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Optimism is associated with chronic kidney disease and rapid kidney function decline among African Americans in the Jackson Heart Study

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Abstract

Objective: Investigate the association of dispositional optimism with chronic kidney disease (CKD) and rapid kidney function decline (RKFD) and determine if there is modification by age, sex, and educational attainment among African Americans.

Methods: Optimism was measured using the 6-item Life Orientation Test-Revised scale (categorized into tertiles and log transformed) among participants from the Jackson Heart Study (n=1960). CKD was defined as the presence of albuminuria or reduced glomerular filtration rate of

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<60 ml/min/1.73m^2, or report of dialysis at baseline examination (2000–2004). RKFD was defined as a decline >3 ml/min/1.73m^2/year between baseline and exam 3 (2009–2013). The cross-sectional and prospective associations between optimism and kidney outcomes were tested using multivariable logistic regression to obtain odds ratios (OR) and 95% confidence intervals (CI), adjusting for demographics, education, risk factors, behaviors, and depressive symptoms. We tested effect modification by age, sex, and education.

Results: 569 participants had CKD and 326 were classified as having RKFD by exam 3. After full adjustment, the OR for CKD was 0.73 for those who reported high (vs. low) optimism (95% CI 0.55–0.99) and 0.56 (95% CI 0.27–1.15) for the optimism score. After 7.21 median years of follow up, the OR for RKFD was 0.51 for those who reported high (vs. low) optimism (95% CI 0.34–0.76), and 0.26 (95% CI 0.10–0.56) for the optimism score, after full adjustment. There was no evidence of effect modification by demographics or educational attainment.

Conclusions: Higher optimism was associated with a lower odds of CKD and a lower odds of RKFD.

Keywords

Optimism; Chronic Kidney Disease; Rapid Kidney Function Decline; African Americans; Jackson Heart Study

Introduction

The burden of chronic kidney disease (CKD) and incidence of end-stage renal disease (ESRD) are greater among African Americans (AAs) than other racial and ethnic groups [1]. A number of studies have attributed the higher prevalence of CKD to traditional risk factors such as diabetes and hypertension [2] and lower socioeconomic status (SES) [3,4]. While most studies have examined psychological risk factors and kidney disease [5, 6, 7], few studies have examined psychological well-being and kidney disease.

Studies have found associations between psychosocial well-being and a lower prevalence and risk of illnesses such as diabetes [7,8,9]. Dispositional optimism, the tendency to believe that future expectations or outcomes will be favorable [10], is a positive psychological asset that may be an effective coping strategy against environmental stressors, even if illusory or unrealistic [11]. Optimistic individuals tend to have better psychological and physical health when compared to pessimistic individuals [11]. Specifically, cross-sectional studies have found that highly optimistic individuals have healthier eating behaviors (e.g., eating more fruits and vegetables) [12], more ideal cardiovascular health, as measured by the American Heart Association's (AHA) Life's Simple 7 (LS7) [13, 14, 15], lower cortisol levels [16], and lower concentrations of interleukin-6, fibrinogen, and homocysteine [17]. A prospective study of participants from the Health and Retirement Study (n=6808) found that optimistic individuals had a lower risk of incident heart failure after four years of follow-up [18]. Another study in the same cohort (n=6044) followed participants for 2 years and found a lower risk of heart failure [19] among highly optimistic individuals. The psychological benefits of coping with stress via positive orientation such as optimism may explain why studies have found biological and physiological benefits among optimistic individuals.

Although studies have found associations of optimism with reduced prevalence/risk of traditional chronic diseases, no study has examined the association with CKD phenotypes in a large sample of AAs. In this study, we examined the association of optimism with prevalent CKD and rapid kidney function decline (RKFD) over time among AAs from the Jackson Heart Study (JHS). We hypothesized an inverse association between optimism and CKD, as well as RKFD.

Methods

The JHS is a prospective cohort study of the etiology of cardiovascular disease among AAs from the Hinds, Madison and Rankin counties of the Jackson, Mississippi metropolitan area. At baseline (2000–2004), 5306 participants (21–95 years old) were recruited from four sources: 1) the Atherosclerosis Risk In Communities (ARIC) study (30%), 2) volunteers from the community (25%), random selection (17%), and family members of participants (28%). Enrolled participants provided demographic, anthropometric, psychosocial, behavioral, and biological data and were followed for two subsequent visits (exam 2: 2005–2008 and exam 3: 2009–2013). The study protocol was approved by the institutional review boards of the University of Mississippi Medical Center, Jackson State University, and Tougaloo College, and all participants provided written informed consent [20, 21].

