THE EFFECT OF HOUSEHOLD COMPOSITION ON DIET DIVERSITY SCORES IN A SOCIOECONOMICALLY DIVERSE URBAN POPULATION OF AFRICAN AMERICAN AND WHITE ADULTS

by

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A thesis submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Master of Science in Human Nutrition

Spring 2017

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ACKNOWLEDGMENTS

Primarily, I would like to thank my advisor Dr. Marie Fanelli Kuczmarski. Without her support, encouragement, and guidance over the past few years, I wouldn't be where I am today. I am continually thankful for the opportunities she has given me to help pave the way for my future career. I would also like to thank Dr. Laura Lessard for her help with the statistical analysis and her patience when I came running with statistical questions. Additionally, I'd like to thank Dr. Shannon Robson for her advice and assistance throughout the writing process.

I would also like to thank my mother, Kimberly Thiel Reilly, as well as my siblings, Katie, Mikey, Ryan, and Amanda, for their support throughout this process. I want to give special thanks however, to my father, Michael Reilly. Thank you for being my best friend, role model, for encouraging me to keep moving forward, and for always believing in me. Finally, to my UD HANDLS team of Emily Shupe and Megan Grimes, as well as my closest friends Meredith Steenkamer and Meg O'Brien for their support and patience during stressful times.

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ABSTRACT

Background: Diet diversity (DD), a measure of variety, is an indicator of diet quality. Individual diet diversity scores (DDS) can be determined by measuring how many food groups are represented in a person's diet, as well as the serving size of each portion associated with food groups within a 24-hour period.

Aim and Hypothesis: The primary aim of the study was to evaluate how household composition effects individual DDS within an urban population of White and African American adults, stratified by race and socioeconomic status (SES).

Subjects: The sample contained 1,610 White and African American adult participants from Wave 3 of the Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) study.

Methods: DD was calculated by two methods, food scores (DDFS) and serving scores (DDSS) using an adapted version of the Healthy Eating Index (HEI)-2010 adequacy components food groups. DDFS were calculated by assigning one point for food consumed from one of eight HEI-2010 adequacy component groups (maximum score = eight). DDSS were created using the HEI scores for the same eight food groups, scoring between zero and five depending on servings consumed (maximum score= forty). Household composition was defined as (1) children and spouse always present (2) children always present with spouse never present, (3) no children present with spouse always present, and (4) no children, spouse never present.

Statistical Analysis: Linear regression models were used to analyze the relationship between DDS and household composition, adjusting for the following covariates: sex, race, age, SES, and education. Interaction terms of race*SES and race*sex were also included in the final model.

Results: Households with children, but no spouse present have the lowest unadjusted DDSS, [White: 15.69(± 0.589); African American: 15.58 (± 0.353) p=0.885]. The highest unadjusted DDSS were found for households with no children, and a spouse always present, [White:18.09(± 0.434); African American: 16.60(± 0.422) p=0.020]. Household composition did not have a significant effect on DDFS or DDSS in the regression analyses when scores were adjusted for demographics. Sex, age, education, and the interaction of race*SES were significantly associated with both DD scoring methods.

Conclusion: Regardless of household composition, DD was better for White compared to African American and for higher SES groups compared to lower SES groups. Older White women with high SES, and a high school diploma had a higher DDSS than all other race-sex groups. Household composition did not affect the overall variety of the diet of the HANDLS participants. Variety is an essential component of a healthful diet and although household composition was not significant, other more comprehensive measures of diet quality could be influenced by household composition.

Chapter 1

DEFINITIONS

Diet Quality

There is no standardized definition for diet quality within the literature. It is understood however that diet quality is dependent upon a person's whole diet and the types of foods or nutrient composition related to them. [1] For the purpose of this study, diet quality was measured in terms of DDS.

Diet Diversity

Diet diversity is defined as the number of different foods or food groups consumed over a given reference period. [2] A diet diversity score (DDS) is calculated using a point-based scoring system based on food group consumption designed by an organization such as the Food and Agriculture Organization (FAO) or other researchers. A higher score denotes a higher diet quality, while a lower score denotes a lower diet quality. Minimum and maximum scores can vary based on the population being studied as well as the number of food groups included, so it is important to make this apparent when disseminating results. For this thesis, DDS were calculated using two different methods, the food score and the serving score.

Diet Diversity Food Score (DDFS)

Diet diversity food scores (DDFS) are used to determine overall consumption of a food group. If any amount of a food group is consumed within a study day, that

person receives a point for that food group. Points for this kind of analysis are often on the lower side because it is meant to only show access to food. For this study, a score from zero to eight was possible because of the maximum of eight food groups included. As an example, if all a study participant consumed in a day was a ham and cheese sandwich on whole grain bread, then they would receive a point in the total protein, dairy, and whole grain category for that day, totaling three points.

Diet Diversity Serving Score (DDSS)

Diet diversity serving scores (DDSS) show the total amount from each of the eight food groups consumed in a 24-hour period. Since these scores are based off of the Healthy Eating Index (HEI)-2010, a point is received every time a particular serving size is reached in a food group, with a maximum of five points per food group being allotted.[3] With a range of zero to five within each food group in this scoring system, it allows a more comprehensive view of a participants diet, and in turn, overall diet quality. A higher score was indicative of multiple servings being consumed, leading to a higher diet quality. Scores in this study for DDSS can range from zero to forty.

Household Composition

Household composition is defined by the amount of people living together under one roof and their relationships to each other.[4] Household composition has been seen to have an effect on economic stability, mental stability, employment levels, and diet quality.[5-7] In the literature, family structure is often a word used interchangeably with household composition. Household composition was broken down into four groups;

(1) children and spouse always present (2) children always present with spouse never present, (3) no children present with spouse always present, and (4) no children, spouse never present, for this study to determine reasons for differences in diet quality based on the environment in which people live.

Literacy

Literacy is defined as "the ability to use printed and written information to function in society, to achieve one's goals and to develop one's knowledge and potential."[8] It's been found that about half of the American population has difficulties with reading and comprehension skills.[9] This finding may also effect a persons ability to read and understand recommendations about ones health, otherwise known as health literacy. Throughout HANDLS data, the Wide Range Achievement Test-3 (WRAT-3) has been used to evaluate literacy.[10] Kuczmarski and colleagues found an independent and synergistic association of literacy and education with diet quality measured by the HEI-2010 for this HANDLS population.[11]

Chapter 2

REVIEW OF THE LITERATURE

Diet Variety and Quality

Diet variety is defined as eating foods from various food groups. Variety is often viewed to improve eating patterns by providing the vitamins, minerals, and macronutrients that are required for optimum health. [12] Increasing the variety of food choices can shift the focus from individual foods to the quality of the total diet. Therefore, diet variety is an essential component to ensure high diet quality. [13]

Healthy Eating Index

The HEI-2010 is known to be a valid and reliable indicator of diet quality, which was created to document compliance to the Dietary Guidelines for Americans (DGA) 2010. [3] The original HEI-1995 included a component on variety. To receive the maximum score for this component an individual needed to consume 16 or more different foods over a three-day period. Less than one-third (32.8%) of the United States (US) population examined in the Continuing Survey of Food Intake by Individuals 1999 achieved the recommended amount of variety in dietary patterns. [14]

Later versions of the HEI dropped this component even though the DGA has continually recommended the public to consume a wide variety of foods. [15] The HEI-2010 is comprised of a pre-determined list of foods and portion sizes in which each individuals diet can be applied to measure compliance to the DGA. This measure has been inversely associated with cardiovascular disease, cancer, and all-cause mortality. [16,17]

The HEI-2010 has also been used to measure national progress towards federal goals. Wilson et al used National Health and Nutrition Examination Survey (NHANES) data from 1999-2000 and 2011-2012 to calculate a national mean HEI score of 49 (out of 100) in 1999-2000, which increased to a 59 in 2011-2012, showing vast improvement. [18] Although the average total HEI increased, it may not be increasing at rate fast enough to reach the Healthy People 2020 goals for diet. [18] These findings suggest that national improvements in diet quality are required. Diets of low socioeconomic, diverse populations are often low quality, and may be targeted for improvement. In addition to the HEI, there are various other known ways to determine an individual's diet quality. This study focused on the assessment of diet quality indicated by DDS. [19]

Diet Diversity Scores

The term diet diversity has been used interchangeably with the term diet variety within the literature. While variety seems to be difficult to quantify, diet diversity generally has a score related with it. Diet diversity is defined as the consumption of a number of different foods or food groups over a given reference period. [2] DDS have been seen to be as good of a predictor of dietary and disease risk biomarkers when compared to the HEI. [20] Unfortunately, consuming a diet high in diversity is something that many populations in the United States have difficulty achieving on a daily basis. [21]

DDS are often used in developing countries to determine a family's or individual's access to food. While this is how diversity scores began, they are

beginning to be more widely used in developed areas such as Canada [22], Asia [23], and the United States [20,21], and confirm the well-documented positive relationship as an alternate measure of diet quality [24].

DDS for an individual (IDDS) or a household (HDDS) can be used as a diet quality indicator. IDDS attempt to show the range of food groups and micronutrient content in a person's diet, while HDDS are meant to provide an indication of household economic access to food. [25] For this research study, DDS were used.

In 2013, the Food and Agriculture Organization (FAO) published preliminary guidelines for measuring IDDS. In these guidelines, the FAO showed an example of how a DDS would be calculated. Before a score is generated, a 16-item questionnaire reflecting 24-hour dietary intake is completed (Appendix A). The food intake is then grouped, in this case, into 14 food groups for determining IDDS scores. These food groups provided by the FAO include cereals, vitamin A rich vegetables and tubers, white tubers and roots, dark green vegetables, other vegetables, vitamin A rich fruits, other fruits, organ meat, flesh meats, eggs, fish, legumes (nuts and seeds), milk/milk products, oils and fats, sweets, and finally, spices/condiments/beverages. [25]

Information on consumption of individual food groups can also be used to investigate dietary patterns. [25] However, there is no international consensus on which food groups to include in the scores, so it is recommended that the population, and their most popular food groups, be taken into account before administering the questionnaire. [25] To calculate scores, the FAO states that it is up to the research team to determine gram weights for cut offs for food in order to gain a point for DDS. Once

total scores are generated, tertiles are sometimes used in data analysis. These tertiles are population-defined, thus not standardized, therefore they cannot be used across different studies. [26] Since low diet qualities are prevalent, it is pertinent to look at them from different approaches. Calculating DDS's is another way to look at diet quality while having the freedom to alter food groups based on the population being studied.

