The Kidney Early Evaluation Program (KEEP): Program Design and Demographic Characteristics of the Population

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Background: Chronic kidney disease (CKD) recently was identified as a public health problem requiring a public health prevention approach. The National Kidney Foundation Kidney Early Evaluation Program (KEEP), initiated in 2000, meets the definition of a public health program, offering surveillance and early detection of CKD. This report aims to detail demographic characteristics of KEEP participants and compare them with characteristics of participants in the National Health and Nutrition Examination (NHANES) 1999-2004.

Methods: KEEP is a CKD screening program enrolling individuals 18 years and older with a family history of kidney disease or personal or family history of diabetes or hypertension. Simple descriptive statistics were used in the analysis. For comparison, the NHANES sample was restricted to participants with hypertension or diabetes or a family history of hypertension or diabetes.

Results: The number of KEEP participants grew exponentially over time. Most participants were aged 46 to 60 years. KEEP enrolled twice as many women as men (68.4% versus 31.5%). Minorities were well represented (33.4% African American, 12.3% Hispanic). Almost 58% of participants had some college or more education, and close to 85.0% had a physician. Compared with NHANES, the KEEP population was older and included a larger proportion of women and African Americans. Self-reported hypertension, self-reported diabetes, obesity, and CKD were higher in KEEP (52.9% versus 38.5%, 26.6% versus 9.9%, 43.6% versus 35.5%, and 22.8% versus 17.6%, respectively).

Conclusions: KEEP has been successful in enrolling individuals at risk of kidney disease, evidenced by the high levels of self-reported hypertension and diabetes.

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INDEX WORDS: Chronic kidney disease; diabetes; hypertension; Kidney Early Evaluation Program (KEEP), National Health and Nutrition Examination Survey (NHANES) 1999-2004; screening.

As evidenced by a recent analysis of National Health and Nutrition Examination Survey (NHANES) data, the prevalence of chronic kidney disease (CKD) in the United States is increasing (results from NHANES 1988-1994, 14.5%; results from NHANES 1999-2004, 16.8%).[1] These results confirmed those of an earlier report in which investigators described the number of Medicare patients 75 years and older with CKD doubling from 1997-1998 to 2003-2004, reaching nearly 1 million patients.[2] CKD is a well-known risk factor for cardiovascular mortality and morbidity,[3-5] and patients with CKD are more likely to die of cardiovascular disease (CVD) than by progressing to end-stage renal disease.[6,7]

Considering the increased prevalence of CKD and the high risk of cardiovascular morbidity and mortality associated with it, identifying at-risk patients and detecting kidney disease early enough to prevent its progression should be a focus of the medical community at large. However, a recent analysis of 2003 data from Medicare and employer group health plan patients with preexisting diabetes and hypertension showed that the probability of serum creatinine being measured was very low for Medicare participants (<0.2) and even lower for working people with employer group health plans.[2] Moreover, the probability of patients with diabetes having urinary albumin measured was only 0.22 for those with Medicare coverage and 0.21 for those aged 50 to 64 years with employer group health plans.[2] These results illustrate the need to educate diabetic and hypertensive patients about their risk of kidney disease and primary care

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providers about treatment and management of these patients.

In 2006, CKD was identified as a major public health problem requiring a public health preventive strategy approach.[7] The National Kidney Foundation (NKF) Kidney Early Evaluation Program (KEEP), initiated in 2000 to detect early kidney disease in at-risk patients,[8] meets criteria for a public health program because it includes surveillance and detection components to assess the burden of disease and promote early identification and intervention.[9] Participants and their physicians receive educational materials describing risk factors and cardiovascular risks associated with kidney disease to promote CKD awareness in participants and physicians and improve care of these high-risk patients.[9]

Finally, KEEP is focused on voluntary enrollment of high-risk participants, not on enrollment of a representative sample of the population. KEEP results are understood best by considering the KEEP population in the context of the US population and comparing KEEP results with results from a representative sample, such as NHANES.

The purpose of this report is to describe the KEEP protocol, describe demographic characteristics of KEEP participants, and compare these characteristics with characteristics of NHANES 1999-2004 participants.

METHODS

Kidney Early Evaluation Program

KEEP is a free community-based health screening program that targets populations at high risk of kidney disease. A pilot program conducted in 1997 screened almost 900 individuals and showed that targeted populations 18 years and older with a history of diabetes or hypertension or with a first-order relative with diabetes, hypertension, or kidney disease were highly likely to show evidence of kidney damage, microalbuminuria, and decreased kidney function. In August 2000, the NKF officially launched the KEEP program nationwide. Now in its seventh year, the program has screened more than 90,000 participants from 49 states and the District of Colombia.