Dispositional Optimism

Dispositional optimism was measured using the 6-item Life Orientation Test-Revised (LOT-R) Scale at the first annual follow up (2001–2005) [21], which consists of three positively and three negatively worded items [22]. Participants were asked the extent to which they agreed with statements such as “In uncertain times, I expect the best” and “If something can go wrong for me, it will.” The negatively worded items were coded to indicate lower optimism. The total optimism score ranged from 0 to 24, where a higher score indicated greater optimism. We used tertiles to categorize each participant into low (score 1–19), moderate (score 20–22), or high optimism (score 23–24) to observe threshold effects. The total optimism score was also examined continuously using log transformation to account for the skewed distribution. Cronbach’s alpha was 0.64 in this sample.

CKD Outcomes

Prevalent CKD was defined as the presence of albuminuria, an estimated glomerular filtration rate (eGFR)<60 ml/min/1.73m^2, or a self-report of dialysis at baseline examination [23]. A dichotomous variable was created where those with CKD were assigned a 1, and those without CKD were assigned a 0.

RKFD is a measure of change in eGFR from exam 1 to exam 3 (2009–2013). Participants whose measured eGFR decreased more than or equal to 3 ml/min/1.73m^2/year from the baseline examination to exam 3 were considered to have RKFD. Those with less than a 3 ml/min/1.73m^2/year change were categorized as not having RKFD.

Covariates

All covariates were measured at baseline and were selected based on previous epidemiologic literature. Based on the literature, we constructed a directed acyclic graph to determine variables that would influence the association between optimism and kidney disease outcomes. We included age (years), sex (male/female), and socioeconomic status (SES) based on self-reported educational attainment. Educational attainment included the following categories: less than a high school diploma (referent), high school diploma and/or some college education, or college degree or more.

Risk factors included as covariates were non-ideal (vs. ideal-referent) blood pressure (BP) adapted from the American Heart Association's Life's Simple 7 [24], waist circumference (WC), prevalent type 2 diabetes, and cardiovascular disease history. Those with a measured systolic BP <120 mmHg and a diastolic BP <80 mmHg who were not on antihypertensive medication were considered to have ideal BP. Non-ideal BP was defined as having a systolic BP ≥120 mmHg or diastolic BP ≥ 80 mmHg or those treated for hypertension with normal BP (systolic<120 mmHg and diastolic <80 mmHg). WC was collected in centimeters (cm). Prevalent diabetes was defined by the American Diabetes Association, as those who had a fasting glucose ≥126 mg/dL, or HbA1c ≥6.5, or those who had been on diabetic medication within 2 weeks prior to the clinic visit, or those who reported a physician diagnosis. Cardiovascular disease history was based on self-reported stroke, carotid angina, and coronary heart disease (note: coronary heart disease was also verified by electrocardiogram).

Self-reported health behaviors (alcohol intake, smoking status, and physical activity) were also included as covariates. Alcohol intake was defined as having an alcoholic beverage within the past 12 months when asked at baseline (yes vs. no). Smoking status and physical activity were also adapted from the American Heart Association's Life's Simple 7 (ideal vs. non ideal) [24]. Non-ideal smoking status included current smokers or those who had quit smoking less than 12 months ago; ideal smoking status included participants who had never smoked or had quit smoking more than a year ago. Non-ideal physical activity was defined as <150 minutes/week (min/wk) of moderate physical activity and <75 min/wk of vigorous physical activity; ideal physical activity was defined as ≥150 min/wk of moderate physical activity; or ≥75 min/wk of vigorous physical activity; or ≥150 min/wk of combined moderate and vigorous physical activity.

We also adjusted for depressive symptoms which is measured from the Centers for Epidemiologic Studies (range 0 to 48), where a higher score represented greater depressive symptoms.

Statistical Analysis

There were 5306 participants at baseline. Missing values for CKD status (n=1876) and optimism (n=430) were removed, leaving a sample size of 3000. Additional missing data for covariates included: education (n=5), alcohol intake (n=11), smoking status (n=35), physical activity (n=2), diabetes prevalence (n=30), non-ideal BP prevalence (n=14), and depressive symptoms (n=949). The final analytic sample was restricted to 1960 participants for CKD

when all covariates were included in the model. At exam 3, there were 394 observations missing RKFD status, restricting the sample size to 1566.