Individual Diet Diversity Scores

IDDS are meant to reflect the nutritional quality of the diet. [25] Scores have been positively correlated with adequate macronutrient and micronutrients in adults. [2,23] In five out of seven studies reviewed by Ruel, dietary diversity scores were strongly associated with a positive micronutrient adequacy. [27] IDDS have been used to determine micronutrient consumption largely in women [23,28-30], infants (6-24mo) [31,32], and occasionally school children [33], especially in developing countries such as Mali [30], Kenya [33], Burkina Faso [28], Vietnam [23], South Africa [29], Madagascar [31], and the Philippines [32]. IDDS have not widely been used in stabilized developed countries, apart from a study completed in the United States in 1991. [21]

A review of the literature revealed that investigators use either the 24-hour recall, or food frequency questionnaire (FFQ) and varying numbers of food groups to determine an IDDS (Appendix B). Food groups for each population vary reflecting the most commonly consumed foods. In countries where diets are perceived as monotonous, fewer groups are represented in the DDS. For instance, participants in the Burkina Faso study ranged from a DDS of two to ten (mean 8.3), with fourteen being the maximum score available, meanwhile in Vietnam, participants ranged from

a score of five to eleven (mean between eight and nine dependent on region), with a maximum of twelve food groups available. [23,28] In both studies, neither group of participants ate a high enough variety of foods to reach the maximum score. Additionally, within the Vietnam population, women from two minority groups had significantly lower DDS than those who were native Vietnamese ($p<0.001$). These findings are often attributed to poverty or inaccessibility to food. [23]

Women from Burkina Faso with low scores had basic diets, consuming food from only three groups at most. [28] Their diets were generally composed of the traditional foods such as cereals, leafy greens and condiments. Women with medium to high scores on the other hand generally consumed fish, meat, nuts and sugar. In Kenya, school children were found to have a mainly cereal based diet, lacking fruits, vegetables, and dairy, leading researchers to discover an inadequacy of intake for 75% of all nutrients in the diet. [33] Populations from South Africa, Madagascar, and the Philippines also had a diet consisting largely of grains, cereals and tubers, which are common characteristics of diets for people with a low socioeconomic status. [29,31,32]

Men, compared to women, are not widely represented in DDS studies because micronutrient inadequacies are not as commonly seen among men in developing countries. A study done in Mali by Torheim et al. however, used both men and women. [30] This study was conducted to examine the association DDS and nutrient adequacy scores. To collect the data for nutrient adequacy scores, two days of direct weighing of meals (with a cut off of 0.1g per food group) was completed and analyzed for specific nutrients such as energy, protein, fat, vitamin A, thiamin, riboflavin,

niacin, vitamin C, calcium and iron. A useful contribution of this study was the comparison of the two diversity measures in a regression analysis, which showed that DDS (based on food groups) is a stronger determinant of nutrient adequacy than a food variety score (FVS), which based on individual foods. Many other studies also reported nutrients consumed, focusing mostly on women [23,29,31-33] with one study finding an IDDS of women were similar to IDDS of men. [30]

In DDS research in developed countries, men are more commonly included. In 1991, Kant and associates used the NHANES II data to measure dietary diversity, focusing on race and sex. [21] This study used only five food groups- dairy, meat, grain, fruit and vegetables. Two approaches were used to assess diet diversity- a food group score and a serving score based on data collected with a 24-hour recall. For the food group score, consuming a food from a specific food group received a score of one, resulting in a maximum score equal to five. For the serving score approach, a point per food group was given if the individual consumed between 15-30g of the food per day (depending on the food group), allowing a maximum score of 20. The investigators reported that approximately 65% of whites and 78% of blacks scored below a five on the food group score. Additionally, more than 40% of all blacks scored zero to three on the food group score as compared to the 25% of whites. Notably, the mean food group score increased with age in white men, white women and black women. Additionally, with increasing education and income, the diversity scores also increased across all sex and race groups. In terms of the serving score, the mean score

for men was a 14, while for women it was a 12. Only 16% of the US population reported a high score between 17-20. [21]

Household Composition and Diet

Household composition is often used interchangeably with the term family structure, referring to the makeup of a family residing in a household. Household composition has been found to be correlated with the amount and types of foods consumed in a household. [34] Most research done has focused on food insecurity, and its effect on the amount of food available in a household. [35] It has been seen that diet diversity and food insecurity are associated; however, to date no studies have been found that focus on diet diversity and household composition.

According to USDA data, households headed by single mothers have had the highest rates of child food insecurity whereas people living with a spouse in households have the lowest rates (18.7% vs 6.3%). [36] The relationship between living alone and food/nutrient intake exists with men and women living alone consuming less of fruits, vegetables, meat, seafood, and eggs when compared to cohabitating people. [5,37] A cross-sectional study done in Japan on 600 adults focusing on family structure and its effect on health and quality of life, showed that families that were coupled, or contained two or more people showed the highest proportion of having regular meals daily and a healthier overall diet when compared to people who lived alone. [7]

Few studies provide evidence that living with a spouse is positively associated with food behavior and compliance with dietary guidelines among both men and

women. [6,38] In a study done by Davis and colleagues on living arrangements and diet patterns, it was found that men who had incomes below the poverty level and were living alone had low DDS. For women, however, it was seen that this association is less apparent, and that having a spouse or not does not show a great effect on diet diversity. [39]

Parental status has been seen to be a determinant of food behavior for women, but not for men. [6] It was also seen that mothers with children under the age of fourteen have better diet quality than those with high school aged children. [6,40] Low-income mothers are often faced with an inadequate amount of food when money is tight. In these situations, children typically eat first leaving the mother with maternal deprivation and ultimately a lower diet diversity, measured by different food. [38,41] Although low-income families may have a lower access to food, it is known that the association between family structure and food behavior remains similar regardless of which indicator of socioeconomic status is used. [6]

Literacy and Education

Literacy is defined as "the ability to use printed and written information to function in society, to achieve one's goals and to develop one's knowledge and potential."[8] Health literacy on the other hand is defined by the degree to which individuals have the capacity to understand basic health information to make appropriate decisions about personal health, is a growing area of research. To be able to understand claims and information that is portrayed to the public on major health issues is crucial. In a study done by Wiig-Dammann and colleagues, it was found that some women were

not sure what was wrong or right when it came to purchasing food for herself and her family. [41]

Inadequate health literacy and education could impact day-to-day decisions on buying, cooking, and consuming food, which in turn could lead to a lower diet quality, or DDS. Among the HANDLS study population literacy and education have a synergistic relationship in predicting diet quality. Higher educational attainment and literacy levels are associated with both higher HEI-2010 and mean nutrient adequacy scores. [42]

Chapter 3

PURPOSE OF THE STUDY

The primary aim of this study was to explore the association between household composition and DDS in an urban population of African American and White adults.

We hypothesized that individuals that have a spouse present and always have children in the household will have a higher DDS than those who do not have a spouse present in the house, but always have children present.

Chapter 4

METHODS

Healthy Aging in Neighborhoods across the Life Span (HANDLS) study and population

This study was designed as a community-based prospective study that focused on the influence of race and socioeconomic status (SES) on health in an urban population. The baseline sample (n=3720) included Whites and African Americans ages 30-64 living in 13 pre-determined neighborhoods in Baltimore, Maryland between 2004-2009. The study design provided equal sampling of four factors: age, sex, race, and SES. [43]

Data for Wave 3 were collected in two sessions between 2009-2013. The first session occurred on the Mobile Research Vehicles (MRV) and the second, by telephone. Data collected on the MRV included 24-hr dietary recall, cognitive evaluation, medical history, physical examination, and psychophysiology assessments such as heart rate variability, arterial thickness, muscle strength and bone density. The second session was scheduled approximately four to ten days after the first session. During this session, the second 24-hr dietary recall and dietary supplement questionnaire were administered. Only participants completing both dietary recalls in Wave 3 (n=2140) were included in the analyses for this study (see consent forms in Appendix C). [44]

Dietary Methods

The United States Department of Agriculture's (USDA) Automated Multiple-Pass Method (AMPM) was used to collect 24-hour recalls. [45] Intake data were collected over a 24-hr span from the previous day starting and ending at midnight. The AMPM collects data through five steps: quick lists, forgotten foods, time and occasion, detailed description, and final probe. These steps enhance the accuracy and completeness of the food record from the respondent. [45] A trained interviewer conducted both the first and second dietary interviews. In Wave 3, the first interview was completed in-person and the second by telephone. Visual aids and a food model booklet were given to the respondents to increase accuracy in measuring portion sizes. After interviews were completed, foods were coded using Survey Net to match food from the Food and Nutrient Database for Dietary Studies (FNDDS), Version 5.0 (2009-2010). [46] From these codes, energy, macronutrients, and micronutrient intakes are calculated.

Diet Diversity Scores

Since the HEI is considered a valid and reliable measure of diet quality, we judged its scoring system versatile enough for DDS calculations. HEI-2010 total scores and DDSS were highly correlated (Pearson correlation = 0.846; $p<0.01$). The data the HEI used to quantify point equivalents to food amounts is based off of USDA's DGA size recommendations, with the highest possible score being 100. [3] DDS were created using the HEI-2010 adequacy component scores for eight food groups. [43] These groups were total fruit, whole fruit, total vegetables, greens and

beans, whole grains, dairy, total protein foods, and seafood/plant proteins. HEI-2010 defines a serving size cut off for each component food group that is tailored to sex and age groups (Table 1). Per past research, all DDS are traditionally given the same point weight to maintain consistency across food groups. Regardless of the approach, scores were calculated for two recall days and then averaged.

DDFS

DDFS was calculated by assigning one point if food was consumed in a component food group, regardless of the amount eaten, and zero was assigned to groups that contained foods not eaten (Table 1). The DDFS provided an idea if a person consumed a morsel of food from any of the eight food groups per day. Points were summed from each study day individually and then averaged. The maximum score possible was eight.

DDSS

For all food group components, except whole grains and dairy, the HEI-2010 scores show a zero to five point range.[3] For whole grains and dairy, groups that had a zero to ten point range on the HEI component list, the HEI score was calculated and then divided by two, resulting in values that ranged between zero and five in order to remain consistent with the other food groups (Table 1).

To calculate DDSS, like DDFS, the eight HEI-2010 component scores for both days were summed and then averaged. Eight groups with a maximum of five points each generated the maximum DDSS of 40. To reach the maximum score of 40, an individual would have to consume the maximum amount of servings of each of the

food groups as determined by the DGA on both days that these 24-hour recalls were collected. [15]

Household Composition

The main variable, labeled household composition, was formed as a result of a cross between two other variables from HANDLS data. These variables were answers to the question "are you living with any children under 18" (Children or No Children) and "does your spouse or significant other live with you" (no, sometimes, always). Participants who answered 'sometimes' were excluded from analysis because of the ambiguity of the word sometimes. Aggregation of the variables resulted in 4 distinct categories: (1) Children in the house as well as a spouse always present. (2) Children in the house, but never has a spouse present. (3) No children in the house, but always has a spouse present. (4) No children in the house and never has a spouse present. This grouping was followed because of the possibilities of participants being married, but not necessarily contributing to the household duties such as caring for children. Among HANDLS participants there is almost an equal amount of single men caring for children as there are single women caring for children.

Demographic Characteristics

SES was defined as above or below 125% of the 2004 federal poverty guidelines. [43] Education was defined as the highest grade of school completed combined into two categories: high school diploma and above (12+ grades) or less than a high school diploma (completion of < 12 grades of school). Wide Range Achievement Test-3 (WRAT-3) raw scores were used to determine literacy level in

the population. Raw WRAT-3 scores are a basic unit of test measure and are combinations of the three tests that make up the WRAT-3.

Statistical Analyses

For the statistical analysis for this study, SPSS Version 24 was used. Descriptive statistics were run for demographics. Means and standard error were used for continuous data: age, WRAT-3, DDFS, and DDSS, while frequencies and percentages were used for categorical data: sex, SES and education. Normality was checked for both DDFS and DDSS using the Sharpiro-Wilk test, and both were found to have non-normal distributions ($p<0.001$). Correlations were also run between variables, and it was found that literacy (WRAT-3) and education were significantly correlated ($r=0.305$; $p<0.01$). As a result, only the education variable was used in the model because of a higher available sample ($n=1,571$) as compared to literacy ($n=934$). The data on literacy can be found in Appendix D.

One-way Analysis of Variance (ANOVA) was used to compare household composition for age, DDFS, and DDSS for men and women separately. Data were also stratified by race. Post-hoc Sidak analysis was used to determine the significance between household composition groups. Significance was set at $p<0.05$ throughout the study.

