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Diet Quality of Urban Older Adults Aged 60-99: The Cardiovascular Health of Seniors and Built Environment Study

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Abstract

There are few studies that evaluate dietary intakes and predictors of diet quality in older adults. The objectives of this study were to describe nutrient intakes and examine associations between demographic, economic, behavioral, social environment, and health status factors and diet quality. Cross-sectional data was from Black, White, and Hispanic adults ages 60-99 years, living independently in New York City and participating in the Cardiovascular Health of Seniors and the Built Environment Study, 2009-2011 (n=1306). Multivariable log-linear regression estimated associations between selected factors and good diet quality, defined as a Healthy Eating Index score based on the 2005 Dietary Guidelines for Americans (HEI-2005)>80. Dietary intakes were similar for men and women; intakes of energy, fiber, and the majority of micronutrients were below recommendations, while intakes of fats, added sugar, and sodium were within the upper range or exceeded recommendations. Hispanic ethnicity (Relative Risk, RR=1.37; 95% Confidence Interval, CI, 1.07-1.75), caloric intake <~1500 calories/day (RR=1.93; 95%CI, 1.37-2.71), adherence to a special diet (RR=1.23; 95%CI: 1.02-1.50), purchasing food at supermarkets at least once/week (RR=1.34; 95%CI, 1.04-1.74), and being married/living with a partner (RR=1.37; 95%CI, 1.10-1.71) were positively associated with HEI-2005>80. Consuming

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at least restaurant one meal/day was negatively associated with HEI-2005>80 (RR=0.69; 95%CI, 0.50-0.94). These findings identify specific groups of older adults, such as Blacks or those who live alone, who may benefit from dietary interventions, as well as specific modifiable behaviors among older adults, such as eating restaurant meals or shopping at supermarkets, which may be targeted through interventions.

Keywords

Older adults; dietary quality; nutrient intake; Healthy Eating Index

INTRODUCTION

Dietary quality has been described in various populations of older adults.[1-5] For instance, among older adults (>=60 years) participating in the 1999-2002 National Health and Nutrition Examination Survey (NHANES), the average Healthy Eating Index score (HEI, based on the Dietary Guidelines for Americans) was 66.6, well below the cut-point of 80, which implies “good” diet quality.[3,6] Less than one-third of participants met recommended intakes of fruits or vegetables and only 23% met recommended intakes of dairy foods.[3] Other studies, which examined intakes of micronutrients in older adults, show that many are inadequate or below recommended levels.[7-10]

Nutritional status is important to the health of older adults. Both inadequate and excessive intakes of certain nutrients are associated with increased risk of chronic conditions, such as osteoporosis and cardiovascular-related diseases.[11,12] A social ecological model of factors that influence nutrition and eating behaviors, including individual characteristics, interpersonal relationships, community networks, and public policy factors, has been conceptualized for older adults.[15] For example, self-reported good health and appetite level are positively associated with dietary quality and intakes[1,3,16], whereas chronic health conditions and medications can diminish appetite and sense of small and taste leading to adverse changes in food choices, and the absorption, transportation, and metabolism of nutrients.[17-20] Other factors associated with dietary quality and intakes include food insecurity[21,22], social isolation (defined as living or eating alone), gender, age, race/ethnicity, education, and smoking status.[1-3,5,16]

Few studies have comprehensively described dietary intakes or investigated predictors of diet quality in older adults. The current study provides unique and valuable information by describing the macro- and micronutrient intakes and HEI scores of a large, independently-living population of Black, Hispanic, and White older adults, aged 60-99 years, in the United States (US). Moreover, the associations between many demographic, economic, behavioral, social, and health status factors and diet quality were evaluated. This information is useful for identifying targets for public health interventions aimed at improving the nutritional status of older adults.

METHODS

This is a cross-sectional analysis of data from the Cardiovascular Health of Seniors and the Built Environment Study, a longitudinal observational study designed to examine the relationships among neighborhood environments, dietary intake and physical activity, and the risk of cardiovascular disease. Older adults were enrolled and provided informed consent, January 2009-June 2011 (n=1453). Participants were recruited from New York City community centers located in Brooklyn and Queens (along the Brooklyn/Queens border). Eligible participants spoke English or Spanish and lived in Brooklyn or Queens for at least

one year. All study procedures were approved by the Institutional Review Board at Mount Sinai School of Medicine.

Of the 1453 enrolled participants, 1306 were eligible and included in the current study. Exclusion criteria included: <60 years (n=21); self-reported race/ethnicity other than Black, White, or Hispanic (n=44); or both dietary recalls were missing or implausible, defined as energy intakes <500 or >5000 calories (n=82).

