ORIGINAL RESEARCH

Dietary Habits, Poverty, and Chronic Kidney Disease in an Urban Population

Deidra C. Crews, MD, ScM,*'† Marie Fanelli Kuczmarski, PhD,‡ Edgar R. Miller, III, MD, PhD,†'§'¶ Alan B. Zonderman, PhD,** Michele K. Evans, MD,** and Neil R. Powe, MD, MPH, MBA††

Background: Poverty is associated with chronic kidney disease (CKD) in the United States and worldwide. Poor dietary habits may contribute to this disparity.

Study Design: Cross-sectional study.

Setting and Participants: A total of 2,058 community-dwelling adults aged 30 to 64 years residing in Baltimore City, Maryland.

Predictors: Adherence to the Dietary Approaches to Stop Hypertension (DASH) diet. DASH scoring based on 9 target nutrients (total fat, saturated fat, protein, fiber, cholesterol, calcium, magnesium, sodium, and potassium); adherence defined as score ≥4.5 of maximum possible score of 9. Poverty (self-reported household income <125% of 2004 Department of Health and Human Services guideline) and nonpoverty (≥125% of guideline).

Outcomes and Measurements: CKD defined as estimated glomerular filtration rate <60 mL/minute/1.73 m^2 (CKD epidemiology collaboration equation). Multivariable logistic regression was used to calculate adjusted odds ratios (AORs) for relation of DASH score tertile and CKD, stratified by poverty status.

Results: Among 2,058 participants (mean age 48 years; 57% black; 44% male; 42% with poverty), median DASH score was low, 1.5 (interquartile range, 1-2.5). Only 5.4% were adherent. Poverty, male sex, black race, and smoking were more prevalent among the lower DASH score tertiles, whereas higher education and regular health care were more prevalent among the highest DASH score tertile ($P < .05$ for all). Fiber, calcium, magnesium, and potassium intake were lower, and cholesterol higher, among the poverty compared with nonpoverty group ($P < .05$ for all), with no difference in sodium intake. A total of 5.6% of the poverty and 3.8% of the nonpoverty group had CKD ($P = .05$). The lowest DASH tertile (compared with the highest) was associated with more CKD among the poverty (AOR 3.15, 95% confidence interval 1.51-6.56), but not among the nonpoverty group (AOR 0.73, 95% confidence interval 0.37-1.43; P interaction $= .001$).

Conclusions: Poor dietary habits are strongly associated with CKD among the urban poor and may represent a target for interventions aimed at reducing disparities in CKD.

Introduction

POVERTY IS ASSOCIATED with multiple adverse chronic kidney disease (CKD) outcomes, including reduced kidney function,[1-3] albuminuria[4,5] and increased risk of end-stage renal disease.[6,7] Poor dietary habits due to limited access to healthy foods could be a contributor. For example, food insecurity, a risk factor for CKD,[8] affects approximately 25% of low-income adults in the United States[9] and is associated with increased intake of energy-dense foods and limited fruit and vegetable intake.[10] Fresh fruits and vegetables are often not readily available in low-income communities,[11,12] and if available they are expensive compared with other foods.[12,13] Thus, poverty may pose a significant challenge for individuals seeking to follow a healthy dietary pattern.

The Dietary Approaches to Stop Hypertension (DASH) diet is a dietary pattern high in fruits and vegetables, moderate in low-fat dairy products, and low in animal protein, but with substantial amounts of plant protein from legumes and nuts.[14] In addition to its favorable effects on blood pressure,[14] adherence to the DASH diet has been associated with better health, including lower risk of hypertension,[15] type 2 diabetes,[16] heart disease, and stroke.[17] Furthermore, DASH diet adherence has been associated with lower risk of estimated glomerular filtration rate (eGFR) decline.[18] However, little is known about the relation of DASH diet adherence to disparities in CKD.

To inform future efforts to mitigate socioeconomic disparities in CKD through tailored interventions and public

**Division of Nephrology, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland.*

†*Welch Center for Prevention, Epidemiology and Clinical Research, Johns Hopkins Medical Institutions, Baltimore, Maryland.*

‡*Department of Behavioral Health and Nutrition, University of Delaware, Newark, Delaware.*

§*Division of General Internal Medicine, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland.*

¶*Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland.*

***Laboratory of Epidemiology and Population Sciences, National Institute on Aging, National Institutes of Health, Baltimore, Maryland.*

††*Department of Medicine, San Francisco General Hospital, University of California at San Francisco, San Francisco, California.*

policy changes, we sought to determine whether DASH diet adherence differs between adults living in poverty versus nonpoverty and to determine if the relation of DASH diet adherence to CKD differed between these populations.

