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Ethnic Variation in Oral Health and Social Integration among Older Rural Adults

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Abstract

This analysis examines the associations of oral health with social integration among ethnically diverse (African American, American Indian, white) rural older adults. Data are from a cross-sectional survey of 635 randomly selected community-dwelling adults aged 60+. Measures include self-rated oral health, number of teeth, number of oral health problems, social engagement, and social network size. Minority elders have poorer oral health than do white older adults. Most rural elders have substantial social engagement and social networks. Better oral health (greater number of teeth) is directly associated with social engagement, while the relationship of oral health to social network size is complex. The association of oral health with social engagement does not differ by ethnicity. Poorer oral health is associated with less social integration among African American, American Indian and white elders. More research on the ways oral health affects the lives of older adults is warranted.

Keywords

Oral health disparities; social engagement; social network; rural aging

Introduction

Oral health is an important component of the general health and well-being of older adults (Avlund, Holm-Pedersen & Schroll, 2001; Hung, Joshipura, Colditz, Manson, Rimm, Speizer, & Willett, 2004; Nowjack-Raymer & Sheiham, 2007; Wu, Plasman, Crout & Laing, 2008). Significant differences in oral health between minority and white older adults exist (Drake, Hunt & Koch, 1995; National Institutes of Health, 2000; Borrell, Taylor, Borgnakke, Nyquist, Woolfolk, Allen & Lang, 2003; Reid, Hyman & Macek, 2004; Sabbah, Tsakos, Chandola, Sheiham & Watt, 2007; Sabbah, Tsakos, Sheiham & Watt, 2009a). Meng, Gilbert, Duncan and Heft (2007) found that minority (African American) adults had greater dissatisfaction with their dental appearance than did white adults. Oral health deficits are another factor in health disparities affecting older minority adults that result from the

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accumulation of greater exposure to health risks and less access to health care across the life course (Borrell, Burt, Gillespie, Lynch & Neighbors, 2002; Sabbah, Tsakos, Sheiham & Watt, 2009b). At the same time, older adults who have spent their lives in rural communities, no matter their ethnicity, also suffer health disparities resulting from greater exposure and limited health care (Chavers, Gilbert & Shelton, 2002; Ahn, Burdine, Smith, Ory & Phillips, 2011). The combined effects of being minority and rural on older adults are probably synergistic (Sabbah et al., 2007).

The social and behavioral effects of oral health and oral health deficits among older adults are receiving greater attention (Makhija, Gilbert, Boykin, Litaker, Allman, Baker, Locher & Ritchie, 2006; Riley, Gilbert, & Heft, 2002; Arcury, Bell, Anderson, Chen, Savoca, Kohrman & Quandt, 2009; Quandt, Chen, Bell, Savoca, Anderson, Leng, Kohrman, Gilbert & Arcury, 2010; Quandt, Chen, Bell, Anderson, Savoca, Kohrman, Gilbert & Arcury 2009). One aspect of oral health that has received limited attention is the association of oral health with the social integration of older adults. Social integration is the means through which people interact, connect, and validate each other within a community (Durkheim, 1897). Glass, Mendes de Leon, Marottoli, and Berkman (1999) differentiate social engagement and social network as different dimensions of social integration. They define social engagement as productive social activities and as an indicator of the quality of social integration, whereas social network is an indicator of the amount of social activity. Glass, Mendes de Leon, Seeman, and Berkman (1997) also demonstrate that social networks can be divided into multiple components that include interaction with children, relatives, friends, and confidants.

Among all adults, good oral health is associated with a sense of social belonging, life-satisfaction, and self-esteem, whereas poor oral health is associated with low morale, stress, and depression (Locker, 2008). Poor oral health can result in social stigma, with poor dental appearance resulting in depressed self-esteem, less social interaction, and lower employability (Bedos, Levine & Brodeur, 2009). Adults with fewer social relationships have unfavorable dental self-perceptions (Siriphant & Drury, 2005). Older adults having no or few teeth have greater mobility limitations than older adults with more teeth (Avlund et al., 2001) Older adults with poor self-perceived oral health had attributes, including lower morale, more life stress, and lower life satisfaction, that reflect less social integration (Locker, Matear, Stephens & Jokovic, 2002).

The objectives of this analysis are to delineate the associations of oral health with social integration among rural older adults and to determine if ethnic differences in these associations are present. We first document the association of ethnicity (African American, American Indian, white) with oral health among the rural older adults who participated in our study. We then examine the association of ethnicity with measures of social integration, including social engagement and social network size. We next document associations of oral health with social integration. Finally, we delineate whether associations of oral health with social integration vary by ethnic group. Our hypotheses are:

Hy1: African American and American Indian rural older adults will have poorer oral health than do white rural older adults.

Hy2: Older adults with poorer oral health will be less socially integrated, including lower levels of social engagement and smaller social networks.

Hy3: The association of oral health with social integration will not vary by ethnic group.

