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Cognitive Function and Oral Health-Related Quality of Life in Older Adults

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Abstract

Objectives—To examine the relationship between cognitive function and self-reported oral health-related quality of life (QoL) in community dwelling older adults.

Design—Cross-sectional

Setting—Community in West Virginia

Participants—Two hundred twenty six community-dwelling older adults

Measurements—Oral health-related QoL was measured by the Geriatric Oral Health Assessment Index (GOHAI) (score range of 12 to 60) and cognitive function was assessed using comprehensive neuropsychological test battery. Oral health examinations were performed by dental professionals.

Results—Participants with normal cognitive function had higher GOHAI total scores (mean: 55.1), indicating better oral health-related QoL, than participants with cognitive impairment without dementia (CIND) (mean: 52.3) and mild dementia (mean: 51.0). The difference remained significant after controlling for covariates including socio-demographics, health status, comorbidity, and clinical dental status.

Conclusion—Oral health-related QoL, as measured by the GOHAI, was better among those with normal cognitive function compared to those with CIND and those with mild dementia in the population we studied.

Keywords

oral health; quality of life; cognition

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INTRODUCTION

Oral health in later life is one of the significant determinants of quality of life (QoL)^{1,2} and life satisfaction³ as well as a key health status indicator related to functional limitations, including mobility problems⁴ and limited activities of daily living.⁵ Another key determinant of QoL in later life is adequate cognitive function.⁶

A number of studies have shown that better cognitive function is related to better oral health status based on clinical oral examinations.^{7,8} A review article concluded that previous studies have consistently shown that institutionalized older adults with dementia have poor clinical oral health status, including more tooth decay and plaque, compared to institutionalized older adults without cognitive impairment.⁷ Several recent studies have also reported that lower cognitive function was associated with a higher number of decayed teeth, missing teeth and a higher rate of periodontal disease in community dwelling older adults.^{8,9}

The assessment of self-reported oral health-related QoL has received attention because it is relatively inexpensive and easy to obtain compared to collecting clinical data. It is also a valid tool to assess and capture the personal experience of physical symptoms such as one's feelings, perceptions, and pain.^{10,11} Clinicians usually attempt to elicit this type of subjective information from their patients in the course of providing care. Researchers have examined self-reported data of persons with cognitive impairment in reference to a range of phenomena including subjective experiences with care,¹² perceptions of overall QoL,^{13,14} and pain.¹⁵ In particular, among individuals with mild to moderate dementia, self-rated QoL was correlated with behavioral observations of pain and restraint,^{13,14} but informants tended to underrate QoL of individuals with dementia.¹⁴ Combined these findings support the use of self-rated QoL among individuals with mild to moderate dementia.

However, few studies have examined the relationship between cognitive function and self-reported oral health-related QoL, and the results from previous studies have been mixed. An observational cross-sectional study on community-dwelling Medicare beneficiaries in three states reported that lower cognitive function was related to poorer perception of oral health status using the 14-item Oral Health Impact Profile (OHIP-14).¹⁶ On the other hand, another study conducted in Spain found participants with mild cognitive impairment had significantly better self-reported oral health measured by the Geriatric Oral Health Assessment Index (GOHAI) than participants with normal cognition.¹⁷ Both studies were limited by the use of brief mental status instruments to determine cognitive status. Such measures do not provide valid diagnoses of mild cognitive impairment or dementia.^{18,19} Thus, further studies are needed to examine whether oral health-related QoL differs by various levels of cognition.

The purpose of this study was to examine the relationship between cognitive function and oral health-related QoL in community dwelling older adults using a comprehensive cognitive evaluation and self-reported oral health-related QoL assessment that are reliable and validated in community-dwelling elders.^{20,21} Two specific research questions were:

1. How does oral health-related QoL vary by cognitive function?
2. Is cognitive function associated with oral health-related QoL after controlling for covariates including demographic characteristics, depressive symptoms, health status, and clinical oral health status?

METHODS

Data source and participants

The study protocol was reviewed and approved by the West Virginia University Institutional Review Board. The criteria for study participants were age 70 years or older, resident of West Virginia, community-living, and at least four natural teeth to obtain sufficient amount of data on individuals' periodontal status, and tooth decay. The sample for the present analyses included 226 participants who had completed the GOHAI questionnaire, the oral health examination, and the cognitive evaluation. We excluded individuals with moderate or severe dementia because the GOHAI has not been validated in this group. Oral evaluations were performed by calibrated three dentists and one dental hygienist using guidelines from the National Health and Nutrition Examination Survey (NHANES) IV.²² The average inter-rater agreement was 98.1% for the number of missing teeth, 95.6% for the number of caries or restorations, and 95.1% for the extent of periodontal disease. Detailed description for the clinical dental evaluation has been published elsewhere.²³

A psychometrician administered to the participant a battery of neuropsychological measures that assessed verbal and visual memory, language, executive function, orientation, praxis, and reading ability. A proxy informant, usually a spouse or adult child, provided information about the participant's cognitive function, functional limitations, medical history, and medications. Two study psychologists reviewed all data collected and assigned the cognitive diagnoses.