Univariate associations of select characteristics by levels of optimism were assessed using chi-square tests and/or Analysis of Variance (ANOVA) tests, for categorical and continuous variables, respectively. To examine the cross-sectional association between optimism and CKD we used multivariable logistic regression to obtain odds ratios (OR 95% confidence interval-CI) of prevalent CKD by tertiles of optimism (low - referent) and log-transformed scores of optimism. The association between optimism and RKFD was examined **prospectively** using multivariable logistic regression to obtain ORs of RFKD. Model 1 adjusted for age, sex, education; Model 2 adjusted for model 1 and non-ideal BP, WC, diabetes and history of cardiovascular disease. Model 3 adjusted for model 2 plus alcohol, smoking status, and physical activity. Model 4 adjusted for model 3 plus depressive symptoms. We tested for linear trend by obtaining the p for trend statistic when using optimism categories as an ordinal variable with three levels in each of the models. We evaluated effect modification by age (<55 years vs. ≥55 years), sex, and educational attainment by including interaction terms in the fully adjusted models. A *p*-value of <0.05 was considered statistically significant. Analyses were performed using Stata 15.0 (StataCorp, College Station, TX).

Results

The mean age of the sample was 54.2 ±12.8 years. Those who were highly optimistic were more educated, had a lower mean waist circumference, and better physical activity and smoking habits (p<0.001). Additionally, those with high optimism had a lower prevalence of non-ideal BP and CKD, and a lower mean depressive symptoms score (p<0.05), while those with moderate optimism had the lowest prevalence of diabetes and CVD history (p<0.05).

The ORs for prevalent CKD by levels of optimism are shown in table 2. In model 1, the odds of CKD for those with high (vs. low) optimism 0.68 (95% CI 0.54–0.85). After adjusting for risk factors in model 2, the odds of CKD was 0.65 (95% CI 0.52–0.83), and when further adding health behaviors the odds of CKD was 0.67 (95% CI 0.53–0.85). When depressive symptoms were added to the model, the odds of CKD was 0.73 (95% CI 0.53–0.99) for those who reported high (vs. low) optimism. There was a significant inverse dose-response effect from moderate-to-high optimism on prevalent CKD in models 1–3 (p for trend <0.001). The continuous log-transformed score for optimism was significantly associated with CKD in models 1–3 but not 4. In model 4, the odds of CKD was 0.56 (95% CI 0.27–1.15) for increasing optimism score. There were no significant *p*-values for interaction by age, sex, or educational attainment in the association between optimism and CKD.

There were 326 participants who were classified as having RKFD by exam 3. Those with high optimism had a lower prevalence of RKFD (high optimism: 10.6% vs. moderate optimism 14.9% and low optimism 17.6%) (data not shown). Table 3 shows the odds of RKFD at exam 3 by baseline optimism. Moderate (vs. low) optimism was not associated with RKFD; however, high (vs. low) optimism was associated with a reduced odds of RKFD in model 1 (OR 0.61, 95% CI 0.44–0.84). In model 2, the odds ratio for RKFD was 0.59

(95% CI 0.43–0.81) for those who had high (vs. low) optimism. In model 3, the odds ratio for RKFD was 0.60 (95% CI 0.43–0.83) for those who had high (vs. low) optimism. After adding depressive symptoms to model 4, the odds ratio of RKFD decreased to 0.51 (95% CI 0.34–0.76). There was a significant inverse dose-response effect from moderate-to-high optimism on prevalent RKFD in models ($p<0.01$). The continuous log-transformed score for optimism was significantly associated with RKFD in all models. After full adjustment, the odds of CKD was 0.24 (0.10–0.56) for increases in the log transformed score for optimism. There were no statistically significant p values for interactions found by sex, age, or educational attainment in the association between optimism and RKFD.

Discussion

In a large sample of AAs, we investigated the association of optimism and kidney disease outcomes at baseline (2000–2004) and exam 3 (2009–2013). We hypothesized that optimism would be inversely associated with CKD and RKFD. Our analysis suggested that depressive symptoms attenuated the association between high (vs. low) and moderate (vs. low) optimism and CKD, but not high (vs. low) optimism and RKFD. We found no significant associations for moderate (vs. low) optimism and RKFD. Additionally, there were no significant associations between log-transformed optimism scores and a lower odds of CKD after full adjustment, but the log-transformed optimism scores were associated with RKFD in all models. Therefore, we found partial support for our hypothesis.

