Racial and Ethnic Variations in Albuminuria in the US Third National Health and Nutrition Examination Survey (NHANES III) Population: Associations With Diabetes and Level of CKD

Chris L. Bryson, MD, MS, Heather J. Ross, BS, Edward J. Boyko, MD, MPH, and Bessie A. Young, MD, MPH

• ***Background:*** **Racial and ethnic differences in prevalence of albuminuria in a nationally representative population with and without diabetes were assessed.** ***Methods:*** **We analyzed cross-sectional data collected for the 20,050 participants of the Third National Health and Nutrition Examination Survey (NHANES III) to determine factors that contributed to racial/ethnic differences in microalbuminuria and macroalbuminuria prevalence.** ***Results:*** **For the 15,522 NHANES III participants for whom relevant data were available, racial/ethnic minorities tended to be younger, be less well educated, have lower income, and be less likely to have insurance than non-Hispanic whites, findings that were similar for those with and without diabetes. After adjusting for baseline covariates and medication use, racial and ethnic minorities with and without diabetes had greater odds of albuminuria compared with whites without diabetes (blacks with diabetes, adjusted odds ratio [aOR], 2.77; 95% confidence interval [CI], 1.46 to 2.72), Mexican Americans with diabetes (aOR, 2.43; 95% CI, 1.07 to 2.11), and those of other ethnicity with diabetes (aOR, 2.93; 95% CI, 1.28 to 6.75). Of those without diabetes, blacks had 2.18-fold (95% CI, 1.44 to 3.30) and Mexican Americans had 1.81-fold (95% CI, 1.08 to 3.02) greater odds of microalbuminuria or macroalbuminuria than whites after adjustment for potential confounding factors. Stratifying by estimated glomerular filtration rate (eGFR) less than 60 mL/min/1.73 m^2 (<1.00 mL/s) showed similar results for racial/ethnic minorities and those with diabetes, whereas results were significant only for blacks with and without diabetes for those with an eGFR of 60 mL/min/1.73 m^2 or greater. Level of metabolic control (hemoglobin A_{1c} level), systolic blood pressure, income, diuretic use, and hypertensive treatment status remained independent factors associated with albuminuria.** ***Conclusion:*** **Racial and ethnic minorities have greater odds of albuminuria than whites with and without diabetes, which persists primarily for those with an eGFR less than 60 mL/min/1.73 m^2.** ***Am J Kidney Dis*** **48:720-726.**

INDEX WORDS: Race; ethnicity; microalbuminuria; macroalbuminuria; proteinuria; diabetes; chronic kidney disease; cohort study.

MICROALBUMINURIA has been well documented as a biomarker for kidney damage caused by diabetes, hypertension, and glomerular diseases, as well as a marker for chronic kidney disease (CKD) and cardiovascular disease.[1-5] Microalbuminuria and macroalbuminuria (albuminuria) are defined by the American Diabetes Association as an increase in urinary albumin excretion between 30 and 299 mg/g creatinine (Cr) and 300 mg/g Cr or greater, respectively, both of which are associated with such adverse health outcomes in adults as cardiac disease and mortality.[6,7] Racial and ethnic differences exist in the prevalence of microalbuminuria between those with and without diabetes;[8,9] however, little is known about which factors contribute most to these disparities in the general population.

We analyzed data from the Third National Health and Nutrition Examination Survey (NHANES III) to determine differences in prevalence of albuminuria between those with and without diabetes in a representative sample of the US civilian population. We hypothesized that

From the Epidemiologic Research and Information Center and Northwest Center of Excellence, Health Services Research and Development, Veterans Affairs Puget Sound Health Care System; Department of Medicine, Division of General Internal Medicine, University of Washington; and Northwest Kidney Centers, Seattle, WA.

Received December 5, 2005; accepted in revised form July 20, 2006.

Originally published online as doi:10.1053/j.ajkd.2006.07.023 on September 26, 2006.

Support: This study was supported by B.A.Y.'s American Diabetes Association Career Development Award and a Robert Wood Johnson Minority Medical Faculty Development Fellowship. C.L.B. is supported by a VA Career Development Award (RCD03-177). Potential conflicts of interest: None.

Views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs or the University of Washington.

Address reprint requests to Bessie A. Young, MD, MPH, VA Puget Sound Health Care System, Epidemiology Research and Information Center, 1100 Olive Way, Ste 1400, Seattle, WA 98101. E-mail: youngb@u.washington.edu

0272-6386/06/4805-0004$32.00/0

doi:10.1053/j.ajkd.2006.07.023

racial/ethnic differences exist in the prevalence of microalbuminuria and are independent of diabetes status. To that end, we determined the effects of race, ethnicity, and other factors on the prevalence of albuminuria in a representative US population-based sample.

METHODS

Study Population/Study Design

Details of the NHANES cohort are described elsewhere.[10] Briefly, the National Center for Health Statistics of the Centers for Disease Control and Prevention has collected self-reported survey and medical information for a cohort of civilian noninstitutionalized US subjects annually through NHANES. NHANES III data were collected for approximately 40,000 people nationwide from 1988 to 1994 by using a multistage stratified cluster sampling design to select persons 2 months and older.[11] Non-Hispanic blacks and Mexican Americans were oversampled to allow for the calculation of more precise prevalence estimates of health indicators in these groups. Medical and demographic data were collected through a standardized survey conducted at participants' homes, followed by a medical examination and laboratory testing that occurred in the Mobile Examination Center. Of 20,050 eligible subjects aged 17 to 90 years, 15,522 had sufficient data that allowed classification of their diabetes and microalbuminuria/macroalbuminuria status for inclusion in the current analysis.

