Acta Odontologica Scandinavica. 2015; 73: 150–155

informa
healthcare

ORIGINAL ARTICLE

Oral health and apraxia among institutionalized elderly people—A pilot study

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Abstract

Objective. Poor oral hygiene and dental health are very common among the institutionalized elderly. The purpose of this study was to evaluate the association of apraxia with oral hygiene and/or health. ***Materials and methods.*** Ninety-two residents of 13 long-term care homes in southwest Germany participated in the study. For each participant, ideomotor apraxia scoring (AS) was conducted and demographic variables were collected. Participants underwent a comprehensive dental examination to assess the oral health indices gingival bleeding index (GBI), community periodontal index of treatment needs (CPITN) and denture hygiene index (DHI). Statistical comparison of dental indices among apraxic and non-apraxic individuals (cut-off < 45) was performed by use of *t*-tests. In addition, linear regression models were constructed with the dental indices as dependent variables. Each model was fitted with the dichotomized variable AS (pathologic or healthy) and adjusted for age and sex. ***Results.*** Mean (SD) GBI of 48.5 (25.9), CPITN of 2.9 (0.7) and DHI of 82.6 (14.6) were observed among the participants. Statistical analysis revealed AS was significantly associated with all oral health indicators ($p < 0.05$). Linear regression models showed apraxia is a predictor of GBI ($p = 0.002$) and CPITN ($p = 0.027$), but not of denture hygiene ($p = 0.916$). ***Conclusions.*** Although this pilot investigation has limitations, the results suggest the presence of apraxia should be considered when planning oral healthcare strategies. Further research with larger samples is encouraged to confirm these relationships.

Key Words: *elderly, apraxia, oral health, GBI, CPITN*

Introduction

All western countries are experiencing a demographic shift to a larger proportion of elderly [1]. With aging, the likelihood of decreasing physical, motor and cognitive capacity increases [2]. There comes a time when some elderly can no longer be cared for in the community and require stationary long-term care. Poor oral hygiene and health are very common among this vulnerable population. The literature reports, among other shortcomings, substantial plaque accumulation on teeth and dentures, high prevalence of periodontal diseases, root caries and misfitting dentures [3–6]. Research on the causes of deterioration of oral conditions has mainly focused on psychiatric end-points, for example dementia [7–9] and depression [10], which have been identified as risk factors for poor oral health. Dementia includes a variety of characteristics however, for example cognitive deficits and behavioural and psychological symptoms [11]. In addition, disorders of higher motor cognition, for example ideomotor apraxia, also apparent among patients after stroke or with Parkinson's disease, are frequently observed among the demented elderly [12–14]. The onset of apraxia initially affects learned and skilled movements. Patients suffering from apraxia face difficulties in handling tools, for example using a spoon during mealtimes or brushing teeth [14–17]. Cognitive deficits and motor impairment reduce the ability to perform daily activities and reduce independence. Apraxia combined with resistance to care prevent caregivers from

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(Received 30 April 2014; accepted 31 August 2014)

ISSN 0001-6357 print/ISSN 1502-3850 online
DOI: 10.3109/00016357.2014.961956

providing sufficient daily care for oral hygiene [18]. Consequently, oral health of the demented elderly diminishes over time. This is of direct significance with regard to nutrition but also leads predisposition to systemic diseases. It has been consistently reported that poor oral and denture hygiene are associated with a higher risk of pneumonia and other febrile illnesses [19,20]. Periodontal disease is closely linked with cardiovascular disease [21], for example stroke [22]. As far as we are aware, however, the literature lacks investigations on relationships between idiomotor apraxia and oral health. The purpose of this study was, therefore, to evaluate the association of apraxia with oral hygiene and/or health.

Materials and methods

Study population

This prospective study was approved by the local ethics committee of the University of Heidelberg (no. S-002/2012). Participants were recruited from 13 long-term care homes in southwest Germany as part of a study initiated by the Federal Ministry of Social Affairs (Sozialministerium Baden-Württemberg). All residents were invited, by letter, to attend an information meeting. For those who did not attend this meeting, details of the study were also provided by letter. The only inclusion criteria were that participants signed an informed consent form, did not intend changing long-term care home and had at least one remaining tooth and/or removable dentures. No advanced exclusion criteria were stated. For participants who were unable to give informed consent, the legal guardian was asked whether the resident should participate in the study. Of 350 possible participants, 82 refused to participate in the dental examinations, another 10 had neither teeth nor dentures and 166 refused to participate in all the psychiatric assessments. Thus, complete target data were available for 92 participants (68.5% female).

