Published in final edited form as:

Nutr Cancer. 2019 ; 71(1): 61–76. doi:10.1080/01635581.2018.1557217.

A Step Toward Understanding Diet Quality in Urban African American Breast Cancer Survivors: A Cross-sectional Analysis of Baseline Data from the Moving Forward Study

Sparkle Springfield, PhD¹, Angela Odoms-Young, PhD^{2,3,4}, Lisa M. Tussing-Humphreys, PhD, RD, PhD^{3,4}, Sally Freels, PhD⁴, and Melinda R. Stolley, PhD⁵

¹Stanford Prevention Research Center, School of Medicine, 3300 Hillview Ave (MC 5411), Palo Alto, CA 94304, US

²Department of Kinesiology and Nutrition, 646 Applied Health Sciences Building, 1919 West Taylor Street (MC 517), Chicago, IL 60612, US

³University of Illinois Cancer Center, 486 Westside Research Office Bldg., 1747 West Roosevelt Road (MC 275), Chicago, IL 60608, US

⁴School of Public Health, Division of Epidemiology and Biostatistics, 953 SPHP1, 1603 W Taylor St (MC 923), Chicago, IL 60612, US

⁵Medical College of Wisconsin, Department of Medicine, 8701 Watertown Plank Road, Milwaukee, WI 53226, US

Abstract

Purpose—Little is known about the dietary behaviors of African American breast cancer survivors (AABCS). We sought to describe diet intake and quality in AABCS as well as explore associations with demographic, social, lifestyle, and body composition factors to potentially inform the development of effective dietary interventions.

Methods—Baseline data from a prospective weight loss trial of 210 AABCS was assessed. A food frequency questionnaire was used to evaluate dietary intake and diet quality via the Healthy Eating Index 2010 (HEI-2010) and the Alternative Healthy Eating Index 2010 (AHEI-2010). Linear regression analysis was conducted to determine the most influential variables on diet quality.

Results—Mean HEI- and AHEI-2010 total scores were 65.11 and 56.83, indicating sub-optimal diet quality. Women were least adherent to whole grains, dairy, sodium, empty calories, sugary beverages, red/processed meats, and trans-fat. Increased self-efficacy for healthy eating behaviors,

Author correspondence and reprint contact: Sparkle Springfield PhD, Postdoctoral Research Scholar, 1Stanford University, Stanford Prevention Research Center, School of Medicine, 3300 Hillview Ave (MC 5411), Palo Alto, CA 94304, US, T: 650-723-7822, F: 650-723-6450, sspring@stanford.edu.

Author contributions: MS and SS conceptualized the study and collected the data; SS, AO, LTH, MS, and SF contributed to the analysis and interpretation of the findings; SS, MS, AO, LTH, and SF contributed to drafting and critical review of the manuscript

Funding/Financial Disclosure: None

Conflict of Interest Disclosure: None

more years of education (AHEI only), negative smoking status, smaller waist circumference, and increased physical activity (HEI only) was significantly associated with higher diet quality scores.

Conclusion—Our findings suggest the diet quality of AABCS needs improvement. Targeting self-efficacy for healthy eating behaviors and waist circumference may be an effective means of increasing diet quality in this group.

Keywords

African American women; breast cancer survivors; diet quality; racial-ethnic disparities; epidemiological

Introduction

Since the 1990s, advances in breast cancer detection, diagnosis, and treatment have led to a progressive decline in breast cancer mortality in the United States (U.S.) [1]. Despite these improvements, all women have not benefited equally [1]. African American (AA) women experience the highest mortality and shortest survival from breast cancer in the U.S. [1]. Breast cancer disparities are attributed to various factors including differences in screening behaviors and follow up after an abnormal screening [2–4], tumor biology, stage at diagnosis [4–6], access to and quality of treatment [4, 7, 8], and socioeconomic status [9, 10]. However, AA – non-Hispanic white differences in survival remain even after accounting for these factors [4].

In an effort to bridge racial/ethnic gaps in breast cancer outcomes, there is growing interest in understanding the contribution of lifestyle factors, such as diet quality, to breast cancer disparities [11, 12]. In contrast to individual dietary components (i.e., specific foods and nutrients), measures of diet quality assess the quality and variety of the overall diet. Diet quality is most often measured by evaluating how closely an individual's dietary intake aligns with population-based dietary recommendations that have been linked to lower chronic disease risk, such as the Dietary Guidelines for Americans (DGAs) [13]. In the past decade, higher diet quality scores have been positively associated with improved survival following a breast cancer diagnosis. However, these studies have been conducted in samples of predominantly non-Hispanic white breast cancer survivors.

Examining diet quality may be particularly relevant to improving breast cancer survivorship in AA women. Compared to their white counterparts, AABCS disproportionately experience diet-related comorbid conditions such as obesity [14–16], cardiovascular disease [17], hypertension [18], and Type 2 diabetes [17]; all which have been associated with negative breast cancer outcomes [17, 19]. Although findings from several lifestyle intervention trials suggests AABCS fail to meet national dietary guideline recommendations for certain nutrients and food groups [20–25] there is little to no evidence on the quality of diets being consumed by AABCS [26].

Understanding dietary intake and diet quality can inform the development of effective dietary interventions that reduce disparities in breast cancer outcomes for AA women. This study aims to address this critical research gap by: 1) describing the diet intake behaviors

and diet quality quantified using the Healthy Eating Index 2010 (HEI-2010) and Alternative Healthy Eating Index 2010 (AHEI-2010) of urban AABCS; and 2) examining the relationship between diet quality and demographic, social, lifestyle, and body composition factors of the participants.

Materials and Methods

Baseline interview data from the Moving Forward study, a community-based randomized weight loss intervention trial in Chicago (NCT02482506), was utilized for this cross-sectional analysis. Detailed study design and methods are published elsewhere [27]. Briefly, study participants were recruited via letters and phone calls to women listed in the cancer registries maintained at three academic medical centers located in the Chicago area, and also through partnerships with community leaders and community-based organizations such as breast cancer support groups, churches, block clubs, and community centers. Notices were also posted on social media sites frequented by the AA community. The study was reviewed and approved by the Institutional Review Board at the University of Illinois at Chicago.

Interested women were screened for study eligibility. Eligibility criteria included: self-identify as AA; age 18 years or older; have a previous diagnosis of stage I, II or III breast cancer and a body mass index (BMI) ≥ 25 kg/m²; completed treatment (i.e., surgery, chemotherapy, radiation) at least six months prior to program start (ongoing treatment with Tamoxifen or aromatase inhibitors was allowed); able to engage in a physical activity program determined by screening questions and primary care provider approval; and agree to be randomized to a guided or self-guided intervention program. Women were excluded if planning to move from the Chicago area; pregnant or < 3 months post-partum, using an FDA-approved or over the counter weight loss medication, participating in another structured weight loss program, or had a history of significant mental illness.

Dietary Assessment

Study participants included in the cross-sectional analytic cohort were those that completed the semi-quantitative 110-item Block 2005 Food Frequency Questionnaire (FFQ), n=216 [28]. The FFQ was administered by a trained interviewer and included reference to a standardized portion guide. The questionnaire was designed to assess habitual diet intake of foods, beverages, and supplements during the past 12 months. Reliability and validity has been established in a wide range of age, gender, income, and ethnic groups, including AA women [29, 30]. Only FFQs deemed reliable and plausible were used for the analysis. Specifically, those with (1) missing survey, (2) more than ten questions blank, (3) reported intakes of more than 5,000 or less than 500 calories per day, or (4) reported repetitive answers throughout the questionnaire were excluded (n = 6). Mean intake of macronutrients, micronutrients, and the HEI-2010 and AHEI-2010 total and component scores were calculated by NutritionQuest (Berkeley, CA).

