RESEARCH LETTER

Health-Related Social Needs and Kidney Risk Factor Control in an Urban Population

To the Editor:

Individuals experiencing health-related social needs, such as housing and food insecurity, face significant health care barriers and are at increased risk for chronic kidney disease (CKD) and end-stage kidney disease. Maintaining blood pressure at ≤130/80 mm Hg, hemoglobin A1c level of 7%, sodium intake < 2,000 mg/d, body mass index (BMI) ≤ 25 kg/m², regular physical activity, and smoking cessation reduce the risk for CKD and CKD progression. We examined whether experiencing social needs was associated with kidney protective measures and hypothesized that those experiencing social needs would achieve fewer kidney protective measures.

We used data from the Healthy Aging in Neighborhoods of Diversity Across the Life Span (HANDLS) Study (Baltimore, MD). HANDLS is a population-based cohort examining the influence and interaction of race and socioeconomic status on the development of health disparities. The cohort includes 3,720 Black and White individuals between the ages of 30 and 64 years who were sampled from 13 socioeconomically diverse neighborhoods. Each participant provided written informed consent, and the National Institute of Environmental Health Sciences, National Institutes of Health, approved the study protocol.

We performed a cross-sectional analysis at HANDLS visit 4 (September 2013 to September 2017). Individuals were included if they attended visit 4 (N = 2,171) and were excluded for missing data (N = 418), leaving a study population of N = 1,753 (Fig S1). There were no substantial differences between included individuals and those who were excluded due to missingness. Having social needs was defined as experiencing housing and/or food insecurity. Food insecurity was defined as self-report of often or occasionally eating less due to not having enough money for food in the past 12 months. Housing insecurity was defined as self-report of inability to afford a suitable home or difficulty making rent or mortgage payments.

The outcome was defined as achieving 4 or more protective measures (yes/no) using data from visit 4 (blood pressure ≤ 130/80 mm Hg, hemoglobin A1c level ≤ 7.5%, average 2-day salt intake < 2,000 mg/d, BMI ≤ 25 kg/m², self-report of physical activity during leisure time, and current nonsmoker).

We compared participant characteristics using χ² tests for categorical variables and t tests for continuous variables. We compared the percentage of participants with the primary outcome and who achieved each individual measure. As our primary analysis, we quantified the association between social needs and achieving 4 or more protective measures. We evaluated for potential effect modification by race by including an interaction term for race × social needs. As secondary analyses, we quantified associations between social needs and achieving 1 or more, 2, 3, 5, and 6 measures and with each measure independently.

As sensitivity analyses, we used a blood pressure target of ≤140/90 mm Hg and defined the outcome as the number of measures met on a continuous scale ranging from 0 to 6. For all analyses, we used log-binomial regression or Poisson regression with robust estimate of variance when the model failed to converge and adjusted for demographics (age, race, sex, and poverty status) and kidney function (estimated glomerular filtration rate and urinary albumin-creatinine ratio).

Among 1,753 HANDLS participants, 876 (49.9%) reported housing and/or food insecurity (Table 1). Overall, 665 participants met 4 or more measures, 1,339 (76.4%) had blood pressure ≤ 130/80 mm Hg, 1,595 (91.0%) had hemoglobin A1c levels ≤ 7.5%, 686 (39.1%) reported average 2-day salt intake < 2,000 mg/d, 421 (24.0%) had...
BMI ≤ 25 kg/m², 558 (31.8%) reported physical activity during leisure time, and 1,022 (58.3%) reported being nonsmokers (Figs S2 and S3).

Compared with those without social needs, those with social needs were less likely to achieve 4 or more measures (unadjusted risk ratio [RR], 0.80; 95% CI, 0.71–0.90; adjusted RR, 0.82, 95% CI 0.72–0.93; Table 2). Individuals with social needs were even less likely to achieve 5 or more and all 6 measures. The adjusted RR for the relation between social needs and achieving 4 or more measures was 0.76 (95% CI, 0.62–0.92) for Whites and 0.87 (95% CI, 0.74–1.02) for Blacks (P for interaction = 0.25).

Experiencing social needs was significantly associated with sodium intake (adjusted RR, 1.22; 95% CI, 1.08–1.37), physical activity (adjusted incidence rate ratio [IRR], 0.72; 95% CI, 0.63–0.83), and smoking status (adjusted IRR, 0.79; 95% CI, 0.73–0.86) but not other measures. Findings were similar when we used a blood pressure target of 140/90 mm Hg and the outcome was defined using a continuous scale.