Methods

Sample

The Rural Nutrition and Oral Health (RUN-OH) Study was conducted in two rural North Carolina counties. Both of the counties are classified as “nonmetropolitan” (US Department of Agriculture). In 2008, the counties had 1.7 and 1.8 dentists per 10,000 residents, compared to 4.3 dentists per 10,000 residents for the state (Lyons, Hadley, Groves, Gaul & Fraher, 2008). The populations of these counties are ethnically diverse; the population in the smaller of the two counties is approximately 25% African American and 75% white, with the population in the larger of the two counties being approximately 25% African American, 40% American Indian, and 35% white. The American Indians in these counties do not reside on reservations. Participants were located using a random dwelling selection and screening procedure based on a multistage cluster sampling design in which the primary sampling units (clusters) were stratified and selected with probability proportionate to their sizes (Quandt et al., 2009). The eligible resident in 635 of the 859 eligible dwelling units completed the interview for a response rate of 73.9%. The sampling procedure was designed and implemented by the investigators in consultation with the University of Illinois Survey Research Laboratory, which provided weights for participants based on size of the clusters from which they were selected and their probability of selection within each dwelling unit.

Data Collection

Data collection was completed between January 2006 and March 2008. Data were collected in face-to-face home interviews lasting 1.5 to 2.5 hours. The questionnaire included sections addressing personal characteristics, current oral health problems, and social interaction and social engagement. Participants with at least one natural tooth were defined as “dentate;” those with no natural teeth were defined as “edentulous.” Dentate participants were asked to undergo an in-home oral assessment. Among 413 dentate participants, 362 completed the oral assessment, for a participation rate of 87.6%. Oral assessments were conducted by dental hygienists who performed tooth counts and other components of oral health. The two hygienists who conducted the assessments underwent training, calibration, and supervision by a research dentist as described elsewhere in detail (Quandt et al., 2009). Participants were given an incentive valued at $10.00 at the completion of the interview and an additional incentive valued at $20.00 at the completion of the oral assessment. The entire research protocol was approved by the Wake Forest University School of Medicine Institutional Review Board.

Measures

The outcome measures for this analysis are indicators of social integration: social engagement and social network size. Our measure of social engagement is based on the combination of items indicating participation in productive social activities in four different domains (Barnes, Mendes de Leon, Bienias & Evans, 2004a; Barnes, Mendes de Leon, Wilson, Bienias & Evans, 2004b): senior centers, clubs, church (0 = do not participate, 1 = seldom participate, 2 = often participate); and employment (0 = not employed, 1 = employed part-time, 2 = employed full-time). Compared to Barnes et al. (2004b), we replaced museum attendance with senior center attendance. These rural communities do not have the large museums that are present in urban areas, and participation in a senior center is salient for older adults in these rural communities. Senior centers in these communities are important for social engagement; they provide the opportunity to socialize and participate in meals, educational programs, and arts-and-crafts classes. Total values ranged from 0 to 8; for some analyses these social engagement values were categorized as 0 (no social engagement), 1 (minimal social engagement), 2 (moderate social engagement), and 3 to 8 (high social engagement).

Two measures of social network size are considered: primary and secondary network size. Primary social network size is based on a measure reported by Mendes de Leon, Gold, Glass, Kaplan, and George (2001). It is a measure of social network intensity as it is based on personal contact. Participants reported the number of children who do not reside with them, other relatives, and friends they interacted with each month. The number of children, other relatives, and friends seen each month was recorded as the actual number and truncated at 10 for those with 10 or more. Total primary social network is the total number of children (truncated at 10), other relatives (truncated at 10), and friends (truncated at 10) with whom the participant interacts each month. Total values ranged from 0 to 30; these primary social network values were placed in the categories 0 to 4, 5 to 15, and 16 to 30. Secondary network size is a measure of social network breadth as it includes both personal and telephone contact. Similar to primary social network size, secondary network size includes the sum of the primary social network plus the number of times the participant speaks on the telephone each week with children (truncated at 10), relatives (truncated at 10), and friends (truncated at 10). Total values ranged from 4 to 60; these secondary social network values were placed in the categories 4 to 15, 16 to 30, and 31 to 60.

Three primary measures of oral health are examined: self-rated oral health, number of teeth, and number of oral health problems. Self-rated oral health is based on a standard question included in the National Health and Nutrition Examination Survey (NHANES) and has the responses excellent, very good, good, fair, and poor (http://drc.hhs.gov). Number of teeth has the values 0, 1 to 16, and 17 to 32. For dentate participants, tooth counts were obtained from the oral examination. If the participant refused the oral examination (n=51), the self-reported number of teeth obtained at the survey was used. The correlation of self-report and examination in those who had both was 0.92 ($p<0.0001$). Partial and complete dentures were extremely common among edentulous participants and did not provide sufficient variability to include in the analysis (Savoca, Arcury, Leng, Bell, Chen, Anderson, Kohrman, Gilbert & Quandt, 2011). Number of oral health problems is the sum of participant self-reports of current mouth or tooth pain, current ill-fitting dentures, current sore or bleeding gums, current dry mouth, and lifetime periodontal disease. The total number was categorized into the groups 0 or 1, 2, and 3 or more.

The ethnicity of participants is based on self-identification as African American, American Indian, or white. General physical functioning was measured with the Medical Outcomes Survey Physical Functioning Measure (McHorney, Ware, Lu & Sherbourne, 1994). The values for this scale range from 0 to 100; for this analysis, values were categorized into the groups 0 to 34, 35 to 69, and 70 to 100. Other personal characteristics are age, sex, marital status (currently married, not currently married), household size (lives alone, lives with one other person, lives with two or more other people), education (less than 9 years, 9 to 11 years, 12 or more years), having health insurance, having dental insurance, and poverty status (household income below or above poverty level). Poverty level was based on the total household income divided by the total number of residents and adjusted for the year in which the data were collected (http://www.census.gov/hhes/www/poverty/data/threshld/index.html).