Intake of Selected Macro- and Micronutrients—Mean energy intake and percent of energy from fat, carbohydrate, and protein and mean intake per 1,000 kcals for total cholesterol, dietary fiber, calcium, and vitamin D were calculated from the FFQ (See Table 2). To allow for comparison, recommendations for daily energy and macro- and

micronutrient intake [e.g., Dietary Reference Intakes (DRIs); American Heart Association recommendation for daily intake of trans-fat] are provided in the results table [31, 32] [33] [34].

Diet Quality Scores—Diet quality was measured using HEI-2010 and AHEI-2010.

HEI-2010, one of the most widely used index measures of diet quality, assesses adherence to the 2010 U.S. DGAs [35]. Every five years the United States Department of Agriculture (USDA) updates its DGAs along with a corresponding HEI score (2010 was the most recent version available at the time of study). The DGAs contain the latest science-based nutrition recommendations for the general public, with the goal of preventing chronic disease and promoting a healthy, active lifestyle [36].

HEI-2010 includes 12 diet components (9 adequacy and 3 moderation) that sum to a total of 100 points; higher scores reflect greater adherence to the 2010 DGAs and superior diet quality. The nine adequacy-focused components (i.e., foods and beverages that should be consumed in adequate amounts) includes: total fruit, whole fruit, total vegetables, grains and beans, whole grains, dairy, protein foods, seafood and plant proteins, and fatty acids. The score for these components ranges from 0–5 points, with the exception of dairy and whole grains, ranging from 0–10 points. The three moderation-focused components (i.e., foods and beverages that should be consumed in moderation) are: refined grains, sodium, and empty calories (calories from solid fats, alcohol, and added sugars) [37]. Scores for these components range from 0–10 points, with the exception of empty calories, ranging from 0–20 points (See Table 3)

AHEI-2010 is also a measure of diet quality [38], but differs from the HEI-2010 in that it assesses adherence to the 2010 Harvard Healthy Eating Plate (HHEP) [39]. The HHEP was first designed to address deficiencies in the USDA's DGAs [39]. Although HEI-2010 and AHEI-2010 recommendations have evolved to be more similar in past years, fundamental differences remain. For example, the HHEP 2010 discourages consumption of low-fat dairy products, 100% fruit juices, and trans-fats, which are not addressed in the 2010 DGAs [36]. However, AHEI is not as widely used a scoring metric for diet quality as HEI. Nonetheless, evidence suggests adherence to the HHEP is a better predictor of favorable breast cancer survivorship outcomes than HEI [38, 40, 41]. AHEI-2010 comprises 11 diet components that sum to 110 points. The index includes six adequacy-focused components including servings of vegetables, fruits, whole grains, nuts and legumes, intake of fatty acids from fish and intake of polyunsaturated fatty acids. AHEI-2010 also has four avoidance components: red/processed, trans-fats, sugary beverages including fruit juices, and sodium. There is also one moderation component, for alcohol consumption. For each component, scores range from 0–10 points [42] (See Table 3).

Clinical, demographic, and lifestyle data

Clinical data included self-reported age at breast cancer diagnosis, years since diagnosis, stage at diagnosis (I-III), and treatment information (e.g., surgery, radiation, chemotherapy) (See Table 1). Demographic data included self-reported age, years of education, and annual household income. Lifestyle data included current smoking status and physical activity. The

Modified Activity Questionnaire was used to assess self-reported leisure time physical activity [43]. Responses were used to calculate the number of hours per week the participant engaged in physical activity. This activity questionnaire has been used in many large studies with diverse samples including cancer survivors [44] and has well-established reliability and validity [43].

Social measures related to diet behavior

Study participants completed three social measures including self-efficacy, social support for healthy eating, and perceived access to healthy foods. The Physical Activity and Nutrition Self-Efficacy (PANSE) scale asks respondents to rate on a nine-point Likert scale how confident they felt about engaging in positive lifestyle behavior changes [45]. PANSE includes 11 items; however only the seven nutrition self-efficacy related items for healthy eating behaviors were analyzed. The Social Support for Healthy Eating questionnaire asks respondents to rate on a five-point Likert scale the likelihood that friends and family influence the participant's efforts to change diet habits [46]. The survey includes ten items and two subscales (encouragement and discouragement) presented separately for friends and family. The Perceived Access to Healthy Foods survey, asks respondents to rate their level of agreement on a four-point Likert scale with five statements regarding their ease of access to healthy eating resources including fresh produce, low-fat milk, and lean meats [47]. All of these measures have demonstrated good internal consistency and adequate test-retest reliability [45, 46] [47]. The PANSE and Perceived Access to Healthy Foods survey have been validated in high-risk groups including low-income women [45] and rural populations [47].

Body composition data

The participant's body weight was assessed in duplicate using a Tanita digital scale (Arlington Heights, IL) wearing light clothing and no shoes. Height was measured in duplicate using a seca portable stadiometer (Issaquah, WA). Body mass index (BMI) was calculated as weight (kg)/height (m)². Waist circumference was measured on bare skin in duplicate at the level midway between the lower rib margin and the iliac crest, with the participant breathing out gently. Body fat was assessed via Dual Energy X-ray Absorptiometry (DXA). A whole-body DXA scan allowed us to quantify the amount of adipose tissue in the abdominal area and throughout the entire body. The DXA measurements were conducted using the DXA GE iLunar Body Composition Scanner (GE Healthcare).

Statistical analysis

Descriptive statistics including means, medians, standard deviations, and ranges were calculated for nutrient intake, HEI-2010 and AHEI-2010 total and component scores, using IBM SPSS for Macintosh, Version 22.0 (Chicago, IL). Linear regression analysis was conducted to determine the most influential demographic, social, lifestyle, and body composition variables on diet quality (HEI-2010, AHEI-2010) (See Table 4). Initially, bivariate linear regression was conducted with each predictor variable to observe unadjusted effects on diet quality (HEI-2010, AHEI-2010) (See column labeled Crude). Then, we used

multiple linear regressions with forward variable selection to compare the amount of influence, each predictor had on diet quality. We did this in an iterative process. First, we assessed associations between the demographic variables and HEI-2010/AHEI-2010 total scores (Model A). Then, we tested selected demographic variables with the social (Model B), lifestyle (Model C), and body composition (Model D) variables in separate forward linear models. Variables with $p \leq 0.05$ were retained in the forward selection linear models. Finally, a single model combining all previously selected variables was fit (fully adjusted “Model E”). Because HEI-2010 uses an energy density approach [48], energy intake (i.e., kcals) was not adjusted for in the HEI-2010 related statistical models. However, the AHEI-2010 scoring methodology does not inherently account for energy intake, thus AHEI-2010 statistical models were adjusted for energy intake.

