Preventive Medicine Reports 15 (2019) 100916

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

The association of positive affect and cardiovascular health in Hispanics/Latinos with chronic kidney disease: Results from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL)

Rosalba Hernandez[a,*], James P. Lash[b], Brett Burrows[c], Kenneth R. Wilund[c], Holly J. Mattix-Kramer[d], Carmen Peralta[e], Ramon A. Durazo-Arvizu[b,d], Gregory A. Talavera[f], Frank J. Penedo[h], Tasneem Khambaty[h], Ashley E. Moncrieft[h], Jinsong Chen[b], Martha L. Daviglus[b,g]

[a] School of Social Work, University of Illinois at Urbana-Champaign, Urbana, IL, United States of America
[b] Department of Medicine, University of Illinois at Chicago, Chicago, IL, United States of America
[c] Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign, Urbana, IL, United States of America
[d] Public Health Sciences, Loyola University, Chicago, IL, United States of America
[e] School of Medicine, University of California, San Francisco, San Francisco, CA, United States of America
[f] Graduate School of Public Health, San Diego State University, San Diego, CA, United States of America
[g] Feinberg School of Medicine, Northwestern University, Chicago, IL, United States of America
[h] Department of Psychology, University of Miami, Miami, FL, United States of America

ARTICLE INFO

Keywords:
Positive affect
Psychological well-being
Hispanics/Latinos
Kidney function
Chronic kidney disease
Cardiovascular health

ABSTRACT

The beneficial influence of positive affect (e.g., joy) remains unexplored in relation to heart health in adults with chronic kidney disease (CKD)—a population at increased risk for poor cardiovascular health (CVH). Therefore, we evaluated the association of positive affect and CVH in a diverse U.S. population of Hispanics/Latinos with CKD. We analyzed cross-sectional data of adults ages 18–74 enrolled between 2008 and 2011 in the Hispanic Community Health Study/Study of Latinos with prevalent CKD (N = 1712). Positively worded items from the Center for Epidemiologic Studies Depression Scale were used to create a composite positive affect score (0–6; higher scores indicate greater positive affect). Prevalent CKD was defined as estimated glomerular filtration $< 60\,\text{ml/min/1.73}\,\text{m}^2$ or urine albumin-to-creatinine ratio ≥ 30 mg/g. A composite CVH score was calculated using diet, body mass index, physical activity, cholesterol, blood pressure, fasting glucose, and smoking status. Each metric was defined as ideal, intermediate, or poor to compute an additive score. Linear regression was used for continuous scores of CVH and logistic regression for binary treatment (e.g., ≥4 Ideal). In participants with CKD, each unit increase in the positive affect score was associated with higher CVH scores when modeling CVH as a continuous outcome (β = 0.06, 95% CI = 0.01, 0.11). Similarly, a 1-unit increase in positive affect was associated with 1.15 times the odds of having > 4 (vs. < 4) ideal CVH indicators. Positive affect is associated with favorable CVH profiles in Hispanics/Latinos with CKD. Replication and prospective studies are needed to elucidate whether emotional well-being is a potential therapeutic target for intervention.

1. Introduction

Hispanics/Latinos in the U.S. experience a higher burden of chronic kidney disease (CKD) when compared to aged-matched peers of European decent and are typified by more rapid disease progression and higher incidence of end-stage renal disease (Desai et al., 2019; Peralta et al., 2006). These disparities are a hypothesized byproduct of the elevated rates of diabetes, metabolic syndrome, and obesity in Hispanic/Latino adults (Desai et al., 2019). Psychological distress is a pervasive impediment encountered in this patient population, imposing

* Corresponding author at: School of Social Work, University of Illinois at Urbana-Champaign, 1010 W. Nevada Street, Urbana, IL, United States of America.
E-mail addresses: rherna17@illinois.edu (R. Hernandez), jplash@uic.edu (J.P. Lash), bburrows@illinois.edu (B. Burrows), kwilund@illinois.edu (K.R. Wilund), hkramer@lumc.edu (H.J. Mattix-Kramer), CarmenAlicia.Peralta@ucsf.edu (C. Peralta), Rdurazo@luc.edu (R.A. Durazo-Arvizu), gtalavera@mail.sdsu.edu (G.A. Talavera), fpenedo@northwestern.edu (F.J. Penedo), khambaty@umbc.edu (T. Khambaty), jinsongc@uic.edu (J. Chen), daviglus@uic.edu (M.L. Daviglus).

https://doi.org/10.1016/j.pmedr.2019.100916
Received 7 January 2019; Received in revised form 1 May 2019; Accepted 4 June 2019
Available online 07 June 2019

a significant added burden (Fischer et al., 2011; Hedayati et al., 2008). For instance, comorbid depression is associated with adverse kidney disease outcomes (Kop et al., 2011), greater risk of hospitalization, and decreased survival rates (Fabrazzo and De Santo, 2006; Hedayati et al., 2010). Evidence linking psychopathology to poor outcomes in patients with CKD has reached critical mass, yet few studies have explored potential health benefits of positive psychological attributes. In lieu of the disproportionate burden of CKD in Hispanics/Latinos, research is needed to identify protective factors to deter incidence of complications and disease progression—particularly, the emergence of poor cardiovascular health that results in premature cardiovascular death. Indeed, when compared to the general U.S. population with no evident kidney dysfunction, patients with severe CKD have a 50-fold increased risk of cardiovascular disease mortality, with a markedly higher likelihood of developing a myocardial infarction, an arrhythmia and/or heart failure (Alani et al., 2014; Go et al., 2004).

