Self-reported Oral Health and Oral Health Behaviors in Older Adults in the Last Year of Life

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Background. The complex physiological, psychological, and functional changes at the end of life may dramatically affect oral health. However, evidence regarding oral health changes at the end of life is scarce. This study's objective was to examine self-rated oral health and oral health behaviors among community-dwelling elders in the last year of life.

Methods. This study was a retrospective longitudinal study including 810 dentate community-dwelling older adults aged 65 and older. Based on death certificate data, the participants were retrospectively classified into two groups: died within 1 year after the last interview (end-of-life group) and survived more than 1 year after the last interview (comparison group). Participants were interviewed at baseline, 18, 36, 60, and 84 months regarding their sociodemographics, self-reported oral health, oral conditions, use of oral health services, and preventive behaviors. Generalized estimating equations were used to compare self-reported oral health and oral health behaviors between two groups.

Results. After adjusting for sociodemographics, the end-of-life group was more likely to rate their oral health (odds ratio [OR] = 2.94, 95% confidence interval [CI]: 1.32, 6.54) and overall health (OR = 2.35, 95% CI: 1.12, 4.91) as bad than the comparison group. End-of-life participants were also more likely to dislike their mouth appearance (OR = 2.27, 95% CI: 1.07, 4.83) and rate their ability to taste (OR = 7.24, 95% CI: 2.64, 19.77) and smell (OR = 2.98, 95% CI: 1.09, 8.15) as bad. There was no difference in self-reported oral conditions, use of oral health services, and preventive behaviors.

Conclusions. Self-rated oral health significantly declines in the last year of life.

Key Words: Oral health—End of life—Older adults.

OLDER adults at the end of life are one of the most challenging groups in geriatric dental care. These individuals usually experience substantial declines in general health and daily function (1–4). The complex physiological, psychological, and functional changes at the end of life may dramatically affect oral health and increase risk of oral infection, dental pain, and oral soft tissue pathology, which in turn may exacerbate systemic health decline and further compromise quality of life in these vulnerable individuals. Poor oral hygiene is commonly seen in older adults with cognitive and functional impairment (5). Poor oral hygiene not only increases the risk of local infection (6,7), but it is also associated with recurrent respiratory infection, a leading cause of death in the medically compromised elderly (8). Oral function loss resulting from tooth loss and decreased denture use can lead to malnutrition (9,10), which compromises the capacity to fight off disease or infection (11) and increases risk of mortality in older adults (12,13). Given the complex interaction between oral health and systemic health and the profound affects of poor oral health on overall health and quality of life, it is essential to understand whether and how oral health changes in older adults at the end of life.

Self-reported oral health is a simple, inclusive, and valid measure of oral health. It has been widely used in population studies to measure and compare oral health status among population groups (14,15) and monitor changes in the oral health status of society (16). This simple global assessment provides a summary of how people perceive their oral health status from multiple dimensions (17) and is significantly associated with clinical findings and unmet treatment needs (15,18,19). Subjective assessment of oral health is an independent predictor of self-esteem, psychological well-being, and life satisfaction (18,20,21). It is also associated with health-seeking behaviors. Individuals who do not visit dentists or use preventive dental care regularly are more

likely to report poor oral health (18,22). Self-reported oral health is also related to general health and daily function in older adults (19,21,23). Older adults with more existing health problems and functional limitations not only report poor self-rated general health but also are more likely to rate their oral health poorly and suffer more impact from oral health problems (19,23). Based on this evidence, it would be reasonable to hypothesize that when older adults experience substantial changes in overall health and function at the end of life, their oral health may also decline.

Evidence regarding oral health in older adults at the end of life is scarce. Although a few studies reveal highly prevalent xerostomia, oral candidiasis, ulceration, and denture-related issues in these individuals (24,25), how older adults perceive their oral health at the end of life remains unknown. Given that self-reported oral health status is not only associated with oral disease and conditions but also predicts unmet dental needs and dental care behaviors, a better understanding of this issue could help dental and other health professionals better address oral health needs and improve quality of the remaining life in older adults at the end of life. In response to this need, we conducted this study aiming to understand self-reported oral health and oral health behaviors in older adults in the last year of life.