Results

A total of 210 AABCS were included in this analysis. The clinical, demographic, social, and lifestyle characteristics of the study participants are presented in Table 1. On average participants were 7 years post diagnoses. The majority attended college, with nearly 20% of participants reporting attainment of a graduate or professional degree. Annual household income ranged from \$10,000 to \$90,000, with most women (66.2%) reporting incomes of \$50,000 or less. About 10% of the women identified as current smokers. With the exception of self-efficacy for healthy eating, mean scores for social factors were on the lower half of each scale. Most women did not meet the national recommendation for cancer survivors of 2.5 hours physical activity per week [48]. All study participants were overweight (11.9 %) or obese (88.1%) based on BMI. Nearly all of the women (97.6 %) exceeded the cutoffs for a healthy waist circumference (≥ 88 cm) and percentage of body fat (35%) recommended by the World Health Organization [49, 50] and the American Association of Clinical Endocrinology, respectively.

As shown in Table 2, mean energy intake and percent of calories from fat, including saturated and trans-fat, exceeded national recommendations. Mean sodium intake was more than twice the recommended amount, while dietary cholesterol intake was below recommendations and percent of mean calories from protein and carbohydrate was within the recommended range. In contrast, total dietary fiber intake was low, as was mean calcium and vitamin D intake, even after considering both dietary and supplemental sources.

Mean HEI-2010 total score and component scores are presented in Table 3, along with the percentage of participants who received the maximum score for the total and component scores. Based on cut-points derived by the USDA Center for Nutrition Policy and Promotion [37], mean total HEI-2010 scores fell in the “needs improvement” range (score 51–79). Participants were most adherent to the HEI-2010 components greens and beans, total protein foods, seafood and plant proteins, and refined grains. Fewer participants received the maximum score for total fruit, whole fruit, and the ratio of saturated to unsaturated fats. Participants were least adherent to the HEI- 2010 components whole grains, dairy, sodium, and empty calories.

Table 3 also presents the mean total score and component scores for AHEI-2010, along with the percentage of participants who received the maximum score for the total score and component scores. Participants were most adherent to the AHEI-2010 components polyunsaturated fats, nuts and legumes, and vegetables. Fewer participants received a maximum score for fruits, fish fatty acids, sodium, and alcohol. Participants were least adherent to the AHEI-2010 whole grains, sugary beverages, red/processed meats, and trans-fat components.

Bivariate analysis and multivariable linear modeling with forward variable selection indicated statistically significant relationships between demographic, social, lifestyle, and body composition factors with diet quality (Tables 4 and 5). In the bivariate linear models more years of education, higher annual household income, self-efficacy for healthy eating behaviors, perceived access to healthy foods, and a greater number of hours spent per week engaged in physical activity, were significantly associated with a higher HEI-2010 and AHEI-2010 total score. Current smoking, higher BMI, and a larger waist circumference were significantly associated with a lower HEI-2010 and AHEI-2010 total score.

Multivariable linear modeling with forward variable selection determined more years of education, increased self-efficacy for healthy eating behaviors and perceived access to healthy foods, negative smoking status and increased weekly hours of physical activity, and smaller waist circumference as the most influential demographic, social, lifestyle, and body composition variables on higher HEI and AHEI diet quality scores; respectively (Model A-D, Table 4 and 5). Self-efficacy and perceived access, negative smoking status and increased physical activity, and smaller waist circumference remained the most influential variables on diet quality scores after adjustment for education only.

In the fully adjusted linear models for HEI-2010 and AHEI-2010 (Model E, Table 4 and 5), self-efficacy for healthy eating behaviors, years of education, smoking status, waist circumference, and weekly hours engaged in physical activity remained significantly associated with diet quality scores; however, we observed some differences by diet quality outcome. Self-efficacy for healthy eating behaviors emerged as the strongest predictor of better HEI-2010 and AHEI-2010 scores. Similarly, negative smoking status and smaller waist circumference were significantly associated with increased total scores for both indices. More years of education showed a significant independent relationship with increased AHEI-2010 only. Although education appeared to have a notable influence on HEI-2010 scores, it did not reach significance in the fully adjusted model. Demonstrating a similar pattern, more hours of physical activity per week was significantly associated with higher HEI-2010 scores.

Discussion

Few studies have examined the dietary behaviors of breast cancer survivors, in particularly AABCS [11, 20, 49]. To our knowledge, this study is among the first to evaluate dietary intake and diet quality, specifically using the HEI-2010 and the AHEI-2010, in a sample consisting exclusively of AABCS. Despite high adherence to certain components, overall, diet quality was sub-optimal in this group. In the fully adjusted linear models, increased self-

efficacy for healthy eating behaviors, negative smoking status, and smaller waist circumference were independent predictors of both higher HEI-2010 and AHEI-2010 diet quality scores. While more years of education and hours of physical activity per week were independent predictors of higher AHEI-2010 and HEI-2010, respectively.

We assessed participants' energy, macronutrient, and selected micronutrient intake. Mean total fat, saturated fat, trans-fat, and sodium intakes exceeded recommended levels while fiber, vitamin D, and calcium fell well below recommendations [34]. Our findings are consistent with baseline dietary intake from previous lifestyle intervention trials for AABCS [20–25] that generally report high consumption of fat and sodium and low consumption of fiber, fruits and vegetables.

In our cohort of AABCS, mean HEI-2010 and AHEI-2010 total scores indicated a need for dietary improvement. Higher total scores on each diet quality index have been associated with improved health outcomes in breast cancer survivors [26, 50]. In the multiethnic Health, Eating, Activity and Lifestyle (HEAL) cohort study (n=670; 36% AABCS), breast cancer survivors with the highest HEI-2005 total score (Q4: 74–87) were 60% less likely to die from any cause and 88% less likely to die from breast cancer than survivors with the lowest HEI-2005 total score (Q1: 35–58) [50]. Further, in the same study survivors with better-quality diets were more likely to be non-Hispanic white vs. racial/ethnic minorities; however, mean HEI-2005 was not reported for AABCS specifically [50]. One study has documented total HEI score in a sample of AABCS. Djuric and colleagues reported a baseline mean total score of 57 for HEI-2005 among 30 AABCS participating in a pilot spirituality-based weight loss maintenance trial [26]. Although our baseline HEI score was higher than this small sample of AABCS, together the means for AABCS enrolling in lifestyle interventions are lower than reported for some non-Hispanic white breast cancer survivors enrolling in lifestyle trials [51]. However, our cohort of AABCS had higher HEI-2010 scores than did a representative sample of breast cancer survivors not enrolling in a weight loss trial [52] and HEI-2005 scores of AA women not previously diagnosed with breast cancer [53, 54].

To our knowledge, two studies have evaluated AHEI among breast cancer survivors, only one of which examined AHEI-2010 [40, 41]. Using data from the Nurses' Health Study, Izano et. al found a 43% reduction in the risk of non-breast cancer mortality among survivors with the highest AHEI-2010 scores compared to those with the lowest scores, while Kim et al. found no association between AHEI-2005 scores and total or non-breast cancer mortality [41]. Unfortunately, neither study reported the means, medians, nor quintile ranges for the AHEI-2010 scores; thus we are unable to make direct comparisons with our findings. In comparison to non-cancer-affected women, our mean total AHEI-2010 score was higher than reported for women participating in the observational Nurses' Health Study (47.6 ± 10.8) as well as the NIH-AARP Diet and Health Study [42, 55]. Our mean AHEI-2010 score was also higher than an AHEI-2005 total score (42.4 ± 12.6) reported for a sample of AA men and women (n=225) with and without Type 2 diabetes [56].

