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The Combined Influence of Psychological Factors on Biomarkers of Renal Functioning in African Americans

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Abstract

Objective—African Americans are disproportionately affected by chronic kidney disease (CKD). Recent research has documented that psychological factors have a significant influence on the progression and treatment of CKD. However, extant evidence exists that has examined the link between psychological factors and renal function in African Americans. The purpose of the study was to determine if psychological factors were associated with several biomarkers of renal functioning in this group.

Participants—129 African American participants, with a mean age of 44.4 years (SD512.25).

Design and Setting—Data were analyzed from a cross-sectional study entitled Stress and Psychoneuroimmunological Factors in Renal Health and Disease.

Main Predictor Measures—Participants completed the Beck Depression Inventory-II, Cook Medley Scale, and Perceived Stress Scale-10.

Main Outcome Measures—Systolic blood pressure, as well as blood and urine samples, were collected and served as biomarkers of renal functioning.

Results—Our findings indicated that psychological factors were not associated with renal functioning. Age, sex, and systolic blood pressure emerged as significant predictors of renal functioning.

Conclusions—Depressive symptomatology, perceived stress, and hostility did not influence renal functioning in this sample. This unexpected finding may be attributed to the fact that this sample population was not elevated on depressive symptoms, perceived stress, or hostility.

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AUTHOR CONTRIBUTIONS

Design and concept of study: Gholson, Mwendwa, Sims Wright, Callender, Campbell
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Elevated levels of these psychological factors, as well as other psychological factors associatd with the CKD, may be more influential on renal functioning in African Americans.

Keywords

Psychological; African Americans; Kidney Functioning; Depressive Symptomatology; Hostility; Perceived Stress

Introduction

African Americans are disproportionately diagnosed with chronic kidney disease (CKD).[1] This reality is concerning since CKD is likely to progress to end-stage renal disease (ESRD), which requires dialysis and often kidney transplantation.[1] Diabetes mellitus (DM) and hypertension are the leading causes of CKD, and both diseases are prevalent in African Americans.[2,3] Recent studies have also linked obesity to the development of CKD[4–6] and, as with DM and hypertension, African Americans have disparate rates of obesity as compared to other ethnic groups.[7] Although the relationship between obesity and CKD remains inconclusive, research has demonstrated strong associations among obesity, DM, and hypertension.[8–10] Therefore, since the above conditions are overrepresented within this population and linked to CKD development and progression, research is warranted to further understand novel risk factors that explain the development and progression of CKD in the African American community.

Prior research has shown an association between depression, depressive symptoms, and CKD patients.[11–13] Depression and depressive symptoms increase mortality, hospitalization, and dialysis withdrawal while reducing adherence to treatment plans among CKD and ESRD patients.[14–17] In addition, perceived stress and hostility have been identified as potential risk factors that influence health outcomes in hypertension and diabetes mellitus.[18–20] In African American populations, little is understood about the influence of psychological factors, such as depressive symptomatology, hostility, and perceived stress, on the development of CKD. This gap in empirical knowledge is problematic given that evidence has demonstrated the deleterious impact depression, depressive symptoms, perceived stress and hostility have on health outcomes, including hypertension, obesity, glucose dysregulation, and cardiovascular disease, in African Americans.[21–24]

Given the known associations between psychological factors and other health outcomes in African Americans, further exploration of psychological influences on renal functioning in this population is needed. We are unaware of any previous studies that have examined the role of several psychological risk factors, (ie, depressive symptomatology, hostility, and perceived stress), or the combined influence of these factors, on renal functioning in African Americans. Therefore, our study sought to identify if depressive symptomatology, hostility, and perceived stress are associated independently, and in combination with, several biomarkers of renal functioning in African Americans. We hypothesized that greater depressive symptomatology, hostility,

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and perceived stress would be associated with poorer urine albumin, systolic blood pressure, and estimated glomerular filtration rate (eGFR) values, and that the pattern of findings would indicate combined associations between psychological factors and biomarkers of renal functioning.

