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Food Avoidance and Food Modification Practices due to Oral Health Problems Linked to the Dietary Quality of Older Adults

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Abstract

OBJECTIVES—1) quantify the association between food avoidance and modification due to oral health problems; 2) quantify the relationship between these nutritional self-management strategies and dietary quality; and 3) determine foods associated with these self-management strategies.

DESIGN—Cross-sectional

SETTING—Rural North Carolina

PARTICIPANTS—Six hundred thirty-five community-dwelling adults aged 60 years and older.

MEASUREMENTS—Demographic and food frequency data and oral health assessments were obtained during home visits. Avoidance (none, 1–2 foods, 3–14 foods) and modification (0–3 foods, 4–5 foods) was assessed for foods representing oral health challenges. Food frequency data were converted into Healthy Eating Index-2005 (HEI-2005) scores. Linear regression models tested the significance of associations between HEI-2005 measures and food avoidance and modification.

RESULTS—Thirty-five percent of the sample avoided 3–14 foods and 28% modified 4–5 foods. After adjusting for age, sex, ethnicity, poverty, education, and tooth loss, the total HEI-2005 score was lower ($P<0.001$) for persons avoiding more foods and higher for persons modifying more foods ($P<0.001$). Those avoiding 3–14 foods consumed more saturated fat and energy from solid fat and added sugar and lower intake of non-hydrogenated fats than those avoiding <3 foods. Those who modified 4–5 foods consumed less saturated fat and solid fat and added sugar but more total grains than those modifying <4 foods.

CONCLUSION—Food avoidance and modification due to oral health problems are associated with significant differences in dietary quality. Approaches to minimize food avoidance and promote food modification by persons having eating difficulties due to oral health conditions are needed.

Keywords

dietary behaviors; minority health; oral health

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INTRODUCTION

An older adult's capacity to consume a healthful diet is a critical self-management practice and key contributor to overall health status.[1, 2] An important consideration in our understanding of dietary quality among older adults is how this group adapts their eating practices to changes in oral health, such as their ability to chew or swallow. These challenges affect a large number of people. Half of a sample of 2425 male military veterans either always or sometimes ate with discomfort.[3] Numerous reports have found that dietary quality is compromised for older adults who shift their food choices toward foods that are softer and easier to chew and swallow, and away from those that are crunchy, stringy, or dry, such as carrots, apples, steaks, and nuts.[4, 5] The effect of such changes is less well understood.[6,7] In order to advance efforts to improve the dietary quality of older adults, the ways in which both food avoidance and modification are related to healthful eating patterns should be better understood.

Age-related changes in eating habits can occur in response to acute and chronic conditions; disease states;, gastrointestinal tract alterations; impaired swallowing; and shifts in taste, smell, and tactile sensations in the mouth.[1] Poor oral health among older adults is one condition that contributes to inadequate dietary intake.[8–14] The effects of tooth loss or other oral health problems on nutritional status have been associated with having a less-varied diet, eating fewer fruits, vegetables and nuts, and eating more foods containing cholesterol and sodium.[15–17] Other effects include lower intake of vitamins, carotenoids, minerals, and trace elements.[15–17] These and other reports have made it evident that it is important to understand the specific ways that older adults adapt their diet because of functional limitations due to oral health problems. This has important implications for developing effective ways to improve their nutritional self-management.[18]

Quandt et al proposed a conceptual framework for examining the self-management of nutritional risk.[2] The model proposes that nutritional self-management strategies (the ways that older adults access, prepare, and consume sufficient amounts of food) are shaped by lifetime accumulation of financial and personal resources, and influenced by on-going changes in their health, household composition, community resources, and knowledge. These factors in turn impact the strategies the elderly use (or have employed for them) to maintain their diets.[2] The importance of nutritional self-management strategies among elders was reflected in a report that found that having difficulties fixing meals was associated with greater risk of mortality than even the lack of financial resources.[19]