Analysis

All data analyses took into account the complex survey design of our study. Stratification, clustering, and sampling weights were incorporated into descriptive, contingency table, and regression analyses. The association between two categorical variables was examined using Rao-Scott Chi-Square tests and weighted frequencies/percentages were reported. Specifically, we first examined the racial differences for personal characteristics (age, physical function, gender, marital status, education, poverty, household size, dental insurance, and general health insurance) and oral health characteristics (self-rated oral

health, number of teeth, and total number of oral health problems). We then examine the association of ethnicity with social engagement and primary and secondary social network sizes. We next evaluated bivariate associations of oral health with social integration. Finally, multiple linear regression models were used to assess whether these associations vary by ethnic group. The interactions between oral health deficits and ethnicity were examined but did not reach statistical significance. Nevertheless, stratified analyses by ethnicity were conducted based on prior experience with this rural population to examine ethnic differences in the association of oral health with social integration. Least square means were reported to describe the average level of social integration measures for various categorical predictors. Regression models were adjusted for oral health characteristics (self-rated oral health, number of teeth, number of oral health problems) and for personal characteristics (sex, education, poverty); health insurance status and dental insurance status were not included in the models as little variability existed for these measures. Age and household size did not differ by ethnic group; therefore, they were not considered to be important covariates in our analysis. All analyses were performed using SAS 9.2 (Cary, NC). A p-value of <0.05 was considered statistically significant.

Results

Participant Characteristics

The mean age of all study participants was 71.5 years, and the mean physical function score was 49.9 (Table 1). Somewhat more than half (54.1%) were women. Somewhat less than half (46.6%) were currently married. About half (50.1%) lived with one other person, with 29.5% living alone and 20.4% living with two or more people. One-third had fewer than nine years of education, while 44.3% had 12 or more years. Most (93.5%) had health insurance, largely Medicare, but few (10.1%) had dental insurance. About one-third (32.1%) lived in households with annual incomes below the poverty level. Participants vary by ethnicity for some characteristics. Participant mean age and physical function score did not differ by ethnicity. Although over 60% of African American and American Indian participants were women, 52.3% of white participants were men ($p = .0016$). One-third of African American participants were currently married, while 46.9% of American Indian participants and 52.3% of white participants were married ($p = .0145$). Household size did not differ by ethnicity. White participants had more education than the minority participants; 56.4% of white participants had 12 or more years of education, compared to 43.2% of African Americans and 26.2% of American Indians. Half of American Indian participants had less than nine years of education, compared to 28.0% of African American and 23.9% of white participants ($p < .0001$). About 40% of African American and American Indian participants were below the poverty level, compared to 23.0% of white participants ($p = .0017$).

Ethnic Differences in Oral Heath

Over half (55.0%) of all participants rated their oral health as excellent, very good, or good, while 45.0% rated their oral health fair or poor (Table 1). Self-rated oral health varied by ethnicity. A greater percentage of white participants (64.4%) than African American (46.9%) or American Indian (45.7%) rated their oral health as excellent, very good, or good ($p=0.0004$). Over a third (34.9%) of participants were edentulous, with 28.2% having 1–16 teeth and 36.9% having 17–32 teeth. Number of teeth did not vary by ethnicity. About one-in-five (19.8%) of the participants had no oral health problems, with about one-third having one oral health problem, 23.9% having two problems, and one-in-five have three or more oral health problems. Number of oral health problems varied by ethnicity, with more white participants (25.9%) than African American (12.3%) or American Indian (15.5%) participants having no oral health problems, and fewer white participants (13.8%) than

African American (26.2%) or American Indian (28.0%) participants having three or more oral health problems (p = .0036).

The prevalence of some specific oral health problems varied by ethnicity. About 11% of participants (African American 13.3%, American Indian 13.8%, white 8.1%; p = .2624) reported experiencing mouth or tooth pain, with about one-in-five reporting ill-fitting dentures (African American 23.7%, American Indian 22.7%, white 19.6%; p = .6151), and almost half reporting dry mouth (African American 45.9%, American Indian 50.9%, white 48.4%; p = .8028). However, fewer white than African American or American Indian participants reported sore or bleeding gums (13.1%, 26.6%, and 30.8% respectively; p = .0002) and periodontal disease (40.5%, 63.8%, and 51.8% respectively; p = .0002).

Social Integration

Most of these rural older adults were socially integrated (Table 2). The mean level of social engagement was 2.2 for African American, 2.1 for American Indian and 1.9 for white older adults. However, the levels of social engagement differed significantly by ethnic group (p = .0027). Fewer African American (7.4%) and American Indian (11.2%) than white (20.0%) older adults had no social engagement. More African American (32.9%), than American Indian (24.5%) and white (28.6%) older adults scored 3 or high on the social engagement measure.

The mean sizes of the social networks of these older adults were also substantial; however, social network size differed significantly by ethnicity, with the social network measures for African American older adults being intermediate between those of American Indian and white older adults. The mean total primary social network size for African Americans was 12.9, as compared to 17.3 for American Indians, and 10.9 for whites (p < .0001). The mean total secondary social network size for African Americans was 27.4, as compared to 35.1 for American Indians, and 21.8 for whites (p < .0001).

Oral Health and Social Integration

Oral health was related to social engagement and social network size among these rural older adults (Table 3). Those with more teeth had greater social engagement (p < .0001). Approximately 42% of people with 17–32 teeth had a score of 3–6 for social engagement while only 8.3% of edentulous people had a score of 3–6 for social engagement. Those with fewer oral health problems had greater social engagement (p = .0335). Those with high versus low self-rated oral health also showed a trend toward greater social engagement, although this relationship did not attain statistical significance (p = .0996).