Methods

Procedure

Our study was conducted as part of a larger study entitled Stress and Psychoneuroimmunology Factors in Renal Health and Disease and was approved by the Howard University (HU) Institutional Review Board. This study was conducted as a part of the National Minority Organ Tissue Transplant Education Program (MOTTEP) at the Howard University Hospital General Clinical Research Center (GCRC). Participants were recruited through flyers posted at HU Hospital and advertisement at local health fairs. Participants provided informed consent. A community-based sample of 214 African American adults in the Washington, DC metropolitan area between ages 21 to 73 years underwent an extensive medical examination. Height and weight were used to calculate body mass index (BMI). A one-time seated blood pressure measurement was taken via a sphygmomanometer. Non-fasting urine and blood samples were drawn and stored at the GCRC. More information on study procedures can be found in previous publications.[25–27]

Psychological data were also collected. Participants completed three measures to assess their psychological well-being. The Perceived Stress Scale (PSS-10) is a 10-item, self-report measure used to assess the extent to which individuals appraise their life experiences as stressful within the past month.[28] Possible scores range from 0 to 40, with higher scores indicating greater stress appraisal. The PSS-10 has an internal reliability of .78 and test-retest correlation of .85.[29] The Cook Medley Hostility Scale[30] is a self-report, 50-item scale used to measure cynical hostility. Possible scores range from 0 to 50, with higher scores indicating a greater level of hostility. The scale has an internal reliability of .86 and a test-retest correlation of .85.[30,31] The Beck Depression Inventory (BDI)-II[32] assesses the severity of depressive symptoms in the general population. Possible scores range from 0 to 63, with higher scores indicating greater severity of depressive symptoms. The measure contains two subscales: cognitive symptoms and somatic symptoms. The BDI-II has an internal reliability coefficient of .92 and a test-retest correlation of .93.

Exclusion criteria for the overall study included current physical, emotional, or drug abuse as well as a previous diagnosis of psychological or behavioral disorders. The study took four to six hours for completion, and participants were monetarily compensated.

Statistical Analyses

Data analyses were conducted using SPSS version 20.0. The Beck Depression Inventory and BMI were positively skewed and square-root transformed for normality. All other variables

were normally distributed. Because we aimed to determine the independent and combined relations between two sets of variables, data were analyzed in two steps: canonical analysis and linear multiple regression. Canonical analysis is a statistical technique that allows common and unique pathways that may link two sets of variables to be identified. The canonical analysis conducted in our study included psychological factors as independent variables and biomarkers of renal functioning as dependent variables. Age, sex, education, and BMI were also added as independent variables to adjust for their relation to renal functioning. To assess relations among the set of independent variables and the set of dependent variables, the analysis tests whether variables tend to correlate or cluster together both within and between independent and dependent variables. These clusters, or variates, yield coefficients that can be interpreted as latent variables representing underlying constructs. As a follow-up to the canonical analysis, linear regression analysis was used to determine unique relations between the independent and dependent variables and confirm the relative importance of each variable's contribution to the canonical analysis results. Three regressions were run, one for each biomarker, and all independent variables were simultaneously entered into the models.

Results

Due to missing data on one or more variables, the analysis consisted of 129 participants (45% female) with a mean age of 44.4 years (*SD*=12.25). Participants had attained an average of 13.9 years of education (*SD*=2.32). The majority of participants (66%) reported being unmarried. Approximately 23% of participants had an income <$10,000 and only 1.5% had an income >$80,000. Regarding health status, 30% of participants were hypertensive, 13% were diabetic, and 16% were previously diagnosed with a mental health disorder. As an indication of overall health, 25% of participants self-reported other illnesses, disorders, or diseases. Sample characteristics and descriptive statistics are shown in Table 1.

The omnibus test of significance for the canonical analysis revealed a significant relationship between the set of independent variables and the set of dependent variables (Wilk's Lambda=.24; *P*<.001). The analysis yielded three canonical variates, of which two were significant. For the first canonical variate, the independent and dependent variables shared 65% of common variance (*R*=.67, *P*<.001). In variate two, the independent and dependent variables shared 4% of common variance (*R*=.09, *P*<.01). Statistics for each variate are shown in Table 2.