Food avoidance and food modification are two self-management strategies.[7] Those who have impaired oral health may avoid foods that are difficult to eat or modify the ways that foods are prepared or eaten. Each can serve a different purpose. Without regard for the impact on the nutritional quality of the diet, avoidance can minimize the effects of chewing difficulties and tooth pain, and other oral health problems.[20]. Modifying foods may serve to maintain certain foods in the diet that one perceives as beneficial or pleasant, and overcome difficulties with the inability to chew food properly.[6] In one of the few reports of food modification, 80% of elderly edentulous Greeks were willing to take the time to prepare foods to make them easier to eat in order to keep these foods in their diets.[6] To the degree that food avoidance eliminates foods that contribute to a healthful diet, those who avoid a greater number of foods may have lower dietary quality than those who avoid fewer foods. Food modification may offer a means to maintain dietary quality and minimize the impact of oral health problems. Examining the relationship between food avoidance and food modification offers the opportunity to further refine this model by assessing how dietary

quality is related to two ways that older adults can adapt their dietary practices in response to oral health problems.

This paper uses data from a population-based survey that measured both oral health status and dietary quality in a multi-ethnic older adult population. A recent analyses of these data found that the number of foods avoided and the types of foods modified were related to several indicators of oral health status including tooth loss.[7] The foods most frequently avoided were whole fruits and raw vegetables and to a lesser extent meats and cooked vegetables. Twenty-five percent to sixty percent of the participants reported modifying specific fruits, vegetables, or meats. The purposes of this present investigation are to extend these findings to: 1) quantify the association between food avoidance and modification done in response to oral health problems, 2) quantify the association between these food practices and overall dietary quality, and 3) determine the foods that are most closely associated with these two nutritional self-management strategies.

METHODS

Sampling Plan and Recruitment

Between January 2006 and March 2008, the Rural Nutrition and Oral Health (RUN-OH) Study conducted a population-based, cross-sectional survey of the dietary intake of an ethnically diverse (African American, American Indian, and white) population of older adults in two rural North Carolina counties. Details of sampling and recruitment are presented elsewhere.[21]

Individuals were considered eligible if they were 60 years or older, spoke English, were able to give informed consent, and were physically able to complete the interview. Of 5,445 selected dwellings, 39 were not screened, 4,647 were screened but did not include an eligible participant, and 859 included an eligible participant, yielding a screening rate of 99.3%. The eligible residents in 635 of the 859 eligible dwelling units completed the interview; and 224 refused to participate, for a response rate of 73.9%.

Data Collection

All data collection procedures were approved by the university's Institutional Review Board. The data were collected in face-to-face interviews at participants' homes, lasting 1.5 to 2.5 hours. Data collection included the 1998 version of the Block Food Frequency Questionnaire (FFQ) (Nutrition Quest Block 98.2), which assesses usual intake of 110 foods. Participants were asked about typical frequency and portion sizes of foods eaten within the past year. Questions were read to participants. Cue cards with response categories were used if necessary. Interviewers completed 8 hours of training and 6 hours of practice interviews. Ten percent of interviews were verified by telephone. To maintain quality, one interview every month was audio-recorded for each interviewer and reviewed by research staff, who provided written feedback. Dentate participants (persons with at least one natural tooth) were asked to undergo an in-home oral examination. Among 413 dentate participants, 362 completed the oral examination, for a participation rate of 87.6%. Oral examinations were conducted by dental hygienists who performed tooth counts and assessed functional occlusal contacts. Two hygienists conducted all study assessments. They underwent an initial one-day training and one-day calibration with a research dentist using volunteers who were representative of the study population. Calibration was repeated annually. The research dentist conducted five replicate examinations with each hygienist, and performed an ongoing review of data collection forms to check for correct logic, legal values, and data ranges.

Demographic data included sex, ethnicity, age, income, education, and marital status. Ethnicity was self-reported and categorized as African American, American Indian, or white. Income was dichotomized as either above or below the poverty line using current-year federal poverty guidelines according to household size.[22] Education categories were: (1) less than high school graduate, (2) high school graduate or (3) more than high school.