Dietary Assessment

Participants completed two interviewer-administered 24-hour recalls on non-consecutive days using Nutrition Data System for Research (NDSR) 2009 (Nutrition Coordinating Center, University of Minnesota, MN). First recalls were collected in person and second recalls were by telephone; over 95% of recalls were collected within three months of each other. Approximately 63% of participants reported using a dietary supplement. Data on nutrient intakes from dietary sources only were included in analyses. Nutrient intakes from two dietary recalls were averaged when both recalls were completed and had plausible reported energy intakes (n=1071). Nutrient intakes from one recall were used when only one recall was completed and/or had a plausible reported energy intake (n=235).

Healthy Eating Index scores based on the 2005 Dietary Guidelines for Americans (HEI-2005) were generated from the NDSR dietary recall data.[23-26] Methods to calculate HEI scores in NDSR based on the 2010 US Dietary Guidelines are currently not validated; however, scoring components and standards between HEI-2005 and 2010 do not greatly differ.[27] The HEI-2005 is the sum of scores on 12 dietary components: total fruits, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grains, whole grains, milk, meat and beans, oils, saturated fat, sodium, and calories from solid fat, alcohol, and added sugar. The first six components have scores of 0-5 points; the component for calories from solid fat, alcohol, and added sugar has a score of 0-20 points; and the remaining components have scores of 0-10 points. The maximal score is 100 points, with higher scores indicating greater compliance with the US Dietary Guidelines: a score of >80 suggests a “good” diet, 51-80 suggests a diet that “needs improvement”, and <51 suggests a “poor” diet.[6]

Covariates—Data on many demographic, economic, behavioral, social environment, or health status factors that were hypothesized to be related to diet quality were collected from baseline questionnaires. The referent groups are noted for all factors that were included in final statistical models (described in the *Statistical Analysis* section).

Demographic Factors

Age was based on birthdate and categorized as 60-70 (Referent), Factors. 71-80, and 81-99 years; race/ethnicity was categorized as White, Black (Referent), and Hispanic; and highest attained education level was categorized as less than high school (grades 1-8, Referent), high school (grades 9-12 and trade school), and college or higher.

Economic Factors

Food security was measured using the US Department of Agriculture Adult Food Security Survey Module, which assesses the level of food security in the previous year.[28] Food security categories were : 0 points, High Food Security; 1-2 points, Marginal Food Security; 3-5 points, Low Food Security; and 6-10 points, Very Low Food Security (Referent).[29] Income was self-reported as the annual household income from all sources during the previous year and dichotomized at $30,000 (<=$30,000 per year, Referent).

Behavioral Factors

Adherence to a special diet (yes or no, Referent) was defined as Factors. reporting one or more of the following special diets: weight loss; low carbohydrate, high protein, Atkins, low cholesterol, gluten-free, low sodium, diabetic, vegetarian or vegan, or other special diet. Mean energy intake was divided into quartiles: very low (500-966 calories), low (967-1206 calories), moderate (1207-1512 calories), and high (>1512 calories, Referent) caloric intakes. The number of times/week that foods were purchased at supermarkets or small corner stores/bodegas was categorized as <once/week (Referent), once/week, and >once/week. The primary food shopper for the household was identified as self or another person (Referent). The number of meals/day that were prepared/consumed at home, local senior service centers, restaurants, and government delivery programs were categorized as ≥1 meal/day and <1 meal/day (Referent). Other behavioral factors included: cooking as much as the participant would like; evaluation of cooking ability; amount of time spent cooking dinner and cleaning up afterwards; distance travelled to conduct major shopping; and frequency of grocery delivery.

Social Environment Factors

Marital status, married/living with a partner or single (Referent); retirement status, retired or not retired (Referent); and household size (number of people supported by annual income) were examined.

Health Status Factors

Depression was measured as a composite score from the 15-point Geriatric Depression Scale[30] : mild or severe depression (5-15 points) and no depression (0-4 points, Referent). Other measurements of health status included: physician-diagnosed heart disease, hypertension, diabetes, stroke, cancer, osteoporosis, arthritis, food allergies; number of hypertensive medications being taken; and percent body fat >30%. Percent body fat was measured by bioelectrical impedance analysis using the Tanita body composition scale (model TBF-300A, Tanita Corporation, Tokyo, Japan).

Statistical Analysis

Participants' characteristics and dietary intakes were stratified by gender and reported as frequencies when categorical and means and standard deviations when continuous. Dietary intakes were compared to gender-specific Dietary Reference Intakes[31,32] for adults ≥51 years. Dietary Reference Intakes do not provide dietary recommendations for saturated fat, trans fat, cholesterol, and added sugar. In these instances, recommendations from the American Heart Association[33] were used. Recommended energy intakes were based on the 2005 Dietary Guidelines for Americans[26] specific for gender and age (>=61 years) and assuming a sedentary activity level. Differences in mean intakes and recommended levels for gender were tested using a two-tailed *t* test. A p-value of <0.05 was considered statistically significant.