Block linear regression models were used to explore the relationship between DDS and household composition. Multiple regressions were run on both DDFS and DDSS, with the final model including three blocks. Block one included control variables such as sex, race, age, SES, and education. Block two introduced the

predictors that we are looking at for effects, presence of spouse and presence of kids. Finally, the third block included the interaction terms of race*SES and race*sex.

Chapter 5

RESULTS

Sample Characteristics

The final study sample size consisted of 1,610 participants, 57% (n=930) African Americans and 43% (n=680) Whites. Approximately 58% (n=940) of the sample was women while 42% (n=670) of the sample was men. The mean (± SE) age of the population was 52.8(± 0.22) years old (range 32-70). It was found 612 (38%) of all participants reported incomes below 125% of the 2004 federal poverty guidelines, of those, approximately 30% were White and 43% were African American. Of the 934 participants with valid literacy data, the mean (± SE) score for this population was 42.13(± 0.27). Of the 1,571 participants with education data available, 69% (n=1095) had a high school education or above (Table 2).

Among the household groups, more participants in the sample did not have children (n=1004) compared to those who did (n=606). Overall, there were more participants with spouses that had children in the household (n=359) than those who did not have spouses but still had children in the household (n=247). The highest household composition group was composed of those who did not have children and did not have a spouse (n=603).

There were no significant differences in age, education, or household composition between African Americans and Whites (Table 2). There were significantly more African Americans with incomes <125% poverty level than of their white counterparts (Table 2). Additionally, literacy scores were significantly different

between Whites and African Americans, with Whites having the higher score (Table 2).

Between men and women, there was a significant difference in mean age for two of the four groups of household composition ($p<0.001$). The mean age of men was greater than women in households who do not have children, but always have a spouse present, ($p=0.034$) while in households who have no children, with spouse never present women were older than men ($p=0.008$) (Table 3). There were no sex differences across household composition. SES was significantly different between men and women for households containing children, but not a spouse ($p=0.004$) (Table 3). There were more women living below the poverty line when compared to men across three of the four household groups (Table 3).

With respect to education there were more White women (34.1%) than African American women (20.9%) who had less than a high school diploma if their households contained both children and a spouse ($p=0.049$) (Table 4). SES was significantly different between races for both sexes for only the household composition groups who had no children and no spouse present (Table 4, 5).

Diet Diversity Food Score

Mean (± SE) DDFS across the whole sample size was 6.64 (±0.31; Range: 0-8). Each category of household composition was analyzed separately, differences weren't found in DDFS between races or by household composition by race (Table 2). However, for both household composition groups with no children, DDFS for women

were significantly higher than men (Table 3). When comparing DDFS by race-sex groups, there were no significant differences (Table 4,5).

Linear regression was used to explore the determinants of DDFS, focusing on whether there was a spouse present in the house, as well as whether there were children under 18 present in the house. Neither the presence of children nor the presence of a spouse were significant in the final model (Table 6). The confounding variables of age, sex, race, education and SES were significant predictors of DDFS. When the interaction terms of race*SES and race*sex were introduced, there was a statistically significant ΔR^2 seen (ΔR^2=0.004; p=0.026), with a final R^2 = 0.055. Figure 2 shows a plot of the interaction terms of race*SES, which showed a significant effect on DDFS (p=0.010). Although White participants had a lower mean DDFS with incomes below the poverty level when compared to African Americans, they had a much sharper increase of DDFS when moving towards a higher SES (Figure 2). However, the interaction term of race*sex did not have a statistically significant effect on DDFS (Table 6).

Diet Diversity Serving Score

The mean DDSS was 16.62 (±0.15; Range: 0-40) across the sample population. Across all participants, households with no children in the home but a spouse always present had the highest DDSS at 17.40 (±0.307), meanwhile households with children but a spouse never present had the lowest DDSS of 15.61(±0.304) (data not shown).

When examining the sample population by race, both White and African American participants saw their lowest DDSS scores when there were children in the household, but no spouse present [W:15.69 (± 0.589); AA:15.58 (± 0.353)] respectively (Table 2). The highest scores for both White and African American participants were found with no children and a spouse always present. Unlike the lowest scores, the highest scores were significantly different by race [W: 18.04 (± 0.43); AA: 16.60 (± 0.42)] (p=0.020) (Table 2).

Overall, when comparing DDSS by sex and household composition, significance was only seen in households with no children and no spouse, with women having a higher score than men (p<0.001) (Table 3). Mean DDSS was only significantly different by race across two groups of household composition for women, specifically in instances where there were no children in the house (p<0.05). White women had a higher DDSS than African American women. No statistical significance was seen for men.

When the dependent variable of diet quality in the linear regression model was DDSS, the final model showed that being a woman (b=-1.714; p<0.001), White (b=-1.787; p<0.001), older (b=0.088; p=<0.001), of higher SES (b= -2.360; p<0.001) with a high school diploma (b=2.027; p<0.001) resulted in having a higher DDSS (Table 7). Presence of a spouse (b=0.251; p=0.403) and presence of children (b=-0.593; p=0.063) was not statistically significant in the model (Table 7). Lastly, when the interaction terms of race*SES and race*sex were introduced, there was a statistically significant ΔR^2 seen (ΔR^2=0.005; p=0.012), with a final R^2=0.092. Also, the

interaction term of race*SES showed a significant effect on DDSS (p=0.012). Figure 3 shows the disparity between the two races regarding SES and DDSS. Both White and African American participants saw an increase in DDSS when entering a SES above the poverty level, however, Whites saw a significantly more dramatic increase (Figure 3). In common with DDFS, the interaction term of race*sex did not have a statistically significant effect on DDSS (Table 7).

Chapter 6

DISCUSSION

To our knowledge, this is the first study to investigate the effect of household composition on diet quality, measured by diet diversity, in a socioeconomically diverse urban population of African American and White adults. We hypothesized that individuals that have a spouse and children present in the household will have a higher DDS than those who do not have a spouse present in the house, but still have children present in the house. Interestingly household composition, namely the presence or absence of a spouse and children, did not have any effect on dietary diversity scores. Regardless of household composition, DDFS and DDSS were associated with sex, age, race, SES, education, and the interaction of race*SES.

In congruence to our findings, a study by Kant et al using NHANES III data from 1988-1994, found that more participants who were women, White, and older than 50 years of age, were in the highest tertile of DDS. [20] Additionally, Torheim et al found that a higher DDS was positively associated with a higher SES; however, in contrast to our study, these same researchers found that DDS was higher in men when compared to women. [30] It is not surprising to find this because in Mali and other developing countries, starchy foods dominate the diet, and it is still common for the men and children to eat first, leading to higher access to a variety of foods than for women. [30] In developed countries there are also cultural and gender differences in food intakes within households that may impact diet diversity. [6]

Higher education was associated with better scores of both DDFS and DDSS. This finding is similar to Kant et al, who found higher DDS scores for those having an education greater than a high school diploma, and in Torheim et al, which found that a higher DDS was positively associated with a higher level of education. [20,30] Previous research with the HANDLS study population found that health literacy was positively associated with diet quality and correlated to education. [42] Health literacy has also been found to correlate with the estimation of portion size and understanding food labels. [47] Since the number of participants who completed the health literacy measures was limited, this variable was not used in the regression models. Thus the DDS observed in this study may reflect the difficulty experienced by the HANDLS study population in eating healthful diets due to less formal education and/or health literacy. Future studies could include measures of health literacy.

DDFS

DDFS were not significantly affected by presence of children or a spouse in the final regression model. This finding was similar to that reported by LaRoche et al in their study examining data of dietary habits of adults before and up to seven years after the entrance of the first child into their home. [48] These researchers found that having a child did not negatively affect the parents' diet, nor did it improve the diet. [48] This lack of effect could possibility be explained by the consumption of the same foods by everyone – men, women and children in the household.

The FAO suggests that between eight and 16 core food groups be included when calculating diet diversity scores. [25] Other researchers recommend the decision

regarding the final number of food groups consider the consumption patterns of the study population. [24] Food diversity of the current study was based on eight food groups, Despite the lack of established criteria for calculating DDFS, the study findings are similar to those published by Kant and colleagues. They based their diversity food score on MyPyramid servings from five food groups - dairy, grain, meat, fruit, and vegetable. [21] Kant et al used a nationally representative sample of African American and White adults examined in the 1976-1980 NHANES II study. These researchers found that 65% of Whites and 78% of African Americans scored below their maximum DDFS of five, while among HANDLS study participants, 68% of Whites and 72% of African Americans scored below the maximum DDFS of eight. This agreement can serve as evidence for reliability of the results across time, as well as for the need to continue improvement of diet quality in the US, a consistent message of the DGAs. [15]

DDSS

Overall, there was no significance in DDSS scores by household composition. This finding was different from previous work. Two studies showed that having a child, but not a spouse, present led to low diet diversity [38,41], while three studies showed that living entirely alone also led to a lower diet diversity [5,7,37]. However, these results have been shown to differ by gender. For example, one researcher showed that having a spouse present in the house leads to a higher diet diversity score [6] but another study found this result to be true only for men [39]. Thus one might speculate that women may have an impact on men's dietary choices during companionship. Studies

by Davis et al and Roos et al both found that income had an effect on DDS in men living alone, with Roos showing that there was no such association seen with women. [6,39] Both researchers' findings have congruence with the current HANDLS sample population, where men without a spouse and without children had lower DDSS than women in the same household situation. On the other hand, women in the HANDLS population who had no spouse present, but had children present, had the lowest unadjusted DDSS compared to women in other household compositions (spouse & children present, spouse but no children). A possible explanation for this finding is that without having the support of a spouse present to assist with aspects of children or income, there can be a negative effect on a women's diet quality.

The current results, which found that overall, the presence of spouse and/or children did not affect DDSS, could also be affected by the participants having a support system in the form of co-workers, neighbors, or family members that don't necessarily live in the house with them. Also, it is possible that there could be other people living in the house not reported as a spouse or a child, who could assist in caring for children, grocery shopping, and preparing meals.

It is a challenge to compare the DDSS for HANDLS study participants to diversity scores calculated by Kant et al for NHANES II participants, given the difference in scoring methods. Kant et al. used the MyPyramid serving scores to generate DDSS with a maximum score of 20 points. The mean score for men and women examined in NHANES was 14 and 12, respectively. Meanwhile in HANDLS, the mean DDSS was 16 and 17 out of a maximum of 40 for men and women, respectively. In an attempt to

compare these findings, the proportion of the sample populations achieving approximately 60% of the maximum score was calculated. More than 40% of African Americans, and 25% of Whites in the NHANES study scored from zero to three, while in the HANDLS population, about 11% of both African Americans and Whites scored from zero to five. The differences in overall diet quality between the studies could be attributed to the alteration in serving sizes and methods within food guidance models, as well as changes in the food supply and consumption. Regardless of these differences, the findings revealed that dietary improvements are needed. The current DGA also acknowledges that improvements are needed in the American diet.

Strengths and limitations

There were several strengths of this study. The HANDLS study targets an understudied population of socioeconomically diverse urban African American and White adults. Additionally, the diet quality scores are based on two 24-hr recalls, similar to commonly used in national cohort studies. Use of recalls provides a better estimation of intake but may not totally reflect typical intake. Also, recalls were completed by trained interviewers using USDA AMPM system to ensure completeness and accuracy of interviews. Most studies have been focused on the effects that parenting has on women since evidence exists that women are more commonly left in charge of children. [38] The current study had almost an equal amount of men caring for children as there were women, which allowed for the exploration of the effects of parenting on men. Finally, the DDSS was calculated using the eight

adequacy components of the HEI-2010 which consist of both episodically and non-episodically consumed foods.