KEEP recruitment methods were described previously in great detail.[8] Screening sites include churches, health centers, schools, community centers, shopping malls, and other public places. All screenings are conducted by KEEP-trained and KEEP-certified NKF affiliate staff and volunteers. Eligible KEEP participants are 18 years or older with self-reported diabetes or hypertension or a first-degree relative with diabetes, hypertension, or kidney disease. Persons with kidney transplants or receiving regular dialysis therapy are excluded. After providing informed consent, participants complete the screening questionnaire (available as supplementary materials at www.ajkd.org), which consists of sociodemographic data (age, sex, race/ethnicity, and education), personal and family health history, smoking status, and information about participant primary care physicians and specialty doctors. Measurements of height, weight, blood pressure, plasma glucose, and urinalysis (microalbuminuria and albumin-creatinine ratio [ACR]) are obtained after the survey questionnaire is completed. Blood and urine samples are drawn from consenting participants and sent to a central laboratory for hemoglobin, creatinine, lipid panel, parathyroid hormone, phosphorus, and calcium tests.

Screening results are reviewed on site by a physician or other qualified medical professional. Participants with test results outside the normal range are encouraged to follow up with a physician. Participants are given test results and letters to give to their physicians, indicating reasons for referral. Participants without ready access to health care providers are referred to local public health centers or other physicians. NKF affiliates work with the national organization to coordinate this list of local health care providers.

The national organization records and tracks results from each screening on a central database and shares this information with participating affiliates. A numerical participant identification coding system ensures confidentiality.

The national organization is responsible for participant follow-up. The KEEP Information and Call Center is staffed by experienced clinical personnel who provide explanations of laboratory results to KEEP participants and interact with physicians who treat KEEP participants.

Because some test results are not available on site, participants receive all screening results by mail within a few weeks after the screening. Those with test results significantly outside the normal range are contacted immediately. Participants with abnormal results are encouraged again to consult a physician if they have not already done so.

The national organization contacts participants deemed at increased risk by mail 2 months after the initial results are sent to determine whether they consulted a physician. Those who do not respond by mail are contacted by telephone.

If KEEP participants provide consent on the day of the screening, their physicians receive a copy of their results. These reports include management and treatment recommendations based on the NKF Clinical Practice Guidelines for CKD and other available evidence-based guidelines.

Serum creatinine values for KEEP participants are calibrated against values measured at the Cleveland Clinic Research Laboratory (Basel, Switzerland) by using the Roche enzymatic assay. Details of the calibration method and results are reported elsewhere in this supplement.[10] Subsequently, estimated glomerular filtration rate (eGFR) using the original (raw) serum creatinine value was recalculated using the isotope dilution mass spectrometry–traceable 4-variable Modification of Diet in Renal Disease (MDRD) Study equation[11] with the newly calibrated serum creatinine values.

This article, its companion articles, and the reference tables reported in this supplement include eligible KEEP participants screened from August 2000 through December

31, 2006, from 47 NKF affiliates and 1,608 screening programs in 49 states and the District of Colombia.

NHANES 1999-2004

NHANES is a series of health examination surveys conducted by the National Center for Health Statistics of the US Centers for Disease Control and Prevention. Begun in 1960, NHANES is designed to monitor the health and nutritional status of the noninstitutionalized civilian population in the United States. In 1999, NHANES became a continuous annual survey to allow annual estimates, with release of public-use data files every 2 years. NHANES 1999-2004 surveys are nationally representative cross-sectional health examination surveys using a complex, stratified, multistage probability cluster sampling design that includes selection of primary sampling units (counties), household segments within the counties, and sample persons from selected households. Survey participants were interviewed in their homes and/or received standardized medical examinations in mobile examination centers.

To allow comparison of KEEP and NHANES, the KEEP data set is restricted to participants 20 years and older (n = 72,963), and the NHANES data set to participants 20 years and older with self-reported hypertension; self-reported diabetes; or family history of hypertension, stroke, or diabetes (n = 10,865).

Statistical Analysis

The Cochran-Armitage test for trend was used to analyze time trends in KEEP demographic characteristics and self-reported comorbid conditions. χ^2 and logistic regression were used to study crude associations between some of the KEEP population characteristics.