Some limitations bear mention. HANDLS does not have traditional measures of housing insecurity, such as housing payment to income ratio. We may not have captured all participants experiencing social needs. Our findings may not be generalizable to nonurban populations. Due to the cross-sectional design, we cannot draw conclusions about temporality or causality, and reverse causality cannot be excluded.

In this cross-sectional study of 1,753 urban-dwelling individuals, people experiencing social needs achieved fewer kidney protective measures. Our work highlights a potential mechanism between previously documented associations between housing insecurity10 and food insecurity7 and the development of kidney disease. Findings appear to be driven by engagement in physical activity during leisure time and smoking status, highlighting potential intervention targets. Risk reduction efforts specifically targeting kidney protective measures among populations experiencing social needs should be considered.

**Table 2. Association Between Health-Related Social Needs and Kidney Protective Measures**

| Outcome | Unadjusted (N = 1,753) | Adjusted* (N = 1,753) |
|---------|------------------------|-----------------------|
| Primary analysis | | |
| Achieved ≥ 24 measures | 0.80 (0.71-0.90) | 0.82 (0.72-0.93) |
| Secondary analyses | | |
| Achieved ≥ 1 measure | 1.00 (1.00-1.00) | 1.00 (1.00-1.00) |
| Achieved ≥ 2 measures | 0.99 (0.97-1.01) | 0.99 (0.98-1.01) |
| Achieved ≥ 3 measures | 0.95 (0.90-1.01) | 0.96 (0.91-1.02) |
| Achieved ≥ 5 measures | 0.72 (0.55-0.94) | 0.76 (0.58-0.99) |
| Achieved all 6 measures | 0.24 (0.08-0.70) | 0.30 (0.10-0.92) |
| BP ≤ 130/80 mm Hg | 1.01 (0.96-1.01) | 1.00 (0.95-1.05) |
| Hemoglobin A1c ≤ 75% | 0.98 (0.67-1.19) | 0.98 (0.95-1.01) |
| Sodium intake < 2,000 mg/d | 1.17 (1.04-1.31) | 1.22 (1.08-1.37) |
| BMI ≤ 25 kg/m² | 1.21 (1.02-1.43) | 1.15 (0.97-1.37) |
| Physically active | 0.73 (0.64-0.84) | 0.72 (0.63-0.83) |
| Nonsmoker | 0.73 (0.67-0.79) | 0.79 (0.73-0.86) |

Abbreviations: BMI, body mass index; BP, blood pressure; RR, risk ratio.

*Fully adjusted models adjusted for age, race, sex, income >125%<125% of federal poverty level, urinary albumin-creatinine ratio, and estimated glomerular filtration rate.

**SUPPLEMENTARY MATERIAL**

**Supplementary File (PDF)**

**Figure S1:** Derivation of study population

**Figure S2:** Number of participants who achieved 1 to 6 protective measures

**Figure S3:** Comparison of the percentage of participants who achieved the primary outcome and each independent measure

**ARTICLE INFORMATION**

**Authors’ Affiliations:** Division of Nephrology, Department of Internal Medicine, University of Texas at Austin Dell Medical School, Austin, TX (TKN); Welch Center for Prevention Epidemiology and Clinical Research, Johns Hopkins Medical Institutions, Baltimore, MD (DH, DCC); Department of Internal Medicine, University of Texas at Austin Dell Medical School, Austin, TX (EJA); Maine Medical Center Research Institute, Baltimore, MD (EJA); National Institute on Aging, National Institutes of Health, Baltimore, MD (AZ, MKE); Division of Nephrology, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD (DCC); and Johns Hopkins Center for Health Equity, Johns Hopkins Medical Institutions, Baltimore, MD (DCC).

**Address for Correspondence:** Tessa K. Novick, MD, MSW, MHS, 1601 Trinity St, Bldg B, Rm 7816, Austin, TX 78712. Email: tessa.novick@austin.utexas.edu

**Authors’ Contributions:** Research and study design: TKN, DCC, DH; data acquisition: TKN, MKE, AZ; data analysis and interpretation: TKN, DH, DCC; statistical analysis: TKN; supervision or mentorship: DCC, EJA, AZ, MKE. Each author contributed important intellectual content during manuscript preparation.
drafting or revision and accepts accountability for the overall work by ensuring that questions pertaining to the accuracy or integrity of any portion of the work are appropriately investigated and resolved.

