Published in final edited form as:

J Nutr Health Aging. 2017 ; 21(10): 1190–1199. doi:10.1007/s12603-016-0834-7.

Racial Differences in Eating Patterns and Food Purchasing Behaviors among Urban Older Women

Wenjun Li, PhD^{1, #}, Gretchen Youssef, MS, RD, CDE², Elizabeth Procter-Gray, PhD, MPH¹, Barbara Olendzki, RD, MPH¹, Tasha Cornish, MPH², Rashelle Hayes, PhD¹, Linda Churchill, MS¹, Kevin Kane, MS¹, Kristen Brown, BS², and Michelle F Magee, MD²

¹Division of Preventive and Behavioral Medicine, University of Massachusetts Medical School, Worcester, MA 01655

²MedStar Diabetes Research and Innovation Institute, Washington, DC 20010

Abstract

Objectives—To examine differences in diet and food purchasing behaviors between Black and White older women living in urban neighborhoods.

Design—Cross-sectional observational study.

Setting—Urban neighborhoods in Washington, DC, USA.

Participants—Community-dwelling White and Black women of age 65 and older.

Measurements—Participants were queried on diet via 24-hour recalls, food purchasing habits, their use of neighborhood resources and local travel patterns. Frequency and location of self-reported food purchasing and consumption were compared by race.

Results—In 2014 and 2015, 49 White and 44 Black older women were enrolled in the study. Compared to Whites, Blacks reported lower daily caloric intake (mean (SD) 1314 (404) vs. 1529 (448), $p=0.02$), with a higher percent of calories from protein and fat 1.8 (7.0), $p=0.03$, and a slightly higher polyunsaturated to saturated fat ratio ($p=0.05$). Blacks had substantially lower healthy eating index (HEI) (33.5 (10.2) vs. 43.9 (10.8) of 80 possible points, $p<0.001$), daily intake (grams) of total fiber (15.3 (8.1) vs. 22.9 (8.5), $p<0.001$), insoluble fiber (10.8 (6.9) vs. 15.9 (6.5), $p<0.001$), and soluble fiber (4.5 (2.0) vs. 6.9 (2.8), $p<0.001$). Blacks had lower intake of

[#]Corresponding author: Wenjun Li, PhD, Health Statistics and Geography Lab, Division of Preventive and Behavioral Medicine, Department of Medicine, University of Massachusetts Medical School S4-314, 55 Lake Avenue North, Worcester, MA 01655, Phone: 774-455-4215 Fax: 508-856-4543, Wenjun.Li@umassmed.edu.

No conflict of interest declared.

Conflict of interest

None.

Contribution/authorship statement

Li and Magee conceived the study and obtained the funding. Youssef managed financials, IRB application, recruitment, measurements and data collection in the field. Hayes and Churchill carried out the key informant interviews and focus groups to generate ethnographic data that are needed for the design of food purchasing and neighborhood perception questionnaires. Li, Churchill, Olendzki, Hayes and Kane designed the food purchasing and neighborhood perception questionnaires. Olendzki managed the 24HR dietary recall data collection and interpreted dietary intake data. Cornish and Brown recruited participants and completed measurement and data collection of the participants. Kane was responsible for database management. Li and Procter-Gray conducted the statistical analysis and drafted the manuscript. All authors contributed to the revision, read and approved the manuscript.

micronutrients, alcohol and caffeine. Blacks shopped for groceries less often (4.4 (3.0) vs. 6.2 (3.0) monthly; $p=0.006$) and spent a longer time traveling to stores (15.8 (9.1) vs. 11.5 (7.2) minutes per trip, $p=0.02$). A lower percent of Blacks walked to stores (14% vs. 40%, $p=0.003$) and a higher percent of Blacks rode in a car with someone else (33% vs. 6%, $p<0.001$).

Conclusions—In an urban setting, food consumption and purchasing behaviors differed substantially between older Black and White women, which should be further investigated and considered to promote healthy eating in older populations.

Keywords

race; eating pattern; food purchasing; healthy eating; aging

INTRODUCTION

A healthy diet is a critical and cost-effective way to prevent and treat obesity and its comorbidities,^{1–4} improve quality of life and preserve independent living among older adults.^{5,6} Calorically-balanced eating patterns are essential for healthy aging.⁷ Such healthy eating patterns are typically low in saturated fat, sugar and sodium, and include fruits and vegetables, whole grains, low-fat dairy or fortified alternative products, lean proteins and beneficial oils. However, older Americans increasingly have a poor diet.^{8,9} Compared to older White women, older Black women carry a disproportionately higher burden of cardiometabolic diseases¹⁰ and related risk factors.^{11,12} To formulate effective interventions, a thorough understanding of the racial differences in determinants of dietary behaviors is fundamental.

Many personal and environmental determinants of dietary behaviors of older adults have been documented in the literature. For example, unhealthy nutritional intake has been associated with a number of personal factors, including lower income, less education, depression, social isolation, widowhood, and poor dentition.¹³ Studies have shown that large supermarkets with a greater variety of healthy foods are more likely to be located in wealthier neighborhoods,¹⁴ suggesting that observed sociodemographic and racial disparities in eating patterns may be attributable to disparities in access to stores with healthy foods. Although access to healthy foods is likely one of the most influential environmental factors impacting healthy eating, the determinants and consequences of disparities in access remain poorly understood. New data are needed to better understand the joint influences of older adults' personal characteristics and their perceived and actual urban neighborhood environment, on their eating patterns and food purchasing behavior. How these influences may vary by an individual's characteristics, such as race/ethnicity, sex, and socioeconomic status may then be examined.

As a step toward this understanding, we performed systematic inquiries of neighborhood environmental influences on healthy eating and active living in older women. We examined the Black to White racial differences in eating patterns and food purchasing behaviors among these women residing in urban neighborhoods in Washington, DC. The implications of such racial differences are meaningful to health promotion in older women.

