteristics (N=506)	
Age (years)	79.2 (12.8)
Gender, female	361 (72%)
Race[c]	
White	324 (64%)
Black or African American	148 (29%)
Other	29 (6%)
Length of stay in nursing home (years)	2.5 (2.3)
Primary payer[c]	
Medicare	53 (10%)
Medicaid	348 (69%)
Private	76 (15%)
Dental status	
Teeth only	330 (65%)
Teeth and dentures	70 (14%)
Dentures only	106 (21%)
Diagnosis of Alzheimer's disease/ dementia	259 (51%)
Resists or refuses care at least one day a week	56 (11%)

Characteristic	Mean (SD) or N (%)
Received antipsychotic or antianxiety medications in the last week	86 (17%)
Currently on hospice	28 (6%)

[a] Average monthly rate paid by private pay, long-stay (i.e., non-rehabilitation) residents for a shared room

[b] Nursing Home Compare overall quality rating based on 1 to 5 stars (5 stars is highest quality); Medicare.gov/nursinghomecompare

[c] Percentage do not sum to 100 due to missing data; other race includes American Indian or Alaska Native, Asian, Hispanic or Latino, and Native Hawaiian or Other Pacific Islander

Table 2

Oral Hygiene: Plaque, Gingiva, and Dentures

	Plaque Index (0–3)[a] n=391			Gingival Index (0–4)[b] n=390		
	Buccal (Outside) Surface	**Lingual (Inside) Surface**		**Buccal (Outside) Surface**	**Lingual (Inside) Surface**	
	Mean (SD)	Mean (SD)	p	Mean (SD)	Mean (SD)	p
Upper teeth	1.7 (0.8)	1.3 (0.8)	<.001	1.6 (1.0)	1.2 (0.9)	<.001
Lower teeth	1.8 (0.8)	1.8 (0.8)	.95	1.7 (0.9)	1.6 (0.9)	<.001
Overall scores	1.8 (0.8)	1.6 (0.8)	<.001	1.7 (0.9)	1.4 (0.8)	<.001
	1.7 (0.8)			1.5 (0.9)		

	Upper Denture (0–4)[c] n=168	Lower Denture (0–4)[c] n = 107	
	Mean (SD)	Mean (SD)	p
Facial, exposed surface	2.2 (1.3)	1.9 (1.3)	.020
Basal, unexposed surface	2.4 (1.3)	2.1 (1.3)	.12
Overall scores	2.3 (1.2)	2.0 (1.3)	.016
	2.2 (1.2)		

[a] 0=no plaque; 1=plaque covers ≤ 1/3 of tooth surface or presence of extrinsic strains; 2=plaque covers > 1/3 but ≤ 2/3 of tooth surface; 3=plaque covers > 2/3 of tooth surface; n=404

[b] 0=no inflammation; 1=mild inflammation with slight change in color, little change in texture but not of the entire margin; 2=mild inflammation with slight change in color, little change in texture of the entire margin; 3=moderate inflammation with glazing, redness, edema, and/or hypertrophy with bleeding on pressure; 4=severe inflammation with marked redness, edema, and/or hypertrophy with spontaneous bleeding, congestion, or ulceration; n=401 due to missing data

[c] 0=no plaque; 1=light plaque covering up to 25% of area; 2=moderate plaque covering 26–50% of area; 3=heavy plaque covering 51–75% of area; 4=very heavy plaque covering 76–100% of area;

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Table 3

Bivariate Associations between Oral Hygiene and Nursing Home and Resident Characteristics[a]

	Plaque Index (PI-LTC)		Gingival Index (GI-LTC)		Denture Plaque Index (DPI)	
	Mean (SE)	**p**	**Mean (SE)**	**p**	**Mean (SE)**	**p**
Nursing Home Characteristics (n=14)						
For profit ownership						
Yes	1.8 (0.1)	.017	1.6 (0.1)	.07	2.3 (0.1)	.18
No	1.4 (0.1)		1.2 (0.2)		1.9 (0.3)	
Percent of residents on Medicaid						
25th percentile	1.6 (0.1)	.045	1.5 (0.1)	.18	2.3 (0.1)	.57
75th percentile	1.8 (0.1)		1.6 (0.1)		2.2 (0.1)	
Overall quality rating[b]						
25th percentile	1.7 (0.1)	.60	1.5 (0.1)	.68	2.3 (0.1)	.028
75th percentile	1.6 (0.1)		1.5 (0.1)		2.0 (0.1)	
Dental hygienist visits at least quarterly						
Yes	1.1 (0.3)	.044	1.1 (0.3)	.21	2.6 (0.7)	.55
No	1.7 (0.1)		1.6 (0. 1)		2.2 (0.1)	
Resident Characteristics (n=506)						
Gender						
Female	1.7 (0.1)	.33	1.5 (0.1)	.88	2.1 (0.1)	.06
Male	1.7 (0.1)		1.5 (0. 1)		2.5 (0.2)	
Race						
White	1.6 (0.1)	.08	1.5 (0.1)	.92	2.2 (0.1)	.14
Black or African American	1.8 (0.1)		1.5 (0.1)		2.4 (0.2)	
Other[c]	1.6 (0.2)		1.5 (0.2)		1.5 (0.3)	

	Plaque Index (PI-LTC)		Gingival Index (GI-LTC)		Denture Plaque Index (DPI)	
	Mean (SE)	**p**	**Mean (SE)**	**p**	**Mean (SE)**	**p**
Length of stay in nursing home (years)						
25th percentile	1.6 (0.1)	.001	1.4 (0.1)	<.001	2.3 (0.1)	.14
75th percentile	1.7 (0.1)		1.6 (0.1)		2.2 (0.1)	
Primary payer						
Medicare	1.6 (0.1)	.18	1.2 (0.2)	.07	2.1 (0.3)	.030
Medicaid	1.7 (0.1)		1.6 (0.1)		2.0 (0.1)	
Private	1.5 (0.1)		1.5 (0.1)		2.7 (0.3)	
Diagnosis of Alzheimer's disease/ dementia						
Yes	1.8 (0.1)	.037	1.6 (0.1)	.004	2.4 (0.1)	.049
No	1.6 (0.1)		1.4 (0.1)		2.0 (0.2)	
Currently on hospice						
Yes	2.1 (0.2)	.017	1.9 (0.2)	.043	2.5 (0.4)	.41
No	1.7 (0.8)		1.5 (0.1)		2.2 (0.1)	

[a] Mean values and standard errors (SE) are from mixed model analyses with a random effect for nursing home, to adjust for the clustering of residents within nursing homes. Because many of the continuous variables are skewed, the effects of continuous variables are estimated at the 25th and 75th percentile values for those variables. Only characteristics with a p value ≤ .10 are displayed.

[b] Nursing Home Compare overall quality rating based on 1 to 5 stars (5 stars is highest quality); Medicare.gov/nursinghomecompare

[c] Includes American Indian or Alaska Native, Asian, Hispanic or Latino, and Native Hawaiian or Other Pacific Islander