Measures

Dependent variable—Oral health-related QoL was collected from the participant using the Geriatric Oral Health Assessment Index (GOHAI), which is a 12-item questionnaire²⁴ with the following response options: 1 = very often; 2 = fairly often; 3 = occasionally; 4 = hardly ever; and 5 = never. For analyses, we reversed the scoring on three items so that a higher total GOHAI score indicated better oral health-related QoL with a score range of 12 to 60. The GOHAI has been widely used in the US and international settings.^{17,20} High reliability and validity have been reported in previous studies.^{10,11}

Independent variable—Cognitive function was assigned within three cognitive categories: normal cognitive function, cognitive impairment without dementia (CIND), and mild dementia (0 = cognitive normal, 1 = CIND, and 2 = mild dementia). The Diagnostic and Statistical Manual of Mental Disorder, Fourth Edition criteria (DSM-IV) were used for diagnosis of dementia.²⁵ To exclude individuals with moderate and severe dementia, we required the individual to have a Dementia Severity Rating Scale (DSRS) score ≤ 19 which is consistent with a Clinical Dementia Rating (CDR)²⁶ score of < 1.0 , indicating any cognitive impairment present did not exceed the level of mild dementia.²⁷ CIND was defined as mild cognitive or functional impairment reported by the participant or informant that did not meet criteria for dementia, or performance on neuropsychological measures that was both below expectation based on reading ability and educational and occupational history, and at least 1.5 SDs below published norms on any test within a cognitive domain (e.g., memory, orientation, language, executive function, praxis). Diagnoses were anchored by these criteria, but final diagnoses were based on clinical judgment. Similar assessment and diagnostic procedures have been used and validated in multiple large epidemiological studies on cognitive impairment in later life.²⁸

Covariates—Covariates in the categories of socio-demographics, health status, medical condition, and clinical dental status were included. Socio-demographic variables consisted of age (continuous variable), gender (0 = male, 1 = female), education (0 = less than high

school, 1 = high school, 2 = more than high school) and dental insurance (0 = no, 1 = yes). General health status was assessed by asking “In general, would you say your health is?” on a Likert scale with anchors 1 (*poor*) to 5 (*excellent*). Depressive symptoms were assessed using the Geriatric Depression Scale (GDS). Medical condition was defined as the presence of diabetes, high blood pressure, heart disease, stroke, lung disease as reported by the proxy informant. Each health problem was treated as a dichotomous variable (0 = no presence, 1 = presence). Clinical dental status included the following continuous variables: number of decayed coronal and root surfaces, number of missing teeth, plaque index, and the mean pocket depth. Plaque index is a common measure for oral hygiene²⁹ and pocket depth is a commonly used index for periodontal disease.³⁰

Data Analysis

One-way Analysis of Variance (ANOVA) was used to examine differences in sample characteristics, GOHAI total score, and each item by cognitive function. Post hoc analysis for group differences was completed using Bonferroni correction. Hierarchical multiple linear regressions were performed with GOHAI total score as the dependent variable. The first step included the cognitive function only; the second step added socio-demographics, perceived health status, depression, and medical conditions. The third step added clinical dental status. Using the variance inflation factor (VIF), we found no multicollinearity. Analyses were completed using the Statistical Package for the Social Science (SPSS), version 19.0 (Chicago, IL).

RESULTS

Table 1 summarizes the sample characteristics by cognitive function. Gender and education were not different by cognitive function. Individuals with normal cognitive function were younger than individuals with CIND and mild dementia. Compared with individuals with normal cognition and CIND, individuals with mild dementia had a higher number of decayed root surfaces.

Oral health-related QoL by cognitive function

The GOHAI total score and nine out of twelve items were significantly different by cognitive function (Table 2). Specifically, participants with normal cognitive function scored higher on GOHAI total score than participants with CIND and mild dementia. Participants with normal cognitive function scored higher on several GOHAI items than participants with mild dementia.

Factors associated with oral health-related QoL

The hierarchical multiple regression analyses (Table 3) showed that poorer cognitive status was significantly related to worse GOHAI total scores and explained 7% of the variation in the model (Model 1). After adding clinical dental status variables to the Model 2, the full model (Model 3) explained 47% of the variation of the GOHAI total score ($p = .03$). The number of decayed coronal surfaces was the only significant clinical predictor; alone it accounted for about 19% of the GOHAI total score. Participants with normal cognitive function had higher GOHAI total scores than participants with CIND ($\beta = -.31, p = .02$) and mild dementia ($\beta = -.38, p = .02$). Individuals with more decayed coronal surfaces reported lower GOHAI total scores ($\beta = -.31, p = .04$).