There are some limitations of this study. Considering the study data being collected in a cross-sectional manner, there is limited availability to make cause and effect conclusions observed in the analysis of this data. Additionally, with any kind of dietary recall, there unfortunately is always room for under or over reporting, as well as recall bias. Another limitation could be that other diet quality measures like the Mean Adequacy Ratio (MAR) or Mediterranean diet adherence scores were not calculated and used to confirm the results. Although we have data to do this, it was not the main outcome of the current study at hand. Also, it is important to keep in mind that the population being studied is a socioeconomically diverse urban population, not a representative sample of the entire United States. Additionally, when determining if someone is living alone, with a spouse, or with children, there is always a possibility that the individual has friends or relatives that stay with them for days or weeks at a time, but report that they do indeed live alone. Finally, it should be remembered that diet diversity is reflective of diet variety, which is just one component of overall diet quality, and may not reflect achievement of all dietary goals. [24]

Conclusion

The study findings provide evidence that the presence of children or a spouse in the household does not affect DDFS or DDSS in a socioeconomically diverse urban population of African American and White adults. Variety is an essential component of a healthful diet and although household composition was not significant, other more

comprehensive measures of diet quality could be influenced by household composition. Regardless of household composition, race and SES, as well as the interaction of race*SES, were predictors of diet diversity. Education and SES had the largest effects on determining a DDSS. Diet diversity was better for Whites compared to African Americans and for higher SES groups compared to lower SES groups. These findings corroborate the research that has been done using other dietary measures. Based on the study findings, diet diversity, appears to be a reasonable approach to assess diet quality. Further studies should be done on the aspect of household composition and its effects on diet quality.

TABLES

Table 1 Criteria to Calculate Diet Diversity Food & Serving Scores

Food group	Food Score (DDFS)	Standard for max serving score of 5	Serving Score (DDSS)
Total Fruit[a]	0-1[g]	≥ 0.8 cup equiv. /1000kcal	0-5
Whole Fruit[b]	0-1	≥ 0.4 cup equiv. /1000kcal	0-5
Total Vegetable[c]	0-1	≥ 1.1 cup equiv. /1000kcal	0-5
Greens and Beans[c]	0-1	≥ 0.2 cup equiv. /1000kcal	0-5
Whole Grains	0-1	≥ 1.5 cup equiv. /1000kcal	0-5
Dairy[d]	0-1	≥ 1.3 cup equiv. /1000kcal	0-5
Total Protein Foods[e]	0-1	≥ 2.5 cup equiv. /1000kcal	0-5
Seafood and Plant Proteins[f]	0-1	≥ 0.8 cup equiv. /1000kcal	0-5
Maximum Total:	8	-	40

[a.] Includes 100% fruit juice; [b.] Includes all forms except juice; [c.] Includes any beans and peas not counted as total protein foods; [d.] Includes all milk products, such as fluid milk, yogurt, and cheese and fortified soy beverages; [e] Beans and peas are included here (and not with vegetables) when the total protein foods standard is otherwise not met; [f.] Includes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted as total protein foods. [g.] A score of zero denotes no food from this group present in the diet, a score of one denotes some kind of food from this group in the diet.

Table 2 Sample Characteristics of HANDLS Population by Race

	African American (n=930)	White (n=680)
Sample Characteristics		
Age, X ±SE	52.53 ± 0.29	53.25±0.34
Sex, Women, %	57.8% (n=543)	42.2% (n=397)
SES, Below 125% FPL, %	43.3% (n=403)	29.9% (n=203) ***
Education (<HS diploma), %	30.2% (n=280)	30.4% (n=196)
WRAT-3, X ±SE	40.64 ± 0.34	43.87 ± 0.41***
Household Composition, %		
Children. Spouse Always Present	20.86% (n=194)	24.26% (n=165)
Children. Spouse Never Present	20.43% (n=190)	8.38% (n=57)
No Children Spouse Always Present	19.35% (n=180)	32.51% (n=221)
No Children Spouse Never Present	39.36% (n=366)	34.85% (n=237)
Diet Quality, X ±SE		
Diet Diversity Food Score	6.61±0.04	6.69 ± 0.05
Diet Diversity Serving Score	16.13 ± 0.18	17.29 ±0.25***
DDFS by Household, X ±SE		
Children. Spouse Always Present	6.60 ± 0.09	6.72±0.10
Children. Spouse Never Present	6.59 ± 0.09	6.53 ± 0.15
No Children Spouse Always Present	6.69 ± 0.09	6.80 ± 0.08
No Children Spouse Never Present	6.57 ± 0.07	6.62 ±0.08
DDSS by Household, X ±SE		
Children. Spouse Always Present	15.65 ± 0.35	16.62 ± 0.51
Children. Spouse Never Present	15.58 ± 0.35	15.69 ± 0.59
No Children Spouse Always Present	16.60 ± 0.42	18.04 ± 0.43*
No Children Spouse Never Present	16.44 ± 0.30	17.44 ± 0.45

*p<0.05, **p<0.01**, ***p<0.001 Abbreviations: HANDLS, Healthy Aging in Neighborhoods of Diversity; X, mean; SE, standard error; AA, African American; SES/FPL, socioeconomic status/federal poverty line above or below 125% of the 2004 Federal Poverty Guidelines; <HS Diploma, having less than a high school diploma; DDFS, diet diversity food scores a 0-8 point scale to represent the number of categories of food present in the diet; DDSS, diet diversity serving score a 0-40 point scale indicative of diet quality based on HEI2010 total value.

Table 3 HANDLS Sample Characteristics based on Household Composition and Sex

Characteristics	Children. Spouse Present (n=359)			Children. Spouse Never Present (n=247)			No Children. Spouse Present (n=401)			No Children, Spouse Never Present (n=603)		
	Men (n=178)	Women (n=181)	P-value	Men (n=45)	Women (n=202)	P-Value	Men (n=180)	Women (n=221)	P-value	Men (n=267)	Women (n=336)	P-value
Age, years, X ± SE	48.61 ± 0.63	47.77 ± 0.65	0.357	49.53 ± 1.26	50.44 ± 0.63	0.532	56.08 ± 0.58	54.36 ± 0.55	**0.034**	54.14 ± .48	55.88 ± 0.45	**0.008**
Race, AA, %	57%	51%	0.218	84%	75%	0.185	46%	44%	0.657	61%	60%	0.745
SES, Below 125% FPL, %	32%	34%	0.653	28.9%	52%	**0.004**	29%	25%	0.776	41%	43%	0.629
<HS diploma, %	30%	27%	0.533	25%	35%	0.202	29%	25%	0.384	32%	32%	0.824
Diet Diversity Food Score (DDFS), X ± SE	6.66 ± 0.09	6.64 ± 0.10	0.872	6.31 ± 0.21	6.63 ± 0.07	0.098	6.61 ± 0.09	6.86 ± 0.08	**0.042**	6.44 ± 0.08	6.71 ± 0.06	**0.008**
Diet Diversity Serving Score (DDSS), X ± SE	15.82 ± 0.41	16.37 ±0.45	0.365	15.32 ± 0.77	15.57 ± 0.33	0.663	16.74 ± 0.42	17.93 ± 0.43	0.054	15.83 ± 0.34	17.63 ± 0.36	**<0.001**

P-values <0.05 are considered significant and are bolded. Abbreviations: HANDLS, Healthy Aging in Neighborhoods of Diversity; X, mean; SE, standard error; AA, African American; SES, socioeconomic status above or below 125% of the 2004 Federal Poverty Guidelines; <HS Diploma, having less than a high school diploma; DDFS, diet diversity food scores a 0-8 point scale to represent the number of categories of food present in the diet; DDSS, diet diversity serving score a 0-40 point scale indicative of diet quality based on HEI2010 total values

Table 4 Characteristics of Women HANDLS Sample Population by Race and Household Composition

	Children. Spouse present (n=181)			Children. Spouse Never Present (n=202)			No Children. Spouse Present (n=221)			No Children. Spouse Never Present (n=336)		
	White(n=89)	African American (n=92)	P-Value	White (n=50)	African American(n=152)	P-Value	White(n=124)	African American(n=97)	P-Value	White (n=134)	African American (n=202)	P-Value
Age, years, X ± SE	48.19 ± 0.92	47.38± 0.93	0.538	50.71 ±1.23	50.34 ± 0.73	0.804	54.91 ± 0.74	53.66± 0.83	0.266	55.23±	55.88 ± 0.45	0.232
SES, Below 125% FPL %	20.8% %	14.5%	0.162	19.2 %	32.9%	0.468	25.6%	11.6%	0.502	34.4%	41%	**<0.001**
<HS diploma, %	34.1%	20.9%	**0.049**	44.9 %	31.8%	0.095	25.9%	24.7%	0.852	27.7%	34.2%	0.228
Diet Diversity Food Score (DDFS), X ± SE	6.67 ± 0.15	6.62 ± 0.14	0.787	6.58 ±0.17	6.65 ±0.09	0.698	6.99 ±0.12	6.70 ±0.13	0.086	6.75 ± 0.12	6.68 ± 0.08	0.607
Diet diversity Serving Score (DDSS), X ± SE	16.63 ±0.73	16.12 ± 0.51	0.574	16.02 ± 0.64	15.56 ± 0.38	0.549	18.91 ± 0.60	16.68 ± 0.60	**0.011**	18.57 ± 0.64	17.01 ± 0.41	**0.032**

P-values <0.05 are considered significant and are bolded. Abbreviations: HANDLS, Healthy Aging in Neighborhoods of Diversity; X, mean; SE, standard error; AA, African American; SES, socioeconomic status above or below 125% of the 2004 Federal Poverty Guidelines; <HS Diploma, having less than a high school diploma; DDFS, diet diversity food scores a 0-8 point scale to represent the number of categories of food present in the diet; DDSS, diet diversity serving score a 0-40 point scale indicative of diet quality based on HEI2010 total values.

Table 5 Characteristics of Men in HANDLS Sample Population by Race and Household Composition

	Children. Spouse present (n=178)			Children. Spouse Never Present (n=45)			No Children. Spouse present (n=180)			No Children. Spouse Never Present. (n=267)		
	White (n=76)	African American (n=102)	P-Value	White (n=7)	African American(n=38)	P-Value	White(n=97)	African American(n=83)	P-Value	White (n=103)	African American (n=164)	P-Value
Age, years, X ± SE	48.60 ± 0.95	48.62 ± 0.85	0.988	49.63± 3.63	49.51 ± 1.36	0.974	56.49 ± 0.80	55.61± 0.86	0.461	54.89 ± 0.74	53.67 ± 0.63	0.217
SES, Below 125%FPL, %	26.9 %	23.4%	0.281	2.6 %	7.1%	0.984	32.1%	17.5%	0.321	38.5 %	51.9%	**<0.001**
<HS diploma, %	28.7 %	31.3%	0.713	16.6 %	26.3%	0.622	31.8%	25.5%	0.441	29.9 %	34.6%	0.380
Diet Diversity Food Score (DDFS), X ± SE	6.77 ± 0.15	6.59± 0.12	0.319	6.14 ± 0.40	6.34± 0.24	0.736	6.55 ± 0.12	6.67± 0.14	0.518	6.43 ± 0.12	6.44 ± 0.10	0.989
Diet diversity Serving Score (DDSS), X ± SE	16.62 ± 0.71	15.22 ± 0.48	0.92	13.36± 1.15	15.69 ± 0.89	0.251	16.93 ± 0.61	16.52± 0.59	0.626	15.98 ± 0.59	15.73 ± 0.42	0.730

P-values <0.05 are considered significant and are bolded. Abbreviations: HANDLS, Healthy Aging in Neighborhoods of Diversity; X, mean; SE, standard error; AA, African American; SES, socioeconomic status above or below 125% of the 2004 Federal Poverty Guidelines; <HS Diploma, having less than a high school diploma; DDFS, diet diversity food scores a 0-8 point scale to represent the number of categories of food present in the diet; DDSS, diet diversity serving score a 0-40 point scale indicative of diet quality based on HEI2010 total values.