More of those with low self-rated oral health had the smallest and the largest primary social networks. Similarly, more of those with the low self-rated oral health had the smallest secondary social networks; the percent of those with low and high self-rated oral health with the largest secondary social networks were the same (trend association). More of those with 1–16 teeth had the smallest primary social networks, but the percent with the largest primary social networks was about equal in those with no teeth and 17–32 teeth.

Oral Health and Social Integration: Ethnic Differences

The association of oral health with social engagement was very similar for each ethnic group in multivariate models in which each of the oral health measures (self-rated oral health, number of teeth, and number of oral health problems) are included along with ethnicity, physical function, sex, education, and poverty (Table 4). Number of teeth had a significant association with social engagement for American Indian and white participants such that those with no teeth had lower levels of social engagement compared to those with 1 to 16

and 17 to 32 teeth. This same pattern in the association of number of teeth and social engagement is present for African American participants, but the association does not attain statistical significance. Greater physical function is significantly associated with social engagement among African American and white participants; this pattern is similar among American Indian participants, but the association does not attain statistical significance. Women had greater social engagement than men among African American and American Indian participants. Greater education was associated with greater social engagement among African American and white participants; this pattern is similar among American Indian participants, but the association does not attain statistical significance.

Self-rated oral health was not strongly associated with social network size for elders from any of the three ethnic groups. Number of teeth was associated with primary social network for white older adults. Those with 1 to 16 teeth had smaller primary social networks than those with no teeth and those with 17 to 32 teeth.

Physical function was similar across the three ethnic groups and was not a determinate of ethnic differences in social integration. Physical function was a determinate of individual differences in social integration. Physical function was associated with primary and secondary social network size for white participants. White participants with greater physical function had larger primary social networks and secondary social networks. African American participants with physical function scores of 35 to 69 had smaller secondary social networks than those with higher and lower scores. Participant sex was associated with secondary social network size for elders in all three ethnic groups. Women had significantly larger social networks than men. Education was associated with secondary social network size among African Americans; those with more education had larger networks. Finally, poverty was associated with social network size for minority older adults. Among American Indian older adults, those below poverty had larger primary and secondary social networks than those above poverty.

Discussion

The rural minority older adults who participated in this study have worse oral health than do white older adults, as anticipated by our first hypothesis. A greater percentage of minority older adults have poorer self-rated oral health than do white older adults. Minority older adults also have more oral health problems than do white older adults. The relationship of oral health to minority status is consistent with other reports. For example, Drake and colleagues (1995) found that African American older adults in North Carolina had fewer teeth and then lost more teeth across three years than did white older adults. Sabbah and colleagues (2009) show that ethnic differences remain in measures of oral health, with minority group members having poorer oral health than white adults, after controlling for income and education.

Social engagement is higher among African American and American Indian than among white older adults, and social network size is greater among African American and American Indian than among white older adults. Social engagement among the rural elders in our study is somewhat lower than among the urban older adults who participated in the study of Barnes and colleagues (2004a). The mean level of social engagement among our rural elders is 2.2 for African Americans and 1.9 for whites (Barnes and colleagues do not have data on American Indians). Among urban older adults, the indicator of social engagement is 2.1 for African American elders and 2.5 for white elders. Possible reasons for less social engagement among rural elders may include less opportunity for participating in clubs and in paid employment, and less access to transportation needed for social engagement (Arcury, Preisser, Gesler & Powers, 2005).

Although social engagement is lower among the rural elders in our study compared to urban elders (Barnes et al., 2004a), the level of social interaction (the size of the social networks) is much greater among these rural elders in comparison to the results of other studies. The mean social interaction scores (equivalent to our Secondary Social Network size) among the elders that participated in the Duke EPESE study were 13.4 for African Americans and 14.4 for whites (Mendes de Leon et al., 2001). The scores for our rural elders were almost twice these levels, with African American, American Indian, and white elders having scores of 27.4, 35.1, and 21.8, respectively. The Duke EPESE was conducted in North Carolina and also included rural participants as well as urban participants.

The oral health of the rural older adults participating in this study is associated with their social integration, as anticipated by our second hypothesis. The associations of oral health and social integration did not vary by the ethnicity of the participants, as predicted by our final hypothesis. In the bivariate analysis, those with more teeth and fewer oral health problems are more socially engaged. Those with better self-rated oral health have larger social networks. The association of number of teeth with social network size presents an interesting pattern; those with no teeth and those with 17 to 32 teeth have larger social networks than do those with 1 to 16 teeth. The association of oral health with social integration partially remains for older adults from all three ethnic groups in multivariate analysis. Number of teeth, as an indicator of oral health is related to social engagement but not to social network size among rural older adults no matter their ethnicity. Other indicators of oral health, including self-rated oral health and number of oral health problems, do not have a consistent association with any of the measures of social integration. It appears that poor oral health is associated with low social engagement, which is an indicator of the quality of social integration (Glass et al., 1999); however, poor oral health is not associated with social network size, which is an indicator of the amount of social integration.

Several factors may account for the lack of a consistent association between oral health and social network size. Some of those with no teeth are in great need and therefore family and friends are in contact with them. However, some of those with no teeth have the resources to have their poor quality teeth removed and to purchase dentures, while those with few resources keep their small number of teeth and cannot purchase dentures (Quandt et al., 2009). Of the 222 edentulous older adults participating in this study, 186 have full dentures and 16 have either top or bottom dentures. Having dentures is an indicator of having financial and social resources that allow individuals to maintain social networks. Having dentures is a social resource as those having few teeth and no dentures may limit social interaction due to embarrassment (Bedos et al., 2009).