Food avoidance measures were developed based on data obtained over ten years of qualitative and quantitative nutrition research in the study population [23–28], as well as a small pilot study. Respondents were read a list of foods and asked if they avoided the food because of the condition of their teeth, mouth, or dentures. The list included common foods consumed in the population that require different types and intensities of biting or chewing (e.g., baked or stewed chicken vs. grilled or fried pork chops, what is commonly referred to in this population as “hard fried meat”) or present different problems for teeth or dentures (e.g., whole apples with skin, anterior biting; grilled or fried meats, posterior grinding; berries and nuts, seeds and small pieces that become lodged in teeth or under dentures; sticky candy, food that can adhere to dental work). These measures are further described elsewhere.[7] Because the distribution was skewed, a categorical variable was created for no foods avoided, 1–2 foods avoided, and 3–14 foods avoided.

For food modification, respondents were asked whether or not they prepared foods in a special way because of the condition of their teeth, mouth, or dentures. The foods included apples; steak, pork chops, or roasts; beans such as limas or black-eyed peas; carrots; and cooked greens. For each, preparation methods common in the area were queried. For example, for apples, respondents were asked if they prepared them by peeling, slicing thin, chopping into small pieces, scraping with a spoon, or cooking. Respondents could indicate more than one modification technique for each food. Measures were created indicating whether any modification method was used or no modification method used. Details of these modification measures are described in another report.[7] Two categories were created for the number of foods modified: 0–3 foods and 4–5 foods.

Dietary Assessment and HEI-2005 Scoring

The HEI-2005 contains 12 components.[29] These include cup equivalent (eq)/1000 kcals of Total Fruit, Whole Fruit, Total Vegetables, Dark Green and Orange Vegetables and Legumes (after Meat and Bean component reach maximum values), and Milk (dairy products including soy milk). Meat and Beans (eggs, nuts, and soy foods excluding drinks), Total Grains, and Whole Grains are calculated in oz eq/1000 kcals. The amounts of Oils (non-hydrogenated fats found in mayonnaise, margarine, salad dressing, nuts and seeds, and fish) and Sodium, measured in g/1000 kcals, and the percent calories from Saturated fat and Solid Fat, Alcohol, and Added Sugar (SoFAAS) comprise remaining components. The Total HEI score, which ranges from 0 to 100, is the sum of scores for all components; the contribution (weighting) of each component to the total score varies. A maximum score of 5 was given for meeting or exceeding recommended intake of Total Fruit, Whole Fruit, Total Vegetable, Dark Green and Orange Vegetables and Legumes, Total Grains, or Whole Grains. A maximum score of 10 was assigned for meeting or exceeding recommended amounts of Milk, Meat and Beans, and Oils and when Saturated Fat and Sodium were *equal to or less* than recommended intake. The recommended percent of energy contributed by SoFAAS was assigned a score of 20 if it was equal to or less than the recommendations.

Completed FFQs were scanned by Nutrition Quest. In addition to standard output variables of daily intake of micro- and macronutrients and USDA servings of food groups, gram amounts and calories of each questionnaire item were provided by Nutrition Quest for the calculation of HEI-2005 component scores. The USDA Food Search Tool 3.0[30] provided additional information to calculate HEI-2005 components, such as grams per cup or ounce,

amounts of fat, or added sugar in certain reference foods. The conversion of dietary measures to HEI-2005 scores can be found in more detail.[31]

Statistical Analysis

All analyses incorporated the multistage cluster sampling design and have been described elsewhere.[21] Weighted sample sizes were reported. Population characteristics by food avoidance/modification category were described using frequency table (categorical variables) or mean and standard error (continuous variables). Linear regression models were used to test for the main effects of food avoidance and food modification on Total HEI-2005 score and its components after adjusting for covariates including age, gender, ethnicity, poverty status, education and number of teeth. Interaction between food avoidance and food modification was tested for all models. If the interaction was not significant, the interaction term was dropped from the final model. Adjusted means and standard errors of Total HEI-2005 score and its components were estimated from the models for all food avoidance/ modification categories. All analyses were performed using SAS 9.1 (Cary, NC), and a level of significance was set at $P<.05$.