Because NHANES surveys are nationally representative cross-sectional health examination surveys using a complex, stratified, multistage probability cluster sampling design, SUDAAN (Research Triangle Institute, Research Triangle Park, NC) was used to obtain national prevalence estimates in NHANES. SEs were calculated by using the Taylor Series Linearization method for NHANES 1999-2004.

To perform statistical testing between the 2 data sets, we merged them and calculated χ^2 P values for categorical variables after rescaling the NHANES weights such that valid comparisons between NHANES data and KEEP data could be made. This rescaling accounted for the complex survey design of the NHANES data while still retaining the weight structure to give correct point estimates.

Data were analyzed using the Statistical Analysis System, version 9.1 (SAS Institute, Cary, NC).

Definitions

To ensure consistent and unbiased comparisons between KEEP and NHANES participants, we applied common definitions for comorbid conditions included in the analyses. The 4-variable MDRD Study equation was used to calculate eGFR, and serum creatinine was calibrated to the Cleveland Clinic Research Laboratory. ACRs were calculated from urine samples and recorded as less than 30, 30 to 300, or greater than 300 mg/g. CKD stages were defined as follows: stage 1, eGFR 90 mL/min/1.73 m^2 or greater ($\geq$1.50 mL/s/1.73 m^2) and ACR of 30 mg/g or greater; stage 2, eGFR of 60 to 89 mL/min/1.73 m^2 (1.00 to 1.48 mL/s/1.73 m^2) and ACR of 30 mg/g or greater; stage 3, eGFR of 30 to 59 mL/min/1.73 m^2 (0.50 to 0.98 mL/s/1.73 m^2); stage 4, eGFR of 15 to 29 mL/min/1.73 m^2 (0.25 to 0.48 mL/s/1.73 m^2); and stage 5, eGFR less than 15 mL/min/1.73 m^2 ($<$0.25 mL/s/1.73 m^2). Diabetes was defined as history of diabetes (self-report or retinopathy), use of medications to treat diabetes, or newly diagnosed diabetes, defined as fasting blood glucose level greater than 125 mg/dL ($>$6.9 mmol/L) or nonfasting blood glucose level 200 mg/dL or greater ($\geq$11.1 mmol/L) in the absence of self-report of medicine use. In NHANES, self-reported diabetes is used for analyses. Hypertension was defined as history of hypertension (self-report), use of medications to treat hypertension, or newly diagnosed hypertension (Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure),[12] defined as systolic blood pressure of 130 mm Hg or greater or diastolic blood pressure of 80 mm Hg or greater for persons with a history of diabetes or CKD; otherwise, systolic blood pressure of 140 mm Hg or greater or diastolic blood pressure of 90 mm Hg or greater. In NHANES, hypertensive medication is not used to define hypertension. History of CVD was defined as self-reported history of heart attack, heart angioplasty, bypass surgery, heart failure, abnormal heart rhythm, or stroke. NHANES defined history of CVD as self-reported history of coronary heart disease, angina/angina pectoris, heart attack, congestive heart failure, or stroke. Obesity was defined as body mass index of 30 kg/m^2 or greater. Race and ethnicity in NHANES are defined as non-Hispanic white, non-Hispanic black, and other; or Hispanic and non-Hispanic. KEEP and NHANES definitions are listed in Table 1.

RESULTS

Since the inception of KEEP in 2000, the number of enrolled participants has grown exponentially from 6,082 to 73,460 in 2006, when 47 NKF affiliates screened 18,203 new participants (Fig 1). On average, the number of persons screened per affiliate increased from 223 (median, 207) in 2002 to 384 (median, 325) in 2005 and 387 (median, 354) in 2006. By region, recruitment is highest in the South (49.1% of participants), followed by the Northeast (23.0%), Midwest (16.1%), and West (11.8%).

Age distribution is stable over time, with the greatest proportion of KEEP participants aged 46 to 60 years (35.2%). However, the proportion of participants aged 31 to 45 years appears to have decreased (test of trend, $P < 0.001$), and the proportion aged 61 to 75 years increased (test of trend, $P < 0.001$; Table 2). Twice as many women as men enrolled in KEEP (68.4% versus 31.5%); this ratio has remained remarkably constant since 2000 to 2001. Minorities are well