Multivariable log linear models were created using forward stepwise regression to develop a parsimonious model of associations between the selected factors and good diet quality, defined as HEI-2005 score>80.[6] Factors were excluded from the model if they did not explain at least 10% of the variance of HEI-2005. Excluded factors: behavioral factors related to cooking, distance travelled to major shopping, and frequency of grocery deliveries; household size; and health status factors related to chronic health conditions, hypertensive medications, and percent body fat. Only factors included in the final model are presented in the Results section.

RESULTS

Characteristics of the study population (n=1306) are shown in Table 1. The population was predominately female (75.6%), between 60-80 years of age (77.9%), racial/ethnic minorities (45.6% Black and 23.7% Hispanic), and mostly retired (89.5%); less than a quarter was married (21.1%), had attended college (22.2%), or had an annual income of >$30,000 (13.7%). More than half had high food security (53.8%). The majority reported being the primary food shopper (76.7%), shopped at supermarkets at least once a week (64.3%) and most meals were prepared/consumed at home or senior centers. Few differences were observed by gender.

HEI-2005 scores and dietary intakes for women and men are shown in Table 2. The mean HEI-2005 scores were 72.0 (range 32.5-97.5) and 69.4 (range 29.4-95.8) for women and men, respectively; 27.2% of women and 21.7% of men had HEI-2005 scores >80. Daily energy intakes were below recommendations; however, both genders consumed adequate amounts of carbohydrates and protein and were within either the upper range or exceeded recommendations for percent of calories from total fat, saturated fat, and trans fat, and grams of added sugar. Both genders exceeded recommended intakes of sodium but had inadequate intakes of fiber, calcium, magnesium, potassium, zinc, folate, and vitamins A, B6, C, D, and E. Women also had thiamin intakes slightly lower than recommendations.

The associations between HEI-2005>80 and selected factors are presented in Table 3. Compared to Blacks, Hispanics were 37% more likely to have HEI-2005 score >80 (Relative risk, RR, 1.37; 95% Confidence Interval, CI: 1.07, 1.75). Lower caloric intake and adherence to a special diet were associated with good diet quality (RR, 1.23; 95% CI: 1.02, 1.50). Greater frequency of purchasing food at supermarkets was positively associated with diet quality (once/week: RR, 1.34; 95% CI: 1.04-1.74 and >once/week: RR, 1.36; 95% CI: 1.05-1.78), whereas a negative association was observed consuming at least one meal/day from a restaurant (RR, 0.69; 95% CI, 0.50-0.94). Being married/living with a partner was positively associated with HEI-2005 score >80 (RR, 1.37; 95% CI: 1.10, 1.71).

DISCUSSION

This study assessed dietary intakes and estimated the associations between demographic, economic, behavioral, social environment, and health status factors and dietary quality in a multi-ethnic, urban population of independently living older adults, aged 60-99 years. Dietary intakes were similar for both genders; intakes of calories, fiber, and many micronutrients were below recommendations, while intakes of fats, added sugar, and sodium were within the upper range or exceeded recommendations. Hispanic ethnicity, adhering to a special diet, purchasing food at a supermarket at least once/week, eating less than one meal/day at a restaurant, having a daily intake of less than ~1500 calories, and being married/living with a partner were independently associated with diet quality.

Nutrient intakes

Mean energy intakes for men and women were below recommended levels and lower than those reported for independently living older adults participating in NHANES.[34,35] Some of the discrepancy in energy intakes between studies may be due to differences in characteristics of the study populations. For example, income and age are inversely associated with energy intakes.[16,34] Participants in the current study tended to be older and have low household incomes, which may have contributed to their lower average energy intakes. The observed low energy intakes may also be due to under-reporting, which is common among women and adults who are older, overweight, or less educated.[36,37] In one study of community-dwelling older adults, ages 66-87 years, approximately 25% were

classified as energy intake under-reporters; however, derived dietary patterns were not significantly different between analyses that included and excluded under-reporters.[37]

Despite low energy intakes, the overall pattern of macro- and micronutrient intakes was similar to those previously described for independently living older adults.[3,7-10] The observed high intakes of fats and added sugars are problematic. High intakes of fats and added sugar are associated with obesity and diabetes.[38] In the US, approximately 35% of older adults (ages >=65 years) are obese [39] and 27% have diabetes.[40] Similarly, high sodium intakes are associated with age-related adverse health outcomes, including hypertension, stroke, left ventricular hypertrophy, and proteinuric kidney disease.[12] Several studies support reductions in dietary salt intakes to lower blood pressure and prevent deaths related to stroke and cardiovascular disease, especially among older adults.[12]

Low intakes of micronutrients are also of concern. For example, calcium and vitamin D are critical for maintaining musculoskeletal health and preventing falls, as well as injuries resulting from falls.[11] Additionally, vitamins C and E can act as antioxidants and reduce damage from age-related oxidative stress, which is a risk factor for endothelial dysfunction, poor vascular health, and consequent cardiovascular disease.[41] Although more than half of our study population reported taking dietary supplements, which is consistent with estimates from other studies,[42,43] supplement use does not necessarily result in achievement of adequate intakes.[44]