While many factors may contribute to the higher total diet quality scores observed in our cohort compared to those of AA women in the general population, and of some breast

cancer survivors enrolled in observational studies, a combination of breast cancer diagnosis and a desire to lose weight (i.e., readiness to make dietary changes) may partially account for these differences [52, 53]. Survivors may adopt improved dietary habits after a cancer diagnosis without any formal intervention [57–60]. In fact, in the qualitative data that informed the development of the Moving Forward intervention, AABCS reported making positive changes such as increasing fruits and vegetables intake and reducing meat consumption, without any formal intervention [57].

Nonetheless, several individual HEI-2010 and AHEI-2010 component scores indicate the need for diet quality improvement. Participant scored lowest for empty calories (HEI-2010), sugary beverages (AHEI-2010), dairy (HEI-2010), whole grains (HEI-2010 and AHEI-2010), red/processed meat (AHEI-2010) and sodium (HEI-2010 and AHEI-2010). Some of these findings were expected, given the low HEI-2010 component scores for whole grains and sodium reported by a recent analysis of a representative sample of U.S. adults [61], in addition to the well-documented evidence for low dairy consumption in the AA community [62, 63]. However, the low scores on empty calories (HEI-2010), red/processed meat (AHEI-2010), and sugary beverages (AHEI-2010) were concerning. They are significant given that these types of habitual dietary practices contribute to co morbid conditions including cardiovascular disease (CVD) [64, 65], which is the leading cause of death in breast cancer survivors and AA women [66]. Furthermore, CVD and diabetes are independent predictors of survival disparities between AA and white breast cancer survivors [17, 18, 67].

Independent of household income, education was the strongest demographic predictor of diet quality in our sample when assessed by AHEI-2010, but not HEI-2010. One explanation may be that participants with higher levels of education had an increased awareness of the diet and disease research underlying the dietary recommendations associated with AHEI-2010. It was somewhat surprising that household income was not an independent predictor of diet quality in the fully adjusted models, given that cost has consistently been cited as a barrier to high quality food consumption, especially among AAs [68, 69]. Still, some evidence suggests that women may leverage their education to seek out healthier foods [70]. This strategy may be particularly relevant to AA women living in racially segregated metropolitan cities such as our study setting, Chicago, IL. Predominately AA urban neighborhoods are likely to be isolated and experience low access to high quality food resources such as fresh produce despite residents having diverse socioeconomic backgrounds as reflected in our participant characteristics [58, 71–73]. Education combined with a unique motivation to engage in healthier diet behaviors after having had a breast cancer diagnosis [74] may explain the convincing association between education and diet quality in this cohort.

Among the social variables, self-efficacy for healthy eating behaviors had the greatest influence on HEI-2010 and AHEI-2010 scores in our sample. Although many studies have demonstrated that self-efficacy is a powerful predictor of nutrition and related health behaviors [75] such as weight control [76] there is limited research on self-efficacy and dietary behaviors in AA women and breast cancer survivors specifically [77]. Similarly, there is little evidence on the perceived access/barriers to healthy foods in breast cancer

survivors [77]. Thus, although it did not reach significance in our fully adjusted models, addressing perceived access to healthy foods could represent an important tool in improving dietary outcomes in AABCS.

Surprisingly, social support for diet behaviors was not associated with diet quality. Social support from friends and family is important to breast cancer survivorship [78, 79] as well as to weight management efforts for AA women [80]. Reasons for the lack of association may be that social support is more relevant to efforts directed at changing dietary practices. Thus, we would not expect an association at baseline, but rather post-intervention.

Overall, AABCS in our study with higher HEI-2010 and AHEI-2010 total scores reported healthier lifestyle practices and had less excess adiposity. It is well established that behaviors often cluster; individuals who practice one healthy behavior (e.g., physical activity, not smoking) often practice others (e.g., consuming a healthy diet) [81]. Similar findings are reported in studies of other breast cancer survivors [50, 82] and in AA women from the general population [54]. Interestingly, physical activity was significantly associated with higher HEI-2010 score, but did not reach significance with AHEI-2010. Considering the rigidity of the HHEP-2010 recommendations, this finding might suggest survivors with higher AHEI-2010 scores prioritize improving dietary behaviors over engaging in physical activity. Smoking status had a particularly strong influence on both diet quality scores. Likewise, waist circumference showed the greatest association with both scores compared to BMI and percent body fat. Importantly, waist circumference has been reported as a better predictor of chronic disease risk than BMI in AA women [83, 84], having demonstrated an independent association with hypertension and diabetes risk in overweight and obese AA women [85]. Taken together with evidence suggesting older AA women are more accepting of larger body sizes than their white counterparts [86], our results may encourage future interventions targeting AABCS to include health messages that focus on the benefits of increasing diet quality beyond weight loss such as obtaining and sustaining a healthy body shape.

Strengths of this study include an analysis of diet quality and exploration of demographic, social, lifestyle, and body composition factors in an exclusively AABCS cohort. However, our study is not without limitation. The FFQ is known to elicit high rates of under-reporting [87], which may be especially prevalent in overweight and AA women [88–90]. Due to the cross-sectional nature of the study, causality cannot be inferred between diet quality and these contextual factors despite assumed temporality in the interpretation of some of the results. There was also the potential for selection bias [91] given that participants self-selected into the Moving Forward weight loss study and thus may not be representative of the wider population of AABCS. Also, none of the social measures were validated in AABCS survivors specifically. And while it is not a limitation per se, it is important to note that the different scoring approaches for the HEI-2010 and AHEI-2010 sometimes leads to incongruences between indices for the same food/nutrient component. For example, to receive the maximum score of 10 points on the AHEI-2010, participants could not consume any red or processed meat [42]. By contrast, the HEI-2010 total protein component does not have a specific cutoff for red or processed meat consumption [37]. Thus, these scoring differences may have contributed to the variations we observed in associations with

demographic, social, lifestyle, and body composition factors between the two diet quality indices. Nonetheless, considering the ability to develop effective dietary interventions targeting AABCS has been limited due to a lack of research in the area, our findings may provide a foundational step toward understanding and thus improving diet quality in this group.

Acknowledgements and notes:

This work was supported by the parent study, Moving Forward, a community-based randomized weight loss intervention trial (NCT02482506, R01CA116750) and the University of Illinois at Chicago Cancer Education and Career Development Program (CA057699), which included help with manuscript preparation from Nina Sandlin.

Biography

Sparkle Springfield

Postdoctoral Research Scholar

Stanford University

Angela Odoms-Young

Associate Professor, Kinesiology and Nutrition

University of Illinois at Chicago

Lisa M. Tussing-Humphreys

Assistant Professor of Medicine

University of Illinois at Chicago

College of Medicine

Division of Academic and Internal Medicine

Sally Freels

Associate Professor of Epidemiology and Biostatistics

University of Illinois at Chicago

Melinda R. Stolley

Professor of Medicine

References

1. ACS, American Cancer Society. Cancer Facts & Figures for African Americans 2016–2018 Atlanta: American Cancer Society, 2016.