METHODS

Study settings and participant recruitment

We recruited 49 White, 44 Black/African American community-dwelling women and 4 women with undisclosed race, aged 65 years and older, living in the Washington, DC Metro area. Because significant differences in food purchasing and consumption behaviors are expected among different age groups, this study focused on older women. Participants were recruited from venues with which MedStar Health Research Institute has established hospital-community relationships. To increase the diversity and representativeness of the study sample, an “area-based” strategy was used for recruitment. We recruited 1) Black women in Black-predominant neighborhoods (BPN) from the Recreation and Senior Centers, places of worship and senior housing complexes; 2) White women in BPN using neighborhood listserves, local universities, hospitals, medical practices, and clinics; 3) Black women in White-predominant neighborhoods (WPN) in Black sororities and professional groups, e.g. Black Nurses Association; 4) White women in WPN in senior groups and residences, places of worship and clinical practices. Potential recruitment sites were approached to offer study participation to their members/residents. Promotional materials, interest surveys and brief presentations were offered at each venue and tailored to meet site preferences.

To be eligible for the study, participants had to be self-identified as Black or White, aged 65 or older, English speaking, ambulatory with or without assistive devices, willing and able to perform all study-related activities independently or with a designated caregiver, and pass cognitive function screening on the Short Portable Mental Status Questionnaire (SPMSQ)¹⁵ with 3 or fewer errors. Four women who expressed strong interest but were not willing to classify themselves as White or Black at the time of assessment were also included in the study.

Once consented, each participant was offered a choice of method of participation via: small groups; one-on-one site visits with a study team member; by mail; or by telephone to facilitate individual participant preferences and needs. Surveys completed at home were returned by mail using a study-provided pre-paid envelope. Each participant completed two batteries of survey instruments, which took about 2–3 hours. The first battery included surveys of demographics, health and health care, lifestyle factors, anxiety, lower extremity problems, and fall history and efficacy. The second battery included instruments on self-report physical activity, general nutrition, and the food purchasing habits, activity time and place, the neighborhood perception, and depression. In the week following the completion of the first battery, participants wore an accelerometer and GPS device for 7 days and completed dietary intake measures including 3 concurrent days of 24- hour recalls of dietary intake. Details about the instruments are described below.

The study protocol was approved by the MedStar Health Institute Review Board (Dock # 2014-261).

Survey of personal characteristics

Each participant was queried about her sociodemographic characteristics, physical and mental health conditions, history of falls and fall injuries, health care utilizations in the past year, and lifestyle habits itemized in Table 1. Assessment of most characteristics was by self-report, e.g., “Have you ever been diagnosed or treated by a doctor for any of the following conditions...?” However, the following standardized instruments were also administered: the Tinetti Falls Efficacy Scale for fear of falling,¹⁶ Beck Anxiety Inventory,¹⁷ CES-D Depression Scale,¹⁸ and the 10-item Short Portable Mental Status Questionnaire (SPMSQ) for cognitive impairment,¹⁵ Activities of Daily Living (ADL) for physical limitations, and the Community Healthy Activities Model Program for Seniors (CHAMPS) survey of frequency of exercise activities, both recreational and functional.^{19,20} Physical activity was also measured objectively by an accelerometer (ActiGraph GT3X-Plus) worn by each participant during all waking hours for 7 consecutive days in the week following the completion of the first battery of questionnaires. A daily mean number of steps was then calculated for each person, dropping any days in which less than 10 steps were recorded (an indication that the accelerometer was not worn).

Measurement of dietary intake and eating patterns

Dietary outcomes of interest were focused on averaged total daily caloric intake and dietary quality, including consumption of fruits and vegetables, fast food and processed food, averaged daily intake of total protein, fat (saturated, poly- and monounsaturated fats), fiber, types of carbohydrate(s), and micronutrients (such as sodium and calcium). Each participant received three unannounced computer-assisted 24-hour dietary recalls (24HRs), conducted on randomly selected days within a 1-week period (two weekdays and one weekend). To reflect the marketplace throughout the study, the 24HR-derived data (i.e., timing of intake, location, food preparation methods, total calories, macro- and micro-nutrients, and dietary supplements) were analyzed using the University of Minnesota’s Nutrition Coordinating Center’s Nutrition Data System for Research software (NDS-R 2011).

Based on this intake data we calculated an alternate healthy eating index (AHEI) for each participant, modifying that developed by the USDA Center for Nutrition Policy and Promotion.²¹ The overall index had a total possible score ranging from 0 to 80 points with higher scores indicating better overall dietary quality. Each of the 8 dietary components (vegetables, fruits, nuts and legumes, ratio of white to red meat, cereal fiber, alcohol, trans fats, and ratio of polyunsaturated to saturated fats) had a scoring range of 0 to 10 points.

Survey of food purchasing behaviors

A 75-item questionnaire developed by our team on food purchasing habits, preferences, and accessibility to stores was administered in this study. The questionnaires for food purchasing habits are purposefully designed for older adults. We used a mixed methodology (qualitative and quantitative) approach to develop the Food Purchasing Behaviors (querying both food store and restaurant purchases) and Neighborhood Perception Surveys. Focus groups (N=7, including 4 in Washington, DC and 3 in Worcester County, MA), were conducted among 34 older women (16 Black, 13 White, 4 Latina/Hispanics, and 1 Native American) living in rural and urban neighborhoods. The focus groups informed the questionnaire development

with respect to content, comprehension, visual representation, and participant burden. Key informant interviews (KII) were conducted among leaders of community organizations working with these aging populations, such as senior centers, recreation centers and neighborhood grassroots organization. The surveys were refined according to focus group participant and KII comments and suggestions.

The resulting questionnaire specifically measures store type, restaurant type, geographic locations, online or phone order vs. in store purchase, and modes of transportation utilized. The instrument disclosed where and when the participant purchased food for herself or her family in the past month. Food stores were defined as any stores selling cooked or uncooked foods, i.e., grocery stores, convenience stores, wholesale clubs, retail stores (e.g., Walmart), fruit and vegetable stores, farm stands and farmer's markets. We defined food shopping as the purchases of relatively large quantities of foods, not including quick runs for a very small quantity of food items (e.g., a gallon of milk).