Discussion

Although there were fewer participants with CIND and mild dementia ($n = 57$) than with normal cognitive function ($n = 169$), this study showed that the oral health-related QoL was

significantly different across the spectrum of cognitive function, with the highest scores among normal cognitive function group, followed by the CIND group, and the lowest scores for the mild dementia group. Moreover, this relationship still held after controlling for covariates such as depressive symptoms, subjective health status, medical condition, clinical dental status, and socio-demographic variables.

While our findings are consistent with Jensen et al.'s study, which was conducted on US community-dwelling older adults using the OHIP-14,¹⁶ they are different from Zuluaga et al.'s study, which also used GOHAI as a measure of the oral health-related QoL. Zuluaga and colleagues reported that persons with mild or moderate cognitive impairment had better oral health-related QoL than persons with normal cognitive function.¹⁷ One likely explanation for this difference is that the study by Zuluaga used a 10-item cognitive screening measure to determine the diagnosis of mild and moderate cognitive impairment. Such brief cognitive measures are neither valid nor reliable for the diagnosis of complex disorders such as mild cognitive impairment or dementia. In contrast, the cognitive diagnosis in our study was made by two psychologists based on review of a comprehensive neuropsychological battery of tests, medical history, and informant report of the participant's functional and cognitive ability.

Our results are consistent with studies of the relationship between cognitive function and oral health outcomes from clinical examinations which suggest that individuals with lower cognitive function have poor oral health status.^{7,8} When the clinical dental variables were added, the amount of variance accounted for the model increased significantly by 19%. Only one variable (i.e., decayed coronal surfaces) met standard significance levels, suggesting that although each variable individually has a small effect on the GOHAI score, combined these variables contribute substantially to the total GOHAI score. We also conducted additional analyses examining whether oral health-related QoL is correlated with clinical dental status by cognitive function. These analyses showed that higher GOHAI scores were significantly correlated with better clinical status, even among persons with mild dementia. However, the degree correlation was typically small except for the number of decayed root surfaces ($r = -.52$, $p = .02$) (result not shown). These findings are consistent with the study by Atchison and Dolan (1990), which reported the correlations between GOHAI scores and clinical measures were small and ranged from -0.09 to -0.13 , except for number of teeth ($r = 0.33$).²⁴ Presumably, the GOHAI score does not exactly reflect the objective dental outcomes from the clinical examination; it may reflect the individual's perception of functional or pain/discomfort concerns related to oral health. Our results suggest the GOHAI is a reliable and convenient tool to assess oral health-related QoL among elders, even those with mild dementia and less severe levels of cognitive impairment. The GOHAI may provide a feasible approach to assess oral health perception regarding functional or pain/discomfort issues for large scale studies and is also appropriate to use in primary care settings.

One of the study limitations is its cross-sectional design. Further longitudinal studies are required to evaluate changes in oral health related QoL over time among individuals with or without cognitive impairment. In addition, generalizability of the findings may be limited since the sample was one of convenience. In future studies, identifying a subset of the GOHAI questions that could be used as a valid brief screen for oral QoL would be useful for the primary care setting.

The main clinical implications are that primary care physicians have the opportunity to address often undetected problems by evaluating the oral health-related QoL among older patients including those with cognitive impairment. Although the GOHAI score does not appear to directly reflect clinical dental problems, it seems to be a good indicator of self-perceived oral health-related QoL regarding patient's oral function or pain/discomfort. Since

Medicare and Medicaid coverage of dental care is limited,³¹ oral health-related QoL may be a valuable indicator for physicians to make dental referrals.

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Table 1

Sample Characteristics by cognitive function (N=226)