Factors Associated with Dietary Quality

Race/ethnicity was the demographic factor most strongly associated with diet quality. These findings are consistent with those using NHANES data for older adults (>=60 years). In an analysis of NHANES 1999-2002, Mexican-Americans had significantly higher HEI scores compared to Blacks.[3] Similarly, among participants in NHANES 2003-2004, Hispanics tended to have higher HEI component scores of total vegetables and dark green/orange vegetables and legumes compared to Black and whites.[2]

Among the selected behavioral factors, following a special diet, consuming less than ~1500 calories per day, purchasing food at supermarkets, and eating restaurant meals were associated with diet quality. Many types of special diets were considered, including those for weight loss or the treatment of medical conditions, such as diabetes or hypertension. It may be that these individuals receive dietary advice from a health professional and are knowledgeable of food and beverage choices and motivated to consume healthy diets. Consistent with this finding, participants with mean energy intakes of less than ~1500 calories were approximately twice as likely to have good quality diets compared to those with higher energy intakes. Previous studies suggest that older adults with nutrient-dense diets tend to have lower energy intakes.[8,43,45] For example, in a rural US cohort of older adults (ages 66-87 years), participants with a high nutrient-dense dietary pattern had lower energy intakes, higher intakes of fiber, iron, zinc, folate, and vitamins B6, B12, and D, and higher HEI scores compared to participants with a low nutrient-dense dietary pattern.[43] Similarly, among older adults (>65 years) in Spain, those with low energy density diets were more likely to meet recommendations for dietary fats, fiber, and vitamins and minerals compared to those with high energy density diets.[45]

Sources of foods and meals also influenced diet quality. Supermarkets often offer a wider variety of food items, including healthier food items, and lower prices compared to smaller food stores.[46,47] Though there is limited evidence in older populations, eating food purchased in supermarkets is associated with healthier diets in younger populations.[48,49] Conversely, restaurant meals tend to be large in portion size and high in calories, fat, and sodium.[50,51]

Finally, marital status was the measure of the social environment most strongly associated with diet quality. Living with a partner is consistently reported as a predictor of adequate nutrition status among older adults,[15] especially among men.[52] Due to traditional gender roles, men who live alone may have difficulty purchasing foods and preparing meals,[52] whereas women may be less likely to cook or prepare meals for themselves when they are alone.[15] Other research in older adults shows that the number of people present during a meal is positively associated with food consumption[53] and that men and women who report eating weekday meals "on lap or on the go" have lower diet quality and lower protein and iron intakes compared to those who eat at a table.[1]

These results should be interpreted with respect to the study's limitations. This is a cross-sectional analysis of predictors of dietary quality and cannot infer causality. The study population was composed of mostly healthy, independently living older adults living in an urban environment and may not be generalizable to other populations of older adults. Lastly, dietary data was based on a maximum of two 24-hour dietary recalls and may not be representative of overall dietary intakes.

CONCLUSIONS

Adequate nutrient intakes and optimal nutrition status are critical for the health and welfare of older adults. Considering that the world's population of older adults is steadily increasing[54], there is a need to evaluate their diets and identify factors associated with dietary intakes and quality. In the current study, the majority of older adults living in urban communities had HEI-2005 scores that fell below the desired cut-point of 80 and many dietary intakes did not meet recommendations. Hispanic ethnicity, following a special diet, purchasing food at supermarkets at least once a week, eating less than one meal per day at a restaurant, being married/living with a partner, and having a daily intake of ~1500 calories were independently associated with diet quality. These findings are valuable from both clinical and research perspectives: They identify at-risk groups of older adults, such as Blacks or those who live alone, who may benefit from individual counseling or dietary interventions. They also identify specific modifiable behaviors among older adults, such as eating restaurant meals or shopping at supermarkets, which may be targeted through counseling or interventions. Future research is needed to confirm these results and determine how these factors can be targeted or altered to assist older adults in achieving adequate dietary intakes.

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References

1. Holmes BA, Roberts CL. Diet quality and the influence of social and physical factors on food consumption and nutrient intake in materially deprived older people. Eur J Clin Nutr. 2011; 65:538–545. [PubMed: 21266981]
2. Hiza HA, Casavale KO, Guenther PM, Davis CA. Diet quality of Americans differs by age, sex, race/ethnicity, income, and education level. J Acad Nutr Diet. 2013; 113(2):297–306. [PubMed: 23168270]
3. Ervin RB. Healthy eating index scores among adults, 60 years of age and over, by sociodemographic and health characteristics: United States, 1999-2002. Adv Data. 2008; 20(395): 1–16. [PubMed: 18646580]
4. Tangney CC, Evans DA, Bienias JL, Morris MC. Healthy eating index of black and white older adults. Nutr Res. 2001; 21:1411–1423.