Table 6 HANDLS Regression Results of Household Composition and Diet Diversity Food Scores

		DDFS	
	Predictor	b ± (SE)	P
Block 1	Sex (ref: Women)	-0.268 (0.097)	**0.006**
	Race (ref: White)	-0.206 (0.096)	**0.033**
	Age, y	0.015 (0.004)	**<0.001**
	SES (ref: <125% FPL)	-0.433 (0.105)	**<0.001**
	Education (ref: <HS diploma)	0.377 (0.068)	**<0.001**
Block 2	Presence of Spouse	0.098 (0.065)	0.128
	Presence of Kids	0.034 (0.069)	0.625
Block 3	Race x SES	0.339 (0.132)	**0.010**
	Race x Sex	0.122 (0.126)	0.334
Model Fit	R2	0.049	**<0.001**
	ΔR2 with Block 2	0.002	0.274
	ΔR2 with Block 3	0.004	**0.026**

P-values <0.05 are considered significant and are bolded. Abbreviations: HANDLS, Healthy Aging in Neighborhoods of Diversity across the Lifespan; SES, socioeconomic status above or below 125% of the 2004 Federal Poverty Guidelines; SE, standard error; HS, high school diploma.

Table 7 HANDLS Regression Results of Household Composition and Diet Diversity Serving Scores

		DDSS	
	Predictor	b ± (SE)	P
Block 1	Sex (ref: Women)	-1.714 (0.452)	**<0.001**
	Race (ref: White)	-1.787 (0.448)	**<0.001**
	Age, y	0.088 (0.017)	**<0.001**
	SES (ref:< 125%)	-2.360 (0.488)	**<0.001**
	Education (ref: <HS diploma)	2.027 (0.315)	**<0.001**
Block 2	Presence of Spouse	0.251 (0.300)	0.403
	Presence of Kids	-0.593 (0.319)	0.063
Block 3	Race x SES	1.541 (0.613)	**0.012**
	Race x Sex	1.010 (0.588)	0.086
Model Fit	R2	0.084	**<0.001**
	ΔR2 with Block 2	0.002	0.131
	ΔR2 with Block 3	0.005	**0.012**

P-values <0.05 are considered significant and are bolded. Abbreviations: HANDLS, Healthy Aging in Neighborhoods of Diversity across the Lifespan; SES, socioeconomic status above or below 125% of the 2004 Federal Poverty Guidelines; SE, standard error; HS, high school diploma.

FIGURES

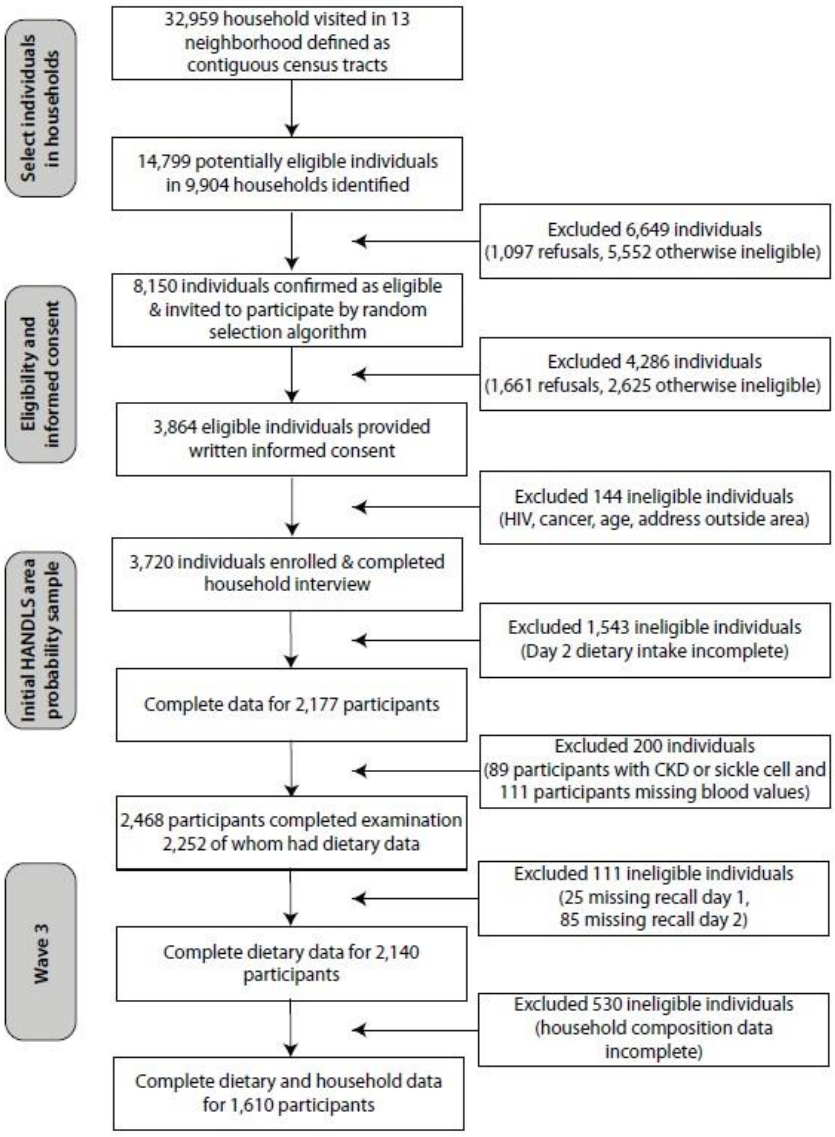

Figure 1 Flow Diagram Of Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) study household screening, participant eligibility, and response rates.