The participants were queried about their eating and food purchasing (eat-in or take-out) habits at establishments outside the home, including cafeterias and other restaurants of all types (such as sit down restaurants, fast food restaurants, Dunkin Donuts, McDonalds, etc.). Information on location, distance from home, travel mode and frequency of purchasing restaurant-prepared food was recorded.

Statistical Analysis

Participant characteristics were summarized and compared by race (White vs. Black). Racial differences in sociodemographic, physical and mental health, and lifestyle factors were evaluated using Chi-squared tests for percentages or Wilcoxon rank-sum tests for continuous variables. Food store preferences and self-report food item availabilities were compared for racial differences using Chi-squared tests after condensing preference responses from five categories ("extremely, very, moderately, a little, or not at all important") into two ("extremely/very important" vs. all others) and after condensing availability responses into "usually/always available" vs. lesser availability categories.

Dietary intake and food purchasing behaviors were evaluated for racial differences using linear regression models, first without any adjustment (Table 2) and then with adjustments (Table 3) for (1) age; (2) age, annual gross family income and highest education level achieved; (3) all of the above plus number of comorbidities, difficulty/non-difficulty with activities of daily living, and physical activity (mean number of daily steps). To preserve degrees of freedom as we increased the number of adjusting factors, we derived a single composite adjustment score for each outcome for each individual using the entire set of adjusting characteristics as predictors in linear regression models. Each person's single composite score used in the adjusted regression model was then predicted as the sum of all the products of each specific regression coefficient multiplied by her value of the corresponding characteristic.²²

RESULTS

Participant Characteristics

Of the 97 participants, 49 are White, and 44 are Black (Table 1). Compared to Whites, Blacks had, on average, younger age, less education and lower household income. Blacks were more likely to have diabetes, less likely to have osteoarthritis and osteoporosis, fewer outdoor falls in the past 6 months, and a lower level of anxiety. Blacks were also less likely to live alone, used alcohol less frequently, and had lower levels of physical activity as measured by daily step counts and by self-reported frequency of exercise activities.

Dietary intake

Based on 24 hour dietary recalls, compared to Whites, Blacks reported a lower daily caloric intake (Table 2A, mean (SD) 1314 (404) vs. 1529 (448), $p=0.02$), lower consumption of vegetable proteins, fiber of all types, and micronutrients such as calcium, iron, magnesium, potassium, vitamin B-6, C, and D. They reported much less caffeine and alcohol consumption. However, Blacks reported a higher percentage of intake from total protein and fat, and foods with vitamin K (typically green, leafy vegetables). Blacks had a higher polyunsaturated to saturated fat ratio and a higher percentage of calories from trans fats. When healthy eating indices (AHEI) were calculated, Blacks averaged a significantly lower total score than Whites, specifically in the categories of vegetables, fruits, nuts and legumes, cereal fiber, alcohol, and trans fats (Table 2B). Blacks and Whites had approximately equal scores in the ratio of red to white meat, and Blacks scored somewhat healthier than Whites in their polyunsaturated/saturated fat ratio.

Adjustment for age (Table 3) had minimal impact on racial dietary differences except for a reduction in the difference in percentage of calories from fat and an apparent increase in the difference in monthly frequency of eating in restaurants, which became significantly higher for Whites when their greater average age was taken into account. The racial difference in restaurant dining was much diminished, however, by further adjustment for income and education. Adjusting for income and education also reduced the apparent racial difference in AHEI by about 20% and accounted for about 50% of the racial difference in travel time to the usual food store. The fully adjusted model shows somewhat reduced racial differences in dietary variables as compared with the crude models, especially in percent of calories from proteins, fats, and trans fats and in AHEI and monthly frequency of food shopping, but even after adjusting for all these factors, Whites averaged significantly more daily calories, fiber, calcium, potassium, caffeine, and alcohol.

Food purchasing

Compared to Whites, Blacks shopped less frequently, traveled a longer time from home to their usual food store, and ate out at restaurants somewhat less frequently (Table 2C). For their usual mode of travel to the food store, Blacks were less likely to walk to stores (14% vs. 40%, $p=0.008$) and more likely to ride in a car with someone else (33% vs. 6%, $p=0.001$). Blacks and Whites were about equally likely to drive themselves to the store (45% vs. 48%). All racial differences persisted when the analysis was limited to those women ($N=36$ Black and 42 White) who claimed to be the primary shoppers for their households.

Higher frequency of grocery shopping was associated with higher intake of calories ($p=0.07$) and total fiber ($p=0.002$) and lower intake of trans fats ($p=0.02$). A greater distance from home to store was associated with greater percentage of protein in the diet ($p=0.05$). Such associations did not vary by race.

Food store preferences

When asked what store features are important, Blacks in general ranked more factors such as location, price, and availability as “extremely or very important” than Whites did (Table 4). Results were very similar when only primary shoppers’ responses were analyzed. Over 90% of both Blacks and Whites rated high product quality and the availability of fresh fruits and fresh vegetables as extremely to very important. Less than 10% of women of both races responded that online/telephone shopping or home delivery service was important in their store choice.

Compared to Whites, Blacks assigned more importance to many store features, including: 1) accessibility by public transportation; 2) safe location and no heavy traffic; 3) comfortable shopping environment (comfortable temperature, cleanliness, non-crowdedness, and friendliness of store clerks); 4) age-friendly features (modest store size that makes shopping easy and not physically demanding, well-organized aisles and ease of finding items, ease of reaching the items on the shelves, multiple checkout stations for fast checkout); 5) availability of price incentives (reasonable prices, sales and promotional items, acceptance of store and factory coupons, and store loyalty or membership discounts); 6) adequate supply of varieties (i.e., most of the food items can be purchased in one store, availability of lean/reduced fat meats, seafood, frozen vegetables, canned fruits, lean/reduced fat processed meats, low salt meat products, frozen/canned/dried organic foods, and foods for health reasons (e.g., gluten-free)).

There was no racial difference in the women’s opinions about the availabilities of the following items in their usual food store: fresh, frozen or canned vegetables and fruits, low-fat dairy, low-sodium foods, and lean meats (Table 5). Blacks, however, were more aware of nutritional rating systems (e.g., Nuval, Guiding Star) at their stores than Whites (36% vs. 62% responding “Don’t Know” of such rating systems, $p=0.01$).