Variate one represented an underlying construct that was highly correlated with eGFR, but no other dependent variables (*β*=.98, *P*<.05). Among independent variables, only age (*β*=–.51, *P*<.05) and body mass index (*β*=.86, *P*<.05) were significantly correlated with variate one. Therefore, variate one was characterized by lower eGFR being associated with greater age and a lower BMI. Examining the underlying construct represented by variate two, the standardized canonical coefficients indicated urine albumin (*β*=–.32, *P*<.05) and systolic blood pressure (*β*=–.89, *P*<.05) as the dependent variables that were most strongly associated. For the set of independent variables, age (*β*=–.83, *P*<.05), sex (*β*=–.41, P<.05) and education (*β*=.22, *P*<.05) had the strongest relationship with this underlying construct.

As a result, variate two was characterized by higher urine albumin and higher systolic blood pressure being associated with greater age, being male, and less years of education.

With respect to the regression results, neither depressive symptomatology, perceived stress, nor hostility were unique predictors of any of the markers of renal functioning after controlling for age, sex, education, and BMI. However, several covariates emerged as significant predictors of markers of renal functioning. Specifically, greater age was associated with lower eGFR (β=–.45; P<.001). In addition, age was positively associated with systolic blood pressure (β=.26; P<.05). Being male was positively associated with higher eGFR (β=.12; P<.05) and higher systolic blood pressure (β=.22; P<.05). Furthermore, greater BMI was associated with higher eGFR (β=.69; P<.001), urine albumin levels (β=.24; P<.05), and systolic blood pressure (β=.27; P<.05). Regression statistics are displayed in Table 3.

Discussion

Our study sought to determine whether psychological factors would be associated with renal functioning in an African American community sample. Few studies have attempted to establish how psychological factors contribute to renal functioning and, even fewer have focused solely on African Americans who have disproportionate rates of CKD.[1] Findings revealed that none of the psychological factors were associated with renal functioning. However, two patterns emerged in the data: 1) lower eGFR was associated with greater age and lower BMI; and, 2) higher urine albumin and higher systolic blood pressure were associated with greater age, being male, and fewer years of education.

We hypothesized that psychological factors would be related to biomarkers of renal functioning both independently

> Findings revealed that none of the psychological factors were associated with renal functioning.

and concomitantly. Our hypotheses were not supported. The results were unexpected given that psychological factors have been implicated in the progression of CKD and ESRD and poor adherence to treatment. Depression has been associated with poor treatment adherence and survival rates among ESRD patients, rapid declines in renal functioning, and acute renal injuries.[14,17,33,34] With perceived stress and hostility being linked to the primary causes of CKD and ESRD, [19,35–37] it is possible that these psychological factors may only be relevant in the renal functioning of those with diabetes and hypertension. Our lack of significant findings may be due to the fact that the majority of participants not being diagnosed with hypertension or diabetes mellitus. Another explanation for our non-significant findings could be that psychological factors mediate or moderate the relationship between renal functioning and maladaptive lifestyle behaviors (eg, physical activity, smoking, unhealthy eating) in healthy individuals rather than having a direct influence. Lastly, overall, our participants did not have high levels of depressive symptomatology, perceived stress, or hostility, indicating that low levels of the aforementioned psychological factors may have a minimal impact on renal functioning.

Being male was associated with higher eGFR and higher systolic blood pressure. Both findings were consistent with the literature, as sex differences have been noted.[38] The tendency for men to have elevated eGFR may be indicative of hyperfiltration, a precursor to decline in renal functioning.[39] Also, men tend to experience a faster decline in renal functioning and in the progression of renal disease.[38,40] African American men also accelerate to ESRD faster than African American women.[1] The finding that African American men have higher systolic blood pressure is not surprising given that men, in general, have higher systolic blood pressure than women.[41]

Body mass index was significantly related to the three biomarkers of renal functioning. These findings were expected and consistent with the literature, as obesity has been identified as a possible risk factor for the onset of renal disease.[4,6] Given that BMI predicted higher eGFR, this may be indicative of glomerular hyperfiltration among our sample, as elevated BMI has been linked to elevated eGFR.[42,43] Obesity and increases in BMI have been strongly associated with systolic hypertension and microalbuminuria.[44,45] Similar findings have emerged among African Americans, in which elevated BMI has been associated with proteinuria and albuminuria.[46] Furthermore, weight loss interventions have been associated with reductions in microalbumin and proteinuria.[47,48] Our study was unique in that is was composed of a sample of non-hypertensive and non-diabetic participants, further underscoring the distinct contribution of BMI to renal functioning. These findings are particularly relevant as African Americans have disproportionately high obesity rates compared to other racial/ethnic groups.[7]