Assessment of dental variables

All dental examinations were performed by one trained dentist.

Oral hygiene. The gingival bleeding index (GBI) was used for assessment of oral hygiene [23]. GBI was determined by gently sliding a periodontal WHO probe (CPC11.5; Hu Friedy, Tutlingen, Germany) across the distal, palatal/lingual, mesial and buccal gingival sulcus of each tooth. The sites of the teeth that bled after probing were counted and divided by the total number of sites. Consequently the quotient could range from 0–100%.

Oral health. The community periodontal index of treatment needs (CPITN) was used to assess the prevalence of gingivitis and periodontitis. CPITN was determined by use of a standard WHO probe (CPC11.5; Hu Friedy), by inserting the probe into the gingival sulcus of each tooth. Clinical findings are five codes indicative of periodontal status. Code 0 reflects healthy conditions, codes 1 and 2 the presence of gingivitis and codes 3 and 4 imply moderate and severe periodontitis, respectively [24].

Denture hygiene. Denture hygiene was assessed by use of the denture hygiene index (DHI). Ten sites per removable denture were evaluated. Prostheses were rinsed with water, dried and dyed by use of a plaque indicator (Plaque Test; Ivoclar Vivadent, Schaan, Liechtenstein). Plaque-positive areas were counted and divided by the total number of sites [25] to give a score from 0–100%.

Psychiatric assessments

Ideomotor apraxia. Participants were screened for apraxia by use of the pantomime test in accordance with Goldenberg et al. [26]. The participants had to perform 20 exercises, for example simulating use of a tooth brush, a key or a screwdriver. For each item, both correct grip and correct movement were evaluated. Correctly performed tasks were each scored with one point with regard to grip and one to three point(s) with regard to the correct movement. The maximum apraxia score (AS) is 55. Scores <45 are regarded as indicative of pathologic apraxia. This method has been proved valid for detection of apraxia [26].

Cognitive state. Cognitive impairment of the participants was evaluated by use of the mini mental state examination (MMSE). The MMSE has been reported to enable objective evaluation of cognitive impairment and is part of dementia screening [27]. The MMSE comprises 30 exercises to be solved by participants. According to Mungas et al. [28], scores higher than or equal to 26 are indicative of normal cognitive function and vice versa.

Functional capacity

The Barthel index (BI) was used for assessment of activities of daily living (ADL) [29]. Use of the BI entails estimation of a participants' ability to perform such ADLs as bathing, using a toilet and dressing. With regard to functional capacity, participants could score from 0–100. A score of 0 implies total dependence on care, whereas 100 is indicative of total independence. Scores ≥71 have been reported to be indicative of no or only mild dependence [30]. The BI

was determined by caregivers of the long-term care homes, as recommended elsewhere [31].

Statistical evaluation

Statistical analysis was conducted with SPSS Ver. 19.0 (IBM Corporation, New York, NY). Normal distribution of the dental target variables GBI, CPITN and DHI was assessed by use of the Kolmogorov–Smirnoff test ($p > 0.5$). To evaluate participants' characteristics, means (SD), medians (25/75% quartiles) and frequencies (%) were plotted for the target variables, as appropriate (normally/non-normally distributed variables). In addition to bivariate testing, linear regression models were compiled with GBI, CPITN (dentate participants only) and DHI (participants with any kind of removable denture only) as dependent variables. Each model was fitted with the dichotomized psychiatric variables 'cognitive impairment', 'dependency' and 'apraxia' according to accredited cut-off values in the respective assessments (see above) and adjusted for age and sex. To discover possible correlations between the psychiatric variables, regression models were calculated by using stepwise backward elimination of each highest non-significant confounder. Level of local statistical significance was set to $p < 0.05$.