Previous studies have not explored the relation between optimism and prevalent CKD and RKFD. However, studies have found dispositional optimism to be associated with better outcomes among patients with kidney disease. Garcia et al [25] conducted a cross-sectional study of 239 hemodialysis patients from Spain and found that those who were optimists had a 45% lower odds of hospitalization. Harwood et al. [26] additionally found in a cross-sectional study that optimism was the most common and effective coping method for patients with CKD. A small focus group study conducted by Lopez-Vargas et al. [27] questioned 38 CKD patients (at stages 1–4) about issues related to CKD and effective coping mechanisms for managing CKD, and found that participants who were optimistic felt that their positive outlook improved their quality of life. Our study similarly found a link between optimism and better health, as indicated by a reduced odds of CKD and a reduced odds of RKFD for those who reported high optimism. However, our study contributes to the existing literature by evaluating a large sample of AAs, a group at high-risk for CKD, in a well-characterized cohort. As previously mentioned, other studies have found that dispositional optimism was associated with better cardiovascular health, lower stress, and less inflammation, which aligns with our findings.

Optimism may be related to favorable kidney disease outcomes because it is an effective coping strategy. Optimism is defined as a tendency to expect the occurrence of positive events across a variety of settings and situations, even when life presents difficult and unfortunate circumstances [11]. It is considered a marker of resilience, and is linked to lower levels of distress, effective problem solving, personal success, and better perceived health [28, 29]. People who are more optimistic tend to have better self-regulation (increasing personal efforts when circumstances are favorable and decreasing efforts when

circumstances are unfavorable) and better diets [30, 31], which could explain why optimists have a lower risk of chronic diseases. Optimists may also be more likely to experience beneficial effects on the neuroendocrine system and on immune responses, which can produce an indirect effect on health outcomes [31]. Associations between optimism and lower cortisol [16] and lower inflammation [17] have been reported in other studies, which may also reduce kidney disease.

This is the first study to examine the association of dispositional optimism with baseline CKD and RKFD over time in a large sample of AAs. A major strength of this study was the inclusion of RKFD, which has rarely been studied in the context of positive optimistic orientation. In addition, this study included clinically relevant variables that measure physical health and demonstrated the robust effect of optimism after adjusting for demographics, behaviors and risk factors that may directly affect the occurrence of kidney disease. After adjustment, the association between optimism and kidney disease and decline was sustained, signifying optimism as a powerful health asset. However, this study has limitations. First, residual confounding could affect our results, as it is possible that we may not have identified all factors that may affect the association between optimism and CKD and RKFD. For example, family history of kidney disease, stress, and other social environmental constructs could influence the observed associations. Additionally, the association between optimism and CKD was cross-sectional, which prevented interpretation about the directionality of the association. However, examining the association between optimism and RKFD provided a better interpretation of directionality. In addition to these limitations, there was a high percentage of missing data for the outcomes, a high usage of self-reported data, possible lack of generalizability, and possible selection bias. Missing data for the outcomes were excluded from the study, which led to conducting a complete case analysis. It is possible that the missing observations could have produced different results, as some characteristics in the included vs. excluded sample were different (see Supplementary Table 1). Optimism, in this study, is a self-reported measure and has the potential to produce biased results due to misclassification. However, the scale utilized to measure optimism has been used in other studies and has good internal validity. The results of this study may not be generalizable to AAs in other regions of the United States (U.S.) due to the participants being sampled from the tri-county area around Jackson, MS. Additionally, this unique sample of AAs includes family members, and optimism scores among families may be more correlated compared to scores unrelated individuals. It was not possible to adjust for familial effects, therefore this is also a limitation. Another limitation of this study includes sampling. Standard methods were used for sampling, but it is plausible that rural parts of the tri-county area were not sampled as heavily, which may contribute to selection bias.

Our findings suggest a link between optimism, a positive psychological asset, and a lower prevalence of CKD and RKFD from 2000–2013. Although this study could not confirm all possible mechanisms by which optimism influences kidney disease, it is important for other studies to consider the role of optimism in CKD among AAs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- This study supports an inverse association between optimism and kidney disease
- High (vs.) low optimism was associated with lower odds of kidney function decline
- Increases in LOT-R score was associated with lower odds of kidney function decline
- Optimism may play a role in kidney disease prevention

Table 1.