Methods
Study Design and Population

We examined cross-sectional data from the National Institute on Aging (NIA), Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) study. HANDLS is a population-based cohort study of the influences and interaction of race and socioeconomic status (SES) on the development of cardiovascular and cerebrovascular health disparities among minority and lower SES subgroups. Participants are community-dwelling blacks and whites aged 30 to 64 years at enrollment, drawn from 13 neighborhoods, each of which composed of contiguous US census tracts in Baltimore City, Maryland that reflect socioeconomic and racial diversities. Participants were sampled representatively using a heuristic study design, which was a factorial cross of 4 factors (age, gender, race, and SES) with approximately equal numbers of participants per "cell." Individuals who self-identified with neither black nor white race were excluded from the study. Household enrollment was from August 2004 to November 2008. Each participant provided written informed consent. The National Institute of Environmental Health Sciences, National Institutes of Health, approved the study protocol.[19]

The total HANDLS Study population is 3,720. For the purposes of this study, we limited our sample to those participants with baseline serum creatinine and 2 24-hour food intake measurements ($N = 2,058$). Compared with excluded participants, those in our sample were of similar age (47.9 vs. 47.6 years) and poverty status (42.2 vs. 40.1%); $P > .05$ for both. However, included persons were less likely to be male (43.6 vs. 47.6%; $P = .015$) and less likely to be black (57.0 vs. 61.7%; $P = .004$) than those excluded.

Measurements
Independent Variables

The independent variables of interest were poverty status and DASH diet adherence. Poverty was chosen as the measure of SES in the HANDLS study to allow ease of selection of a representative sample. Poverty was defined as a self-reported annual household income below 125% of the 2004 Department of Health and Human Services poverty guideline (family of 4 earning <$23,562).[20] Nonpoverty was defined as the converse. Poverty status was determined at the doorstep during household enrollment based on several screening questions, including "how many people are in your household?" and "is your family income above or below this cutoff?" This cutoff value for poverty was selected by a panel of experts and has been used in initiatives

such as the National School Lunch Program.[21] DASH diet adherence was defined using 24-hour food intake information gathered using the US Department of Agriculture's (USDA) Automated Multiple-Pass Method (AMPM), versions 2.3 to 2.6, a computerized methodology, on 2 separated days separated by 7 to 10 days.[22] This method was supplemented by measurement aids, such as measuring cups, spoons, a ruler, and an illustrated Food Model Booklet to assist participants in estimating accurate quantities of foods and beverages consumed. Both dietary recalls were administered in-person by trained interviewers. The AMPM was validated in a study with 524 healthy, weight-stable volunteers, aged 30 to 69 years, and studies with 20 adult women and 12 adult men.[22,23] The method is effective for collecting accurate group energy intake of adults, based on comparisons of reported energy intake to total energy expenditure using the doubly labeled water technique.[22-24] The dietary recalls were coded using Survey Net, matching foods consumed with codes in the Food and Nutrient Database for Dietary Studies, version 3. Energy and selected nutrient intakes were calculated for each recall day.[25] There were no significant differences in energy or nutrient intakes between the first and second recall days. The recalls represented both weekend and weekday consumption patterns and no differences existed between energy and nutrient intakes by day of the week. For this study, the mean nutrient values were used to assess adherence to the DASH diet. Individuals who reported no foods or reported fasting were not included in the analysis.

A DASH diet adherence score was calculated for each participant based on nutrient targets for the DASH dietary pattern as reported by Mellen et al.[26] There were 9 target nutrients, namely protein, total fat, saturated fat, cholesterol, fiber, magnesium, calcium, potassium, and sodium, used to calculate the total score (a maximum of 9). Individuals who met the DASH target for a nutrient received a score of 1, whereas those who achieved the intermediate target for a nutrient received a score of 0.5 (Table 1).

Table 1. Dietary Approaches to Stop Hypertension (DASH) Diet Adherence Nutrient Intake Targets

Nutrient	DASH Target	DASH Intermediate Target
Saturated fat, % energy	≤6	≤11
Total fat, % energy	≤27	≤32
Protein, % energy	≥18	≥16.5
Cholesterol, mg/1,000 kcal	≤71.4	≤107.1
Fiber, g/1,000 kcal	≥14.8	≥9.5
Magnesium, mg/1,000 kcal	≥238	≥158
Calcium, mg/1,000 kcal	≥590	≥402
Potassium, gm/1,000 kcal	≥2,238	≥1,534
Sodium, mg/1,000 kcal	≤1,143	≤1,286

Individuals meeting the DASH target for a nutrient received a score of 1, whereas those who achieved the intermediate target for a nutrient received a score of 0.5 for that nutrient, for a total possible score of 9.[26,52]