RESULTS

Sample Characteristics

The total sample of 635 participants had a mean age (± SE) of 71.5 ± 0.4 years. The sample included 344 women (54.1%) and 291 men (49.9%). The race/ethnic breakdown of the sample was 21.4% African American, 30.7% American Indian, and 47.8% white. Thirty-two percent of the participants were below the poverty level. A total of 55.7% had less than and 19.8% had more than a high school education. Approximately half of the participants had fewer than 11 teeth indicating severe tooth loss (Table 1).

Food Avoidance and Modification Categories

Participants were categorized into two modification categories (0–3 foods modified and 4–5 foods modified). Within these two categories, participants were categorized into three sub-categories based on the number of foods they reported avoiding (no foods avoided, 1–2 foods avoided, or 3–14 foods avoided). The descriptive characteristics of these six sub-categories are also found in Table 1. Three quarters of the sample modified 0–3 foods. Of these, 48.6% did not report avoiding any of the listed foods and 25% reported avoiding 3–14 foods. In contrast, among those who reported modifying 4–5 of the foods (N=162), only 9.9% indicated that they did not avoid any of the listed foods, while two-thirds avoided 3–14 foods. Ethnicity, poverty status, education, and severity of tooth loss were related to the food modification and avoidance patterns of these participants. Whites were less likely than other groups to modify 4–5 foods and avoid 3–14 and were more likely to modify 0–3 foods and avoid none ($P=.016$). Those whose incomes were above the poverty line were less likely to modify 4–5 foods and avoid 3–14 foods and more likely to modify 0–3 and avoid no foods ($P=.0014$). Similarly, 61.5% of those with more than a high school education modified fewer foods and avoided none and 9.5% reported modifying 4–5 and avoiding 3–14 foods ($P< .0001$). Finally, 51.9% of those with 11 or more teeth modified 0–3 foods and avoided none in contrast to 21.4% with severe tooth loss ($P <.0001$).

HEI-2005 Scores

After adjusting for the effects of age, gender, ethnicity, poverty status, education, and severity of tooth loss, the total HEI-2005 score and four of the ten food categories comprising the total score differed based on whether or not a participant reported modifying and/or avoiding foods. There were no statistically significant interactions between the food

modification category and food avoidance category. Therefore, we are reporting the results of models that tested the main effects of food modification and avoidance categories (Table 2).

For the total sample, the HEI-2005 total score (mean ± SE) was 61.87 ± 0.72 of the possible 100 points. Those who avoided 3–14 foods had lower HEI-2005 total scores than those who avoided fewer foods (*P*=0.001). Modifying 4–5 foods compared to modifying 0–3 foods was associated with HEI-2005 total scores that were approximately three points higher across all of the foods avoidance categories (*P*=.0086). The net effect of these two variables can be found by comparing the extremes: participants who modified 4–5 foods and avoided none had a HEI-2005 total score that was approximately six points higher (64.70 ± 1.01) than the group who avoided 3–14 foods and modified 0–3 foods (58.78 ± 1.02).

Differences in total grains, saturated fat, SoFAAS, and oils (non-hydrogenated fats) were related to these food practices. Higher reported intakes of total grains was related to modifying 4–5 foods (*P*=.005) although not related to the number of foods avoided (*P*=.34). Those who modified 4–5 foods consumed less energy from saturated fat (p=.04) and SoFAAS (*P*=.03) compared to those who modified 0–3 foods. The percent of energy from saturated fat was related to the number of foods avoided (*P*=.04) with persons who avoided 1–2 foods consumed less saturated fat than those who avoided either no foods or 3–14. Those who avoided more foods consumed more energy from SoFAAS (*P*=.01). Those who avoided 3–14 foods and modified 0–3 were estimated to consume 30.6 ± .9% of their energy from SoFAAS, compared to 25.9 ± .9% for those who modified 4–5 foods and avoided no foods. The intake of oils was lower for those who avoided more foods (*P*=.03). The estimated amounts of fruit, vegetables and legumes, whole grains, milk products, meat and beans, and sodium were not related to food modification and avoidance practices.