Sample Characteristics by Levels of Optimism, JHS (2000–2004)

	Total (N=3000)	Low Optimism (N=922) Score: 1–19	Moderate Optimism (N=1057) Score: 20–22	High Optimism (N=1021) Score: 23–24	P-value
Mean Age Years (± SD)	54.2 ± 12.8	56.6 ± 13.2	53.2 ± 12.6	53.1 ± 12.2	<0.001
% Male	36.4	33.8	37.1	38.0	0.14
% < High School Diploma	17.1	25.8	14.9	11.4	<0.001
% Alcohol in past 12 months	45.7	42.5	47.5	46.7	0.06
Mean Waist Circumference (± SD)	100.5 ± 16.4	102.3 ± 17.3	100.5 ± 16.3	99.0 ± 15.6	<0.001
% Non-Ideal Physical Activity	80.0	83.6	80.6	76.0	<0.001
% Non-Ideal Smoking	12.8	16.1	11.8	10.7	0.001
% Non-Ideal Blood Pressure	79.2	82.0	78.4	77.6	0.041
% Diabetic	20.2	24.1	18.1	18.9	0.002
% CVD History	9.2	11.3	8.0	8.6	0.034
Mean Depressive Symptoms Score (± SD)	10.8 ± 8.0	14.0 ± 9.4	10.3 ± 7.5	8.6 ± 6.5	<0.001
% CKD	19.0	24.4	16.9	16.2	<0.001

P values based on Chi Square and Analysis of Variance (ANOVA) tests and Chi Square tests. Abbreviations: SD standard deviation, CKD chronic kidney disease; CVD cardiovascular disease; SD standard deviation. Additional missing data for covariates include: education (n=5), alcohol intake (n=11), smoking status (n=35), physical activity (n=2), diabetes prevalence (n=30), hypertension prevalence (n=14), and depressive symptoms (n=949).

Table 2.

Odds Ratios (OR 95% CI) of Prevalent Chronic Kidney Disease by levels of Optimism, JHS (2000–2004)

		Odds of Chronic Kidney Disease			
		Model 1	**Model 2**	**Model 3**	**Model 4**
Optimism	N(%) CKD				
Low (referent)	225 (24.4)	1.0	1.0	1.0	1.0
Moderate	179 (16.9)	0.69 (0.55–0.87)	0.68 (0.54–0.86)	0.68 (0.54–0.86)	0.74 (0.55, 0.99)
High	165 (16.2)	0.68 (0.54–0.85)	0.65 (0.52–0.83)	0.67 (0.53–0.85)	0.73 (0.53, 0.99)
P for trend		<0.001	<0.001	<0.001	0.07
Optimism Score *		0.38 (0.23–0.65)	0.40 (0.24–0.69)	0.42 (0.24–0.74)	0.56 (0.27–1.15)

Note: Optimism score ranged from 0–24; those with low optimism scored between 1 and 19, those with moderate optimism scored between 20 and 22, and those with high optimism scored between 23 and 24. Model 1: age, sex, education, Model 2: Model 1 + waist circumference, diabetes, non-ideal blood pressure, cardiovascular disease history. Model 3: Model 2+ alcohol intake, smoking, and physical activity. Model 4: Model 3 + depressive symptoms. The analytic sample included 1960 in model 4 with complete covariate information. Abbreviations: CKD, chronic kidney disease

* Score was log transformed.

Table 3.

Odds Ratios (OR 95% CI) of Rapid Kidney Function Decline (RKFD; by Levels of Optimism, JHS (2009–2013)

		Odds of RKFD (>3mL decline)			
		Model 1	**Model 2**	**Model 3**	**Model 4**
Optimism	N(%) RKFD				
Low (referent)	118 (17.6)	1.0	1.0	1.0	1.0
Moderate	124 (14.9)	0.89 (0.67–1.18)	0.90 (0.68–1.20)	0.89 (0.66–1.19)	0.77 (0.54, 1.10)
High	84 (10.6)	0.61 (0.44, 0.84)	0.59 (0.43–0.81)	0.60 (0.43–0.83)	0.51 (0.34, 0.76)
P for trend		0.006	0.003	0.005	0.004
***Optimism score**		0.42 (0.21–0.85)	0.40 (0.20–0.82)	0.41 (0.20–0.84)	0.24 (0.10–0.56)

Note: Optimism score ranged from 0–24; those with low optimism scored between 1 and 19, those with moderate optimism scored between 20 and 22, and those with high optimism scored between 23 and 24. Model 1: age, sex, education, Model 2: Model 1 + waist circumference, diabetes, non-ideal blood pressure, cardiovascular disease history. Model 3: Model 2+ alcohol intake, smoking, and physical activity. Model 4: Model 3 + depressive symptoms. The analytic sample included 1566 in model 4 with complete covariate information.

*Score was log transformed.