This analysis expands the picture of how oral health and social integration are associated in the lives of older adults. Older adults who have a large number of teeth and with few oral health problems are socially integrated. With cross-sectional data we can only suggest that those with better oral health also have greater confidence to engage in more productive social activities. The results show that those with greater physical function have greater social integration. The disablement process model (Verbrugge & Jette, 1994) suggests that those with greater social integration are better able to maintain their oral health status. Surprisingly, those with no teeth have greater social integration than those with a few teeth. As we note, this may indicate that those with no teeth have greater resources for dental care (tooth extraction and dentures). However, having dentures is not the only factor, as Savoca and colleagues (2011) show. How the dentures fit is important to their use. Many of those with ill-fitting dentures, and many dentures are ill-fitting, wear them when socializing but take them out to eat. The use of prostheses needs to be considered in further research examining the association of oral health status with social integration.

Sabbah and colleagues (2007, 2009a, 2009b) have proposed the importance of socioeconomic gradients in understanding oral health disparities as well as general health disparities. In line with Marmot (2005), they suggest that the causes and the solutions of health disparities are social and, the remedies, therefore, must be social. The associations of oral health disparities with social integration provide another perspective on the importance of the social aspects of health.

The limitations of this research should be considered when interpreting the results. Most importantly, this research is based on cross-sectional data. Therefore, the causality between ethnicity and oral health, and oral health and social integration cannot be determined. However, the associations reported in this paper are based on data collected from a stratified-random multi-ethnic sample of older adults. The design and size of the sample allow us to examine ethnic differences in oral health and social integration among rural older adults.

Finally, in considering the associations of oral health with social integration among these rural older adults, we must consider that these associations may represent a cohort effect. The older adults who participated in this study grew up in a period of limited access to general health care, limited access to dental care, and no water fluoridation (Ricketts, 1999). Access to general health care in rural communities has improved, and some rural water systems now use fluoridation. Therefore, rural older adults in the future may have better oral health. However, as indicated for the two counties included in this study, for which fewer than two dentists are present for every 10,000 persons, access to dental care is still limited for all members of the community (Vargas, Dye & Hayes, 2003; Stearns, Slifkin & Edin 2000).

In conclusion, this analysis expands discussion of the ways in which oral health affects older adults by documenting an association of oral health with social integration. African American and American Indian older adults have poor oral health relative to white older adults in terms of self-rated oral health and number of oral health problems, but not in number of teeth. The association that having more teeth is associated with greater social engagement is similar for older adults from each of the three ethnic groups. Further research on the manner in which oral health affects social integration will help develop interventions that improve the social resources of older adults and interrupt the progression from pathology to disability.

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References

Ahn S, Burdine JS, Smith ML, Ory MG, Phillips CD. Residential rurality and oral health disparities: Influences of context and individual factors. Journal of Primary Prevention. 2011; 32:29–41. [PubMed: 21249452]

Arcury TA, Bell RA, Anderson AM, Chen H, Savoca MR, Kohrman T, Quandt SA. Oral health self-care behaviors of rural older adults. Journal of Public Health Dentistry. 2009; 69:182–189. [PubMed: 19486460]

Arcury TA, Preisser JS Jr, Gesler WM, Powers JM. Access to transportation and health care utilization in a rural region. Journal of Rural Health. 2005; 21:1–38. [PubMed: 15667003]

Avlund K, Holm-Pedersen P, Schroll M. Functional ability and oral health among older people: a longitudinal study from age 75 to 80. Journal of the American Geriatric Society. 2001; 49 954-062.

Barnes LL, Mendes de Leon CF, Bienias JL, Evans DA. A longitudinal study of Black – White differences in social resources. Journal of Gerontology: Social Sciences. 2004a; 59B:S146–S153.

Barnes LL, Mendes de Leon CF, Wilson RS, Bienias JL, Evans DA. Social resources and cognitive decline in a population of older African Americans and whites. Neurology. 2004b; 63:2322–2326. [PubMed: 15623694]

Bedos C, Levine A, Brodeur JM. How people on social assistance perceive, experience, and improve oral health. Journal of Dental Research. 2006; 88:653–657. [PubMed: 19641153]

Borrell LN, Burt BA, Gillespie BW, Lynch J, Neighbors H. Periodontitis in the United States: beyond Black and White. Journal of Public Health Dentistry. 2002; 62:92–101. [PubMed: 11989212]

Borrell LN, Taylor GW, Borgnakke WS, Nyquist LV, Woolfolk MW, Allen DJ, Lang WP. Factors influencing the effect of race on established periodontitis prevalence. Journal of Public Health Dentistry. 2003; 63:20–29. [PubMed: 12597582]

Chavers LS, Gilbert GH, Shelton BJ. Racial and socioeconomic disparities in oral disadvantage, a measure oral health-related quality of life: 24-month incidence. Journal of Public Health Dentistry. 2002; 62:140–147. [PubMed: 12180041]

Drake CW, Hunt RJ, Koch GG. Three-year tooth loss among Black and White older adults in North Carolina. Journal of Dental Research. 1995; 74:675–680. [PubMed: 7722064]

Durkheim É. Suicide. 1897 The Free Press reprint 1997.