2. McCarthy EP, et al., Mammography use helps to explain differences in breast cancer stage at diagnosis between older black and white women. *Annals of Internal Medicine*, 128(9): p. 729–736. 1998. [PubMed: 9556466]
3. Smith-Bindman R, et al., Does utilization of screening mammography explain racial and ethnic differences in breast cancer? *Annals of internal medicine*, 144(8): p. 541–553. 2006. [PubMed: 16618951]
4. Curtis E, et al., Racial and ethnic differences in breast cancer survival, *Cancer* 112(1): p. 171–180. 2008. [PubMed: 18040998]
5. McBride R, et al., Within-stage racial differences in tumor size and number of positive lymph nodes in women with breast cancer. *Cancer*, 110(6): p. 1201–1208. 2007. [PubMed: 17701948]
6. Chagpar AB, et al., Primary tumor size, not race, determines outcomes in women with hormone-responsive breast cancer. *Surgery*, 150(4): p. 796–801. 2011. [PubMed: 22000193]
7. Hershman D, et al., Racial disparities in treatment and survival among women with early-stage breast cancer. *Journal of Clinical Oncology*, 23(27): p. 6639–6646. 2005. [PubMed: 16170171]
8. Gorin SS, et al., Delays in breast cancer diagnosis and treatment by racial/ethnic group. *Archives of Internal Medicine*, 166(20): p. 2244–2252. 2006. [PubMed: 17101943]
9. Cross CK, Harris J, and Recht A, Race, socioeconomic status, and breast carcinoma in the U.S: what have we learned from clinical studies. *Cancer*, 95(9): p. 1988–99. 2002. [PubMed: 12404294]
10. Byers TE, et al., The impact of socioeconomic status on survival after cancer in the United States. *Cancer*, 113(3): p. 582–591. 2008. [PubMed: 18613122]
11. Rock CL and Demark-Wahnefried W, Nutrition and survival after the diagnosis of breast cancer: a review of the evidence. *Journal of Clinical Oncology*, 20(15): p. 3302–3316. 2002. [PubMed: 12149305]
12. Kroenke CH, et al., Dietary patterns and survival after breast cancer diagnosis. *Journal of clinical oncology*, 23(36): p. 9295–9303. 2002.
13. Wirt A and Collins CE, Diet quality—what is it and does it matter? *Public health nutrition*, 12(12): p. 2473–2492. 2009. [PubMed: 19335941]
14. Greenlee H, et al., Survivorship care plans and adherence to lifestyle recommendations among breast cancer survivors. *Journal of Cancer Survivorship*, p. 1–8. 2016.
15. Kroenke CH, et al., Weight, weight gain, and survival after breast cancer diagnosis. *Journal of clinical oncology*, 23(7): p. 1370–1378. 2005. [PubMed: 15684320]
16. Chlebowski RT, Aiello E, and McTiernan A, Weight loss in breast cancer patient management. *Journal of clinical oncology*, 20(4): p. 1128–1143. 2002. [PubMed: 11844838]
17. Tammemagi CM, et al., Comorbidity and survival disparities among black and white patients with breast cancer. *Jama*, 294(14): p. 1765–1772. 2005. [PubMed: 16219879]
18. Braithwaite D, et al., Hypertension is an independent predictor of survival disparity between African-American and white breast cancer patients. *International Journal of Cancer*, 124(5): p. 1213–1219. 2009. [PubMed: 19058216]
19. Protani M, Coory M, and Martin JH, Effect of obesity on survival of women with breast cancer: systematic review and meta-analysis. *Breast cancer research and treatment*, 123(3): p. 627–635. 2010. [PubMed: 20571870]
20. Parker EAD, Sheppard VB, and Adams-Campbell L, Compliance with national nutrition recommendations among breast cancer survivors in “Stepping Stone”. *Integrative cancer therapies*, 13(2): p. 114–120. 2014. [PubMed: 24105362]
21. Paxton RJ, et al., Was race a factor in the outcomes of the Women’s Health Eating and Living Study? *Cancer*, 117(16): p. 3805–3813. 2011. [PubMed: 21319157]
22. Griffith KA, et al., A culturally specific dietary plan to manage weight gain among African American breast cancer survivors: a feasibility study. *Nutr Health*, 21(2): p. 97–105. 2012. [PubMed: 23139389]
23. Stolley MR, et al., A weight loss intervention for African American breast cancer survivors, 2006 9: p. 10 2009.

24. Sheppard VB, et al., The feasibility and acceptability of a diet and exercise trial in overweight and obese black breast cancer survivors: The Stepping STONE study. *Contemporary clinical trials*, 46: p. 106–113. 2016. [PubMed: 26655430]
25. Ramirez LA, et al., Determinants of adherence to nutrition-related cancer prevention guidelines among African American breast cancer survivors. *Journal of the Georgia Public Health Association*, 6(2 Suppl): p. 210 2016. [PubMed: 28066830]
26. Djuric Z, et al., A pilot trial of spirituality counseling for weight loss maintenance in African American breast cancer survivors. *Journal of the National Medical Association*, 101(6): p. 552 2009. [PubMed: 19585923]
27. Stolley MR, et al., Study design and protocol for moving forward: a weight loss intervention trial for African-American breast cancer survivors. *BMC cancer*, 15(1): p. 1 2015. [PubMed: 25971837]
28. Block G, Hartman AM, and Naughton D, A reduced dietary questionnaire: development and validation. *Epidemiology*,: p. 58–64. 1990. [PubMed: 2081241]
29. Norris J, et al., US trends in nutrient intake: the 1987 and 1992 National Health Interview Surveys. *American journal of public health*, 87(5): p. 740–746. 1997. [PubMed: 9184499]
30. Kumanyika SK, et al., Relative validity of food frequency questionnaire nutrient estimates in the Black Women's Health Study. *Annals of epidemiology*, 13(2): p. 111–118. 2003. [PubMed: 12559670]
31. Trumbo P, et al., Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids. *Journal of the American Dietetic Association*, 102(11): p. 1621–1630. 2002. [PubMed: 12449285]
32. Health U.D.o. and Services H, US Department of Agriculture. *Dietary Guidelines for Americans 2015–2020*. 2016.
33. Mayne CJR and Shapses SA, *The 2011 Report on Dietary Reference Intakes for Calcium and Vitamin D from 2011*.
34. Lichtenstein AH, et al., Diet and lifestyle recommendations revision 2006. *Circulation*, 114(1): p. 82–96. 2006. [PubMed: 16785338]
35. Guenther PM, et al., The Healthy Eating Index-2010 is a valid and reliable measure of diet quality according to the 2010 Dietary Guidelines for Americans. *The Journal of nutrition* p. jn. 113.183079 2014.
36. McGuire S, US Department of Agriculture and US Department of Health and Human Services, *Dietary Guidelines for Americans*, 2010. Washington, DC: US Government Printing Office, January 2011. *Advances in Nutrition: An International Review Journal*, 2(3): p. 293–294. 2011.
37. Guenther PM, et al., Update of the healthy eating index: HEI-2010. *Journal of the Academy of Nutrition and Dietetics*, 113(4): p. 569–580. 2013. [PubMed: 23415502]
38. McCullough ML, et al., Diet quality and major chronic disease risk in men and women: moving toward improved dietary guidance. *The American journal of clinical nutrition*, 76(6): p. 1261–1271. 2002. [PubMed: 12450892]
39. HHEP, *Healthy Eating Plate & Healthy Eating Pyramid 2002*.
40. Izano MA, et al., Are diet quality scores after breast cancer diagnosis associated with improved breast cancer survival? *Nutrition and cancer*, 65(6): p. 820–826. 2013. [PubMed: 23909725]
41. Kim EH, et al., Diet quality indices and postmenopausal breast cancer survival. *Nutrition and cancer*, 63(3): p. 381–388. 2011. [PubMed: 21462090]
42. Chiuve SE, et al., Alternative dietary indices both strongly predict risk of chronic disease. *The Journal of nutrition*, p. jn. 111.157222. 2012.
43. Kriska AM and Caspersen CJ, Introduction to a collection of physical activity questionnaires. *Medicine & Science in Sports & Exercise*, 29(6): p. 5–9. 1997.
44. Irwin ML, et al., Physical activity levels before and after a diagnosis of breast carcinoma. *Cancer*, 97(7): p. 1746–1757. 2003. [PubMed: 12655532]
45. Latimer L, et al., Self-efficacy Scale for Weight Loss among multi-ethnic women of lower income: a psychometric evaluation. *Journal of nutrition education and behavior*, 43(4): p. 279–283. 2011. [PubMed: 21683276]