Results

None of the 92 of 350 eligible participants finally included in the study was lost to statistical evaluation (drop-out = 73.7%). Mean age (SD) was 83.7 (8.6), range = 62–102. Participants had a median (25/75% quartiles) of 3.0 (2.0/5.0) diseases and frequently took a mean number of 7.0 (3.3) drugs. Most of the participants suffered from apraxia (53; 58%). The median (25/75% quartiles) number of remaining teeth was 3.0 (0.0/12.8). Of the participants 33.7% were edentulous. Sixty-one participants had at least one remaining tooth (66%); 68 participants wore removable dentures of any kind (74%). A mean (SD) GBI of 48.5 (25.9), a CPITN of 2.9 (0.7) and a DHI of 82.6 (14.6) were observed among the participants. Participants' characteristics are listed in Table I.

Bivariate analysis

In assessment of oral hygiene, mean GBI (SD) was 57.3 (22.9) for participants with apraxia, whereas subjects without apraxia scored 36.6 (25.3). Mean (SD) CPITN was 3.0 (0.7) and 2.6 (0.7) for those with and without apraxia, respectively. Detailed results are presented in Table I. Statistical analysis revealed GBI was significantly worse among individuals with ideomotor apraxia than among non-apraxic participants (*t*-test; $p = 0.002$). The same was true for comparison of CPITN among apraxic and non-apraxic participants (*t*-test; $p = 0.014$) but not for DHI (*t*-test; $p = 0.367$). No statistically significant differences could be found for GBI, CPITN or DHI between cognitively impaired participants and those with normal cognitive function or for participants with different degrees of dependency (*t*-tests; $p > 0.05$).

Table I. Characteristics of participants with and without apraxia ($n = 92$).

Variable	Total sample	Apraxia (AS < 45)	No apraxia (AS ≥ 45)
Age (years)[a]	83.7 (8.6)	84.1 (8.5)	83.0 (8.8)
Sex[b]			
Female	63 (68.5%)	36 (67.9%)	27 (69.2%)
Male	29 (31.5%)	17 (32.1%)	12 (30.8%)
Number of diseases[c]	3.0 (2.0/5.0)	3.0 (2.5/5.0)	3.0 (1.0/5.0)
Number of drugs[a]	7.0 (3.3)	6.6 (3.1)	7.5 (3.5)
AS[c]	41.0 (3.3/49.0)	12 (0.0/38.0)	51.0 (48.0/53.0)
MMSE[a]	16.6 (7.7)	12.6 (6.7)	22.1 (5.1)
BI[a]	50.4 (30.7)	38.1 (26.1)	67.1 (28.7)
GBI* ($n = 61$)[a]	48.5 (25.9)	57.3 (22.9)	36.6 (25.3)
CPITN* ($n = 61$)[a]	2.9 (0.7)	3.0 (0.7)	2.6 (0.7)
DHI* ($n = 68$)[a]	82.6 (14.6)	84.1 (15.2)	80.8 (13.8)
Number of teeth[c]	3.0 (0.0/12.8)	3.0 (0.0/14.5)	3.0 (0.0/8.0)

*GBI and CPITN were assessed for dentate participants only (at least one remaining tooth); DHI was assessed for participants with any kind of removable denture.
[a]Mean (SD); [b]Frequency (percentage); [c]Median (25/75% quartiles).
AS, idiomotor apraxia scoring; MMSE, mini mental state examination; BI, Barthel index; GBI, gingiva bleeding index; CPITN, community periodontal index of treatment needs; DHI, denture hygiene index.

Table II. Linear regression model with GBI as dependent variable; dichotomized psychiatric variables as factors adjusted for age and sex ($n = 61$)*.

	Coefficient	95% CI	*p*-value
AS: Apraxia ($n = 35$) vs no apraxia ($n = 26$)	25.2	9.7, 40.7	0.002
MMSE: Cognitive impairment ($n = 51$) vs no cognitive impairment ($n = 10$)	−11.2	−31.1, 8.6	0.262
BI: Moderate or severe dependency ($n = 44$) vs no or mild dependency ($n = 17$)	0.7	−14.9, 16.3	0.930
Age	0.3	−1.1, 0.5	0.272
Sex	7.6	−21.3, 6.1	0.452

*The start model is displayed; after step-wise backwards elimination of non-significant variables (order: dependency, age, cognitive impairment and sex); only apraxia remained in the model (95% CI = 8.2, 33,0; $p = 0.002$).
AS, idiomotor apraxia scoring; MMSE, mini mental state examination; BI, Barthel index.