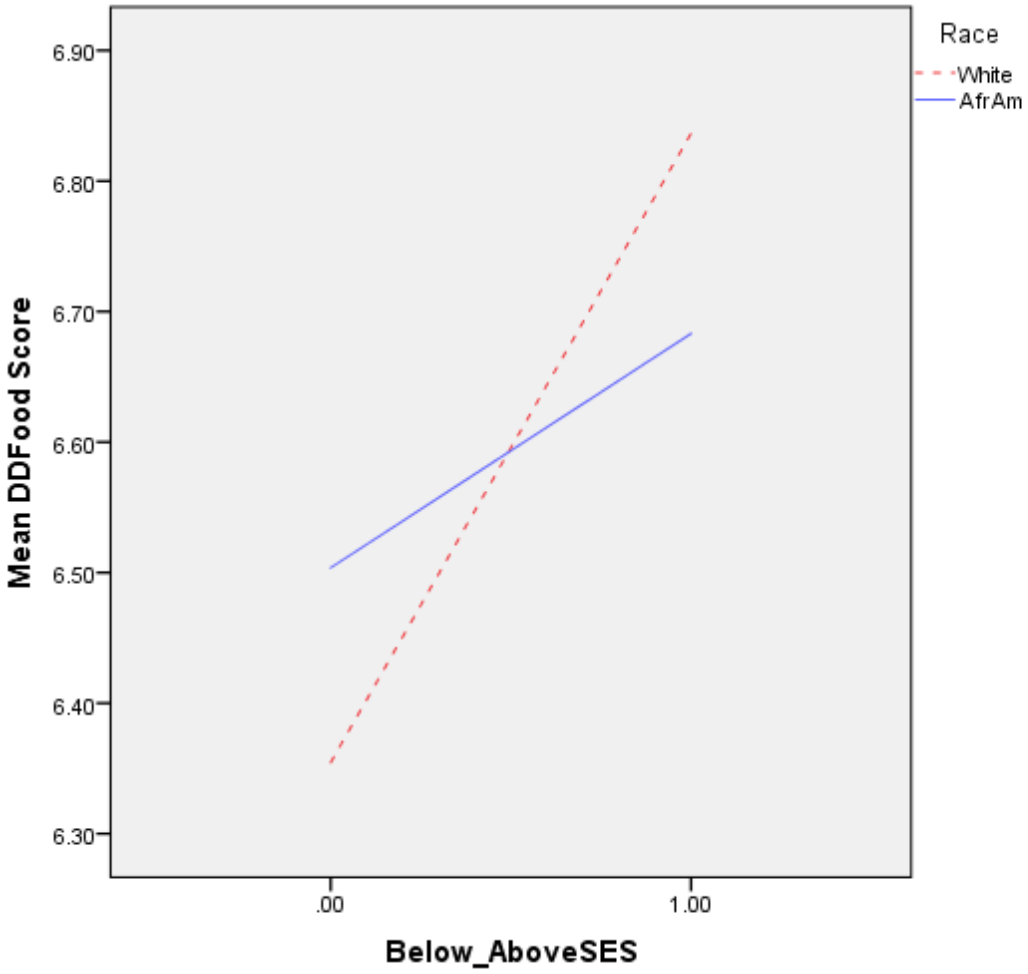

Figure 2 Interaction of Race*SES and mean DDFS

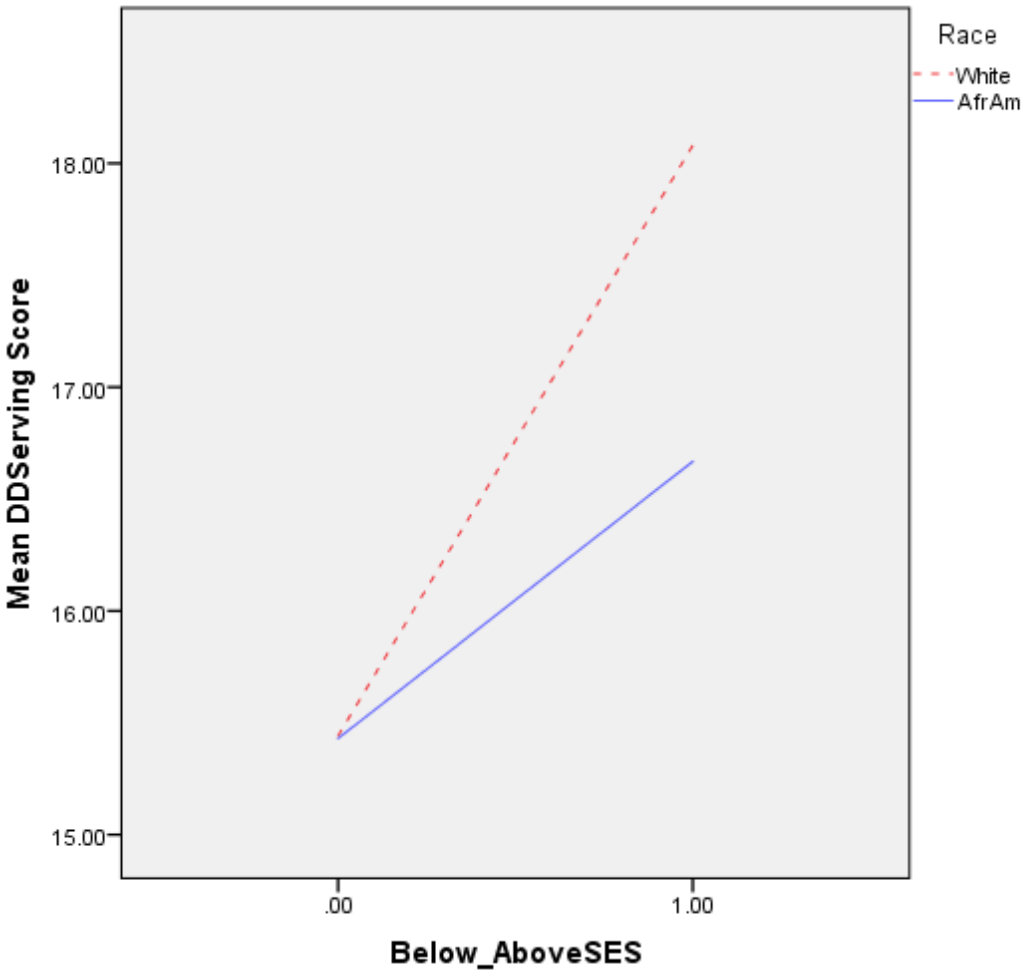

Figure 3 Interaction of Race*SES and mean DDSS

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Appendix A

FAO DIET DIVERSITY GUIDELINE QUESTIONNAIRE

Guidelines for Measuring Household and Individual Dietary Diversity

Question number	Food group	Examples	YES=1 NO=0
1	CEREALS	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + *insert local foods e.g. ugali, nshima, porridge or paste*	
2	WHITE ROOTS AND TUBERS	white potatoes, white yam, white cassava, or other foods made from roots	
3	VITAMIN A RICH VEGETABLES AND TUBERS	pumpkin, carrot, squash, or sweet potato that are orange inside + *other locally available vitamin A rich vegetables (e.g. red sweet pepper)*	
4	DARK GREEN LEAFY VEGETABLES	dark green leafy vegetables, including wild forms + *locally available vitamin A rich leaves such as amaranth, cassava leaves, kale, spinach*	
5	OTHER VEGETABLES	other vegetables (e.g. tomato, onion, eggplant) + *other locally available vegetables*	
6	VITAMIN A RICH FRUITS	ripe mango, cantaloupe, apricot (fresh or dried), ripe papaya, dried peach, and 100% fruit juice made from these + *other locally available vitamin A rich fruits*	
7	OTHER FRUITS	other fruits, including wild fruits and 100% fruit juice made from these	
8	ORGAN MEAT	liver, kidney, heart or other organ meats or blood-based foods	
9	FLESH MEATS	beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds, insects	
10	EGGS	eggs from chicken, duck, guinea fowl or any other egg	
11	FISH AND SEAFOOD	fresh or dried fish or shellfish	
12	LEGUMES, NUTS AND SEEDS	dried beans, dried peas, lentils, nuts, seeds or foods made from these (eg. hummus, peanut butter)	
13	MILK AND MILK PRODUCTS	milk, cheese, yogurt or other milk products	
14	OILS AND FATS	oil, fats or butter added to food or used for cooking	
15	SWEETS	sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cakes	
16	SPICES, CONDIMENTS, BEVERAGES	spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages	
Household level only	Did you or anyone in your household eat anything (meal or snack) OUTSIDE the home yesterday?		
Individual level	Did you eat anything (meal or snack) OUTSIDE the home yesterday?		

Appendix B

SUMMARY OF KEY FINDINGS IN ALL DDS STUDIES RESEARCHED

Country/Author	Population being studied	Collected Data	Cut off point	Nutrient Focus	Major Finding
Mali (IDDS) Torheim	Adults Men and Women 15-69yo	2d Direct weighing of meals and 7day FFQ DDS range: 4-10 max 10	0.1g (as long as it was consumed)	Food groups and NAR scores for: energy, protein, fat, vit A, thiamin, riboflavin, niacin, vit c, calcium, iron	For men the two diet variety scores seem to be relatively good indicators for nutrient adequacy For women, there was less agreement between the diet variety scores and nutrient adequacy. Being male, having a higher SES and higher education led to a higher DDS, age was negatively associated. This study suggests that FVS, DDS and MAR can be assessed by a FFQ.
Mozambique (HDDS) Drenowski	*Adults*	*24hr recall*	*Not noted (HDDS)*	Food groups and : energy, protein, vit A, iron (**at the HH level)**	-

Burkina Faso (IDDS) Savy	Adults (women mothers)	24 hr recall DDS range 2-10 /max 14	"the frequency of consumption and amount of food consumed were not taken into account" (women all ate from communal bowls, asked for ingredients)	Food groups no micronutrients	Hardly ever consumed roots or tubers, milk or dairy products, eggs, fruit or drinks.- resulting in low DDS- reflecting poverty Women with lowest scores basic diets of 3 foods Larger number of women with high scores when the level of properties of the household was higher, when the hygiene index of the household was better, and when the head of the household had received a basic education. It was also apparent that the proportion of underweight women was much higher among women belonging to the category of low dietary scores
Vietnam(IDDS) Ogle	Adult Women	7d FFQ DDS range: 5-11 max 12	Not noted	Food groups, and : energy, CHO,PRO,fat, Ca, Fe, Zn, Vit A, B1, B2, B3, Folate, Vit C	- Mostly comparing wild vegetable intake between two rural villages in Vietnam using a rapid FVS. Noted DDS was used to compare nutrient adequacy.
South Africa (IDDS) Acham	Adult Women	24 hr recall 3 non consecutive days DDS: mean 6 food groups max 9 Used a mean DDS of 4 to be a 'low' DDS	Not noted	Food groups and: NAR of : Ca, Fe, Z, Vit A, B1, B2, B3, B6, folate, B12, Vit C	Grains/cereals/tubers most consumed food group, followed by flesh foods and dairy. Less than 50% of population reported consuming cabbage/beet root/onion/green beans, but still were reported as top consumed vegetables
Madagascar (IDDS) (most like HANDLS in terms of DDS) Moursi	Babies 6-23mo	24 hr recall	1-10g	Food groups, 1 or 0. Points based on amounts of food after. Nutrients: Vit A, B1, B2, B6, folate, vit C, Ca, Fe, Zn	Grains roots tubers main food source

Phillipeanes (IDDS) Daniels	Child 24mo	24 hr recall	1-10g	Food groups and: Vit A, B1, B2, B3, Ca, Fe	Cereals, roots, tubers most consumed
Kenya (IDDS) Gewa	School children (mean age 7yr)	24hr recall (maternal)	10-15g	Total energy, Fe, Zn, Ca, Mg, K, Vit A, Vit B6, Vit B12, B1, B2, B3, Folate, Vit C, Vit E.	Cereals, tubers highest intake, lack in fruits, veg, dairy foods, meats
USA (IDDS) NHANES	Adults (MEN and women)	24 hr recall	15-30g	Food groups Called them serving scores—essential what we are doing	Food Group Score was 4.0 [+ or -] 0.01 in men and women. Nearly 65% of whites and 78% of blacks scored below 5 on the Food Group Score; they did not consume foods from all five groups on the day of the survey. More than 40% of all blacks scored 0 to 3 on the Food Group Score, compared with approximately 25% of whites. Mean Food Group Score increased with age in white men, white women, and black women.
USA –HANDLS	Adults men and women	2 24 hr recall	MyPyramid serving size calculations	Food groups and quantity of food: this study is focused on **how much** of what they are eating	

Appendix C

HANDLS PARTICIPANT CONSENT FORM

HEALTH DISPARITIES RESEARCH SECTION
LABORATORY OF EPIDEMIOLOGY AND POPULATION SCIENCES
NATIONAL INSTITUTE ON AGING, INTRAMURAL RESEARCH PROGRAM
NATIONAL INSTITUTES OF HEALTH
DEPARTMENT OF HEALTH AND HUMAN SERVICES

INFORMED CONSENT FOR RESEARCH WITH HUMAN SUBJECTS

Study: Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) – Wave 3

Principal Investigator: Michele K. Evans, M.D.

Lead Associate Investigator: Alan B. Zonderman, Ph.D.

Associate Investigators: Deidra C. Crews, MD; Ngozi Ejiogu, MD; Marie T. Fanelli Kuczmarski, PhD, RD, LDN; Michael Nalls, PhD

Medical Advisory Investigator: Michele K. Evans, M.D.

Study Number: 09-AG-N248

INTRODUCTION

We invite you to take part in the next phase of a National Institute on Aging (NIA) research study called Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS). You were selected as a participant in this study because when we were looking for residents from 30 and 64 years old in your neighborhood, you decided you wanted to take part in the study. It is time for us to return to your neighborhood for the first follow-up examination. You now have an opportunity to decide whether you would like to participate in the next phase of HANDLS. You will notice that some of the tests are the same as the last time we saw you. We have added some different tests and questionnaires that you might not be familiar with. Please take your time to read this form. Be sure to ask any questions you may have before making your decision. We encourage you to discuss your decision with your family, friends and your doctor(s).

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of this study is to learn about changes in health over time in an urban group of African-American and white men and women residing in Baltimore city. Our goal is to study health change, as people grow older. We plan to do this by studying many people in different neighborhoods and the same people over many years. This gives us the information we want about how peoples' bodies change over time.

We also want to study why some people are healthier than others as they get older. We want to discover if we can predict the causes of good health with aging and if we can find better ways to prevent and treat disease. If we can find the causes of good health, then we might find cures for some of the diseases related to aging. This is a research study where we will follow you for twenty

years to see how you age. This will help us learn about diseases like heart disease, Alzheimer's disease, high blood pressure, diabetes and stroke. We are trying to understand why some Americans have higher rates of certain diseases and more severe diseases than other Americans.

WHAT ELSE SHOULD I KNOW ABOUT THIS RESEARCH STUDY?

It is important that you read and understand several points that apply to all who take part in our studies:

- Taking part in the study is entirely voluntary and refusal to participate will not affect any rights or benefits you normally have;
- You may or may not benefit from taking part in the study, but knowledge may be gained from your participation that may help others;
- You may stop being in the study at any time without any penalty or losing any of the benefits you would have normally received; and
- Some people have personal, religious or ethical beliefs that may limit the kinds of medical or research treatments they would want to receive. If you have such beliefs, please discuss them with the HANDLS research team before you agree to the study.

The nature of the study, the benefits, risks, discomforts and other information about the study are discussed further below. The information is also explained in the informed consent booklet that goes with this consent form. If any new information is learned, at any time during the research, which might affect your participation in the study, we will tell you. We urge you to ask any questions you have about this study with the staff members who explain it to you and with your own advisors before agreeing to participate.

WHO CAN PARTICIPATE IN THIS STUDY?

To be eligible for this research study the following must apply:

- You must be able to give informed consent - you must understand what the research is about and what we are requesting of you;
- You must have agreed to participate in Wave 1 of the HANDLS study;
- You must have one form of government issued identification

ARE THERE ANY REASONS I SHOULD NOT PARTICIPATE?

You will not be able to participate in this research study if any of the following apply:

- You were not enrolled in Wave 1 of the HANDLS study;
- You are pregnant;
- You are currently (or within the last 6 months of) undergoing cancer treatment (chemotherapy or radiation)

WHAT IF I AM PRESENTLY PARTICIPATING IN ANOTHER RESEARCH STUDY?

Are you presently participating in any other research studies? Yes ☐ No ☐

If yes, please state which study (ies) _____

While participating in this study, you should not take part in any other research project that in the judgment of the principal investigator is incompatible with this research study. This is to protect you from possible injury arising from such things as extra blood drawing, extra x-rays, interaction of research drugs, or similar hazards.

WHAT HAPPENS IF I AGREE TO BE IN THE STUDY?

The HANDLS Wave 3 study data will be collected in two parts. The first part of the study is the examination visit to the mobile Medical Research Vehicles. The second part of the study is a telephone interview that will happen 7-10 days after your examination visit. You may also be invited to participate in a third part of HANDLS Wave 3. The third part of HANDLS Wave 3 consists of three optional studies. You will learn more about those studies during this examination visit, if you are eligible to participate. You will be asked to sign a separate consent form if you decide to join any of those studies.