5. Hsiao PY, Mitchell DC, Coffman DL, et al. Dietary patterns and diet quality among diverse older adults: The University of Alabama at Birmingham Study of Aging. J Nutr Health Aging. 2013; 17(1):19–25. [PubMed: 23299373]
6. Basiotis, PP.; Carlson, A.; Gerrior, SA.; Juan, WY.; Lino, M. The healthy eating index: 1999-2000. US Department of Agriculture, Center for Nutrition Policy and Promotion; 2002. CNPP-12
7. King DE, Mainous AG, Lambourne CA. Trends in dietary fiber intake in the United States. J Acad Nutr Diet. 2012; 112:641–648.
8. Roberts SB, Hajduk CL, Howarth NC, Russell R, McCrory MA. Dietary variety predicts low body mass index and inadequate macronutrient and micronutrient intakes in community-dwelling older adults. J Gerontol A Biol Sci Med Sci. 2005; 60(5):613–621. [PubMed: 15972614]
9. Zheng JJ, Rosenberg IH. What is the nutritional status of the elderly? Geriatrics. 1989; 44(6):57–64. [PubMed: 2721969]
10. Ryan AS, Craig LD, Finn SC. Nutrient intakes and dietary patterns of older americans: A national study. J Gerontol. 1992; 47(5):M145–M150. [PubMed: 1512429]
11. Murad MH, Elamin KB, Abu Elnour NO, et al. Clinical review: The effect of vitamin D on falls: A systematic review and meta-analysis. J Clin Endocrinol Metab. 2011; 96(10):2997–3006. [PubMed: 21795448]
12. Frisoli TM, Schmieder RE, Grodzicki T, Messerli FH. Salt and hypertension: Is salt dietary reduction worth the effort? Am J Med. 2012; 125(5):433–439. [PubMed: 22482843]
13. Kaiser MJ, Bauer JM, Rämsch C, et al. Frequency of malnutrition in older adults: A multinational perspective using the mini nutritional assessment. J Am Geriatr Soc. 2010; 58(9):1734–1738. [PubMed: 20863332]
14. Volkert D. Malnutrition in older adults - urgent need for action: A plea for improving the nutritional situation of older adults. Gerontology. 2013 Epub ahead of print.
15. Locher, JL.; Sharkey, JS. An ecological model for understanding eating behavior in older adults. In: Bales, CW.; Ritchie, CS., editors. Handbook of clinical nutrition and aging. 2. Vol. 1. Totowa, NJ: Humana Press; 2009. p. 3-17.
16. Shahar D, Shai I, Vardi H, Fraser D. Dietary intake and eating patterns of elderly people in Israel: Who is a nutritional risk? Eur J Clin Nutr. 2003; 57:18–25. [PubMed: 12548292]
17. Drewnowski A, Shultz JM. Impact of aging on eating behaviors, food choices, nutrition and health status. J Nutr Health Aging. 2001; 5:75–79. [PubMed: 11426286]
18. Murphy C. Nutrition and chemosensory perception in the elderly. Crit Rev Food Sci Nutr. 1993; 22:3–15. [PubMed: 8424852]
19. Clarke DM, Wahlqvist ML, Strauss BJG. Undereating and undernutrition in old age: Integrating bio-psychosocial aspects. Age Ageing. 1998; 27:527–538. [PubMed: 9884014]
20. Henkin RI. Drug-inducted taste and smell disorders. Drug Safety. 1994; 11:318–377. [PubMed: 7873092]
21. Hall B, Brown L. Food security among older adults in the United States. Topics Clin Nutr. 2005; 20(4):329–338.
22. Lee JS, Frongillo EA. Nutritional and health consequences area associated with food insecurity among US elderly persons. J Nutr. 2001; 131(5):1503–1509. [PubMed: 11340107]
23. Miller P, Mitchell D, Harala P, Pettit J, Smiciklas-Wright H, Hartman T. Development and evaluation of a method for calculating the health eating index-2005 using the nutrition data system for research. Public Health Nutr. 2011; 14(2):306–313. [PubMed: 20576195]
24. Guenther P, Reedy J, Krebs-Smith J. Development of the healthy eating index-2005. J Am Diet Assoc. 2008; 108:1896–1901. [PubMed: 18954580]
25. Reedy J, Krebs-Smith S, Bosire C. Evaluating the food environment: Application of the healthy eating index-2005. Am J Prev Med. 2010; 38:465–471. [PubMed: 20171823]
26. Dietary guidelines for Americans, 2005. 6. Washington, DC: U.S. Government Printing Office; Jan. 2005 U.S. Department of Health and Human Services and U.S. Department of Agriculture.
27. Guenther PM, Casavale KO, Reedy J, et al. Update of the healthy eating index: HEI-2010. J Acad Nutr Diet. 2013; 113(4):569–580. [PubMed: 23415502]