Variable	Label	Normal n=169	CIND n=38	Mild dementia n=19	p
Gender	Male	60 (35.5)	13 (34.2)	4 (21.1)	.45
	Female	109 (64.5)	25 (65.8)	15 (78.9)	
Age, mean±SD		77.4±5.8 ^{ab}	80.6±5.4 ^a	83.9±7.9 ^b	<.001
Education	Less than high school	25 (14.8)	5 (13.2)	2 (10.5)	
	High school	50 (29.6)	11 (28.9)	7 (36.8)	.96
	More than high school	94 (55.6)	22 (57.9)	10 (52.6)	
Dental insurance	No	143 (85.6)	32 (84.2)	16 (84.2)	
	Yes	24 (14.4)	6 (15.8)	3 (15.8)	.97
GDS score (0–30), mean±SD		2.6±2.1	2.2±2.4	2.2±1.9	.74
General health	Poor or fair	22 (13.0)	7 (18.4)	6 (31.6)	
	Good	48 (28.4)	16 (42.1)	8 (42.1)	.02
	Very good or excellent	99 (58.6)	15 (39.5)	5 (26.3)	
# of decayed coronal surfaces, mean±SD		0.8±2.1	1.4±3.2	1.0±1.6	.34
# of decayed root surfaces, mean±SD		0.5±1.1 ^a	0.8±2.2	1.8±3.6 ^a	.004
# of missing teeth, mean±SD		12.7±7.6	12.7±8.0	10.2±7.5	.40
pocket depth, mean±SD		1.5±1.2	1.3±1.2	1.4±1.1	.55
Plaque index, mean±SD		0.5±0.6	0.6±0.8	0.9±0.7	.06

Note:

^{a–c} Groups with same letter are significantly different according to Bonferroni post hoc test.

Table 2

GOHAI total and sub-scores by cognitive function

Variable	Normal mean±SD	CIND mean±SD	Mild dementia mean±SD	P
1. How often did you limit the kinds or amounts of food you eat because of problems with your teeth or denture?	4.7±0.8 ^a	4.5±0.9	4.2±1.0 ^a	.02
2. How often did you have trouble biting or chewing any kinds of food, such as firm meat or apple?	4.5±0.9 ^a	4.3±1.1	3.9±1.1 ^a	.01
3. How often were you able to swallow comfortably?	4.7±1.0	4.5±1.1	4.3±1.3	.25
4. How often have your teeth or dentures prevented you from speaking the way you wanted?	4.9±0.5 ^a	4.4±1.2 ^a	4.7±0.5	<.001
5. How often were you able to eat anything without feeling discomfort?	4.3±1.3	3.8±1.7	4.0±1.5	.10
6. How often did you limit contacts with people because of the condition of your teeth and gums, or dentures?	4.9±0.3 ^a	4.9±0.4 ^b	4.6±0.6 ^{ab}	.003
7. How often were you pleased or happy with the looks of your teeth and gums, or dentures?	4.1±1.1 ^a	3.6±1.5 ^a	3.9±1.1	.05
8. How often did you use medication to relieve pain or discomfort from around your mouth?	4.8±0.4 ^a	4.8±0.6	4.7±0.6 ^a	.50
9. How often were you worried or concerned about problems with your teeth, gums, or dentures?	4.3±1.0 ^a	4.1±1.2	3.5±1.2 ^a	.009
10. How often did you feel nervous or self-conscious because of problems with your teeth, gums, or dentures?	4.7±0.7 ^a	4.4±1.3	4.1±1.1 ^a	.003
11. How often did you feel uncomfortable eating in front of people because of problems with your teeth or dentures?	4.8±0.6	4.7±0.8	4.6±0.6	.17
12. How often were your teeth or gums sensitive to hot, cold, or sweets?	4.2±1.2	4.3±1.1	4.4±0.8	.80
Total score	55.1± 4.7 ^{ab}	52.3±6.5 ^a	51.0± 4.8 ^b	<.001

Note:

^{a-b} Groups with same letter are significantly different according to Bonferroni post hoc test.

Table 3

Influencing factors on GOHAI total score

	Model 1		Model 2		Model 3	
	beta	t	Beta	t	beta	t
Cognitive function:						
CIND	-0.20	-3.11 **	-0.32	-2.25 *	-0.31	-2.43 *
Mild dementia	-0.22	-3.40 **	-0.44	-2.79 **	-0.38	-2.34 *
Socio-demographics:						
Female			-0.25	-1.62	-0.29	-1.90
Age			0.08	0.54	0.18	1.16
High school			0.18	0.56	0.11	0.58
More than high school			0.18	1.02	0.04	0.19
Dental insurance			0.02	0.11	-0.01	0.10
Health status:						
General health			-0.06	-0.42	-0.00	-0.03
Depressive symptom			-0.15	-1.08	-0.20	-1.46
Medical condition:						
Diabetes			-0.02	-0.17	-0.05	-0.40
High blood pressure			0.06	0.40	0.10	0.66
Heart disease			0.07	0.55	0.11	0.85
Stroke			0.11	0.89	0.09	0.71
Lung disease			0.08	0.58	0.05	0.40
Clinical dental status:						
# of decayed coronal surfaces					-0.31	-2.09 *
# of decayed root surfaces					-0.07	-0.44
# of missing teeth					-0.06	-0.40
# of pocket depth					0.04	0.31
Plaque index					-0.16	-1.05
R ²		0.07		0.28		0.47
F (p)		9.34 (<.001)		1.45 (.166)		1.98 (.033)

Note.

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<.50
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