Materials and Methods

This study was a secondary data analysis based on the oral health interview data of the Piedmont 65+ Dental Study and the National Death Index (NDI). The University of North Carolina Institutional Review Board approved the protocol of this study.

The Piedmont 65+ Dental study (PDS) was an ancillary study of the Duke Established Populations for Epidemiologic Studies of the Elderly (EPESE). The EPESE study included a stratified random sample of more than 4,000 community-dwelling older adults aged 65 and older residing in five counties in the Piedmont region of North Carolina. The PDS was a 7-year longitudinal study (1988–1995) based on a subsample of the EPESE study, including 818 dentate and 200 edentulous elderly participants. These study participants were randomly selected within the same strata as the parent study. Oral examinations and interviews were conducted in the home of the dentate participants by a calibrated team of dentists at baseline, 18, 36, 60, and 84 months follow-up. Oral examinations focused on dental caries, missing teeth, and periodontal assessment using a mirror, dental explorer, and light-intensified headlamps. Interviews were conducted using a structured questionnaire. The detailed study design, sampling method, and data collection of the PDS have been reported previously (26).

Eight hundred eighteen dentate participants were examined and interviewed at baseline. Among them, eight were neither black nor white and excluded from the analysis. Of the remaining 810 participants, 448 (55.3%) were black and

362 (44.7%) were white. During the 7-year study period, 598 participants were dropped from the study because they moved out of the area (5.9%), were too ill to examine (4.8%), refused to be reexamined (14.3%), deceased (26.2%), became edentulous (9.5%), or could not be contacted (12.6%). Two hundred and twelve participants remained in the study at the end of follow-up. Based on the death certificate data, 810 study participants were retrospectively classified into two groups: (a) being in the last year of life (end-of-life group), including 71 participants who died within 1 year after their last interview; (b) not being in the last year of life (comparison group), including 739 participants who survived more than 1 year after their last interview. Decedents and their death dates were identified using the NDI.

Oral health interviews were conducted by trained, calibrated dentists and assistants at baseline and each follow-up using structured questionnaires. The oral health interviews provided data on sociodemographic characteristics, health behaviors, preventive dental behaviors, use of oral health services, history of oral pain and discomfort, and self-perceived oral and general health. The questionnaires used at baseline and each follow-up were slightly different. During data collection, questions related to the same topic were grouped together for this study.

Self-perceived health was measured from seven aspects, including overall general health, overall oral health, mouth appearance, appearance of face, ability to chew, ability to taste foods, and ability to smell. The participants were asked to rate their oral and general health from these seven aspects in comparison with their peers using a three-level scale, "good," "neither good nor bad," and "bad." Besides self-perceived health, self-perceived oral health conditions were also queried. Use of oral health services was measured in two aspects: (a) have seen a dentist recently (yes or no), and (b) pattern of dental visit (regular check up, having discomfort or in need of a repair, or do not see dentist). Three questions were designed to query participants' preventive dental behaviors: (a) how often did you brush your teeth yesterday, (b) do you ever require assistance from someone else in brushing your teeth, and (c) do you regularly use any type of mouthwash or rinse?

The number of interviews that each participant completed ranged from 1 to 5 depending on their length of follow-up. Although gender, race, and education were abstracted from the baseline and remained unchanged during the follow-up, age, marital status, employment status, living status, health history, self-rated oral and general health, use of oral health services, and preventive dental behaviors were time-dependent variables that were allowed to change in each follow-up interview. Study participants' vital status was also treated as a time-varying variable. In other words, study participants who were in the comparison group at previous interviews could die and become members of the end-of-life group if they died within 1 year after their last interview.

Descriptive statistics were first performed on the selected variables to explore data distribution and to identify missing values. Bivariate analyses were conducted using generalized estimating equations (GEE) to compare self-reported oral health, self-reported oral health conditions, use of oral health services, and preventive dental behaviors between end-of-life group and comparison group. Multivariate analyses were then completed using the GEE method to estimate the associations between end-of-life status and outcomes of interest controlling for the following sociodemographic variables: age, education, gender, race, living status, employment status, and marital status. All analyses were completed using the GENMOD procedure in SAS 9.2 (SAS Institute, Cary, NC).