28. Bickel, G.; Nord, M.; Price, C.; Hamilton, W.; Cook, J. Guide to measuring household food security, revised 2000. U.S. Department of Agriculture, Food and Nutrition Service; Alexandria VA: 2000 Mar.
29. USDA Guide. [March, 2013] Food security in the US. 2006. http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/measurement.aspx#.UUIlhBfqnzg. Updated 2012
30. Yesavage JA, Brink TL, Rose TL, et al. Development and validation of geriatric depression screening scale: A preliminary report. J Psych Res. 1982; 17(1):37–49.
31. Otten, JJ.; Hellwig, JP.; Meyers, LD., editors. National Research Council Dietary reference intakes: The essential guide to nutrient requirements. Washington, DC: The National Academies Press; 2006.
32. Ross, AC.; Taylor, CL.; Yaktine, AL.; Del Valle, HB., editors. Dietary reference intakes for calcium and vitamin D. Washington, DC: The National Academies of Medicine; 2011.
33. Gidding SS, Lichtenstein AH, Faith MS, et al. Implementing American Heart Association pediatric and adult nutrition guidelines: A scientific statement from the American Heart Association nutrition committee of the council of nutrition, physical activity, and metabolism, council on cardiovascular disease in the young, council on cardiovascular nursing, council on epidemiology and prevention, and council for high blood pressure research. Circulation. 2009; 119:1161–1175. [PubMed: 19255356]
34. Cole, N.; Fox, MK., editors. Nutrition and health characteristics of low income populations: Volume IV, older adults. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service; 2004. E-FAN-04-014-4
35. Wright JD, Wang CY, Kennedy-Stephenson J, Ervin RB. Dietary intake of ten key nutrients for public health, United States: 1999-2000. Adv Data. 2003; 17(334):1–4. [PubMed: 12743879]
36. Briefel RR, Sempos CT, McDowell MA, Chien S, Alaimo K. Dietary methods research in the third national health and nutrition examination survey: Underreporting of energy intake. Am J Clin Nutr. 1997; 65(4):1203S–1209S. [PubMed: 9094923]
37. Bailey RL, Mitchell DC, Miller C, Smiciklas-Wright H. Assessing the effect of underreporting energy intake on dietary patterns and weight status. J Am Diet Assoc. 2007; 107(1):64–71. [PubMed: 17197273]
38. Astrup A. The role of dietary fat in obesity. Semin Vasc Med. 2005; 5(1):40–47. [PubMed: 15968579]
39. Fakhouri TH, Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity among older adults in the United States, 2007-2010. NCHS Data Brief. 2012; 106:1–8. [PubMed: 23102091]
40. American Diabetes Association. [March, 2013] Diabetes statistics. http://www.diabetes.org/diabetes-basics/diabetes-statistics/?loc=DropDownDB-stats. Updated 2013
41. Wray DW, Nishiyama SK, Harris RA, et al. Acute reversal of endothelial dysfunction in the elderly after antioxidant consumption. Hypertension. 2012; 59(4):818–824. [PubMed: 22353612]
42. Briefel RR, Johnson CL. Secular trends in dietary intake in the United States. Annu Rev Nutr. 2004; 24:401–431. [PubMed: 15189126]
43. Ledikwe JH, Wright HS, Mitchell DC, Miller CK, Jensen GL. Dietary patterns of rural older adults are associated with weight and nutrition status. J Am Geriatr Soc. 2004; 52:589–595. [PubMed: 15066076]
44. Ervin RB, Kennedy-Stephenson J. Mineral intakes of elderly adult supplement and non-supplement users in the third national health and nutrition examination survey. J Nutr. 2002; 132(11):3422–3427. [PubMed: 12421862]
45. Schroder H, Vila J, Marrugat J, Covas MI. Low energy density diets are associated with favorable nutrient intake profile and adequacy in free-living elderly men and women. J Nutr. 2008; 138:1476–1481. [PubMed: 18641194]
46. Azuma AM, Gilliland S, Vallianatos M, Gottlieb R. Food access, availability, and affordability in 3 Los Angeles communities, project CAFE, 2004-2006. Prev Chronic Dis. 2010; 7(2):A27. [PubMed: 20158956]
47. Lee RE, Heinrich KM, Medina AV, et al. A picture of the healthful food environment in two diverse urban cities. Environ Health Insights. 2010; 4:49–60. [PubMed: 20706621]

48. Moore LV, Diez Roux AVD, Nettleton JA, Jacobs DR. Associations of the local food environment with diet quality – A comparison of assessments based on surveys and geographic information systems: The multi-ethnic study of atherosclerosis. Am J Epidemiol. 2008; 167:917–924. [PubMed: 18304960]

49. Moore LV, Diez Roux AV. Associations of neighborhood characteristics with the location and type of food stores. Am J Public Health. 2006; 96(2):325–331. [PubMed: 16380567]

50. Scourboutakos MJ, L'Abbé MR. Restaurant menus: Calories, caloric density, and serving size. Am J Prev Med. 2012; 43(3):249–255. [PubMed: 22898117]