Limitations and Conclusions

Because of the study's cross-sectional design, observational changes overtime as well as cause and effect were unable to be determined. Secondly, using non-fasting measures for blood and urine may have impacted the levels of urine albumin, systolic blood pressure, and eGFR. Thirdly, the majority of participants were physically healthy and did not have poor psychological well-being, which may account for our lack of significant findings regarding the psychological factors. Future studies should include participants with diabetes or hypertension, as these are biological factors that precipitate CKD and ESRD.

Considerable attention has been given to the importance of psychological factors in the progression and treatment of CKD and ESRD as well as in the causes of the conditions. Yet, it remains unknown as to whether psychological factors contribute to poorer renal functioning. Present findings suggest that the psychological factors may not be more influential than BMI and demographic factors. Other psychological factors, such as anxiety and social support, may be associated with renal functioning in healthy participants, given that they are consistently related to poor self-care and adverse health outcomes in those with CKD and ESRD.[49–51] Perceived discrimination, a common stressor in the lives of African Americans, may also contribute to poorer renal functioning, as it negatively impacts chronic conditions that disproportionately affect African Americans.[52] Our findings do suggest that African Americans with higher BMI and systolic blood pressure should have their renal functioning closely monitored. This is especially important for African American men given that being male was associated with having a high GFR and systolic blood pressure. Because

BMI emerged as a predictor of renal functioning for each biomarker, mental health professionals can implement evidence-based behavioral health interventions, such as cognitive behavioral therapy and stimulus control, to reduce weight and blood pressure.

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Table 1

Sample characteristics and descriptive statistics for 129 African Americans

	M	SD
Age	44.40	12.25
Years of education	13.90	2.32
Beck Depression Inventory-II	8.13	8.21
Cook Medley Scale	23.27	7.82
Perceived Stress Scale	15.64	7.12
eGFR	129.67	48.39
Systolic blood pressure	133.34	18.54
BMI	31.00	8.58
Sex	*n*	%
Females	58	45
Males	71	55
Income	*n*	%
<$10, 000	30	23.3
$10,001–$40,000	70	54.3
$40,001–$80,000	27	20.9
>$80,000	2	1.5

Table 2

Canonical correlations between psychosocial variables and biomarkers of renal disease

Variates	*R*	R^2	Wilk's Lambda	*F*	*P*
1	.67	.65	.24	10.50	<.001
2	.09	.04	.78	2.72	<.01
3	.21	.16	.98	.39	.86

Table 3

Biomarkers of renal functioning and corresponding parameter estimates for independent and control variables

	Independent Variables	*β*	*t*	*P*
eGFR				
	Beck Depression Inventory	.03	.42	.68
	Perceived Stress Scale Total	.03	.40	.68
	Cook Medley Scale Total	–.02	–.28	.78
	Age	–.45	–8.04	.000[a]
	Sex	.12	2.09	.04[b]
	Education	–.00	–.07	.94
	Body mass index	.69	12.74	.000[a]
			F	*P*
			2.27	.14
Urine albumin				
	Beck Depression Inventory	.03	.29	.78
	Perceived Stress Scale Total	.06	.59	.56
	Cook Medley Scale Total	.03	27	.80
	Age	.15	1.56	.12
	Sex	.06	.52	.54
	Education	–.01	–.15	.89
	Body mass index	.24	2.65	.01[b]
			F	*P*
			1.65	.20
Systolic blood pressure				
	Beck Depression Inventory	–.02	–.22	.82
	Perceived Stress Scale Total	.12	1.20	.23
	Cook Medley Scale Total	–.06	–.67	.50
	Age	.26	2.93	.00[b]
	Sex	.22	2.57	.01[b]
	Education	–.11	–1.26	.21
	Body mass index	.27	3.18	.00[b]
			F	*P*
			13.25	.000[a]

[a] $P<.001$.

[b] $P<.05$.