46. Sallis JF, et al., The development of scales to measure social support for diet and exercise behaviors. *Preventive medicine*, 16(6): p. 825–836. 1987. [PubMed: 3432232]
47. Casey AA, et al., Impact of the food environment and physical activity environment on behaviors and weight status in rural U.S. communities. *Prev Med*, 47 2008.
48. Guenther PM, et al., Evaluation of the healthy eating index-2005. *Journal of the American Dietetic Association*, 108(11): p. 1854–1864. 2008. [PubMed: 18954575]
49. Pierce JP, et al., Telephone counseling intervention increases intakes of micronutrient-and phytochemical-rich vegetables, fruit and fiber in breast cancer survivors. *The Journal of nutrition*, 134(2): p. 452–458. 2004. [PubMed: 14747688]
50. George SM, et al., Postdiagnosis diet quality, the combination of diet quality and recreational physical activity, and prognosis after early-stage breast cancer. *Cancer Causes & Control*, 22(4): p. 589–598. 2011. [PubMed: 21340493]
51. Anderson C, et al., Changes in diet quality in a randomized weight loss trial in breast cancer survivors: the lifestyle, exercise, and nutrition study. *npj Breast Cancer*, 2: p. 16026 2016. [PubMed: 28721384]
52. Zhang FF, et al., Diet quality of cancer survivors and noncancer individuals: Results from a national survey. *Cancer*, 121(23): p. 4212–4221. 2015. [PubMed: 26624564]
53. Fitzgibbon ML, et al., Obesity reduction black intervention trial (ORBIT): design and baseline characteristics. *Journal of Women's Health*, 17(7): p. 1099–1110. 2008.
54. Hartman TJ, et al., Dietary and Behavioral Factors Associated with Diet Quality among Low-income Overweight and Obese African American Women. *Journal of the American College of Nutrition*, 34(5): p. 416–424. 2015. [PubMed: 25910081]
55. Reedy J, et al., Higher diet quality is associated with decreased risk of all-cause, cardiovascular disease, and cancer mortality among older adults. *The Journal of nutrition*, 144(6): p. 881–889. 2014. [PubMed: 24572039]
56. Huffman FG, et al., Healthy eating index and alternate healthy eating index among Haitian Americans and African Americans with and without type 2 diabetes. *Journal of nutrition and metabolism*, 2011.
57. Stolley MR, et al., Health behaviors and breast cancer: experiences of urban African American women. *Health education & behavior*, 33(5): p. 604–624. 2006. [PubMed: 16923833]
58. Zenk SN, et al., “ You Have to Hunt for the Fruits, the Vegetables”: Environmental Barriers and Adaptive Strategies to Acquire Food in a Low-Income African American Neighborhood. *Health education & behavior*, p. 1090198110372877. 2011.
59. Maunsell E, et al., Dietary change after breast cancer: extent, predictors, and relation with psychological distress. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 20(4): p. 1017–1025. 2002. [PubMed: 11844825]
60. Bluethmann SM, et al., Grasping the ‘teachable moment’: time since diagnosis, symptom burden and health behaviors in breast, colorectal and prostate cancer survivors. *Psycho-Oncology*, 24(10): p. 1250–1257. 2015. [PubMed: 26060053]
61. Wilson MM, Reedy J, and Krebs-Smith SM, American Diet Quality: Where It Is, Where It Is Heading, and What It Could Be. *Journal of the Academy of Nutrition and Dietetics*, 116(2): p. 302–310. e1. 2016. [PubMed: 26612769]
62. Jackson KA and Savaiano DA, Lactose maldigestion, calcium intake and osteoporosis in African-, Asian-, and Hispanic-Americans. *Journal of the American College of Nutrition*, 20(2): p. 198S–207S. 2001. [PubMed: 11349943]
63. Beydoun MA, et al., Ethnic differences in dairy and related nutrient consumption among US adults and their association with obesity, central obesity, and the metabolic syndrome. *The American journal of clinical nutrition*, 87(6): p. 1914–1925. 2008. [PubMed: 18541585]
64. Liu S, et al., A prospective study of dietary glycemic load, carbohydrate intake, and risk of coronary heart disease in US women. *The American journal of clinical nutrition*, 71(6): p. 1455–1461. 2000. [PubMed: 10837285]
65. Palmer JR, et al., Sugar-sweetened beverages and incidence of type 2 diabetes mellitus in African American women. *Archives of internal medicine*, 168(14): p. 1487–1492. 2008. [PubMed: 18663160]