DISCUSSION

Healthy eating is very important for older adults to maintain good health and independent living, and to prevent and treat obesity and other chronic diseases. The determinants of and racial differences in eating behaviors among older adults remain poorly understood. Our preliminary study, though limited by sample size, found notable Black to White racial differences in a number of macro- and micronutrient outcomes, food purchasing behaviors and preferences in food store choice among older women living in densely populated urban neighborhoods in the Washington DC metropolitan area. The remarkable racial differences could not be entirely attributable to the variations in geographic access to well-stocked food stores because the study was carried out in densely populated urban neighborhoods. The differences appeared more likely to be related to socioeconomic and behavioral differences between Black and White older women. Our data suggest that racial, socioeconomic, and

cultural differences as well as perceptions of neighborhood resources should be carefully considered when designing community-based programs to promote healthy eating among urban older women.

Although access and exposure to healthy foods is likely one of the most influential environmental factors affecting healthy eating, the determinants and consequences of disparities in access remain to be elucidated. Due to reduced physical ability, limited mobility and income, older adults are particularly vulnerable to adverse neighborhood environments. Distance from and lack of public transportation to adequately stocked food stores appears to limit the frequency and amount of food purchasing. Our study found that Blacks who traveled greater distances to food stores shopped less frequently, which explains some of our observed dietary differences, including lower averaged intake of fiber, fresh vegetables and fruits. The travel time to stores averaged within 30 minutes travel each way among both Black and White women living in DC neighborhoods. However, even slightly longer travel times (approximately 4 minutes longer) were associated with less frequent food shopping among Blacks. Further analysis is needed to explore how such subtle differences in travel time influence shopping frequency among older women. It is also of interest to investigate why the Black women traveled farther: because they had to (fewer stores in their neighborhoods), or because they preferred stores farther away with greater variety and availability of food items and other specific store characteristics (Table 4). Our future analysis will carefully address this issue.

Less healthy eating and less frequent food shopping may also be partially explained by the Black to White differences in income and education level. Limited income often negatively affects the purchase of healthy foods. In line with previous studies,¹³ our study also showed that less healthy nutritional intake in these urban older women was associated with lower income and less education.

Previous studies have shown that social isolation and living alone negatively affect healthy eating and frequency of shopping. However, our study found that older White women were twice as likely to live alone as Black women (64% vs. 32%), yet ate healthier than their Black counterparts.

Although the vast majority of women of both races agreed that product quality and the availability of fresh fruits and vegetables was “extremely or very important” in their choice of food store, it very interesting to observe the large discrepancies in importance given to other store characteristics by older Black and White women. Blacks, in general, ranked far more store factors as extremely or very important than Whites (Table 4). Compared to Whites, older Black women were more concerned about availability of public transportation, safety, and a comfortable shopping environment. Age-friendly features, including modest store size, ease of reaching and finding items in well-organized aisles were of greater concern to Blacks. Blacks were more concerned about the availability of price incentives, which may be reflective of lower income level. Although Blacks tended to eat less healthy diets, it is interesting that they stated more concern than White women about adequate supply of healthy foods in stores. They were particularly interested in obtaining lean/reduced fat meats, seafood, frozen vegetables, canned fruits, low salt processed meat products,

frozen/canned/dried organic foods, and foods needed for health reasons (e.g., gluten-free). Public health initiatives are needed to investigate why older Black women want to but don't purchase these healthier foods compared with their White counterparts.

Another important finding is that there was no racial difference in the women's opinions about the actual availabilities of the following items in their usual food store: fresh, frozen or canned vegetables or fruits, low-fat dairy, low-sodium foods, and lean meats (Table 5). Even though Black women had a lower mean education level and reported a less healthy diet than White women, Black women reported being more aware of nutritional rating systems (e.g., Nuval, Guiding Star) at their stores (36% vs. 62% responding "Don't know" of such rating systems, $p=0.01$). It is unclear whether such large racial differences are due to racial differences in social desirability reporting bias (answering to please the observer) or circumstantial in the stores the Black women frequented. Further studies need to carefully address this issue.

Our study has several strengths. First, we contributed to addressing the gap in understanding food purchasing behavior in older adults by developing and administering new instruments capable of measuring correlated activities of shopping habits, store preferences, travel mode and distance to stores. The new instruments complement existing instruments for measuring individual eating behaviors. These new tools were used in conjunction with GPS data, and data can be validated for reliability and address reporting bias. Critical elements of the data included information on place (geographic location, indoor vs. outdoor, etc.), frequency and transportation mode (e.g., walking, shuttle service, driving) of older women's food purchasing behaviors (e.g., grocery store shopping), eating outside the home (restaurant food consumption) and physical exercise (both utilitarian and leisure physical activities). With this new approach, participants' neighborhood environment exposures can be more precisely computed, and environmental influences on perceptions of neighborhoods, food purchasing and diet can be more effectively assessed. Second, use of multiple recruitment access points ensured the geographic, socioeconomic and racial representativeness of the participants. We purposefully recruited participants living in a variety of urban neighborhoods, geographically spread over the DC metropolitan area. This area-based recruitment strategy ensured variety and representativeness of the participants. Third, we strategically limited the study to older women with an equal allocation of sample sizes to Blacks and Whites. Even with the relatively small sample size, the study was able to detect a number of modest to large differences that point out relatively robust racial differences among older women. This cannot be accomplished without a careful sampling design.

However, our study was limited in its small size, single geographic location and single sex, cross-sectional nature, and lack of observed data on food store environments. Except for the GPS and accelerometer data, the study relied heavily on self-report data which are subject to recall and social desirability bias. The study was also limited by the use of three 24-hour recalls of dietary intake within a week to approximate a person's habitual intake. To capture a more realistic cross-sectional view of and longitudinal changes in food purchasing and eating habits, a larger number of repeated 24-hour recalls by season of the year and over multiple years are necessary. Our future studies will carefully address each of these methodological limitations by incorporating a longitudinal design and inclusion of older

men, other races/ethnicities, and other older adults living in suburban and rural neighborhoods in diverse geographic locations..