Regression models

Linear regression models for the dependent variables GBI (Table II) and CPITN (Table III) each identified apraxia as a factor affecting poor oral hygiene and health ($p < 0.05$). The linear regression model for the dependent variable DHI revealed no significant effect (Table IV).

Discussion

Our purpose was to analyze relationships between ideomotor apraxia and oral and/or denture hygiene and oral health. The results of this study suggest that apraxia is significantly negatively associated with oral health and hygiene. Previous studies that focused on relationships between cognitive impairment and oral health condition showed that, among other shortcomings, periodontal disease is more likely to be present among the elderly with cognitive impairment than among those without [4,7,9]. Greater accumulation of plaque has also been reported for aged people with cognitive impairment [7,9]. Cognitive deficits also lead to loss of ability to perform normal daily activities, including taking care of oral hygiene. Consequently, individuals need support from caregivers; many refuse this care, however [18]. It should also be mentioned that caregivers have to perform many duties and oral hygiene does not often have priority.

In this investigation, apraxic individuals with poor oral health were limited in their ability to execute purpose-directed movements, even though their physical ability and cognitive function would allow this [14]. Moreover, their intellect and physical capacity may initially project a more independent image to caregivers, which can lead to under-estimation of the level of care needed, especially at an early stage. Another explanation might also be lack of communication by apraxic elderly, which hinders them in asking for caregivers' support.

The study participants usually had poor oral and/or denture hygiene. This, however, is not unexpected. First, these findings are consistent with other reports dealing with oral health among the institutionalized elderly [3–6,10]. Second, the participants in this study reflect an even more compromised community with substantially diminished cognitive and physical capacity compared with other studies. With regard to the method of estimation of participants' oral hygiene, it should be noted that the GBI was used and no qualitative or quantitative plaque test. This must be regarded as a limitation. Determination of plaque indices, however, provides information about current oral hygiene status only, which is frequently biased by care routines (i.e. cleaning of teeth because of the dentists' visit) within a long-term care setting. According to literature recommendations, however, bleeding of marginal gingiva can be interpreted as an

Table III. Linear regression model with CPITN as dependent variable; dichotomized psychiatric variables as factors adjusted for age and sex ($n = 61$)*.

	Coefficient	95 % CI	*p*-value
AS: Apraxia ($n = 35$) vs no apraxia ($n = 26$)	0.5	0.1, 0.9	0.027
MMSE: Cognitive impairment ($n = 51$) vs no cognitive impairment ($n = 10$)	−0.4	−1.0, 0.1	0.142
BI: Moderate or severe dependency ($n = 44$) vs no or mild dependency ($n = 17$)	−0.2	−0.6, 0.3	0.467
Age	0.0	0.0, 0.0	0.283
Sex	−0.2	−0.6, 0.1	0.217

*The start model is displayed; after step-wise backwards elimination of non-significant variables (order: dependency, age, sex and cognitive impairment) only apraxia remained in the model (95% CI = 0.1, 0.8; $p = 0.014$).
AS, idiomotor apraxia scoring; MMSE, mini mental state examination; BI, Barthel index.

Table IV. Linear regression model with DHI as dependent variable; dichotomized psychiatric variables as factors adjusted for age and sex (n = 68)*.

	Coefficient	95 % CI	p-value
AS: Apraxia (n = 35) vs. no apraxia (n = 26)	0.5	−8.1, 9.1	0.916
MMSE: Cognitive impairment (n = 51) vs no cognitive impairment (n = 10)	5.8	−4.9, 16.6	0.283
BI: Moderate or severe dependency (n = 44) vs no or mild dependency (n = 17)	−1.5	−10.0, 6.9	0.717
Age	0.2	−0.3, 0.7	0.519
Sex	−2.3	−11.1, 6.5	0.610

*The start model is displayed; after step-wise backwards elimination of non-significant variables (order: apraxia, dependency, sex and age), cognitive impairment was the last variable in the model (95% CI = −1.9, 16.4; p = 0.119).
AS, idiomotor apraxia scoring; MMSE, mini mental state examination; BI, Barthel index.

inflammatory reaction of supragingival plaque accumulation during the preceding few days; it is, therefore, a correlate of oral hygiene [23]. Nevertheless, no conclusion can be reached on sub-gingival infections and inflammation, even though GBI might be more highly correlated with CPITN than is plaque index (Pearson correlation GBI/CPITN: r = 0.202; p = 0.119).