RESULTS

Characteristics of the Study Participants

Of the 810 study participants, 71 died within 1 year after their last interview. Among them, 14.7% died within 3 months after their last interview, 25.3% died within 4–6 months after their last interview, and 54.9% survived beyond 6 months (eg, 7–12 months). The mean survival of this group was 6.8 months. The mean age of the end-of-life group was 75.8 years old, 2.7 years older than the comparison group ($p < .001$; Table 1). Compared with the comparison group, the end-of-life group also had more males participants (58%) and African Americans (70%). They were also less educated (8 vs 10 years, $p < .001$) and less likely to live in their own houses ($p = 0.01$) than the

comparison group. There was no statistically significant difference in marital status and employment status between the two groups.

Self-rated Oral Health

As expected, overall health declined at the last year of life. Compared with the comparison group, the end-of-life participants were 2.4 times more likely to report their overall general health as bad (Table 2). Similarly, oral health also declined in the last year of life. The end-of-life participants were also more likely to rate their oral health as bad than the comparison group (odds ratio [OR] = 2.94; 95% confidence interval [CI]: 1.32–6.54). More specifically, the end-of-life participants had approximately two times greater risk of disliking their mouth appearance than the comparison group. They were also more likely to report chewing difficulty (OR = 2.27; 95% CI: 1.11–4.63). Neurosensory function also remarkably declined at the end of life. Participants in the last year of life were 7.24 times more likely to report not having good taste ability than their counterparts. Ability to smell also significantly declined in these individuals (OR = 2.98; 95% CI: 1.09–8.15).

Self-reported Oral Health Conditions

There was no difference in self-reported oral health conditions between the two groups. Although the end-of-life participants tended to be more likely to report oral pain or discomfort and less likely to have bleeding gums, sensitive teeth, loose teeth, and dry mouth; these differences were nonsignificant (Table 3).

Table 1. Characteristics of the Study Participants

Sociodemographics	End-of-life Group ($N = 71$)	Control Group ($N = 739$)	p Value
Age, mean (SD)	75.82 (6.56)	73.11 (5.61)	<.001
Gender, N (%)			
Male participants	41 (57.7)	289 (39.1)	<.01
Race, N (%)			
Black	50 (70.4)	398 (53.9)	<.01
White	21 (29.6)	341 (46.1)	
Education, mean (SD)	7.9 (4.7)	9.82 (4.5)	<.001
Marital status*, N (%)			
Married	31 (43.7)	339 (45.9)	.94
Separated/divorced	7 (9.9)	58 (7.8)	.56
Widowed	30 (42.2)	306 (41.4)	.66
Never married	3 (4.2)	35 (4.7)	.89
Type of living*, N (%)			
House	63 (88.7)	679 (91.9)	.01
Retirement community	5 (7.0)	52 (7.0)	.70
Others	3 (4.2)	8 (1.1)	<.01
Work status, N (%)			
Completely retired	66 (93.0)	613 (82.9)	.06
Partially retired/never worked	5 (7.0)	126 (17.0)	

Note: *Comparisons were performed between each category versus others.

Table 2. Self-rated Oral Health: Participants in the Last Year of Life Versus Participants Not in the Last Year of Life

Self-reported Oral Health	Crude		Adjusted*	
	Odds Ratio	95% CI	Odds Ratio	95% CI
Bad overall general health	3.19[†]	1.65–6.19	2.35[†]	1.12–4.91
Bad overall oral health	3.45[†]	1.65–7.20	2.94[†]	1.32–6.54
Bad face appearance	1.35[†]	0.41–4.47	1.12[†]	0.33–3.83
Bad mouth appearance	2.42[†]	1.21–4.84	2.27[†]	1.07–4.83
Bad/neutral ability to chew food	2.66[†]	1.37–5.17	2.27[†]	1.11–4.63
Bad/neutral ability to taste food	8.71[‡]	2.89–26.25	7.24[‡]	2.64–19.77
Bad/neutral ability to smell	4.24[‡]	1.31–13.70	2.98[‡]	1.09–8.15

Note: *Adjusted for age, sex, race, education, employment status, marital status, and type of living.
[†]Cumulative odds ratio based on all data: bad versus neutral or good.
[‡]Cumulative odds ratio based on all data: bad or neutral versus good.