Table 1. KEEP and NHANES Comorbid Condition Definitions

Condition	Definition	
	KEEP	NHANES 1999-2004
CKD	eGFR $<$ 60 mL/min/1.73 m^2 ($<$1.0 mL/s/1.73 m^2) or eGFR $\geq$ 60 mL/min/1.73 m^2 and ACR $\geq$ 30 mg/g	Same as KEEP
Diabetes	History (self-report or retinopathy), medication use, or new diagnosis*	Self-reported
History of CVD	Self-reported history of heart attack, heart angioplasty, bypass surgery, heart failure, abnormal heart rhythm, or stroke	Self-reported history of coronary heart disease, angina/angina pectoris, heart attack, congestive heart failure, or stroke
Hypertension	History (self-report), medication use, or new diagnosis†	Same as KEEP, without using medication information
Obesity	Body mass index $\geq$ 30 kg/m^2	Same as KEEP

Abbreviations: KEEP, Kidney Early Evaluation Program; NHANES, National Health and Nutrition Examination Survey; CKD, chronic kidney disease; CVD, cardiovascular disease; ACR, albumin-creatinine ratio; eGFR, estimated glomerular filtration rate.

*Defined as fasting blood glucose level greater than 125 mg/dL ($>$6.9 mmol/L) or nonfasting blood glucose level 200 mg/dL or greater ($\geq$11.1 mmol/L) in the absence of self-report of medicine use.

†Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, defined as systolic blood pressure of 130 mm Hg or greater or diastolic blood pressure of 80 mm Hg or greater for persons with a history of diabetes or CKD[12]; otherwise, systolic blood pressure of 140 mm Hg or greater or diastolic blood pressure of 90 mm Hg or greater.

represented in KEEP (33.4% African American, 12.3% Hispanic), although the proportion of whites tended to increase over time (test of trend, $P < 0.001$). Most KEEP participants are nonsmokers (82.7%), with a decreasing trend in smoking over time (test of trend, $P < 0.001$).

The educational status of KEEP participants has remained consistent since 2000 to 2001 (Table 2). Almost 26.0% completed high school, 25.9% have some level of college, 19.7% are college graduates, and nearly 12.0% have more than 16 years of schooling. The proportion of participants without health insurance increased from 14.5% in 2000 to 2001 to 19.0% in 2004 and stayed approximately at that level since then. Almost 85.0% of KEEP participants report having a physician. This proportion is consistent over time, but varies greatly with age, sex, race, and ethnicity (Fig 2). The likelihood of having a physician increases with age (test of trend, $P < 0.001$), is greater for women (odds ratio [OR], 1.64; 95% confidence [CI], 1.57 to 1.70), and is less in Hispanics versus non-Hispanics (OR, 0.26; 95% CI, 0.24 to 0.27), African Americans (OR, 0.73; 95% CI, 0.69 to 0.76), and others (OR, 0.34; 95% CI, 0.32 to 0.36) versus whites.

Demographic characteristics vary by region. For example, participants enrolled in the Northeast are more likely to be white and have health insurance than participants enrolled in other regions (Table 3). More African American participants were enrolled in the South, and more

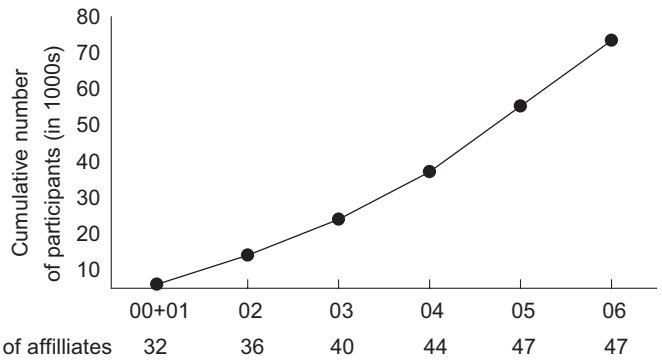

Figure 1. Cumulative number of Kidney Early Evaluation Program participants and affiliates.