51. Wu HW, Sturm R. What's on the menu? A review of the energy and nutritional content of US chain restaurant menus. Public Health Nutr. 2013; 16(1):87–96. [PubMed: 22575557]

52. Davis MA, Randall E, Forthofer RN, Lee ES, Margen S. Living arrangements and dietary patterns of older adults in the United States. J Gerontol. 1985; 40(4):434–442. [PubMed: 4008878]

53. De Castro JM. Age-related changes in the social, psychological, and temporal influences on food intake in free-living, healthy, adult humans. J Gerontol A Biol Sci Med Sci. 2002; 57(6):M368–M377. [PubMed: 12023266]

54. World Health Organization. [March, 2013] Ageing. http://www.who.int/topics/ageing/en/. Updated 2013

J Acad Nutr Diet. Author manuscript; available in PMC 2015 February 01.

Table 1

Characteristics of older adults participating in the Cardiovascular Health of Seniors and Built Environment Study (n=1,30)

	Total		Women (n=988)		Men (n=318)	
	n	%	n	%	n	%
DEMOGRAPHIC FACTORS						
Age in years						
60-70	516	39.5	375	38.0	141	44.3
71-80	501	38.4	377	38.2	124	39.0
81-99	289	22.1	236	23.9	53	16.7
Race/Ethnicity						
Black	595	45.6	478	48.4	117	36.8
Hispanic	310	23.7	229	23.2	81	25.5
White	401	30.7	281	28.4	120	37.7
Highest grade attended						
Less than high school (1-8 years)	361	27.6	264	26.7	97	30.5
High school (9-12 years)	622	47.6	436	44.1	113	35.5
College or greater	290	22.2	218	22.1	72	22.6
ECONOMIC FACTORS						
Food security						
Secure						
High food security	703	53.8	541	54.8	162	50.9
Marginal food security	378	28.9	294	29.8	84	26.4
Insecure						
Low food security	92	7.0	62	6.3	30	9.4
Very low food security	103	7.9	65	6.6	38	12.0
Annual income ($)						
20,000 or less	733	56.1	566	57.3	177	55.7
20,001 - 30,000	48	3.7	95	9.6	38	12.0
30,001 - 40,000	73	5.6	47	4.8	26	8.2
40,001 or greater	106	8.1	72	7.3	34	10.7
BEHAVIORAL FACTORS						

	Total		Women (n=988)		Men (n=318)	
	n	%	n	%	n	%
Special diet	480	36.8	376	38.1	104	32.7
Frequency of purchases by store type						
Supermarket						
More than once a week	381	29.2	272	27.5	109	34.3
Once a week	458	35.1	349	35.3	109	34.3
Less than once a week	435	33.3	339	34.3	96	30.2
Bodega/Small corner market						
More than once a week	214	16.4	149	15.1	65	20.4
Once a week	242	18.5	179	18.1	63	19.8
Less than once a week	801	61.3	618	62.6	183	57.6
Self as primary food shopper	1002	76.7	781	79.1	221	70.0
Location eaten/prepared (≥ 1meals per day)						
Home	1096	83.9	843	85.3	253	79.6
Restaurants	243	18.6	172	17.4	71	22.3
Local senior services	894	68.5	660	66.8	234	73.6
Delivered by government program	60	4.6	5	0.5	19	6.0
SOCIAL ENVIRONMENT						
Married or living with a partner	289	22.1	168	16.2	121	38.1
Retired	1169	89.5	855	86.5	284	89.3
HEALTH STATUS FACTORS						
Mild or severe depression	201	15.4	157	15.9	44	13.8

Table 2

Comparisons of mean (± standard deviation, SD) daily intakes of selected nutrients to dietary recommendations for women and men participating in the Cardiovascular Health of Seniors and Built Environment Study (n=1306)