This is the consent form for HANDLS Wave 3. You will be asked to give your consent for all of the procedures and interviews that make up Wave 3 of HANDLS. Specifically, we want to be sure you understand the nature of the research we are doing and what is being requested of you. It is also important that you understand any potential risks to you. Please be sure to read the **HANDLS Examination Visit Informed Consent Booklet** that provides more information about each test and any risks or discomforts you may experience.

You may participate in any of the tests, but you do not have to participate in all of the tests. Choosing not to participate in a test will not affect your right to participate in the rest of this study. You may stop any test after it starts. If you are unable to complete all of the tests in one visit you may be invited to return to the MRVs to complete your testing. All of the tests are performed for the purpose of research and are not designed to improve your health at this time. There are no experimental medications, tests or procedures in this study. We perform these tests free of charge. If there are tests in which you do not wish to participate, please list them on the back of this form.

For the first part you will be required to spend a day at our Mobile Medical Research Vehicles (MRVs) to have testing. You will be asked to provide an update about your medical history since your last examination and you will receive a physical examination. We will ask you to remember all of the food you ate the day before your visit. We will assess your muscle strength and bone density. You will have a test to check the blood flow in your heart and to see if your heart valves are leaking. We will also ask you to complete a questionnaire and to participate in memory testing. You will be asked about activities of daily living, use of health care services, and any income and/or employment changes since your last visit to the MRVs. We will also take blood, tissue and urine samples.

You will be asked to give a DNA sample by providing a blood sample and by using a method that collects cells from a saliva (spit) sample you provide. Before you agree to give the DNA sample please review the information that explains the possible risks of providing DNA samples described below and in the Informed Consent Booklet. Genes are composed of the genetic material called DNA. DNA (deoxyribonucleic acid) is the part of the cell that is responsible for providing hereditary

characteristics (such as eye color) and is used to build proteins. More and more, we are discovering that our genes are important for understanding our health. We will study genes and parts of genes that may cause age related diseases or make these diseases more severe. By finding out the genes that cause specific conditions associated with aging, we may be able to find ways to prevent certain diseases, find them at an earlier and milder stage, or at least be able to treat these conditions better. This study is particularly interested in genes that may be involved with loss of memory, high blood pressure, heart disease, stroke, cancer, diabetes, and arthritis.

As part of this study, you will be offered a test for the human immunodeficiency virus (HIV). This is the virus that causes AIDS. If you are infected with HIV, you will still be able to participate in this study. We will tell you what the results mean, how to find care, how to avoid infecting others, how we report newly diagnosed HIV infection, and the importance of informing your partners of the possible risk because of your HIV infection. If you decide to have the test, you will be asked to sign a separate consent form. It will explain the HIV testing procedures for the HANDLS study.

Below is a table that shows the tests you will be expected to complete during your MRV visit. This chart also tells you how long we think it will take each test to be done and in which vehicle it will be given.

HANDLS Wave 3 Part 1 – Medical Research Vehicle Examination

Measure or Procedure	Estimated Timing	Location
Consent	20 minutes	MRV2/3
Specimen Collection (Urine, Blood, DNA)	20 minutes	MRV 3
Anthropometrics (height & weight)	5 minutes	MRV 1
Interim Medical History	20 minutes	MRV 2
Interim Physical Exam	20 minutes	MRV 1
Dietary Recall I	30 minutes	MRV 2
Cognition	40 minutes	MRV 2
Physical Performance	15 minutes	MRV 1
Echocardiogram	20 minutes	MRV 1
Questionnaire Section	50 minutes	MRV 2
Test of Health Literacy	30 minutes	MRV 1
Body Composition/Bone Densitometry	30 minutes	MRV 1

HANDLS Wave 3 Part 2 – Telephone Interview

The HANDLS Wave 3-telephone interview is designed to take place after your visit to our Mobile Medical Research Vehicles (MRVs). We will ask you to complete an interview over the phone.

The telephone interview is a dietary recall questionnaire that asks you to remember what you had to eat and drink in the last 24 hours. We will use pictures to help you give us information about how much food and drink you had in the last 24 hours. We will also ask you about nutritional supplements and over-the counter medications that you take. You may remember the dietary recall interview from your last visit to the MRVs. The difference for this interview is that we will conduct the interview over

the phone. All materials (pictures, etc.) for the phone interview will be delivered to you by US mail or given to you at the end of your MRV visit.

ARE THERE RISKS AND SIDE EFFECTS OF THIS STUDY?

The potential risks for this study are minimal. You should know that there are some risks in donating a blood sample. The trained HANDLS staff member will insert a needle in a vein in your arm. There is a risk of an infection from the needle puncture. There is also a risk of a black and blue mark, and you may feel faint. These risks are very small. Our staff is well trained and has drawn blood many times. It is common to have a small black and blue mark, but it disappears after a day or so. Some people have begun perspiring, or they felt nauseated and their pulse slowed. None of them had any after effects.

The risk of genetic testing (by providing the DNA sample) includes the possible misuse of personal, genetic information. Although rare, misuse of such information has caused problems for persons related to employment, life, or health insurance benefits and right. There is a risk that being in a genetics study can cause psychological distress or tension with other family members. Although there can be no absolute guarantees, every reasonable effort will be made to keep your personally identifiable information secret so that there will be no misuse. Even when the information is kept secret, if you are asked if you have ever been tested for a genetic disorder, answering "yes" could cause benefits to be denied or could cause other problems including discrimination.

This research study requires a small amount of radiation from the DEXA Scan. It must be noted that this radiation exposure is not needed for your medical care. It is for research purposes only. The total amount of radiation you will receive from this study is from one DEXA scan. The NIH Radiation Safety Committee has reviewed the use of radiation in this research study. It has approved this use as involving minimal risk and needed to obtain the research information desired.

Using the standard way of describing radiation exposure, from one DEXA Scan you will receive an effective dose of less than one thousandth of one rem. By comparison the average person in the United States receives this much radiation every day from natural sources, such as the sun. In this scan the only part of the body exposed is the skin, which is less sensitive to radiation than other parts of the body. There is a very small risk of cancer from the x-rays in DEXA scan, but it is too small to measure. If you are pregnant you may not participate in this study. Unborn babies are more sensitive to radiation than children or adults.

The risks for the dietary recall interview, the questionnaires and memory testing are very minimal. The only risk of this part of the study is that you may become tired and sometimes, people feel nervous when they do these tests. All examiners who are involved in giving these tests are experienced in using these procedures and they will minimize any discomfort that you might feel. If the tests are disturbing you, then you may stop testing any time you want.

For more information about risks and side effects, you should call the Principal Investigator, Michele K. Evans, M.D. at 410-558-8573.

WHAT WILL HAPPEN TO MY SAMPLES WHEN THE STUDY IS OVER?

The NIA will retain custody of your samples for studies as outlined above. You will retain the right to have the sample material made unavailable for future genetic testing and other specific testing by completing the section below by initiating on the line next to your choice. The NIA will be the exclusive owner of any data, discoveries or derivative materials from the sample materials and is responsible for the restriction of sample use at your request. If a potential commercial product is developed from this research project, the NIA will develop patents and promote commercialization of the product as required by law. You will not profit financially from such a product.

Doctors often make new discoveries by testing blood and urine. We would like to freeze a portion of your blood and urine samples to save them in our frozen tissue bank. We are not sure what new discoveries will appear in the future. We want to set aside your samples until there are new tests that will help us understand health and aging.

Your samples will be stored in secured freezers at an NIA facility. Your name and identifying information will be removed and we will give the samples a code. The key to the code will be kept in a separate, secure area. Your samples will be used only for the study described in this consent form unless you give us permission to use them for other studies.

If a future research project arises where your samples could be useful, we ask you to designate as to whether or not your sample can be used. Any future research use will require approval by the Institutional Review Board (IRB).

Please initial by the line indicating your wishes:

_____YES, I give permission to use my (blood or other fluids, tissues) samples in future research studies under the following conditions:

> _____These samples may be used for other research projects without contacting me only if the identification code is removed so that the sample can no longer be identified as mine.
>
> _____These samples may be used for other research projects without contacting me even if the code is left on the samples. I understand that if the samples are coded, they may be able to be traced back to my personally identifiable information and my medical records.

_____MAYBE, I wish to be re-contacted if further studies with my samples are considered. After the study has been explained, I will then decide if I want my samples to be included.

_____NO under no circumstances shall my samples be used for any future studies. My samples should be discarded once the present study is complete.

If you allow future research on your sample and the research provides information important for your health, we will try to contact you. If you wish to be contacted please keep the principal investigator for this study or the NIA updated about changes in your address or phone number.

WHAT ARE THE POSSIBLE OR EXPECTED BENEFITS?

This study is not designed to give direct benefits to any participants. If you agree to take part in this study, there may or may not be direct medical benefits to you. We hope the information learned from this study will benefit others in the future. There is no charge for any of the testing described. You may benefit by learning more about your health, or possibly from learning that you have a condition or problem.

DO I HAVE AN ALTERNATIVE TO PARTICIPATING?

There are no other options associated with your participation in this study. You may choose either to participate or not to participate in this research. Taking part in this study is entirely voluntary. You may choose to withdraw from the study at any time.

WILL I BE GIVEN MY STUDY RESULTS?

You will receive a Participant Report Packet in the mail, with results of your visit to the MRVs. If the study doctor discovers any condition or problem, the information will be provided to you and your doctor, if you authorize it. To authorize the reporting of results to your physician you will need to sign a form called "Release of Medical Information". You will be asked to sign this form only if you want us to communicate with your physician. The study doctors do not provide medical treatment.

CONFIDENTIALITY CERTIFICATE

To help us protect your privacy, we have obtained a Certificate of Confidentiality from the National Institutes of Health. With this certificate the researchers cannot be forced to disclose information that may identify you, even by court subpoena, in any federal, state, or local civil, criminal, administrative, legislative or other proceedings. The researchers will use the certificate to resist any demands for information that would identify you, except as explained below.

The Certificate cannot be used to resist a demand for information from personnel of the U.S. Department of Health and Human Services that is used for auditing or program evaluation or for information that must be disclosed in order to meet federal regulations.

You should understand that a Certificate of Confidentiality does not prevent you or a member of your family from voluntarily releasing information about yourself or your involvement in this research. If an insurer, employer, or other person obtains your written consent to receive research information, then the researcher may not use the Certificate to withhold that information.

The Certificate of Confidentiality does not prevent the researchers from disclosing voluntarily, without your consent, information that would identify you as a participant in the research project under the following conditions: It does not apply to state requirements to report certain communicable diseases. In addition, the study doctor may be required to report certain cases of abuse, neglect, or suicidal or homicidal intent to the appropriate authorities.

WILL IT COST ME ANYTHING TO PARTICIPATE?

You do not have to pay anything to be in this study. However, if taking part in this study leads to procedures or care not included in the study, it may lead to added costs for you or your insurance company. You will not be charged for tests that are part of this research study.

WILL I BE PAID FOR PARTICIPATING?

You will receive $160 for the first phase (MRV visit) of the study. Your payment will be made in the form of an ATM debit card at the end of the MRV visit. If you are unable to complete all of the tests you may receive a portion of the payment. If you have to return to the MRVs to complete testing on another day, you could be compensated for the additional visit. The ATM card will be activated before you leave the vehicle. You will be able to take the card to an ATM machine in your neighborhood to withdraw your payment.