DISCUSSION

These results are consistent with several studies that reporting that those who adapt to impaired oral health avoiding certain foods are likely to have lower dietary quality.[32–35] This study corroborates that previous research and builds on it by demonstrating that modifying foods in response to oral health problems was associated with higher HEI-2005 scores. Taking these two strategies together, those who avoid many foods and yet modify several foods had total HEI-2005 scores that were comparable to the scores of those who modified few foods and avoided none. This was true even when the effects of poverty, ethnicity, education, and, most importantly, the severity of tooth loss were controlled for in the analysis. To our knowledge this is the first report to link these two nutrition self-management strategies; it also begins to define how management of impaired oral health leads to lower dietary quality.

The individuals who avoided the most foods were approximately evenly split when categorized as either modifying 0–3 foods or 4–5 foods. Those who avoided the most foods were more often ethnic minorities, those with lower education and income, and those who have experienced greater tooth loss. However, these results do not tell us what characteristics distinguish those who avoid many foods yet are able or willing to modify their foods from those who do not modify. Research has found that the inability to fix meals for oneself, lack of companionship, and widowhood were related to nutritional status or mortality.[19, 25, 36] Limited cooking ability has been associated with risk of early mortality among community-dwelling black and white older adults.[19] Companionship has been found to mediate the effects of poor appetite on vitamin and mineral, protein, and energy intake among older adults.[36] Recently widowed rural elders were more likely to skip meals, had less food variety, and prepared foods less frequently. [25] Our results along with previous

findings suggest that it is important to understand the impact of support for meal preparation and the particular barriers faced by elders who may want to modify foods to make eating easier or more enjoyable but are unable to do so.

The foods that participants were asked whether they either avoided or modified because of oral health conditions included whole apples, carrots, grilled or fried meats, berries, nuts, seeds, sticky candy, beans, and certain vegetables. Given this wide array of foods, we did not hypothesize which of the HEI-2005 component foods would contribute to the number of foods avoided. Avoiding 3–14 foods was positively associated with intake of saturated fats and percentage of energy from solid fat and added sugar. It was negatively associated with amounts of fats found in dressing, nuts, seeds, and fish. Persons who modified 4–5 foods consumed less saturated fat and solid fat and added sugar and more total grains. However, we did not find a statistically significant association between fruits, vegetables, and meat components. This may reflect that not all fruits, vegetables, or meats are hard to chew or swallow (e.g. bananas, peas, or ground meat) and participants are likely to continue to eat similar foods that contribute to those component score. Bradbury et al found that reported avoidance of hard and difficult-to-chew foods was correlated with perceived chewing ability but not total fruit and vegetable intake.[37] Other reports have shown that those with greater tooth loss consumed less of foods like carrots and salads, and have lower dietary intake or serum levels of certain vitamins.[8, 35, 38] However, these reports did not directly test the association between the intake of these foods and nutrient intake or serum levels of vitamins or minerals. Others have not found any association between having difficulties eating solid food and nutrient intake, nor have they found that oral health problems, chewing difficulties or temperature sensitivity were associated with food avoidance but they did find that those who had fewer natural teeth and poorly-fitting dentures had less food variety in their diets.[11] It may be that the combined effect of eliminating certain fruits and vegetables due to oral health problems along with increased consumption of high fat and sugar foods contributed to the overall differences in dietary quality found among those who avoided more foods.

This study has several strengths. The results are based on a large population-based survey of older adults living in rural multi-ethnic communities where they are more likely to be obese or overweight, experience high rates of chronic disease, and have limited access to preventive healthcare.[38–41] Furthermore, the study differed from other research on the effects of oral health on food choices because it considered the associations between dietary quality and both food avoidance and modification. Finally, we considered the dietary quality of rural elders using the HEI-2005, which reflects the most recent USDA guidance and uses density standards rather than absolute amounts of food (i.e., the food amounts per 1000 kilocalories of intake compared to amounts per day).[29] For older adults who often have reduced energy intake, the HEI-2005 density standard provides a useful approach for understanding food choices of older adults regardless of the total amounts of food.[42–44]