The findings from this study have important implications to aging and public health research. Studies have shown that poor dietary quality, characterized by lower intakes of fiber, fruits, vegetables, whole grains, lean protein, and a higher intake of unhealthy fats are associated higher risk for diabetes,²³ cardiovascular diseases,²⁴ certain types of cancer,²⁵ decline in physical and cognitive functions,^{26,27} fall injuries,²⁸ hip fractures,²⁹ and earlier loss of independent living.^{30,31} Racial differences in diet quality may contribute to health disparities in older age. Successful promotion of healthy eating among older Blacks may help reduce disparities in nutrition-related health outcomes. To accomplish this, more rigorous studies on racial and cultural differences in food preference, food purchasing habits and eating behaviors are needed to support racially and culturally appropriate programs to promote healthy eating.

In conclusion, food consumption, purchasing behaviors and preferences of store features differed substantially between older Black and White women. Such racial differences should be further examined to understand their causes and mechanisms in order to promote healthy eating in older populations.

Acknowledgments

This project was supported in part by a grant from the Georgetown-Howard Universities Center for Clinical and Translational Science and MedStar Health Research Institute (Co-PIs: Michelle MaGee and Wenjun Li), and by a Life Science Moment Fund Award (PI: Li) of University Massachusetts Center for Clinical and Translational Sciences which is funded by the National Center for Advancing Translational Sciences, National Institutes of Health, through Grant UL1TR000161. Several instruments used in this project were created in a pilot study supported by NIH-funded Women's Health Initiatives (HHSN268201100001C). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

References

1. Larson NI, Story MT, Nelson MC. Neighborhood environments: disparities in access to healthy foods in the U.S. *American journal of preventive medicine*. Jan; 2009 36(1):74–81. [PubMed: 18977112]
2. Mozaffarian D, Fried LP, Burke GL, Fitzpatrick A, Siscovick DS. Lifestyles of older adults: can we influence cardiovascular risk in older adults? *Am J Geriatr Cardiol*. May-Jun;2004 13(3):153–160. [PubMed: 15133418]
3. Siscovick DS, Fried L, Mittelmark M, Rutan G, Bild D, O'Leary DH. Exercise intensity and subclinical cardiovascular disease in the elderly. The Cardiovascular Health Study. *American journal of epidemiology*. Jun 1; 1997 145(11):977–986. [PubMed: 9169906]
4. The Diabetes Prevention Program Research Group. The Diabetes Prevention Program: baseline characteristics of the randomized cohort. The Diabetes Prevention Program Research Group. *Diabetes care*. Nov; 2000 23(11):1619–1629. [PubMed: 11092283]
5. Miller ME, Rejeski WJ, Reboussin BA, Ten Have TR, Ettinger WH. Physical activity, functional limitations, and disability in older adults. *Journal of the American Geriatrics Society*. Oct; 2000 48(10):1264–1272. [PubMed: 11037014]
6. Bath PA, Morgan K. Customary physical activity and physical health outcomes in later life. *Age and ageing*. Dec; 1998 27(Suppl 3):29–34. [PubMed: 10408681]
7. U.S. Department of Health and Human Services, U.S. Department of Agriculture. [Accessed May 10, 2016] 2015 – 2020 Dietary Guidelines for Americans. 82015. <http://health.gov/dietaryguidelines/2015/guidelines/>

8. Ervin RB. Healthy Eating Index scores among adults, 60 years of age and over, by sociodemographic and health characteristics: United States, 1999–2002. *Advance data*. May 20.2008 (395):1–16.
9. Savoca MR, Arcury TA, Leng X, et al. The diet quality of rural older adults in the South as measured by healthy eating index-2005 varies by ethnicity. *Journal of the American Dietetic Association*. Dec; 2009 109(12):2063–2067. [PubMed: 19942025]
10. Mensah GA, Mokdad AH, Ford ES, Greenlund KJ, Croft JB. State of disparities in cardiovascular health in the United States. *Circulation*. Mar 15; 2005 111(10):1233–1241. [PubMed: 15769763]
11. Kurian AK, Cardarelli KM. Racial and ethnic differences in cardiovascular disease risk factors: a systematic review. *Ethnicity & disease*. Winter;2007 17(1):143–152. [PubMed: 17274224]
12. King KM, Khan NA, Quan H. Ethnic variation in acute myocardial infarction presentation and access to care. *The American journal of cardiology*. May 15; 2009 103(10):1368–1373. [PubMed: 19427430]
13. Understanding and Improving Health. Washington, DC: US Department of Health and Human Services; 2001. *Healthy People 2010*.
14. Morland K, Wing S, Diez Roux A, Poole C. Neighborhood characteristics associated with the location of food stores and food service places. *American journal of preventive medicine*. Jan; 2002 22(1):23–29. [PubMed: 11777675]
15. Pfeiffer E. A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *Journal of the American Geriatrics Society*. Oct; 1975 23(10):433–441. [PubMed: 1159263]
16. Tinetti ME, Mendes de Leon CF, Doucette JT, Baker DI. Fear of falling and fall-related efficacy in relationship to functioning among community-living elders. *Journal of gerontology*. May; 1994 49(3):M140–147. [PubMed: 8169336]
17. Beck AT, Epstein N, Brown G, Steer RA. An inventory for measuring clinical anxiety: psychometric properties. *Journal of consulting and clinical psychology*. Dec; 1988 56(6):893–897. [PubMed: 3204199]
18. Radloff LS. The CES-D scale: A self report depression scale for research in the general population. *Applied Psychological Measurement*. 1977; 1:385–401.
19. Cyarto EV, Marshall AL, Dickinson RK, Brown WJ. Measurement properties of the CHAMPS physical activity questionnaire in a sample of older Australians. *Journal of science and medicine in sport/Sports Medicine Australia*. Aug; 2006 9(4):319–326.
20. Stewart AL, Mills KM, Sepsis PG, et al. Evaluation of CHAMPS, a physical activity promotion program for older adults. *Ann Behav Med*. Fall;1997 19(4):353–361. [PubMed: 9706362]
21. 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]
22. Li W, Procter-Gray E, Lipsitz L, et al. Utilitarian walking, neighborhood environment and risk for outdoor falls among older adults. *American journal of public health*. 2014; :e1–e8. (Published online ahead of print July 17, 2014). DOI: 10.2105/AJPH.2014.302104
23. Ma Y, Hebert JR, Balasubramanian R, et al. All-cause, cardiovascular, and cancer mortality rates in postmenopausal white, black, Hispanic, and Asian women with and without diabetes in the United States: the Women's Health Initiative, 1993–2009. *American journal of epidemiology*. Nov 15; 2013 178(10):1533–1541. [PubMed: 24045960]
24. Fung TT, Pan A, Hou T, et al. Food quality score and the risk of coronary heart disease: a prospective analysis in 3 cohorts. *The American journal of clinical nutrition*. Jun 8.2016
25. Vargas AJ, Neuhauser ML, George SM, et al. Diet Quality and Colorectal Cancer Risk in the Women's Health Initiative Observational Study. *American journal of epidemiology*. Jun 5.2016
26. Huang T, Tobias DK, Hruby A, Rifai N, Tworoger SS, Hu FB. An Increase in Dietary Quality Is Associated with Favorable Plasma Biomarkers of the Brain-Adipose Axis in Apparently Healthy US Women. *The Journal of nutrition*. May; 2016 146(5):1101–1108. [PubMed: 27075907]
27. Nijholt W, Jager-Wittenaar H, Visser M, van der Schans CP, Hobbelen JS. Are a Healthy Diet and Physical Activity Synergistically Associated with Cognitive Functioning in Older Adults? *The journal of nutrition, health & aging*. 2016; 20(5):525–532.