Table 2. Demographic Characteristics of KEEP Participants: Time Trends

	KEEP Cohort						
	All	2000-2001	2002	2003	2004	2005	2006
No. of participants	73,460	6,082	8,044	9,921	13,124	18,086	18,203
Age (y)							
18-30	8.1	9.3	8.0	10.1	8.3	7.7	6.9
31-45	22.4	24.5	24.6	24.1	22.4	22.0	20.2
46-60	35.2	34.5	33.0	34.5	35.7	35.5	36.0
61-75	26.0	24.7	25.2	24.0	25.4	26.3	27.9
>75	8.4	7.0	9.2	7.3	8.2	8.5	9.0
Sex							
Men	31.5	32.2	31.9	29.7	31.6	32.5	31.1
Women	68.4	67.8	68.0	70.3	68.4	67.2	68.9
Missing	0.1	0.0	0.0	0.0	0.0	0.3	0.0
Race/ethnicity							
White	45.5	37.6	38.6	43.4	44.1	49.8	49.3
African American	33.4	43.6	42.2	34.6	32.6	29.0	30.3
Other	18.8	15.9	16.9	18.6	22.7	18.9	17.9
Unknown/missing	2.3	2.9	2.4	3.4	0.6	2.3	2.5
Non-Hispanic	87.7	89.8	91.1	88.8	85.6	86.7	87.3
Hispanic	12.3	10.2	8.9	11.2	14.4	13.3	12.7
US Census region							
Northeast	23.0	20.1	23.0	23.0	23.1	24.7	22.3
Midwest	16.1	13.8	15.2	17.2	18.8	14.3	16.4
South	49.1	58.5	50.7	47.9	48.1	47.3	48.6
West	11.8	7.5	11.0	11.9	10.0	13.7	12.7
Missing	0.0	0.2	0.1	0.0	0.0	0.0	0.0
Current smoker							
Yes	11.4	13.2	13.0	11.6	12.6	11.0	9.6
No	82.7	80.3	80.4	82.6	80.4	83.5	85.3
Missing	5.9	6.5	6.6	5.8	7.0	5.5	5.0
Education (y)							
≤6	5.6	6.0	5.0	5.0	6.2	5.8	5.6
<12	9.7	9.6	10.8	9.3	9.1	9.8	9.6
12	25.7	26.1	27.3	26.1	26.6	25.4	24.4
>12	25.9	26.8	26.8	28.0	26.4	25.8	23.8
16	19.7	18.8	18.2	19.3	19.3	20.0	20.8
>16	11.9	11.3	10.7	11.4	11.2	11.8	13.4
Missing	1.5	1.5	1.2	0.9	1.3	1.4	2.4
Health insurance							
Yes	78.4	81.4	79.9	79.5	77.4	77.5	77.6
No	17.5	14.5	15.3	16.7	19.0	17.9	18.4
Missing	4.1	4.1	4.7	3.7	3.6	4.5	3.9
Physician							
Yes	84.8	85.9	86.2	85.3	83.5	84.6	84.5
No	12.6	10.7	10.9	12.3	13.0	13.0	13.4
Missing	2.6	3.4	2.9	2.3	3.5	2.3	2.1

Note: Categorical values are expressed in percent.
Abbreviation: KEEP, Kidney Early Evaluation Program.

Hispanic participants, in the West. The proportion of participants with health insurance was the lowest in the West (Table 3).

The proportion of new KEEP participants with comorbid conditions increased over time (test of trend for self-reported diabetes, hypertension, CVD, and kidney disease, $P < 0.001$), except for obesity, which decreased (test of trend, $P = 0.002$; Table 4).

Although eligibility criteria similar to KEEP were applied to the NHANES 1999-2004 data, age distribution, man-woman ratio, and race dis-

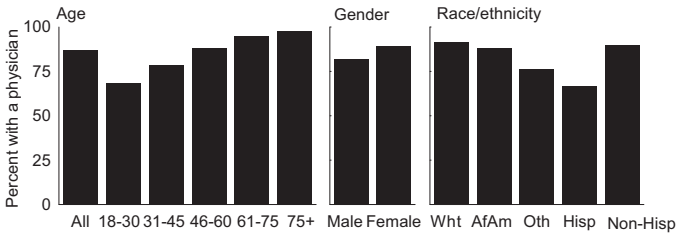

Figure 2. Kidney Early Evaluation Program participants who have a physician, by age, sex, race, and ethnicity (n = 73,460).

tribution differ greatly between the KEEP and NHANES populations (Fig 3). The KEEP population is older than the NHANES population ($P < 0.001$) and includes a greater proportion of women (68.4% versus 54.7%; $P < 0.001$) and African Americans (33.4% versus 12.1%; $P < 0.001$). Interestingly, Hispanics are not better represented in KEEP than in the NHANES subgroup (12.3% versus 12.2%).

The proportion of high school graduates is similar in KEEP and the NHANES subgroup, but more KEEP participants than NHANES participants have at least some college education (57.6% versus 52.8%; $P < 0.001$). In contrast to the NHANES subgroup, more African American KEEP participants report at least some college education than whites (61.5% versus 59.3% in KEEP; 43.4% versus 56.5% in NHANES). Similarly, the proportion of Hispanic participants with at least some college education is greater in KEEP than in the NHANES subgroup (37.9% versus 37.5%; $P < 0.0001$; Fig 4). Insurance coverage is lower in KEEP than in the NHANES subgroup (78.4% versus 84.0%; $P < 0.001$). Insurance coverage in Hispanics is lowest in both KEEP (52.0%) and the NHANES subgroup (65.1%; Fig 5).