66. Patnaik JL, et al., Cardiovascular disease competes with breast cancer as the leading cause of death for older females diagnosed with breast cancer: a retrospective cohort study. *Breast Cancer Research*, 13(3): p. R64 2011. [PubMed: 21689398]
67. Eley JW, et al., Racial differences in survival from breast cancer. Results of the National Cancer Institute Black/White Cancer Survival Study. *JAMA*, 272(12): p. 947–54. 1994. [PubMed: 8084062]
68. Lucan SC, Barg FK, and Long JA, Promoters and barriers to fruit, vegetable, and fast-food consumption among urban, low-income African Americans—a qualitative approach. *American Journal of Public Health*, 100(4): p. 631–635. 2010. [PubMed: 20167885]
69. Yeh M-C, et al., Understanding barriers and facilitators of fruit and vegetable consumption among a diverse multi-ethnic population in the USA. *Health Promotion International*, 23(1): p. 42–51. 2008. [PubMed: 18182418]
70. Lawrence W, et al., Why women of lower educational attainment struggle to make healthier food choices: the importance of psychological and social factors. *Psychology and Health*, 24(9): p. 1003–1020. 2009. [PubMed: 20205042]
71. Williams DR and Collins C, Racial residential segregation: a fundamental cause of racial disparities in health. *Public health reports*, 116(5): p. 404–416. 2001. [PubMed: 12042604]
72. Laska MN, et al., Peer Reviewed: Lack of Healthy Food in Small-Size to Mid-Size Retailers Participating in the Supplemental Nutrition Assistance Program, Minneapolis–St. Paul, Minnesota, 2014. Preventing chronic disease, 12 2015.
73. Ghosh-Dastidar B, et al., Distance to store, food prices, and obesity in urban food deserts. *American journal of preventive medicine*, 47(5): p. 587–595. 2014. [PubMed: 25217097]
74. Demark-Wahnefried W, et al., Riding the crest of the teachable moment: promoting long-term health after the diagnosis of cancer. *Journal of Clinical Oncology*, 23(24): p. 5814–5830. 2005. [PubMed: 16043830]
75. Abusabha R and Achterberg C, Review of self-efficacy and locus of control for nutrition-and health-related behavior. *Journal of the American Dietetic Association*, 97(10): p. 1122–1132. 1997. [PubMed: 9336559]
76. Martin PD, Dutton GR, and Brantley PJ, Self-Efficacy as a Predictor of Weight Change in African-American Women. *Obesity Research*, 12(4): p. 646–651. 2004. [PubMed: 15090632]
77. Mosher CE, et al., Long-term outcomes of the FRESH START trial: exploring the role of self-efficacy in cancer survivors' maintenance of dietary practices and physical activity. *Psycho-Oncology*, 22(4): p. 876–885. 2013. [PubMed: 22544562]
78. Kroenke CH, et al., Social networks, social support, and survival after breast cancer diagnosis. *Journal of clinical oncology*, 24(7): p. 1105–1111. 2006. [PubMed: 16505430]
79. Thompson T, et al., Perceived social support in African American breast cancer patients: Predictors and effects. *Social Science & Medicine*, 2017.
80. Wolfe WA, A review: Maximizing social support-A neglected strategy for improving weight management with African-American women. *Ethnicity and Disease*, 14(2): p. 212–218. 2004. [PubMed: 15132206]
81. Pronk NP, et al., Meeting recommendations for multiple healthy lifestyle factors: prevalence, clustering, and predictors among adolescent, adult, and senior health plan members. *American journal of preventive medicine*, 27(2): p. 25–33. 2004. [PubMed: 15275671]
82. George SM, et al., Better postdiagnosis diet quality is associated with less cancer-related fatigue in breast cancer survivors. *Journal of Cancer Survivorship*, 8(4): p. 680–687. 2014. [PubMed: 25001403]
83. Janssen I, Katzmarzyk PT, and Ross R, Waist circumference and not body mass index explains obesity-related health risk. *The American journal of clinical nutrition*, 79(3): p. 379–384. 2004. [PubMed: 14985210]
84. Zhu S, et al., Race-ethnicity-specific waist circumference cutoffs for identifying cardiovascular disease risk factors. *The American journal of clinical nutrition*, 81(2): p. 409–415. 2005. [PubMed: 15699228]

85. Warren TY, et al., Peer Reviewed: Independent Association of Waist Circumference With Hypertension and Diabetes in African American Women, South Carolina, 2007–2009. Preventing chronic disease, 9 2012.
86. Schuler PB, et al., Body-shape perceptions and body mass index of older African American and European American women. Journal of cross-cultural gerontology, 23(3): p. 255–264. 2008. [PubMed: 18379865]
87. Kristal AR, Peters U, and Potter JD, Is it time to abandon the food frequency questionnaire? Cancer Epidemiology Biomarkers & Prevention, 14(12): p. 2826–2828. 2005.
88. Klesges RC, Eck LH, and Ray JW, Who underreports dietary intake in a dietary recall? Evidence from the Second National Health and Nutrition Examination Survey. Journal of consulting and clinical psychology, 63(3): p. 438 1995. [PubMed: 7608356]
89. Krebs-Smith S, et al., Low energy reporters vs others: a comparison of reported food intakes. European journal of clinical nutrition, 54(4): p. 281–287. 2000. [PubMed: 10745278]
90. Alcantara I, et al., Relative validation of fruit and vegetable intake and fat intake among overweight and obese African-American women. Public health nutrition, 18(11): p. 1932–1940. 2015. [PubMed: 25412867]
91. Odgaard-Jensen J, et al., Randomisation to protect against selection bias in healthcare trials The ICochrane Library, 2011.

Table 1.

Participant characteristics at baseline of 210 AABCS

N=210 ^a	Mean (SD) or N(%)
Clinical	
Years since diagnosis	7.1 (5.25)
Stage (self-reported)	
Stage I	69 (36.3)
Stage II	85 (44.7)
Stage III	36 (18.9)
Treatment	
Surgery	207 (98.6)
Chemotherapy	159 (75.7)
Radiation	165 (78.6)
Demographic	
Age, years	57.67 (10.14)
Education, years	14.33 (2.34)
Mean family income, \$	46285.71 (28945.0)
Social	
Self-Efficacy, max=63 ^b	46.53 (9.29)
Encouragement from Family, max=25 ^b	10.83 (5.55)
Encouragement from Friends, max=25 ^c	10.35 (5.26)
Discouragement from Family, max=25 ^d	10.82 (4.47)
Discouragement from Friends, max=25 ^e	9.66 (4.40)
Perceived Access to Healthy Foods, max=20 ^f	9.04 (2.83)
Lifestyle	
Current Smoker, % Y	18 (8.6)
Physical Activity, hours per week	2.4 (3.17)
Body Measurement	
Body Mass Index, kg/m ²	36.20 (6.34)
Body fat %	46.28 (5.13)
Waist, cm	113.49 (15.24)

^aN=207 for years since diagnosis, N=209 for age, N=190 Stage I-III, N=208 for surgery, N=208 for chemotherapy, N=208 for radiation, N=209 for discouragement from healthy eating from friends, perceived access to health eating, N=209 for percent body fat.

^bA higher score indicates greater self-efficacy for healthy eating.

^cA higher score indicates greater encouragement from family.

^dA higher score indicates greater encouragement from friends.

^eA higher score indicates greater discouragement from family.

^fA higher score indicates greater discouragement from family.

^gA higher score indicates less access to healthy foods

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 2.

Mean total energy and macro and micronutrient intake of 210 AABCS

Variable	Mean (SD)	Min - Max	Recommended Diet Intakes
Energy, kcal	1947.62 (925.83)	559.85 – 4631.18	1600 – 1800 ^{a,c}
Fat, % kcal	40.08 (6.25)	19.72 – 56.38	20 – 35% ^c
Saturated fat, % kcal	11.43 (2.30)	5.26 – 19.20	<7% ^b
Trans Fat, % kcal	1.17 (0.46)	0.20 – 2.50	<1% ^b
Carbohydrate, % kcal	47.03 (7.67)	28.93 – 73.22	45 – 65% ^c
Protein, % kcal	14.78 (2.82)	8.55 – 27.39	10 – 35% ^c
Cholesterol, mg	270.18 (162.91)	13.39 – 1014.21	<300 ^b
Total Diet Fiber, grams	17.63 (8.79)	3.47 – 42.08	22.4 – 25.2 ^c
Diet Calcium, mg	719.49 (365.37)	191.31 – 2127.96	1000 – 1200 ^{c,d}
Total Calcium (food and supplement), mg	964.00 (545.58)	191.31 – 3175.13	1000 – 1200 ^{c,d}
Diet Vitamin D IU	106.13 (81.64)	5.84 – 497.13	600 – 800 ^{c,e}
Total Vitamin D IU (food and supplement), IU	301.91 (220.26)	5.84 – 883.99	600 – 800 ^{c,e}
Sodium, mg	3070.84 (1546.98)	723.19 – 8105.06	1500 ^{a,b}

^a2015–2020 Diet Guidelines for Americans: Estimated Calorie Needs per Day, by Age, Sex, & Physical Activity Level [31, 32]^bAmerican Heart Association Diet Recommendation [34]^cDiet Reference Intakes (DRIs): Estimated Average Requirements. Estimated Average Requirement (EAR) is the average daily nutrient intake level estimated to meet the requirements of half of the healthy individuals in a group [31]^dCalcium Recommended Diet Allowances (mg/d) for females ages 31–50y=1000–2500; 51–70y=1200–2000 [33]^eVitamin D Recommended Diet Allowances (mg/d) for females ages 31+ = 600–4000 [33]

Table 3.