		Women (n=988)	Men (n=318)
	Dietary recommendations for women/men	Mean ± SD	Mean ± SD
HEI	>=80	72.0 ± 11.9[c]	69.0 ± 12.1[c]
Total calories (kilocalories)	1600/2000	1205.0 ± 413.9[c]	1443.8 ± 524.6[c]
Percent calories from fat	<=30%	29.0 ± 7.4[c]	29.2 ± 7.5[a]
Percent calories from saturated fat	<10%	9.7 ± 3.4[b]	10.1 ± 3.4
Percent calories from trans fat	<1%	1.4 ± 0.9[c]	1.3 ± 0.7[c]
Cholesterol (milligrams, mg)	<=300	185.7 ± 121.2[c]	244.3 ± 171.9[c]
Total carbohydrates (grams, g)	130	160.4 ± 57.2[c]	187.3 ± 72.6[c]
Added sugar (g)[a]	25/38	38.7 ± 30.6[c]	45.0 ± 41.8[b]
Total dietary fiber (g)	21/30	13.3 ± 6.6[c]	14.8 ± 7.6[c]
Total protein (g)	46/56	53.8 ± 18.8[c]	66.1 ± 25.4[c]
MINERALS			
Calcium (mg)	1200/1000	564.7 ± 293.2[c]	683.3 ± 357.4[c]
Iron (mg)	8	9.9 ± 5.1[c]	12.2 ± 6.4[c]
Magnesium (mg)	320/420	198.8 ± 78.3[c]	226.0 ± 88.9[c]
Potassium (mg)	4700	1895.6 ± 694.7[c]	2205.1 ± 892.4[c]
Sodium (mg)	1500	1818.7 ± 778.6[c]	2308.9 ± 1045.2[c]
Zinc (mg)	8/11	7.0 ± 3.7[c]	8.9 ± 4.6[c]
VITAMINS			
Folate (micrograms, ug)	400	265.1 ± 148.1[c]	319.8 ± 163.7[c]
Niacin (mg)	14/16	15.1 ± 6.4[c]	18.3 ± 8.1[c]
Riboflavin (mg)	1.1/1.3	1.5 ± 0.7[c]	1.7 ± 0.8[c]
Thiamin (mg)	1.1/1.2	1.0 ± 0.5[c]	1.3 ± 0.6[a]
Vitamin A (Retinol Activity Equivalents)	700/900	637.6 ± 756.7[b]	721.8 ± 751.9[c]
Vitamin B6 (mg)	1.7	1.3 ± 0.7[c]	1.6 ± 0.8[b]
Vitamin B12 (ug)	2.4	3.6 ± 4.7[c]	4.5 ± 5.1[c]
Vitamin C (mg)	75/90	71.0 ± 51.2[b]	80.4 ± 65.1[b]
Vitamin D (International Units)	600	150.6 ± 122.7[c]	208.1 ± 242.8[c]
Vitamin E (mg)	15	7.1 ± 6.4[c]	8.0 ± 7.2[c]

[a] p<0.05;

[b] p<0.01;

[c] p<0.001

[d] Grams of added sugar was based on the American Heart Association recommendation of <=100 kcal for women (100 kcal/4 = 25 grams) and <=150 kcal for men (150 kcal/4 = 38 grams)

Table 3

Associations between demographic, economic, behavioral, social environment, and health status factors and Heathly Eating Index-2005 score >80 among older adults participating in the Cardiovascular Health of Seniors and Built Environment Study (n=1030)[a]

	Risk Ratio	95% Confidence Interval
DEMOGRAPHIC FACTORS		
Age		
71-80 years	1.03	(0.81, 1.31)
81-99 years	1.11	(0.84, 1.46)
Female	1.18	(0.91, 1.52)
Race/Ethnicity		
White	1.29	(0.98, 1.71)
Hispanic	1.37	(1.07, 1.75)[b]
Highest grade attended		
High school	0.78	(0.60, 1.01)
College or greater	1.04	(0.77, 1.39)
ECONOMIC FACTORS		
Annual income > $30,000	1.20	(0.93, 1.55)
Food security		
High food security	1.34	(0.81, 2.21)
Marginal food security	1.33	(0.80, 2.21)
Low food security	0.90	(0.44, 1.83)
BEHAVIORAL FACTORS		
Mean calories		
Very low (500-966 calories)	1.93	(1.36, 2.74)[d]
Low (967-1206 calories)	2.18	(1.56, 3.06)[d]
Moderate (1207-1512 calories)	1.93	(1.37, 2.71) [d]
Adherence to special diet(s)	1.23	(1.02, 1.50)[b]
Purchase food at supermarket		
Once a week	1.34	(1.04, 1.74) [b]
More than once a week	1.36	(1.05, 1.78) [b]
Purchase food at bodega		
Once a week	1.07	(0.84, 1.36)
More than once a week	0.89	(0.65, 1.22)
Self as primary food shopper	1.15	(0.89, 1.50)
Location of meal preparation		
Home	0.93	(0.68, 1.28)
Community program	1.23	(0.98, 1.54)
Restaurants or other	0.69	(0.50, 0.94) [b]
Government program (delivered)	0.96	(0.56, 1.66)
SOCIAL ENVIRONMENT		

	Risk Ratio	95% Confidence Interval
Married or living with partner	1.37	(1.10, 1.71)[c]
Retired	0.83	(0.59, 1.16)
HEALTH STATUS FACTORS		
Mild or severe depression	0.83	(0.61, 1.12)

[a] Additional co-viariates entered into stepwise regression that did not meet criteria for final adjusted model: Behavioral Factors included time spent cooking dinner, cooking abilities, cooks as much as would like, frequency groceries delivered, distance of primary food store from home; Social Environment variables included the number of people supported by household income; and Health Status Factors included self-reported, doctor diagnosed hypertension, diabetes, stroke, osteoporosis, arthritis, cancer, and number of hypertensive medications.

[b] $p<0.05$;

[c] $p<0.01$;

[d] $p<0.001$