With regard to denture hygiene, no associations with apraxia were found. This could be related to the very high proportion of dentures with high plaque levels (dentures of almost all participants).

Study limitations

In general, the results may be limited because of the small sample size, even though the literature acknowledges that comparable, poor response is typical of German long-term care studies dealing with psychiatric assessments [32]. It would, however, have been desirable to achieve a better response, but one should also take into account that this study included a vast number of tests which may have overtaxed and, hence, deterred, potential subjects and their legal guardians from participation, even though breaks were offered. The sample size also decreased as a result of withdrawal of consent for single examinations, for example the dental examination, by those who initially agreed to participate. In this context one should mention that some potential participants had psychological problems and were unco-operative. Nevertheless, the vast majority of the participants included was cognitively and functionally compromised, which resulted in rather unbalanced statistical groups, probably leading to statistical bias. Interestingly, the sample seems to be representative of the background distribution of cognitively impaired elderly people in previous studies [33]. One could also speculate that the low response led to positive selection. This, however, would lead to underestimation of possible effects of apraxia on oral health and, therefore, to statistical bias also. With this in mind, the results should be interpreted with caution.

One strength of this study is that participants were not pre-selected and, therefore, a broad range of more or less compromised participants was investigated. One should also recognize that this study is—as far as we are aware—the first to examine the association of apraxia with oral health; the data presented will enable power analysis to be performed in future studies.

To summarize, within the limitations of this study, oral hygiene and health are poor among long-term residents of care homes. The presence of ideomotor apraxia should be considered when planning adequate oral healthcare strategies. More extensive research with larger sample sizes is encouraged to confirm relationships between apraxia and oral health.

Acknowledgments

We are grateful to all the participants in this study, for their patience, and to the long-term care facilities, for their gentle support. We are grateful to the Ministry of Social Affairs of Baden-Württemberg (Sozialministerium Baden-Württemberg) for financial support.

***Declaration of interest*:** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

[1] Corsini V, Gourdol A, Juchno P, Kraszewska K, Marcu M, Oblak A, et al. Eurostat; Demography report 2010. Publications office of the European Union, Luxembourg; 2011.
[2] Friedlander AH, Norman DC, Mahler ME, Norman KM, Yagiela JA. Alzheimer's disease: psychopathology, medical management and dental implications. J Am Dent Assoc 2006;137:1240–51.
[3] McMillan AS, Wong MCM, Lo ECM, Allen F. The impact of oral disease among the institutionalized and non-institutionalized elderly in Hong Kong. J Oral Rehabil 2003;30:46–54.
[4] Chalmers JM, Carter KD, Spencer AJ. Caries incidence and increments in Adelaide nursing home residents. Spec Care Dentist 2005;25:96–105.