Glass TA, Mendes de Leon C, Seeman TE, Berkman LF. Beyond single indicators of social networks: a LISREL analysis of social ties among the elderly. Social Science & Medicine. 1997; 44:1503–1517. [PubMed: 9160440]

Glass TA, Mendes de Leon C, Marottoli RA, Berkman LF. Population based study of social and productive activities as predictors of survival among elderly Americans. BMJ. 1999; 319:478–483. [PubMed: 10454399]

Hung H-C, Joshipura KJ, Colditz G, Manson JE, Rimm EB, Speizer FE, Willett WC. The association between tooth loss and coronary heart disease in men and women. Journal of Public Health Dentistry. 2004; 64:209–215. [PubMed: 15562943]

Locker D. Self-esteem and socioeconomic disparities in self-perceived oral health. Journal of Public Health Dentistry. 2008; 69:1–8. [PubMed: 18662257]

Locker D, Matear D, Stephens M, Jokovic A. Oral health-related quality of life of a population of medically compromised elderly people. Community Dental Health. 2002; 19:90–97. [PubMed: 12146588]

Lyons, JC.; Hadley, HL.; Groves, JS.; Gaul, K.; Fraher, EP. North Carolina Health Professions 2008 Data Book. Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill; 2008.

Makhija SK, Gilbert GH, Boykin MJ, Litaker MS, Allman RM, Baker PS, Locher JL, Ritchie CS. The relationship between sociodemographic factors and oral health-related quality of life in dentate and edentulous community-dwelling older adults. Journal of the American Geriatrics Society. 2006; 54:1701–1712. [PubMed: 17087697]

Marmot M. Social determinants of health inequalities. Lancet. 2005; 365(9464):1099–1104. [PubMed: 15781105]

McHorney CA, Ware JE Jr, Lu JF, Sherbourne CD. The MOS 36-item Short-Form Health Survey (SF-36): III. Tests of data quality, scaling assumptions, and reliability across diverse patient groups. Medical Care. 1994; 32:40–66. [PubMed: 8277801]

Mendes de Leon CF, Gold DT, Glass TA, Kaplan L, George LK. Disability as a function of social networks and support in elderly African Americans and whites: the Duke EPESE 1986–1992. Journal of Gerontology: Social Sciences. 2001; 56B:S179–S190.

Meng X, Gilbert GH, Duncan RP, Heft MW. Satisfaction with dental appearance among diverse groups of dentate adults. Journal of Aging and Health. 2007; 19:778–791. [PubMed: 17609413]

Nowjack-Raymer RE, Sheiham A. Numbers of natural teeth, diet, and nutritional status in US adults. Journal of Dental Research. 2007; 86:1171–1175. [PubMed: 18037650]

National Institutes of Health. Oral Health in America: A Report of the Surgeon General-Executive Summary. Rockville, MD: National Institute of Dental and Craniofacial Research, US Dept of Health and Human Services; 2000.

Quandt SA, Chen H, Bell RA, Anderson AM, Savoca MR, Kohrman T, Gilbert GH, Arcury TA. Disparities in oral health status between older adults in a multiethnic rural community: the rural nutrition and oral health study. Journal of the American Geriatrics Society. 2009; 57:1369–1375. [PubMed: 19563519]

Quandt SA, Chen H, Bell RA, Savoca MR, Anderson AM, Leng X, Kohrman T, Gilbert GH, Arcury TA. Food avoidance and food modification practices of older rural adults: association with oral health status and implications for service provision. The Gerontologist. 2010; 50:100–111. [PubMed: 19574543]

Reid BC, Hyman JJ, Macek MD. Race/ethnicity and untreated dental caries: The impact of material and behavioral factors. Community Dentistry and Oral Epidemiology. 2004; 32:329–336. [PubMed: 15341617]

Ricketts, TC., III, editor. Rural Health in the United States. New York: Oxford University Press; 1999.

Riley JL 3rd, Gilbert GH, Heft MW. Race/ethnic differences in health care use for orofacial pain among older adults. Pain. 2002; 100:119–130. [PubMed: 12435465]

Sabbah W, Tsakos G, Chandola T, Sheiham A, Watt RG. Social gradients in oral and general health. Journal of Dental Research. 2007; 86:992–996. [PubMed: 17890677]

Sabbah W, Tsakos G, Sheiham A, Watt RG. The effects of income and education on ethnic differences in oral health: a study in USA adults. Journal of Epidemiology and Community Health. 2009a; 63:516–520. [PubMed: 19254911]

Sabbah W, Tsakos G, Sheiham A, Watt RG. The role of health-related behaviors in the socioeconomic disparities in oral health. Social Science & Medicine. 2009b; 68:298–303. [PubMed: 19027214]

Savoca MR, Arcury TA, Leng X, Bell RA, Chen H, Anderson AM, Kohrman TK, Gilbert GH, Quandt SA. Impact of denture usage patterns on dietary quality and food avoidance among older adults. Journal of Nutrition in Gerontology and Geriatrics. 2011; 30:86–102. [PubMed: 23286643]

Siriphant P, Drury TF. Healthy practices, social relationships and dental perceptions among US dentate adults. Journal of Public Health Dentistry. 2005; 65:36–42. [PubMed: 15751493]

Stearns SC, Slifkin RT, Edin HM. Access to care for rural Medicare beneficiaries. Journal of Rural Health. 2000; 16:31–42. [PubMed: 10916313]

US Department of Agriculture. [Accessed July 12, 2005] Measuring rurality: rural-urban continuum codes. Available at: http://ers.usda.gov/Briefing/Rurality/RuralUrbCon/.