Although NHANES records were selected for this analysis by using eligibility criteria similar to KEEP, self-reported hypertension and self-reported diabetes are more prevalent in KEEP than in the NHANES subgroup (52.9% versus 38.5%; $P < 0.001$; 26.6% versus 9.9%; $P < 0.001$). Likewise, the proportion of obese participants and patients with CKD is greater in KEEP than in the NHANES subgroup (43.6% versus 35.5%; $P < 0.001$; 22.8% versus 17.6%; $P < 0.001$, respectively; Fig 6A). Finally, self-reported hypertension, diabetes, and CVD were more prevalent in the KEEP population than the NHANES subgroup regardless of presence or absence of CKD (Fig 6B and C), whereas self-reported kidney disease (awareness of kidney disease) in participants with CKD was slightly higher in NHANES than in KEEP (9.2% versus 7.3%; $P < 0.001$).

DISCUSSION

KEEP enrollment seems to have reached a steady pace, with a yearly average between 384 and 387 participants per site in the last 2 years. Whether the success of the program is caused by better communication strategies from the affiliates or increased public awareness of the risk of

Table 3. Demographic Characteristics of KEEP Participants by Region

	Region				
	Northeast	Midwest	South	West	$P(\chi^2)$
No. of participants	16,903	11,803	36,095	8,633	
Men	33.1	29.7	31.2	32.2	<0.001
Age > 60 y	35.9	36.7	33.2	33.2	<0.001
African American	28.1	32.2	42.9	38.5	<0.001
White	52.7	48.6	42.6	39.8	<0.001
Hispanic	10.0	13.3	11.2	20.4	<0.001
Health insurance (yes)	83.8	78.3	76.5	75.8	<0.001
Education ≥ 12 y	83.7	81.3	83.4	83.7	<0.001

Note: With the exception of the first row, categorical values are expressed in percent. Region information was missing for 26 KEEP participants.

Abbreviation: KEEP, Kidney Early Evaluation Program.

Table 4. Self-reported Comorbid Conditions and Obesity, KEEP Participants: Time Trends

	KEEP Cohort						
	All	2000-2001	2002	2003	2004	2005	2006
No. of participants enrolled each year	73,460	6,082	8,044	9,921	13,124	18,086	18,203
Diabetes*	26.5	24.6	24.1	24.4	25.8	26.7	29.6
Hypertension*	52.6	51.0	51.9	51.2	52.1	53.0	54.2
Cardiovascular disease*	19.8	16.4	16.4	15.8	15.6	22.0	25.6
Kidney disease*	3.4	2.6	2.1	2.7	2.8	3.8	4.6
Obesity†	43.4	43.0	45.1	45.4	43.6	43.2	41.9

Note: With the exception of the first row, categorical values are expressed in percent.
Abbreviation: KEEP, Kidney Early Evaluation Program.
*Self-reported.
†Body mass index of 30 kg/m^2 or greater.

kidney disease associated with comorbid conditions is unknown. The current screening questionnaire does not ask participants how they heard about KEEP.

KEEP enrollment is more than twice as high in the South as in any other area of the United States. This may be related to heightened health consciousness of the population because of very high end-stage renal disease prevalence in the Gulf Coast states and Texas and Arizona[2] and the high percentage of self-reported diabetes (from 8.6% of the population in North Carolina to 10.0% in Mississippi) and hypertension (from 28.7% of the population in North Carolina to 33.2% in Mississippi).[13]

KEEP seems to consistently attract more women than men, adding evidence for the idea that health consciousness is higher in women.[14] Likewise, markers of socioeconomic status, such as education level, presence of health insurance, and not smoking, also are consistently high over the years, confirming the known association between health consciousness and socioeconomic status.[14,15] However, more effort seems to have been made since 2004 to recruit patients without health insurance. The likelihood of having health insurance differs by region of enrollment. Participants from the South or West seem to be less likely to have health insurance than participants from the other regions.

As expected, women and older people are more likely to report having a physician, whereas African Americans and Hispanics are less likely to report having a physician than whites and non-Hispanics (respectively), consistent with other reports.[16-18] KEEP has been successful over the years in enrolling more individuals with self-reported diabetes, hypertension, CVD, or kidney disease. This enrollment pattern may help explain the aging trend of new KEEP participants.