Demographic Characteristics and Comorbid Conditions

Age was defined at the time of the interview. Racial/ethnic categories were self-reported by participants and assigned by NHANES as the following: non-Hispanic white (whites), non-Hispanic black (blacks), Mexican Americans, and others (Asians, Native Americans, and those of unknown race/ethnicity). Insurance coverage (present/absent) was determined by whether the subject had medical insurance coverage (Medicare, Medicaid, Veterans Administration healthcare benefits/CHAMPUS/military, or private insurance) versus none. Subjects with a fasting blood glucose level (glucose hexokinase method; White Sands Research Center, Alamogordo, NM) of 126 mg/dL or greater (≥7.0 mmol/L), an oral glucose tolerance test postload glucose level of 200 mg/dL or greater (≥11.1 mmol/L), or who reported using insulin or oral hypoglycemic medications were classified as having diabetes.[6] Subjects with gestational diabetes, defined as reporting a diagnosis of diabetes while pregnant, were excluded from the subpopulation. Subjects were identified as having self-reported diabetes if they answered affirmatively to the question: "Has your doctor ever told you you have diabetes?" Smoking status was categorized into current, past, and never. Metabolic control, determined by hemoglobin A_{1c} (HbA_{1c}) level[6] (Bio-Rad DIAMAT; Bio-Rad Laboratories, Hercules, CA) were categorized as follows: good, 6.9% or less; average, 7% to 9%; or poor, greater than 9%. Hypertension categories were based on the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, & Treatment of High Blood Pressure recommendations (JNC-7) as normal (<120/80 mm Hg), prehypertension (120 to 139/80 to 89 mm Hg), stage 1 hypertension (140 to 159/90 to 99 mm Hg), and stage 2 hypertension (≥160/≥100 mm Hg).[12] Those with hypertension also were categorized based on self-report into 2 groups: treated, those who reported use of antihypertensive medications; and untreated, persons who had high blood pressure, but reported no use of antihypertensive medication. Body mass index (BMI)[13] was classified as underweight (<18.5 kg/m^2), normal weight (18.5 to 24.9 kg/m^2), overweight (25 to 29.9 kg/m^2), obese (30 to 39.9 kg/m^2), and morbidly obese (≥40 kg/m^2).

Classification of Microalbuminuria and Macroalbuminuria and Kidney Disease

Urine albuminuria was measured by using a solid-phase fluorescent immunoassay (University of Minnesota School of Medicine, Minneapolis, MN). Serum and urine Cr were measured by means of the Jaffé reaction using a Hitachi 737 analyzer (Boehringer Mannheim Corp, Indianapolis, IN). Albuminuria is expressed as milligrams of albumin per gram of Cr (mg/g Cr) using American Diabetes Association categories: normal (<30 mg/g Cr]), microalbuminuria (30 to 299 mg/g Cr), and clinical albuminuria or macroalbuminuria (≥300 mg/g Cr).[7]

Finally, the modified Modification of Diet in Renal Disease Study equation[14] was used to calculate estimated glomerular filtration rates (eGFR). The National Kidney Foundation–Kidney Disease Outcomes Quality Initiative guidelines were used to determine stage of CKD as normal function, GFR of 90 mL/min/1.73 m^2 or greater (≥1.50 mL/s/1.73 m^2) and urine albumin level less than 30 mg/g Cr; stage 1 (early), GFR of 90 mL/min/1.73 m^2 or greater (≥1.50 mL/s/1.73 m^2) and urine albumin of 30 mg/g Cr or greater; stage 2 (mild), GFR of 60 to 89 mL/min/1.73 m^2 (1.00 to 1.48 mL/s/1.73 m^2); stage 3 (moderate), GFR of 30 to 59 mL/min/1.73 m^2 (0.50 to 0.98 mL/s/1.73 m^2); stage 4 (severe), GFR of 15 to 29 mL/min/1.73 m^2 (0.25 to 0.48 mL/s/1.73 m^2); and stage 5 (failure) GFR less than 15 mL/min/1.73 m^2 (<0.25 mL/s/1.73 m^2). These categories were collapsed into those with normal or early-stage CKD, defined as an eGFR of 60 mL/min/1.73 m^2 or greater (≥1.00 mL/s/1.73 m^2), and those with later-stage CKD, defined as an eGFR less than 60 mL/min/1.73 m^2 (<1.00 mL/s/1.73 m^2).

Statistical Analysis

The complex sample design used by NHANES III was accounted for in all analyses by using complex survey commands in Stata, version 7.0 (StataCorp, College Station, TX). To examine group demographic differences, chi-squared tests were used for categorical variables and independent Student *t*-tests were used for continuous variables. Logistic regression was used to determine the odds of microalbuminuria/macroalbuminuria (odds ratio [OR] and 95% confidence interval [CI]), adjusted for potential confounders.[15] Potential confounding is defined as a 10% change in OR of the primary outcome with the predictor of interest upon inclusion of a covariate in the model. Potential confounders and predictors included in models were age, duration of diabetes, sex, education, marital status, income,