Vargas CM, Dye BA, Hayes K. Oral health care utilization by US rural residents, National Health Interview Survey 1999. Journal of Public Health Dentistry. 2003; 63:150–157. [PubMed: 12962468]

Verbrugge LM, Jette AM. The disablement process. Social Science & Medicine. 1994; 38:1–14. [PubMed: 8146699]

Wu B, Plasman BL, Crout RJ, Laing J. Cognitive function and oral health among community-dwelling older adults. Journal of Gerontology: Medical Sciences. 2008; 63A:495–499.

Table 1

Participant Personal Characteristics and Oral Health Characteristics for the Weighted Study Sample, Total and by Ethnic Group.

Personal and Oral Health Characteristics	Total		African American		American Indian		White	
	n	%	n	%	n	%	n	%
Total n	635	100.0	136	100.0	195	100.0	304	100.0
Personal Characteristics								
Age [Mean ± SE]	71.5 ± 0.4		72.2 ± 0.8		70.1 ± 0.6		72.2 ± 0.7	
Physical Function [Mean±SE]	49.9±1.8		49.8±2.5		49.3± 2.8		50.3±2.9	
Female **	344	54.1	83	61.1	122	62.5	139	45.7
Currently married *	296	46.6	45	33.5	92	46.9	159	52.3
Household Size								
Lives alone	187	29.5	40	29.2	49	25.1	98	32.4
Lives with one other person	318	50.1	59	43.4	99	50.5	161	52.9
Lives with two or more other people	129	20.4	37	27.3	48	24.3	45	14.7
Education ****								
Less than 9 years	210	33.0	38	28.0	99	50.7	73	23.9
9 to 11 years	144	22.7	39	28.8	45	23.0	60	19.7
12 or more years	281	44.3	59	43.2	51	26.2	171	56.4
Has Health Insurance	594	93.5	125	91.8	181	92.7	288	94.7
Has Dental Insurance	64	10.1	16	11.7	14	7.4	34	11.2
Below poverty level **	204	32.1	53	39.3	81	41.3	70	23.0
Oral Health Characteristics								
Self-Rated Oral Health ***								
Excellent, Very good, Good	347	55.0	63	46.9	88	45.7	196	64.4
Fair, Poor	284	45.0	71	53.1	105	54.3	108	35.6
Number of Teeth								
None	222	34.9	43	31.7	68	35.1	110	36.2
1 to 16	179	28.2	43	31.3	61	31.3	76	24.9
17 to 32	234	36.9	50	37.0	66	33.6	118	38.9
Total Oral Health Problems **								

Personal and Oral Health Characteristics	Total		African American		American Indian		White	
	n	%	n	%	n	%	n	%
None	126	19.8	17	12.3	30	15.5	79	25.9
One	226	35.5	50	37.1	67	34.4	108	35.5
Two	152	23.9	33	24.4	43	22.0	75	24.8
Three or more	132	20.8	36	26.2	55	28.0	42	13.8

**** < .0001

*** < .001

** < .01

* < .05

Table 2

Ethnic Differences in Social Integration among Rural Older Adults in North Carolina.

Social Engagement and Social Network	African American				American Indian				White			
	Mean	SE	Weighted n	%	Mean	SE	Weighted n	%	Mean	SE	Weighted n	%
Social Engagement**	2.2	0.1			2.1	0.1			1.9	0.2		
0 (no engagement)			10	7.4			22	11.2			61	20.0
1 (minimal engagement)			22	15.9			30	15.2			64	21.0
2 (moderate engagement)			60	43.8			96	49.1			92	30.4
3 to 8 (high engagement)			45	32.9			48	24.5			87	28.6
Primary Social Network****	12.9	0.7			17.3	0.6			10.9	0.6		
0 to 4			17	12.2			5	2.3			50	16.6
5 to 15			67	49.5			67	34.4			190	62.5
16 to 30			52	38.3			124	63.3			63	20.8
Secondary Social Network****	27.4	1.5			35.1	1.2			21.8	1.4		
4 to 15			50	16.6			25	13.0			109	35.8
16 to 30			190	62.5			46	23.7			116	38.0
31 to 60			63	20.8			124	63.3			79	26.2

**** < .0001

*** < .001

** < .01

* < .05

Table 3

Oral Health and Social Integration among Older Adults in Rural North Carolina.

	Self-rated Oral Health		Number of teeth			Number of Oral Health Problems			
	Low %	High %	0 %	1–16 %	17–32 %	0 %	1 %	2 %	3+ %
Social Engagement									
0	18.7	11.4	21.4	13.9	8.7***	4.1	14.9	19.6	18.3*
1	15.5	20.5	29.9	14.8	8.8	20.0	16.3	19.2	18.3
2	40.6	37.0	40.4	35.6	40.3	36.7	36.9	35.0	49.3
3 to 6	25.2	31.1	8.3	34.8	42.2	39.2	31.9	26.1	14.2
Primary Social Network									
0 to 4	16.0	7.5*	8.4	21.0	6.6**	16.9	9.5	11.4	8.8
5 to 15	43.7	56.6	54.4	42.8	54.3	52.4	55.8	45.9	47.9
16 to 30	40.3	35.9	37.3	36.2	39.1	30.8	34.7	42.7	43.4
Secondary Social Network									
4 to 15	32.2	22.0	23.0	33.0	24.7	31.8	23.5	26.2	26.6
16 to 30	26.4	36.1	39.2	26.7	28.9	27.8	39.0	27.5	28.6
31 to 60	41.3	41.8	37.8	40.3	46.4	40.3	37.5	46.3	44.8

*** < .001

** < .01

* < .05

Table 4

Multivariate Analysis of Oral health and Social Engagement, Primary Social Network, and Secondary Social Network Adjusting for Physical Function, Sex, Education, and Poverty for African American, American Indian, and White Older Adults in Rural North Carolina.