Table 3. Self-reported Oral Health Conditions: Participants in the Last Year of Life Versus Participants Not in the Last Year of Life

Self-reported Oral Health Conditions	Crude		Adjusted*	
	Odds Ratio	95% CI	Odds Ratio	95% CI
Having oral pain or discomfort now	1.34	0.63–2.88	1.44	0.67–3.08
Having bleeding gum now or in the past 2 wks	0.79	0.35–1.75	0.62	0.27–1.46
Teeth sensitive to heat or cold now	0.72	0.37–1.42	0.72	0.34–1.51
Having loose teeth	0.93	0.27–3.18	0.58	0.12–2.80
Having dry mouth	0.85	0.39–1.87	0.88	0.38–2.04

Note: *Adjusted for age, sex, race, education, employment status, marital status, and type of living.

Use of Oral Health Services

Overall, there was no significant difference in the pattern of use of oral health services between the end-of-life group and the comparison group (Table 4). Compared with the comparison group, the end-of-life participants tended to be less likely to use dental services (OR = 0.66; 95% CI: 0.36–1.19). In terms of dental care patterns, the end-of-life participants were more likely to see dentists when having a problem (OR = 1.53; 95% CI: 0.75–3.13) or not to seek dental care at all (OR = 1.36; 95% CI: 0.53–3.51). However, the differences were not significant after adjusting for age, gender, and other factors.

Preventive Dental Behaviors

There was no significant difference in frequency of daily tooth brushing activity between the end-of-life group and the comparison group (Table 4). Although the end-of-life participants tended not to brush their teeth compared with the comparison group, the difference was nonsignificant after adjusting for sociodemographic factors (OR = 1.47; 95% CI: 0.58–3.69). Additionally, the end-of-life group was more likely to require assistance to perform daily oral hygiene care as compared with the comparison group

(OR = 55.04; 95% CI: 11.7–258.84), indicating possible functional loss at the end of life. However, due to limited sample size, how oral care function changed at the end of life still remains unclear. There was no difference in regular use of oral rinse between the two groups.

DISCUSSION

This study examined self-reported oral health and oral health behaviors in community-dwelling older adults in the last year of life. Although there was no difference in oral health behaviors, the end-of-life participants were more likely to report poor oral health, mouth appearance, and ability to chew food than their counterparts. Neurosensory function such as taste and smell also remarkably declined at the end of life. This study outlined the self-perceived oral health profile of community-dwelling older adults in the last year of life and provided valuable information for dental professionals to understand oral health needs of these vulnerable individuals.

As expected, self-rated health declined at the end of life. Compared with their counterparts, the end-of-life participants were 2.4 times more likely to rate their overall health as poor. This decline may result from the increased morbidity, cognitive and physical functional deterioration, and impaired quality of life at the end of life (4,27,28). Like systemic health, oral health also declined at the end of life. End-of-life participants were 2.9 times more likely to report poor oral health compared with the comparison group. These findings suggest that when systemic health deteriorates at the end of life, as an integrated component of health, oral health also declines and people are able to recognize and report those changes. However, several issues regarding the end-of-life oral health changes still remain unknown (eg, When does oral health begin to decline? Is there any lag between oral health decline and systemic health decline at the end of life? Whether systemic and oral health deterioration occur together or whether one deteriorates at a faster/slower rate than the other?). Given that poor perception of health may lead to less engagement in preventive practice or self-care and nonadherence with proposed treatment (18,22,29), a better understanding of these issues would be of great value for dental professionals to design appropriate intervention strategies to improve oral health and quality of remaining life for these individuals.