HEI 2010 and AHEI 2010 component and total score for 210 AABCS

Diet quality index, max score	Score mean (SD)	Min - Max	Participants who received maximum score N(%)
Healthy Eating Index			
Total Fruit, 5	3.49 (1.56)	0.44 – 5.00	84 (40.0)
Whole Fruit, 5	3.71 (1.52)	0.33 – 5.00	98 (46.7)
Total Vegetables, 5	4.07 (1.13)	1.33 – 5.00	88 (41.9)
Greens and Beans, 5	4.40(1.14)	0.26 – 5.00	146 (69.5)
Whole Grains, 10	3.76 (2.39)	0.30 – 10.00	7 (3.3)
Dairy, 10	3.92 (2.35)	0.52 – 10.00	4.8 (10.0)
Total Protein Foods, 5	4.75 (0.56)	2.35 – 5.00	154 (73.3)
Seafood and Plant Proteins, 5	4.33 (1.11)	0.64 – 5.00	129 (61.4)
Fatty Acids, 10	7.51 (2.37)	0.00 – 10.00	57 (27.1)
Refined Grains, 10	8.90 (1.66)	1.62 – 10.00	109 (51.9)
Sodium, 10	4.79 (2.61)	0.00 – 10.00	4 (1.9)
Empty Calories, 20	11.39 (4.89)	0.00 – 20.00	10 (4.8)
HEI Total Score, 100	65.07 (11.18)	38.90 – 93.92	0 (0.0)
Alternative Healthy Eating Index			
Vegetables, no potatoes, 10	6.01 (2.98)	1.12–10.00	48 (22.9)
Fruit, not including fruit juice, 10	4.21 (3.18)	0.35–10.00	29 (13.8)
Whole Grains, 10	2.16 (1.71)	0.15–10.00	1 (0.5)
Nuts and Legumes, 10	5.68 (3.58)	0.21–10.00	67 (31.9)
DHA & EPA (fish fatty acids), 10	4.41 (2.81)	0.03–10.00	9 (19)
Polyunsaturated Fat (oils), 10	8.39 (1.73)	2.44–10.00	70 (33.3)
Red/processed Meats, 10	5.22 (3.11)	0.00–10.00	4 (1.9)
Trans Fats, 10	8.08 (1.29)	4.12–10.00	7 (3.3)
Sugary Beverages, 100% juice, 10	2.80 (3.81)	0.00–10.00	6 (2.9)
Sodium, 10	5.14 (3.80)	0.00–10.00	32 (15.2)
Alcoholic Drinks, 10	4.78 (2.50)	0.00–10.00	30 (14.3)
AHEI Total Score, 110	56.83 (10.97)	24.29–85.80	0 (0.0)

Table 4.
Associations between Demographics, Social, Lifestyle, Body Composition factors and HEI in 210 AABCS

N=210	Crude β (SE)	Model A Demo	Model B Demo+Soc	Model C Demo+Life	Model D Demo+BC	Model E Full Model
Demographic (Demo)						
Age, years	0.11 (0.08)					
Education, years	1.04 (0.32) ***	1.04 (0.32) **	0.81 (0.31) *	0.86 (0.33) *	0.88 (0.33) **	0.57 (0.31)
Income, \$	1.44 (0.52) **					
Social (Soc)						
Self-Efficacy	0.39 (0.08) ***		0.34 (0.08) ***			0.34 (0.08) ***
Social Support						
Encouragement from Family	0.15 (0.14)					
Encouragement from Friends	-0.03 (0.15)					
Discouragement from Family	0.31 (0.17)					
Discouragement from Friends	0.30 (0.17)					
Perceived Access	-1.02 (0.27) ***		-0.58 (0.27) *			-0.23 (0.28)
Lifestyle (Life)						
Current Smoker	-8.86 (2.70) ***			-6.93 (2.67) *		-6.90 (2.56) **
Physical Activity	0.70 (0.24) **			0.60 (0.23) *		0.49 (0.22) *
Body Composition (BC)						
Body Mass Index, kg/m ²	-0.33 (0.12) **					
Body Fat Percentage %	-0.38 (0.15) *					
Waist Circumference, cm	-0.16 (0.05) **				-0.14(0.05) **	-0.10 (0.05) *

*
p-value < 0.05

**
p-value < 0.01

p-value < 0.001

Model A: Forward Selection of Demographic (DM) factors

Model B: Forward Selection of Social (Soc) factors adjusted for Education

Model C: Forward Selection of Lifestyle (Life) factors adjusted for Education

Author Manuscript
Author Manuscript
Model D: Forward Selection of Body Composition (BC) characteristics adjusted for Education
Model E: Full Model

Author Manuscript

Author Manuscript

Table 5.

Associations between Demographics, Social, Lifestyle, Body Composition factors and AHEI in 210 AABCS

N=210	Crude β (SE)	Model A Demo	Model B Demo+Soc	Model C Demo+Life	Model D Demo+BC	Model E Full Model
Demographic (Demo)						
Age, years	0.08 (0.08)					
Education, years	1.14 (0.32) ***	1.17 (0.32) ***	0.97 (0.30) **	1.01 (0.32) **	0.98 (0.32) **	0.70 (0.30) *
Income, \$	1.51 (0.52) **					
Social (Soc)						
Self-Efficacy	0.41 (0.08) ***		0.34 (0.08) ***			0.35 (0.08) ***
Social Support						
Encouragement from Family	0.24 (0.14)					
Encouragement from Friends	<0.01 (0.15)					
Discouragement from Family	0.26 (0.17)					
Discouragement from Friends	0.26 (0.17)					
Perceived Access	-1.07 (0.26) ***		-0.64 (0.26) *			-0.34 (0.27)
Lifestyle (Life)						
Current Smoker	-7.36 (2.73) **			-5.47 (2.70) *		-6.01 (2.57) *
Physical Activity	0.54 (0.24) *			0.46 (0.23) *		0.35 (0.22)
Body Composition (BC)						
Body Mass Index, kg/m ²	-0.27 (0.12) *					
Body Fat Percentage %	-0.40 (0.15) **					
Waist Circumference, cm	-0.16 (0.05) **				-0.12 (0.05) *	-0.11 (0.05) *

*
p-value < 0.05**
p-value < 0.01***
p-value < 0.001

Model A: Forward Selection of Demographic (DM) factors

Model B: Forward Selection of Social (Soc) factors adjusted for Education

Model C: Forward Selection of Lifestyle (Life) factors adjusted for Education

Author Manuscript
Author Manuscript
Model D: Forward Selection of Body Composition (BC) characteristics adjusted for Education
Model E: Full Model

Author Manuscript

Author Manuscript