If you decide to participate in the second phase of this study, the follow-up telephone interview, scheduled to occur with-in 7-10 days after your MRV visit, you will be paid an additional $40.00. Your payment will be added to the ATM debit card given to you during your MRV visit.

We will provide round-trip transportation from your home to our mobile testing center if you want it. We will serve a box breakfast and box lunch if you are participating in tests during mid-day. We will do our best to meet your dietary needs if you have any.

OTHER PERTINENT INFORMATION

1. **Confidentiality.** When results of an NIH research study are reported in medical journals or at scientific meetings, the people who take part are not named and identified. In most cases, the NIH will not release any information about your research involvement without your written permission. However, if you sign a release of information form, for example, for an insurance company, the NIH will give the insurance company information from your medical record. This information might affect (either favorably or unfavorably) the willingness of the insurance company to sell you insurance.

   The Federal Privacy Act protects the confidentiality of your NIH medical records. However, you should know that the Act allows release of some information from your medical record without your permission, for example, if it is required by the Food and Drug Administration (FDA), members of Congress, law enforcement officials, or authorized hospital accreditation organizations.

2. **Conflict of Interest.** No NIH investigator involved in this study receives payments or other benefits from any company whose drug, product or device is being tested.

3. **Policy Regarding Research-Related Injuries.** The National Institute on Aging will provide short-term medical care for any injury resulting from your participation in this research study. In general, no long-term medical care or financial compensation for research-related injuries will be provided by the National Institute on Aging, National Institutes of Health, or the Federal Government. However, you have the right to pursue legal remedy if you believe that your injury justifies such action.

4. **Payments.** The amount of payment to research volunteers is guided by the National Institute of Health policies. In general, patients are not paid for taking part in research studies at the National Institutes of Health. Reimbursement of travel and subsistence will be offered consistent with NIH guidelines. Compensation of $600 or more in one year will be reported to the IRS per federal regulations.

5. **Problems or Questions.** If you have any problems or questions about this study, or about your rights as a research participant, or about any research-related injury, contact the Principal Investigator, Michele K. Evans, MD at 410-558-8573. You may also call the NIA Clinical Research Protocol Office at 410-350-3947.

6. **Consent Document.** Please keep a copy of this document in case you want to read it again.

COMPLETE APPROPRIATE ITEM(S) BELOW:	
A. Adult Patient's Consent I have read the explanation about this study and have been given the opportunity to discuss it and to ask questions. I hereby consent to take part in this study. Signature of Adult Patient/Legal Representative _____ Date _____ Print Name _____	**B. Parent's Permission for Minor Patient.** I have read the explanation about this study and have been given the opportunity to discuss it and to ask questions. I hereby give permission for my child to take part in this study. (Attach NIH 2514-2, Minor's Assent, if applicable.) Signature of Parent(s)/Guardian _____ Date _____ Print Name _____
C. Child's Verbal Assent (If Applicable) The information in the above consent was described to my child and my child agrees to participate in the study. Signature of Parent(s)/Guardian _____ Date _____ Print Name _____	
THIS CONSENT DOCUMENT HAS BEEN APPROVED FOR USE **FROM *Continuing Review Approval Date* THROUGH *Expiration Date*.** Signature of Investigator _____ Date _____ Signature of Witness _____ Date _____ Print Name _____ Print Name _____	

Appendix D

WRAT-3 RAW SCORES OF HANDLS SAMPLE POPULATION

HANDLS Raw WRAT-3 Scores by Household Composition and Sex

Characteristics	Children. Spouse Present			Children. Spouse Never Present			No Children. Spouse Present			No Children. Spouse Never Present		
	Men (n=99)	Women (n=110)	P-value	Men (n=21)	Women (n=122)	P-Value	Men (n=104)	Women (n=131)	P-value	Men (n=148)	Women (n=199)	P-value
WRAT-3, raw score, X ± SE	42.27 ± 0.84	41.90 ± 0.88	0.763	40.90 ± 0.25	41.49 ± 0.64	0.744	42.08 ± 0.87	43.90 ± 0.55	0.068	42.18 ± 0.68	41.51 ± 0.62	0.474

P-values <0.05 are considered significant and are bolded. Abbreviations: HANDLS, Healthy Aging in Neighborhoods of Diversity across the Lifespan; Wide Range Achievement Test- version 3 (WRAT-3) scores are reflective of the participant's level of literacy; X, mean; SE, standard error.

HANDLS Raw WRAT-3 Scores by Household Composition and Race

Characteristics	Children. Spouse Present			Children. Spouse Never Present			No Children. Spouse Present			No Children. Spouse Never Present		
	African American	White	P-value	African American	White	P-Value	African American	White	P-value	African American	White	P-value
WRAT-3, raw score, X ± SE	40.66 ± 0.678	43.45 ± 1.0	**0.023**	40.65 ± 0.762	43.50 ± 1.055	**0.046**	40.65 ± 0.678	43.50 ± 0.701	0.118	40.65 ± 0.594	43.50 ± 0.658	**<0.001**

P-values <0.05 are considered significant and are bolded. Abbreviations: HANDLS, Healthy Aging in Neighborhoods of Diversity across the Lifespan; Wide Range Achievement Test- version 3 (WRAT-3) scores are reflective of the participant's level of literacy; X, mean; SE, standard error

Appendix E

HANDLS REGRESSION RESULTS OF DDS AND USEAGE OF FOOD STAMPS/WIC

		DDSS	
	Predictor	**b ± (SE)**	***P***
Block 1	Sex (ref: Women)	-1.1864 (0.513)	**<0.001**
	Race (ref: White)	-2.151 (0.512)	**<0.001**
	Age, y	0.085 (0.020)	**<0.001**
	SES (ref: <125% FPL)	-2.354 (0.564)	**<0.001**
	Education (ref: <HS diploma)	2.099 (0.376)	**<0.001**
	Pay for groceries using WIC/Food Stamps	-0.913 (0.420)	**0.030**
Block 2	Presence of Spouse	0.292 (0.351)	0.405
	Presence of Kids	-0.621 (0.374)	0.097
Block 3	Race x SES	1.892 (0.706)	**0.007**
	Race x Sex	1.129 (0.677)	0.096
Model Fit	R^2	0.093	**<0.001**
	ΔR^2 with Block 2	0.003	0.184
	ΔR^2 with Block 3	0.007	**0.009**

		DDFS	
	Predictor	**b ± (SE)**	***P***
Block 1	Sex (ref: Women)	-0.288 (0.107)	**0.007**
	Race (ref: White)	-0.333 (0.107)	**0.002**
	Age, y	0.015 (0.004)	**<0.001**
	SES (ref:< 125% FPL)	-0.430 (0.118)	**<0.001**
	Education (ref: <HS diploma)	0.361 (0.078)	**<0.001**
	Pay for groceries using WIC/Food Stamps	-0.098 (0.087)	0.193
Block 2	Presence of Spouse	0.084 (0.073)	0.249
	Presence of Kids	0.065 (0.078)	0.405
Block 3	Race x SES	0.409 (0.147)	**0.005**
	Race x Sex	0.159 (0.141)	0.260
Model Fit	R^2	0.049	**<0.001**

	ΔR^2 with Block 2	0.002	0.364
	ΔR^2 with Block 3	0.007	**0.013**

P-values <0.05 are considered significant and are bolded. Abbreviations: HANDLS, Healthy Aging in Neighborhoods of Diversity across the Lifespan; SES, socioeconomic status above or below 125% of the 2004 Federal Poverty Guidelines; SE, standard error; HS, high school diploma; FS, food stamps; WIC, Women Infant and Children.

Women, Infants and Children (WIC)/Food Stamps

Out of the 1610 participants included in this study, 1243 had data available for the usage WIC benefits or food stamps to pay for groceries. Of these participants, 76% (941) did not use WIC or food stamps. Among individuals using food assistance, 15% were White and 31%, African Americans. When put into a regression model, it had a significant effect on DDSS (p=0.030), showing that if you did not use food stamps or WIC benefits, then you had a DDS. There was no significant effect on DDFS (Appendix E).

Appendix F

HANDLS REGRESSION RESULTS OF HOUSEHOLD COMPOSTIION AND HEI-2010 SCORES

		HEI_2010	
	Predictor	**b ± (SE)**	***P***
Block 1	Sex (ref: Women)	-3.073 (0.929)	**0.001**
	Race (ref: White)	-6.634 (2.554)	**0.046**
	Age, y	0.146 (0.035)	**<0.001**
	SES (ref: < 125% FPL)	-3.923 (1.003)	**<0.001**
	Education (ref: <HS diploma)	3.852 (0.647)	**<0.001**
Block 2	Presence of Spouse	-0.221 (0.617)	0.720
	Presence of Kids	-1.428 (0.656)	**0.030**
Block 3	Race x SES	1.858 (1.260)	0.140
	Race x Sex	2.932 (1.209)	**0.015**
Model Fit	R^2	0.060	**0.000**
	ΔR^2 with Block 2	0.003	0.055
	ΔR^2 with Block 3	0.005	**0.022**

P-values <0.05 are considered significant and are bolded. Abbreviations: HANDLS, Healthy Aging in Neighborhoods of Diversity across the Lifespan; HEI, Healthy Eating Index-2010; SES, socioeconomic status above or below 125% of the 2004 Federal Poverty Guidelines; SE, standard error; HS, high school diploma.

Appendix G

HEALTHY EATING INDEX-2010 COMPONENTS AND STANDARDS FOR SCORING

Component	Maximum points	Standard for maximum score	Standard for minimum score of zero
HEI-2010[1]			
Adequacy:			
Total Fruit[2]	5	≥0.8 cup equiv. per 1,000 kcal	No Fruit
Whole Fruit[3]	5	≥0.4 cup equiv. per 1,000 kcal	No Whole Fruit
Total Vegetables[4]	5	≥1.1 cup equiv. per 1,000 kcal	No Vegetables
Greens and Beans[4]	5	≥ 0.2 cup equiv. per 1,000 kcal	No Dark Green Vegetables or Beans and Peas
Whole Grains	10	≥1.5 oz equiv. per 1,000 kcal	No Whole Grains
Dairy[5]	10	≥1.3 cup equiv. per 1,000 kcal	No Dairy
Total Protein Foods[6]	5	≥2.5 oz equiv. per 1,000 kcal	No Protein Foods
Seafood and Plant Proteins[6,7]	5	≥0.8 oz equiv. per 1,000 kcal	No Seafood or Plant Proteins
Fatty Acids[8]	10	(PUFAs + MUFAs)/SFAs ≥2.5	(PUFAs + MUFAs)/SFAs ≤1.2
Moderation:			
Refined Grains	10	≤1.8 oz equiv. per 1,000 kcal	≥4.3 oz equiv. per 1,000 kcal
Sodium	10	≤1.1 gram per 1,000 kcal	≥2.0 grams per 1,000 kcal
Empty Calories[9]	20	≤19% of energy	≥50% of energy

[1]Intakes between the minimum and maximum standards are scored proportionately.
[2]Includes fruit juice.
[3]Includes all forms except juice.
[4]Includes any beans and peas (called legumes in HEI-2005) not counted as Total Protein Foods (called Meat and Beans in HEI-2005).
[5]Includes all milk products, such as fluid milk, yogurt, and cheese, and fortified soy beverages.
[6]Beans and peas are included here (and not with vegetables) when the Total Protein Foods (called Meat and Beans in HEI-2005) standard is otherwise not met.
[7]Includes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted as Total Protein Foods.
[8]Ratio of poly- and monounsaturated fatty acids to saturated fatty acids.

[9]Calories from solid fats, alcohol, and added sugars; threshold for counting alcohol is >13 grams/1000 kcal.