[5] Montal S, Tramini P, Triay JA, Valcarcel J. Oral hygiene and the need for treatment of the dependent institutionalized elderly. Gerodontology 2006;23:67–72.
[6] Zenthöfer A, Dieke R, Dieke A, Wege KC, Rammelsberg P, Hassel AJ. Improving oral hygiene in the long-term care of the elderly–a RCT. Community Dent Oral Epidemiol 2013;41: 261–8.
[7] Ship JA, Puckett SA. Longitudinal study on oral health in subjects with Alzheimer's disease. J Am Geriatr Soc 1994;42: 57–63.
[8] Chalmers JM, Carter KD, Spencer AJ. Caries incidence and increments in community-living older adults with and without dementia. Gerodontology 2002;19:80–94.
[9] Purandare N, Woods E, Butler S, Morris J, Vernon M, McCord JF, et al. Dental health of community-living older people attending secondary healthcare: a cross-sectional comparison between those with and without diagnosed mental illness. Int Psychogeriatr 2010;22:417–25.
[10] Hassel AJ, Danner D, Schmitt M, Nitschke I, Rammelsberg P, Wahl HW. Oral health-related quality of life is linked with subjective well-being and depression in early old age. Clin Oral Investig 2011;15:691–7.
[11] Grossberg GT. Diagnosis and treatment of Alzheimer's disease. J Clin Psychiatry 2003;64:3–6.
[12] Della SS, Lucchelli F, Spinnler H. Ideomotor apraxia in patients with dementia of Alzheimer type. J Neurol 1987;234:91–3.
[13] Leiguarda RC, Pramstaller PP, Merello M, Starkstein S, Lees AJ, Marsden CD. Apraxia in Parkinson's disease, progressive supranuclear palsy, multiple system atrophy and neuroleptic-induced parkinsonism. Brain 1997;120:75–90.
[14] Zadikoff C, Lang AE. Apraxia in movement disorders. Brain 2005;128:1480–97.
[15] Ochipa C, Rothi LJG, Heilman KM. Conceptual apraxia in Alzheimer's disease. Brain 1992;115:1061–71.
[16] Goldenberg G, Hagmann S. Tool use and mechanical problem solving in apraxia. Neuropsychologia 1998;36:581–9.
[17] Foundas AL, Shields JA. Apraxia in dementia: impact on oral intake. Perspectives on swallowing and swallowing disorders. Dysphagia 2012;21:85–90.
[18] Mahoney EK, Hurley AC, Volicer L, Bell M, Gianotis P, Hartshorn M, et al. Development and testing of the Resistiveness to Care Scale. Res Nurs Health 1999;22:27–38.
[19] Scannapieco FA. Relationship between periodontal disease and bacterial pneumonia. J Periodontol 1996;67:1114–22.
[20] Terpenning MS, Taylor GW, Lopatin DE, Kerr CK, Dominguez BL, Loesche WJ. Aspiration pneumonia: dental and oral risk factors in an older veteran population. J Am Geriatr Soc 2001;49:557–63.
[21] Beck J, Garcia R, Heiss G, Vokonas PS, Offenbacher S. Periodontal disease and cardiovascular disease. J Clin Periodontol 1996;67:1123–37.
[22] Dörfer CE, Becher H, Ziegler CM, Kaiser C, Lutz R, Jörss D, et al. The association of gingivitis and periodontitis with ischemic stroke. J Clin Periodontol 2004;31:396–401.
[23] Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. Int Dent J 1975;25:229–35.
[24] Ainamo J, Barmes D, Beagrie G, Cutress T, Martin J, Sardo-Infirri J. Development of the World Health Organization (WHO) community periodontal index of treatment needs (CPITN). Int Dent J 1982;32:281–91.
[25] Wefers KP. Der 'Denture Hygiene Index' (DHI). Dental Forum 1999;1:13–15.
[26] Goldenberg G, Hartmann K, Schlott I. Defective pantomime of object use in left brain damage: apraxia or asymbolia? Neuropsychologia 2003;41:1565–73.
[27] Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189–98.
[28] Mungas D, Reed BR, Marshall SC, González HM. Development of psychometrically matched English and Spanish language neuropsychological tests for older persons. Neuropsychology 2000;14:209–23.
[29] Mahoney FI, Barthel DW. Functional evaluation: the Barthel index. Md State Med J 1965;14:61–5.
[30] Supervía A, Aranda D, Márquez MA, Aguirre A, Skaf E, Gutiérrez J. Predicting length of hospitalisation of elderly patients, using the Barthel Index. Age Ageing 2008; 37:339–42.
[31] Collin C, Wade DT, Davies S, Horne V. The Barthel ADL index: a reliability study. Int Disabil Stud 1988;10:61–3.
[32] Seidl U, Lueken U, Völker L, Re S, Becker S, Kruse A, et al. Nicht-kognitive Symptome und psychopharmakologische Behandlung bei demenzkranken Heimbewohnern. Fortschr Neurol Psychiatr 2007;75:720–7; article in German.
[33] Alzheimer's Association. Alzheimer's disease. Facts and figures. Alzheimers' Association, Washington, USA; 2011. Available online at http://www.alz.org/downloads/facts_figures_2011.pdf.accessed on 20 August 2013.