The limitations of this research call attention to the need for future research. First, this study was a cross-sectional investigation and thus causal relationships can not be established. However, the results suggest that there is a need to consider how declining oral health affects the ability to chew and eat without pain, leading to food adaptations and subsequent declines in dietary quality. Second, the functional and health status of older adults varies widely. We were not able to consider the effects of these differences on participants' food choices and preparation efforts. These differences may have a substantial impact on nutritional self-management practices, particularly for those with type 2 diabetes or cardiovascular disease, where nutritional self-management is a standard clinical recommendation. Finally, the cooking and food acquisition habits of elders vary based on the level and quality of support received from family, friends, and community services.[2]

These sources of nutritional support were not considered and may have contributed to the differences between those who did and did not modify their foods.

CONCLUSION

This study demonstrates a link between two nutritional self-management practices, food avoidance and food modification, and current USDA dietary recommendations thus furthering our understanding of how changes in oral health may relate to declines in dietary quality and nutrient intake. Further research is necessary to build on these findings and provide a more complete picture of how elders adapt to limitations associated with tooth loss and other oral health concerns, particularly in poor communities with fewer resources. Those developing nutrition intervention and health promotion programs for elders should consider including components that focus directly on how participants adapt to oral health problems and increase the ways in which food can be made easier to eat. Lastly, the pleasure of eating is an important component of daily living and learning more about how quality of life changes when eating becomes less enjoyable should also be explored.

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Table 1

Characteristics of rural older adults categorized by the number of foods that are modified and avoided because of the condition of their teeth, mouth, and dentures.

		Modify 0–3 Foods			Modify 4–5 Foods			
Variables	**TOTAL**	**Avoid 0 Foods**	**Avoid 1–2 foods**	**Avoid 3–14 foods**	**Avoid 0 Foods**	**Avoid 1–2 foods**	**Avoid 3–14 foods**	***P*-value**
N* (%)	635	230 (36.2)	127 (20.0)	116 (18.2)	16 (2.5)	39 (6.14)	107 (16.9)	
Age (Mean ± SE)	71.5 (0.4)	71.1 (0.6)	71.4 (1.0)	72.28 (1.0)	67.2 (1.6)	72.6 (1.4)	72.1 (0.9)	.07
Body Mass Index, (Mean ± SE)	29.4 (0.4)	30.0 (0.9)	28.6 (0.7)	28.1 (1.0)	33.2 (1.7)	29.7(1.1)	29.4(0.8)	0.16
Gender [N (%)]								
Women	344 (54.1)	113 (33.8	55 (21.1)	64 (15.0)	9 (2.5)	26 (7.5)	69 (20.1)	.17
Men	291 (45.9)	116 (39.0)	72 (18.8)	52 (22.1)	7 (2.5)	13 (4.5)	38 (13.2)	
Ethnicity [N (%)]								
African American	136 (21.4)	58 (29.9)	30 (22.0)	18 (13.6)	4 (3.0)	9 (6.6)	28 (20.7)	.016
American Indian	195 (30.7)	46 (34.0)	30 (15.4)	37 (19.0)	9 (4.5)	14 (6.9)	48 (24.4)	
White	304 (47.8)	125 (41.2)	67 (22.1)	60 (19.9)	3 (1.0)	16 (5.3)	32 (10.4)	
Income [N (%)]								
Below poverty level	204 (32.1)	46 (22.7)	41 (20.0)	50 (24.7)	5 (2.4)	12 (5.8)	50 (24.5)	.001
Above poverty level	431 (67.9)	184 (42.6)	86 (20.0)	66 (15.2)	11 (2.6)	27 (6.3)	57 (13.3)	
Education [N (%)]								
Less than high school	354 (55.7)	94 (26.5)	58 (16.3)	81 (22.9)	11 (3.2)	31 (8.9)	79 (22.3)	<.001
High school	156 (24.5)	59 (37.9)	44 (28.2)	27 (17.6)	2 (1.3)	4 (2.8)	19 (12.2)	
More than high school	126 (19.8)	77 (61.5)	25 (20.3)	8 (6.1)	3 (2.2)	3 (2.4)	9 (7.5)	
Tooth Loss [N (%)]								
0–10 teeth	327 (51.5)	70 (21.4)	63 (19.3)	99 (30.3)	4 (1.1)	14 (4.4)	77 (23.6)	<.001
11 or more teeth	308 (48.5)	160 (51.9)	64 (20.7)	17 (5.4)	12 (4.1)	25 (8.0)	30 (9.9)	