28. Sahni S, Mangano KM, McLean RR, Hannan MT, Kiel DP. Dietary Approaches for Bone Health: Lessons from the Framingham Osteoporosis Study. *Current osteoporosis reports*. Aug; 2015 13(4): 245–255. [PubMed: 26045228]
29. Haring B, Crandall CJ, Wu C, et al. Dietary Patterns and Fractures in Postmenopausal Women: Results From the Women's Health Initiative. *JAMA internal medicine*. May 1; 2016 176(5):645–652. [PubMed: 27019044]
30. Hegerova P, Dedkova Z, Sobotka L. Early nutritional support and physiotherapy improved long-term self-sufficiency in acutely ill older patients. *Nutrition (Burbank, Los Angeles County, Calif. Jan; 2015 31(1):166–170.*
31. Ng TP, Feng L, Nyunt MSZ, et al. Nutritional, Physical, Cognitive, and Combination Interventions and Frailty Reversal Among Older Adults: A Randomized Controlled Trial. *American Journal of Medicine*. Nov.2015 128(11):1225-+. [PubMed: 26159634]

Table 1

Sociodemographic, health and lifestyle characteristics of participants (Mean±SD or %)

	Overall (N=97)	White (N=49)	Black (N=44)	p-value for racial diff. ¹
Sociodemographic				
Age (years)	74.2±7.0	75.9±7.3	72.1±5.3	0.01
Education (years)	16.3±3.0	17.5±2.5	14.9±3.1	<0.001
Annual income<\$50,000	48.4	35.4	60.5	0.02
Married or living with partner	36.1	36.7	34.1	0.79
Living alone	48.5	63.3	31.8	0.002
Health and healthcare				
CESD Depression Scale	7.7±6.6	7.5±6.5	7.6±6.9	0.94
Beck Anxiety Scale	5.5±6.6	6.3±6.9	4.8±6.5	0.054
Number of comorbid conditions ²	1.7±1.1	1.6±1.2	1.7±1.1	0.94
Currently taking 2 medications ³	39.6	37.5	43.2	0.58
Heart or circulatory condition	60.8	51.0	68.2	0.09
Diabetes	23.7	12.2	34.1	0.01
Respiratory disease	13.4	12.2	15.9	0.61
Cancer	4.1	6.1	2.3	0.36
Rheumatoid arthritis	5.2	2.0	9.1	0.13
Osteoarthritis	22.7	30.6	13.6	0.05
Osteoporosis	10.3	18.4	2.3	0.01
Poor vision	8.2	12.2	2.3	0.07
Physical limitations (ADL)	3.1	4.1	2.3	0.62
Hospitalized in past 3 mos.	5.2	2.0	9.1	0.13
No. of indoor falls in past 6 mos.	0.1±0.4	0.2±0.4	0.1±0.4	0.18
No. of outdoor falls in past 6 mos.	0.2±0.4	0.3±0.4	0.1±0.3	0.01
Tinetti Falls Efficacy Scale	15.3±15.9	16.4±17.5	12.9±11.1	0.24
Lifestyle				
Current smoker	7.2	6.1	6.8	0.89
Weekly frequency of alcohol	1.6±2.1	2.6±2.4	0.7±1.3	<0.001
Paid or volunteer employment	15.6	16.3	16.3	1.00
Physical activity (daily steps)	4462±2798	5457±2989	3256±1917	<0.001
Weekly frequency of exercise activities	22.4±10.9	25.2±11.8	19.7± 8.7	0.02

¹ Chi2 test for categorical variables, and Wilcoxon rank sum test for continuous variables.

² Number of comorbidities from the following list: heart or circulatory conditions (stroke, ischemic attack, high blood pressure); respiratory (asthma, COPD); cancer or malignant tumor; rheumatoid arthritis (not including rheumatism); intestine or colon polyps or adenomas; gallbladder disease or gallstones; systemic lupus erythematosus (lupus); kidney or bladder stones (renal or urinary calculi); diabetes; cataracts; glaucoma; osteoporosis (weak or brittle bones); and osteoarthritis.

³ Medications taken for any of the comorbid conditions listed.