	African American		American Indian		White	
	Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**
Social Engagement						
Self-rated oral health						
Excellent, Very good, Good	2.42	0.14§	2.18	0.16	2.02	0.15
Fair, Poor	2.08	0.12	1.99	0.12	1.87	0.19
Number of Teeth						
None	1.98	0.13§	1.66	0.13**	1.53	0.22*
1 to 16	2.24	0.16	2.29	0.19	2.25	0.31
17 to 32	2.46	0.14	2.36	0.22	2.17	0.15
Number of Oral Health Problems						
None	2.05	0.19	1.66	0.13§	1.96	0.22
One	2.15	0.14	2.29	0.19	1.96	0.19
Two	2.34	0.14	2.36	0.22	1.95	0.28
Three or more	2.35	0.14	1.66	0.13	2.01	0.45
Physical Function						
0 to 34	1.99	0.18*	1.80	0.11§	1.45	0.19**
35 to 69	2.22	0.11	2.08	0.15	1.95	0.20
70 to 100	2.48	0.14	2.39	0.25	2.41	0.24
Sex						
Female	2.54	0.11****	2.28	0.15**	2.06	0.16
Male	1.77	0.14	1.77	0.12	1.87	0.22
Education						
Less than 9 years	1.85	0.17***	1.89	0.16§	1.49	0.20*
9 to 11 years	2.08	0.15	1.85	0.15	1.69	0.21
12 or more years	2.55	0.13	2.64	0.25	2.21	0.19
Poverty						

	African American		American Indian		White	
	Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**
Below poverty	2.35	0.11§	2.26	0.14*	1.99	0.15
Above poverty	2.07	0.14	1.84	0.16	1.88	0.24
Primary Social Network						
Self-rated oral health						
Excellent, Very good, Good	13.07	1.01	17.50	0.93	11.44	0.60
Fair, Poor	13.09	0.80	16.88	0.81	10.67	0.62
Number of Teeth						
None	13.98	0.96	17.95	0.70	12.13	0.87**
1 to 16	12.24	1.36	16.39	1.26	9.11	0.85
17 to 32	13.12	1.12	17.00	0.83	11.64	0.73
Number of Oral Health Problems						
None	10.63	1.48§	16.91	1.36	10.32	1.03
One	12.35	0.97	17.96	0.97	11.10	0.56
Two	15.04	1.03	16.72	0.89	12.07	0.91
Three or more	13.32	1.47	16.75	1.21	11.07	1.58
Physical Function						
0 to 34	13.03	0.96	16.82	1.05	9.58	0.89*
35 to 69	12.44	0.95	16.86	1.33	11.69	0.71
70 to 100	13.69	1.08	17.89	0.70	12.06	0.69
Sex						
Female	13.89	0.94§	17.79	0.78	12.05	0.57§
Male	11.84	0.90	16.26	0.94	10.27	0.79
Education						
Less than 9 years	11.12	1.25§	16.98	0.75	11.66	0.92
9 to 11 years	13.24	1.25	17.35	1.39	9.45	0.87
12 or more years	14.05	0.78	17.37	1.19	11.42	0.88
Poverty						
Below poverty	14.03	0.95§	18.49	0.80**	11.27	0.50
Above poverty	11.66	1.06	15.44	0.86	10.83	1.41

	African American		American Indian		White	
	Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**
Secondary Social Network						
Self-rated oral health						
Excellent, Very good, Good	28.48	1.87	36.20	1.67	23.68	1.41§
Fair, Poor	27.48	1.53	33.29	1.56	20.27	1.13
Number of Teeth						
None	31.50	2.04	36.20	1.67	24.57	1.98
1 to 16	26.50	2.44	33.29	1.56	18.95	2.23
17 to 32	26.17	1.89	35.80	1.50	22.86	1.61
Number of Oral Health Problems						
None	24.61	2.30§	32.77	2.87	21.88	1.92
One	26.31	1.85	34.09	1.86	22.08	0.99
Two	31.62	1.94	35.59	1.95	23.69	2.05
Three or more	27.96	3.19	35.43	1.83	22.34	2.88
Physical Function						
0 to 34	30.17	1.96**	33.00	2.00	19.06	1.59*
35 to 69	24.19	1.47	34.58	2.75	24.36	1.57
70 to 100	29.20	2.15	36.52	1.62	23.77	1.19
Sex						
Female	32.39	1.69****	39.84	1.57****	27.04	1.00***
Male	21.18	1.84	27.04	1.69	17.85	1.88
Education						
Less than 9 years	22.62	2.23**	32.95	1.47	23.15	1.99
9 to 11 years	28.05	2.21	36.19	2.84	18.39	3.03
12 or more years	30.77	1.60	36.58	1.96	23.26	1.31
Poverty						
Below poverty	30.02	1.71§	37.34	1.46*	23.32	1.28
Above poverty	24.82	2.37	31.07	1.98	19.10	2.29

**** < .0001

*** < .001

** < .01

* < .05

§ < .10