The cognitive process that leads to a particular self-evaluation of health status is complex. Many factors such as physical health status, psychological well-being, physical functioning, health behavior, and sociodemographics may influence how older adults judge their health status (19,29). Locker and colleagues found that oral health–related functional limitation is the most important factor that underlies older adults' global rating of oral health. Self-rated general health, existing oral health conditions, the influence of oral health on daily life, time since last dental visit, and

Table 4. Self-reported Use of Oral Health Services and Preventive Dental Behaviors: Participants in the Last Year of Life Versus Participants Not in the Last Year of Life

	Crude		Adjusted	
	Odds Ratio	95% CI	Odds Ratio	95% CI
Self-reported use of oral health services				
Have seen dentist in the past two years	0.42	0.26–0.69	0.66[*]	0.36–1.19
Go to see dentist regularly	0.35	0.18–0.68	0.54[*]	0.24–1.22
See dentist when having discomfort or something to be repaired	1.99	1.13–3.52	1.53[*]	0.75–3.13
Don't go to see dentist	2.13	0.93–4.84	1.36[*]	0.53–3.51
Self-reported preventive dental behaviours				
Do not brush teeth	2.47	1.16–5.27	1.47[*]	0.58–3.69
Require assistance in brushing teeth	42.00	9.79–180.15	55.04[†]	11.7–258.84
Regular use of mouthwash	0.64	0.36–1.13	0.61[*]	0.34–1.11

Notes: [*]Adjusted for age, sex, race, education, employment status, marital status, and type of living.
[†]Adjusted for age and race.

other factors also contribute to this self-evaluation process (18,19). Given the multidimensional nature of this process, besides the global rating of oral health, we also assessed self-reported oral health from other perspectives in this study. Although no difference was found in self-reported oral health conditions, use of oral health services, and preventive dental behaviors between the two groups; end-of-life participants were more likely to report poor mouth appearance and chewing ability and less likely to report good ability to taste or smell than those not in the last year of life. These findings imply that rather than pain, tooth sensitivity, dry mouth and looseness of teeth, dentally-related aesthetic concerns, and impaired oral function might underlie the self-perceived poor oral health in the end-of-life participants. However, exactly what contributed to this self-evaluation process at the end of life still remains unknown. This question was out of the scope of this study and will be addressed in the future.

Unexpectedly, this study revealed that end-of-life participants did not report more dental pain, gingival bleeding, tooth sensitivity, looseness of teeth, and dry mouth than the comparison group. These findings fail to support our hypothesis that as a result of declined systemic health and daily function, end-of-life participants were more likely to report poor oral health conditions than their counterparts. This negative finding might be associated with the characteristics of the study participants. In this study, all the study participants, including those at the end of life, were community-dwelling older adults. A vast majority of these participants lived in their own house. These features suggested that unlike long-term care residents, the end-of-life participants were relatively independent in daily function. Even in the last year of life, many of them might still be able to maintain activities of daily living, including oral hygiene care, without needing help from professional caregivers. For these relatively healthy individuals, the terminal functional drop usually occur in the last few months of life (1,4). Because the duration of the terminal functional drop was short, the oral health issues

commonly seen in frail older adults at the end of life (eg, caries, dental pain, or infection) might not have become clinically apparent before death occurred. Additionally, if this late-occurring terminal functional drop took place after the interview, we might not be able to capture the oral health changes, if any, resulting from physical and cognitive functional declines.

This study was based on existing data that were originally collected in the 1990s. The sociodemographic characteristics of the study participants might differ from the current generation of older adults. As a result of improved public health education, the current generation of older adults is more likely to value oral health and preventive dental care. Their preventive dental behaviors may, therefore, differ from those of the study participants. However, because this study focused on the intrageneration difference between participants in the last year of life and those who were not, the affect of these intergeneration differences on the study outcomes should be minimal. Moreover, the original study was not designed to study oral health issues at the end of life. The oral health measures might not be sensitive to catch the potential oral health changes in older adults at the end of life. Important variables characterizing end-of-life persons such as burden of comorbidity, cognition, and activities of daily living were not available in the data set. We were, therefore, unable to evaluate how these variables correlate with self-reported oral health in end-of-life participants. The small sample size in the end-of-life group not only affected the precision of estimates of the differences in self-reported oral health but also limited our ability to detect the potential differences in self-reported oral health conditions and oral health behaviors between the two groups.

In conclusion, corresponding to overall deterioration in the last year of life, self-reported oral health also significantly declined. Although there was no difference in self-reported oral health conditions, oral function, especially taste function, declined remarkably in the last year of life.

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