Although we used a subgroup of NHANES participants selected according to criteria similar to KEEP (except for family history of kidney disease, which is not available in NHANES) for this analysis, KEEP participant demographic and

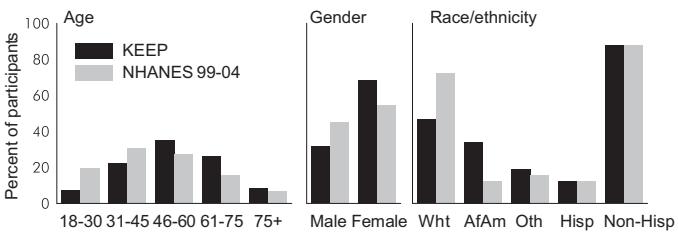

Figure 3. Demographic characteristics for Kidney Early Evaluation Program (KEEP) and National Health and Nutrition Examination (NHANES) participants. For comparison purposes, the KEEP data set is restricted to participants 20 years and older (n = 72,963), and the NHANES data set, to participants 20 years and older with 1 or more of the following: self-reported hypertension, self-reported diabetes, and family history of hypertension, stroke, or diabetes (n = 10,865). Missing KEEP data were included in the analysis; however, χ^2 values were similar regardless of whether missing data were included. For sex, 0.09% of data were missing, and for race, 0.6%.

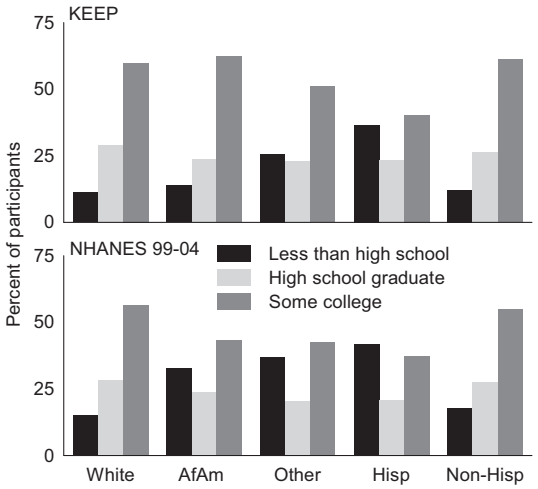

Figure 4. Education level of Kidney Early Evaluation Program (KEEP) and National Health and Nutrition Examination (NHANES) participants by race and ethnicity. For comparison purposes, the KEEP data set is restricted to participants 20 years and older (n = 72,963), and the NHANES data set, to participants 20 years and older with 1 or more of the following: self-reported hypertension, self-reported diabetes, and family history of hypertension, stroke, or diabetes (n = 10,865). Missing KEEP data (3.5% of data) were included in the analysis; however, χ^2 values were similar regardless of whether missing data were included.

clinical characteristics are very different from those of NHANES participants. The selection bias associated with voluntary screening is important to keep in mind when interpreting some of these results. Interestingly, although the proportion of Hispanic participants in KEEP and the NHANES subgroup is the same, their demographic characteristics differ markedly. KEEP Hispanic participants have a higher level of education than NHANES subgroup Hispanic participants and, paradoxically, lower insurance cover-

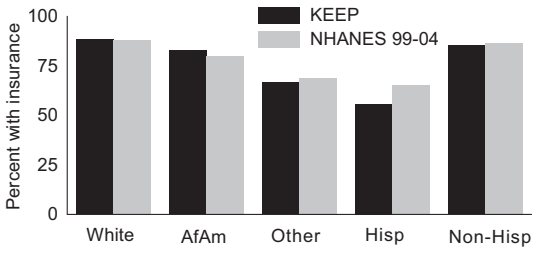

Figure 5. Insurance status for Kidney Early Evaluation Program (KEEP) and National Health and Nutrition Examination (NHANES) participants by race and ethnicity. For comparison purposes, the KEEP data set is restricted to participants 20 years and older (n = 72,963), and the NHANES data set, to participants 20 years and older with 1 or more of the following: self-reported hypertension, self-reported diabetes, and family history of hypertension, stroke, or diabetes (n = 10,865). Missing KEEP data (6.1%) were included in the analysis; however, χ^2 values were similar regardless of whether missing data were included.