Table 2

Dietary intake μ and food purchasing habits σ^2 of participants, overall and by race

	Overall (N=97)		White (N=49)		Black (N=44)		p-value for racial diff.
	Mean	SD	Mean	SD	Mean	SD	
A. Dietary intake (amounts shown are daily means unless specified)							
Total calorie intake(kcal)	1442	450	1529	448	1314	404	0.02
% Calories from Carbohydrate	46.0	7.8	46.8	7.5	45.5	7.5	0.41
% Calories from Protein	18.5	4.4	17.6	4.2	19.4	4.3	0.04
% Calories from Fat	33.5	7.0	31.8	7.0	34.9	6.4	0.03
% Calories from Sat Fat	10.5	3.3	10.5	3.6	10.1	2.7	0.52
Polyunsat/Sat Fat ratio	0.9	0.4	0.8	0.4	1.0	0.5	0.05
% Calories from trans fats	1.0	0.7	0.8	0.4	1.3	0.8	<0.001
Cholesterol (mg)	212.6	102.9	197.5	100.1	224.8	106.4	0.21
Vegetable protein (g)	21.2	9.4	23.3	7.6	18.3	9.9	0.01
Omega-3 fatty acids (g)	1.6	0.9	1.6	1.0	1.5	0.8	0.47
Total dietary fiber (g)	19.4	9.2	22.9	8.5	15.3	8.1	<0.001
Insoluble dietary fiber (g)	13.6	7.1	15.9	6.5	10.8	6.9	<0.001
Soluble dietary fiber (g)	5.7	2.7	6.9	2.8	4.5	2.0	<0.001
Calcium (mg)	684.7	242.8	743.1	244.1	587.8	181.8	0.001
Iron (mg)	11.3	4.8	12.6	5.2	9.5	3.7	0.002
Magnesium (mg)	274.9	98.8	304.6	93.4	238.0	92.9	0.001
Potassium (mg)	2343	800	2646	772	2004	704	<0.001
Sodium (mg)	2137	761	2161	808	2098	737	0.70
Total Vitamin A activity (IU)	10226	7780	11010	7469	9579	8417	0.39
Vitamin B-12 (cobalamin) (mcg)	4.5	3.6	4.6	2.5	4.6	4.6	0.94
Vitamin B-6 (mg)	1.7	0.7	1.8	0.7	1.5	0.6	0.04
Vitamin C (ascorbic acid) (mg)	94.2	64.6	110.2	65.3	76.7	60.1	0.01
Vitamin D (calciferol) (mcg)	5.1	3.8	5.9	4.4	4.3	3.0	0.05
Vitamin E (International Units)	12.2	7.3	13.5	6.9	11.0	7.8	0.11

	Overall (N=97)		White (N=49)		Black (N=44)		p-value for racial diff.
	Mean	SD	Mean	SD	Mean	SD	
Vitamin K (phylloquinone) (mcg)	222.7	247.3	163.9	121.6	287.5	330.8	0.02
Total sugars (g)	75.3	32.5	80.0	31.6	68.5	30.0	0.08
Caffeine (mg)	103.6	105.3	152.5	117.2	52.4	61.3	<0.001
Alcohol (g)	4.6	9.1	8.6	11.3	0.5	1.9	<0.001
B. Healthy Eating Index (AHEI) scores (10 point maximum unless stated)							
Vegetables	4.6	2.6	5.1	2.6	4.0	2.6	0.04
Fruits	4.6	2.9	5.5	2.8	3.7	2.7	0.002
Nuts and legumes	4.1	3.8	5.7	3.5	2.5	3.4	<0.001
Ratio of white to red meat	6.0	3.0	6.0	2.8	6.1	3.2	0.85
Cereal fiber	2.6	2.1	3.1	2.1	2.1	2.0	0.02
Alcohol	1.8	3.1	3.2	3.6	0.3	1.2	<0.001
Trans fats	8.4	1.5	9.0	1.0	7.7	1.8	<0.001
Polyunsaturated/saturated fat ratio	6.7	2.5	6.3	2.5	7.3	2.3	0.08
Total AHEI (80 point maximum)	38.8	11.8	43.9	10.8	33.5	10.2	<0.001
C. Food purchasing behaviors							
Travel minutes to usual food store	13.5	8.3	11.5	7.2	15.8	9.1	0.02
Monthly freq. of food shopping	5.2	3.1	6.2	3.0	4.4	3.0	0.006
Monthly freq. of eating at restaurants ³	3.2	3.9	3.8	3.5	2.5	4.3	0.10
Monthly freq. of eating commercially prepared foods ⁴	5.2	7.3	6.1	8.8	4.0	5.0	0.17

¹ Calculated as daily averages of three 24-hour dietary recalls within one week.

² Based on self-report data collected using the Food Purchasing Behaviors Survey.

³ Restaurants include cafeterias, fast food places and sit-down restaurants.

⁴ Commercially prepared foods include restaurant dining plus takeout.

Table 3

Crude and adjusted mean racial differences (White-Black) in dietary intakes and food purchasing habits

	Crude	Adjusted for age	Adjusted for age, income, education	Adjusted for age, income, education, comorbidities, ADL, PA
Dietary intake (daily means unless specified)				
Energy (kcal)	215.0 *	217.5 *	202.7 *	209.5 *
% Calories from Protein	-1.8 *	-1.4	-1.7 *	-1.2
% Calories from Fat	-3.0 *	-2.2	-2.4	-1.6
% Calories from trans fats	-0.5 **	-0.5 **	-0.4 **	-0.3
Vegetable Protein (g)	5.0 **	5.6 **	4.8 **	3.7
Total Dietary Fiber (g)	7.6 **	7.9 **	7.0 **	5.5 *
Calcium (mg)	155.3 **	148.8 **	151.3 **	148.8 **
Potassium (mg)	642.2 **	607.4 **	514.3 **	437.2 *
Sodium (mg)	63.4	89.3	107.0	139.7
Total Sugars (g)	11.5	6.6	11.4	7.4
Caffeine (mg)	100.0 **	107.9 **	97.8 **	79.7 **
Alcohol (g)	8.1 **	7.8 **	6.4 **	5.1 *
Total AHEI (80 point maximum)	10.3 **	10.1 **	8.0 **	5.3
Food purchasing behaviors				
Travel minutes to usual food store	-4.3 *	-3.8 *	-2.1	-2.2
Monthly freq. of food shopping	1.8 **	2.1 **	1.6 **	1.2
Monthly freq. eating at restaurants ¹	1.4	1.9 *	0.9	0.8
Monthly freq. commercially prepared foods ²	2.1	2.0	1.4	0.5

Abbreviations: ADL=activities of daily living (some difficulty vs. no difficulty); PA=physical activity (mean number of steps daily); AHEI=Alternate healthy eating index

*
p<0.05;

**
p<0.01;

¹Restaurants include cafeterias, fast food places and sit-down restaurants.