*Weighted n

Table 2

The relationship of the number of foods modified and foods avoided in response to the condition of teeth, mouth, and dentures to the Healthy Eating Index-2005 total score and the estimated intake of component foods*

Healthy Eating Index-2005 Category	Modifies 0–3 Foods (N=473)			Modifies 4–5 Foods (N=162)			*P*-value*	
	Number of foods avoided			Number of foods avoided				
	None (N=230)	1–2 (N=127)	3–14 (N=116)	None (N=16)	1–2 (N=39)	3–14 (N=107)	Avoid	Modify
	Least Square Mean (SE)							
Total Score (0–100 points)	61.76 (0.98)	62.65 (1.28)	58.78 (1.02)	64.70 (1.01)	65.58 (1.35)	61.72 (0.78)	<.001	<.001
Total Fruit (cup eq/1000 kcal)	056 (0.03)	0.58 (0.04)	0.48 (0.04)	0.62 (0.04)	0.64 (0.04)	0.53 (0.04)	.08	.13
Whole Fruit (cup eq/1000 kcal)	0.36 (0.02)	0.35 (0.02)	0.27 (0.03)	0.40 (0.02)	0.39 (0.03)	0.34 (0.02)	.14	.06
Total Vegetable (cup eq/1000 kcal)	0.88 (0.06)	0.89 (0.06)	0.76 (0.04)	0.89 (0.06)	0.90 (0.06)	0.78 (0.04)	.13	.70
Dark Green and Orange Vegetables and Legumes (cup eq/1000 kcal)	0.47 (0.04)	0.50 (0.05)	0.39 (0.35)	0.50 (0.04)	0.53 (0.05)	0.42 (0.03	.06	.28
Total Grains (oz/1000 kcal)	2.44 (0.11)	2.56 (0.09)	2.41 (0.11)	2.80 (0.15)	2.91 (0.13)	2.77 (0.13)	.34	.005
Whole Grains (oz/1000 kcal)	0.94 (0.07)	1.06 (0.07)	0.89 (0.07)	1.12 (0.11)	1.25 (0.11)	1.80 (0.09)	.07	.05
Milk (cup eq/1000 kcal)	0.49 (0.03)	0.45 (0.05)	0.48 (0.06)	0.42 (0.06)	0.38 (0.06)	0.42 (0.04)	.76	.16
Meat and Beans (oz eq/1000 kcal)	2.39 (0.10)	2.27 (0.08)	2.33 (0.10)	2.32 (0.11)	2.27 (0.12)	2.20 (0.07)	.48	.46
Oils (g eq/1000 kcal)	5.83 (0.39)	5.91 (0.54)	4.62 (0.47)	5.29 (0.46)	5.38 (0.59)	4.09 (0.42)	.03	.20
Saturated Fat (% of kcal)	11.4 (0.2)	10.8 (0.2)	11.3 (0.2)	10.7 (0.3)	10.1 (0.3)	10.6 (0.2)	.04	.0041
Sodium (mg/1000 kcal)	1352 (28.09)	1299 (24.52)	1329 (29.89)	1328 (31.07)	1275 (30.47)	1305 (23.91)	.20	.33
Calories from Solid Fat, Alcohol, and Added Sugar (% of kcal)	28.0 (0.9)	28.5 (0.9)	30.6 (0.9)	25.9(0.9)	26.5 (0.9)	28.6 (0.7)	.01	.03

*P-value for multiple regression. Adjusted for age, gender, marital status, poverty status, and severity of tooth loss.