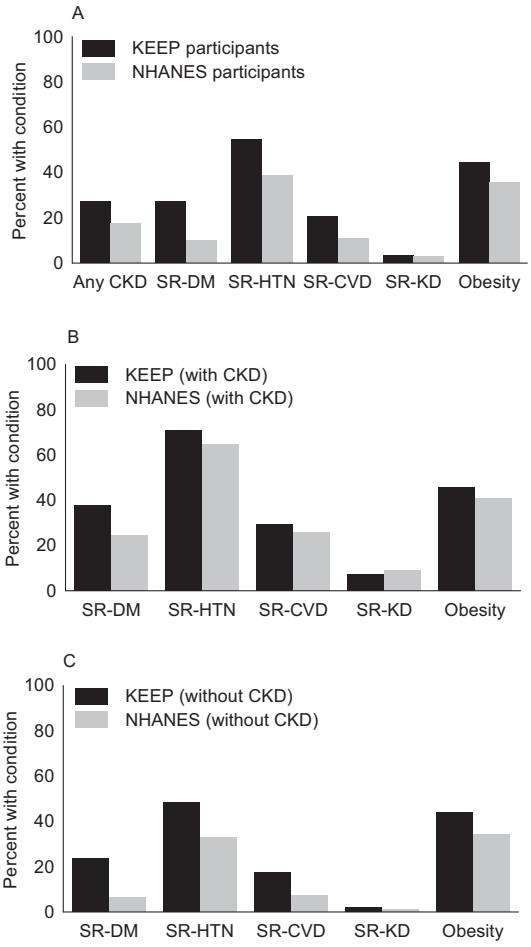

Figure 6. Prevalence of self-reported comorbid conditions and chronic kidney disease (CKD) for Kidney Early Evaluation Program (KEEP) and National Health and Nutrition Examination (NHANES) participants. CKD is defined as estimated glomerular filtration rate (eGFR) less than 60 mL/min/1.72 m^2 (<1.0 mL/s/1.72 m^2) or eGFR of 60 mL/min/1.72 m^2 or greater (≥1.0 mL/s/1.72 m^2) and albumin creatinine ratio of 30 mg/g or greater. For comparison purposes, the KEEP data set is restricted to participants 20 years and older (n = 72,963), and the NHANES data set, to participants 20 years and older with 1 or more of the following: self-reported hypertension, self-reported diabetes, and family history of hypertension, stroke, or diabetes (n = 10,865). Missing KEEP data were included in the analysis. Reported χ^2 values were similar regardless of whether missing data were included. Abbreviations: SR, self-reported; DM, diabetes mellitus; HTN, hypertension; CVD, cardiovascular disease; KD, kidney disease.

age. This is surprising because a large body of evidence emphasizes the positive association between education level and insurance status.[19,20] However, this positive association is found in African American and white participants, who have a higher level of education and higher insurance coverage in KEEP than in the NHANES subgroup.

Although KEEP participants seem to have higher socioeconomic status than NHANES subgroup participants, the proportion of KEEP participants with self-reported diabetes, hypertension, obesity, or CVD is much greater regardless of whether CKD is present. However, this difference is attenuated in participants with CKD, probably because of the well-documented strong association between CKD and the other comorbid conditions.[1,2,21,22]

The proportion of NHANES subgroup participants reporting being told that they had kidney disease is slightly greater than reported by Coresh et al[21] in a previous analysis of NHANES data (2.8% versus 2.0%), probably because our NHANES subgroup specifically includes participants at risk of kidney disease. Finally, although KEEP participants have a higher level of education and report more comorbid conditions than NHANES subgroup participants, their awareness of kidney disease is lower. This result illustrates the issue of missed kidney disease educational opportunities during physician office visits for diabetes or hypertension control.

In conclusion, KEEP has been successful in enrolling participants at greatest risk of kidney disease, evidenced by the much greater proportion of KEEP participants with self-reported hypertension and diabetes compared with the NHANES subgroup. However, one could postulate that the proportion of participants with these kidney disease risk factors might increase if more participants with lower education level and without health insurance were enrolled in the program. KEEP's role is not only to detect kidney disease and inform participants about their risk of kidney disease, but also to encourage them to actively seek care for control of their risk factors. Individuals of lower socioeconomic status therefore may benefit more from KEEP than those of higher socioeconomic status. Finally, because KEEP refers participants back to their primary care physicians or other physicians, the nephrology community should also emphasize information and training for primary care physicians regarding appropriate management of patients with kidney disease.

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SUPPLEMENTARY DATA

Item S1: KEEP Screening Questionnaire.

Note: The supplementary data accompanying this article (doi:10.1053/j.ajkd.2007.12.022) is available at www.ajkd.org.

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