²Commercially prepared foods include restaurant dining plus takeout.

Table 4

Store characteristics rated as extremely or very important when older women choose a store for food shopping (percent)

Characteristic	Overall N=93	White N=48	Black N=42	p-value ^{\$}
Location and environment				
Short distance (close to home)	60.9	66.7	53.7	0.21
Accessible by public transportation	20.4	10.4	28.6	0.03
No heavy traffic or traffic congestion	30.1	18.8	40.5	0.02
Parking is easily available	71.0	66.7	78.6	0.21
Location of store is safe	76.3	66.7	88.1	0.02
Walking routes to the store are safe	59.1	60.4	57.1	0.75
Easy to pull carts on the streets/sidewalks	44.1	37.5	50.0	0.23
Close to businesses or places I visit often	39.8	31.3	47.6	0.11
Noise level is low	23.7	14.6	31.0	0.06
Comfortable temperature	35.5	20.8	50.0	0.004
Store services, features or conditions				
Modest store size that makes shopping easy and not physically demanding	37.6	20.8	54.8	0.001
Organized aisles/ease of finding items	65.6	54.2	78.6	0.02
Easy to reach the items on the shelves	55.9	39.6	73.8	0.001
Sales/promotion items available	47.8	29.8	66.7	0.001
Can get most of the food items in one store	73.3	61.4	87.2	0.01
Fast checkout (many checkout stations)	65.6	54.2	78.6	0.02
Self-service checkout station	22.6	14.6	31.0	0.06
Store cleanliness	90.3	83.3	97.6	0.02
Not very crowded	40.9	29.2	52.4	0.03
Online/telephone shopping option	7.5	8.3	4.8	0.50
Home delivery service	6.5	8.5	2.4	0.21
Electric cart/wheelchair available	17.2	10.4	21.4	0.15
Ramps for wheelchair access	16.3	8.3	22.0	0.07
Friendliness of store clerks	60.2	37.5	83.3	<0.001
Availability of fresh foods				
Fresh vegetables (excluding potatoes)	96.8	95.8	97.6	0.64
Fresh fruits	98.9	97.9	100.0	0.35
Lean/reduced fat meats	71.7	55.3	88.1	0.001
Seafood	65.2	51.1	78.6	0.01
Low fat dairy products	71.0	64.6	81.0	0.08
Specialty fresh produce (e.g., ethnic, cultural, traditional, religious)	38.0	31.9	42.9	0.29
Fresh organic produce	34.1	27.1	45.0	0.08
Availability of processed foods				

Characteristic	Overall N=93	White N=48	Black N=42	p-value ^{\$}
Frozen vegetables	44.1	33.3	54.8	0.04
Canned vegetables	19.4	10.4	26.2	0.05
Frozen fruits	23.7	14.6	31.0	0.06
Canned fruits	15.1	6.3	21.4	0.04
Dried fruits	22.8	16.7	26.8	0.24
Lean/reduced fat processed meats	23.7	10.4	35.7	0.004
Low salt meat products	32.3	12.5	52.4	<0.001
Low fat dairy products (e.g., cheese)	51.6	47.9	57.1	0.38
Frozen meals	23.7	18.8	26.2	0.40
Frozen/canned specialty food (e.g., ethnic, cultural, traditional, religious)	9.7	6.3	11.9	0.35
Frozen/canned/dried organic foods	12.9	6.3	21.4	0.04
Foods for health reasons (e.g., gluten-free)	24.7	12.5	35.7	0.009
Availability of bakery, deli, cereals, nuts, snacks, etc.				
Bakery (breads and sweets)	25.8	25.0	23.8	0.90
Deli, prepared (ready-to-eat) foods	20.4	14.6	23.8	0.27
Cereals	47.3	45.8	47.6	0.87
Nuts and seeds	55.9	60.4	52.4	0.44
Snacks between meals, such as chips, crackers, packaged cookies or cakes, etc.	17.2	10.4	21.4	0.15
Whole grains (e.g., brown rice, oats, and oatmeal)	64.5	58.3	69.0	0.29
White rice, white bread, pasta, non-fried potatoes	17.2	14.6	16.7	0.79
Quality and price				
High quality	93.5	91.7	95.2	0.50
Reasonable prices	93.5	87.5	100.0	0.02
Store loyalty or membership discount	47.3	20.8	76.2	<0.001
Sale/promotion items	54.8	31.3	81.0	<0.001
Accepts store coupons	48.4	20.8	78.6	<0.001
Accepts factory coupons	47.3	22.9	76.2	<0.001

^{\$} p-value for Black to White racial difference using Chi2 test.

Table 5

Availability of selected food items in food stores most frequently shopped by participants (percent saying usually or always available)

Food item	Overall (N=93)	White (N=48)	Black (N=42)	p-value ¹
Fresh vegetables	100	100	100	1.00
Frozen/canned vegetables	94.7	95.8	92.9	0.54
Fresh fruits	100	100	100	1.00
Frozen/canned fruits	93.6	93.8	95.2	0.76
Low fat dairy ²	92.6	95.8	92.9	0.54
Low sodium foods ³	85.1	83.3	88.1	0.52
Lean meats ⁴	96.8	97.9	97.6	0.92
A nutritional rating system on foods ⁵	43.0	25.5	61.9	0.001
Don't know about NuVal, etc.	49.4	61.7	35.7	0.01

¹ p-value for racial difference based on Chi2 test.

² Dairy products labeled as low fat, such as low fat or fat free milk, fat free yogurt, or reduced fat cheeses).

³ Including foods labeled as low in salt, no added salt, or low sodium

⁴ Including boneless, skinless chicken or turkey breast, fish, shellfish, and ground meat labeled lean and extra lean.

⁵ For example, NuVal, Guiding Star, ANDI.