Support: This research was supported in part by the Intramural Research Program of the National Institutes of Health (NIH), National Institute on Aging. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH. Dr Crews was supported by grant K24 HL148181 from the National Heart, Lung and Blood Institute, NIH.

Financial Disclosure: The authors declare that they have no relevant financial interests.

Peer Review: Received October 3, 2020. Evaluated by 2 external peer reviewers, with direct editorial input from the Statistical Editor and the Editor-in-Chief. Accepted in revised form March 14, 2021.

Publication Information: © 2021 The Authors. Published by Elsevier Inc. on behalf of the National Kidney Foundation, Inc. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/). Published online May 2, 2021 with doi: 10.1016/j.kjme.2021.03.005

REFERENCES
1. Centers for Disease Control and Prevention. Chronic Kidney Disease Surveillance System—United States. Accessed August 13, 2020. http://www.cdc.gov/ckd.
2. Novick TK, Omenyi C, Han D, Zonderman A, Evans M, Crews D. Housing insecurity and risk of adverse kidney outcomes. Kidney360. 2020;1(4):241-247.
3. Hall YN, Choi AI, Himmelfarb J, Chertow GM, Bindman AB. Homelessness and CKD: a cohort study. Clin J Am Soc Nephrol. 2012;7(7):1094-1102.
4. Crews DC, Kuczmarski MF, Grubbs V, et al. Effect of food insecurity on chronic kidney disease in lower-income Americans. Am J Nephrol. 2014;39(1):27-35.
5. Kushel MB, Gupta R, Gee L, Haas JS. Housing instability and food insecurity as barriers to health care among low-income Americans. J Gen Intern Med. 2006;21(1):71-77.
6. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney Int Suppl. 2013;3:1-150.
7. Evans MK, Lepkowski JM, Powe NR, LaVeist T, Kuczmarski MF, Zonderman AB. Healthy aging in neighborhoods of diversity across the life span (HANDLS): overcoming barriers to implementing a longitudinal, epidemiologic, urban study of health, race, and socioeconomic status. Ethn Dis. 2010;20(3):267-275.
8. USDA. U.S. Household Food Security Survey Module: Six-Item Short Form. https://www.ers.usda.gov/media/8282/short2012.pdf. Accessed August 13, 2020.
9. Novick TK, Han D, Tuot DS, et al. Housing instability and health care engagement among people with CKD. Kidney Med. 2020;2(3):367-368.
10. Banerjee T, Crews DC, Wesson DE, et al. Food insecurity, CKD, and subsequent ESRD in US adults. Am J Kidney Dis. 2017;70(1):38-47.
Supplemental Figure S1. Derivation of study population.

Total HANDLS Cohort
N = 3720

Excluded
- Missing serum creatinine = 85
- Missing urine albumin-creatinine ratio: N = 63
- Missing housing security: 121
- Missing food security: 17
- Missing BMI measurement: N = 10
- Missing smoking status: N = 41
- Missing A1c measurement: N = 10
- Missing activity status: N = 1
- Missing BP measurement: N = 8
- Missing sodium intake: N = 62

Included: attended visit 4
N = 2171

Study Population
N = 1753
Supplemental Figure S2. Number of participants who achieved 1-6 protective measures.

| Number of Participants Achieving 1-6 Protective Measures |
|---------------------------------------------------------|
| Without Social Needs (N)                              |
| 0            | 1            | 2            | 3            | 4            | 5            | 6            |
| 1            | 28           | 183          | 295          | 253          | 100          | 17           |
| With Social Needs (N)                                 |
| 0            | 1            | 37           | 206          | 337          | 211          | 80           | 4            |
Supplemental Figure S3. Comparison of the number of participants who achieved the primary outcome and each independent measure.

*P-value <0.05

Abbreviations: BMI – body mass index

Units: BMI – kg/m²; Blood pressure – mmHg; Sodium intake – mg/day

Having social needs was defined as reporting housing and/or food insecurity. Food insecurity was defined as often or occasionally eating less due to not having enough money for food in the past 12 months. Housing insecurity was defined as inability to afford a suitable home, or difficulty making rent or mortgage payments.