Multiple constructs are identified as partial indicators of psychological well-being and include attributes of life purpose, emotional vitality, positive affect, life satisfaction, happiness, and optimism (Kubzansky et al., 2015; Seligman, 2012). In observational studies, psychological wellbeing is frequently associated with improved longevity, lower risk of illness onset, and slower disease progression across a number of disease types (e.g., type 2 diabetes) even when other predictors of health are included in the model (Boehm and Kubzansky, 2012; Hernandez et al., 2015; Pressman and Cohen, 2005). In the last decade, positive affect has emerged as a domain of psychological well-being that consistently predicts better health (Hoogwegt et al., 2013; Judith Tedlie Moskowitz et al., 2008). Positive affect is defined as the subjective experience of positively valenced feelings including lower-activation affect (such as calm or satisfied) as well as higher-activation sentiments such as excited or thrilled (Gruber and Moskowitz, 2014). Prior research shows that independent of negative affect and psychological distress, positive affect uniquely predicts lower mortality risk, enhanced glycemic control, and greater adherence to self-care behaviors in adults with type 2 diabetes (Gruber and Moskowitz, 2014; Judith Tedlie Moskowitz et al., 2008; Tsenkova et al., 2008). A psychosocial intervention to boost positive emotion reduced viral load in patients newly diagnosed as HIV positive (Judith T Moskowitz et al., 2017). Unfortunately, this area of research remains unexplored in the context of chronic kidney disease. Considering the complex self-care regimen, emotional fatigue, and high risk of cardiovascular mortality associated with CKD, it is critical to explore the influence of positive emotion (or lack thereof) on heart health in adults with prevalent CKD. The concept of cardiovascular health (CVH) [i.e., Life's Simple 7s (LS7s)] as defined by the American Heart Association (AHA) focuses on maintenance and promotion of favorable behavioral health practices (e.g., diet and physical activity) and biological attributes (e.g., blood pressure).

To our knowledge, no study has explored the association of positive affect with favorable levels of cardiovascular risk factors as denoted by CVH profiles in adults with prevalent CKD—much less in a minority population wholly composed of Hispanic/Latino adults. Thus, the current study examined the cross-sectional association of positive affect and heart health among Hispanic/Latino adults with CKD independent of socio-demographic factors and psychological distress, using data from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) (Sorlie et al., 2010). We hypothesized that participants with higher scores of positive affect would display more favorable profiles of cardiovascular health as characterized by favorable levels across the multiplex markers of risk.

2. Methods

2.1. Study population and data source

We analyzed data of Hispanic/Latino adults (N = 16,415) enrolled in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) (Sorlie et al., 2010). The HCHS/SOL is a multi-center epidemiologic cohort study that aims to identify risk and protective factors for multiple chronic disorders in a heterogeneous sample of Hispanic/Latino adults, with exploration of influences of acculturation and cultural-specific factors. Details of the HCHS/SOL study protocol have been previously published (Sorlie et al., 2010). Briefly, HCHS/SOL participants were enrolled between 2008 and 2011 from across four US regions (Bronx, New York; Chicago, Illinois; San Diego, California; Miami, Florida) and included 16,415 adults ages18 to74 years. Adults of HCHS/SOL reported heritages (first and second generations or beyond) from Mexico, Cuba, Puerto Rico, the Dominican Republic, and Central and South America. A two-stage area household probability sampling approach was used for participant selection. The Institutional Review Boards at the data-coordinating center and at each field center approved the HCHS/SOL study and all subjects gave written consent.

The analytic sample for the current study was limited to participants with prevalent CKD and those with available scores for measures of positive affect and indicators needed to compute a cardiovascular health score (n = 1712). Thus, we arrived at our analytic sample by excluding HCHS/SOL participants free from CKD (n = 14,152) and a consequence of missing data across main variables of interest, i.e., positive affect (n = 98), indicators of CVH (n = 2), and covariates (n = 451).

2.2. Study measures

2.2.1. Positive affect

Positively worded items of the 10-item Center for Epidemiologic Studies Depression Scale (CES-D 10) (Radloff, 1977) were used to create a composite score for positive affect. As a result, the positive affect subscale was derived by summing responses for items #5 and #8—*I felt hopeful about the future*; *I was happy*. Scores ranged from 0 to 6 with higher scores indicative of greater positive affect. Validity of this underlying factor of positive affect in the CES-D 10 has been previously established (Sheehan et al., 1995; Zhang et al., 2012).

2.2.2. Kidney function and CKD measures

The estimated glomerular filtration rate (eGFR) and urine albumin-to-creatinine ratio (ACR) served as the main measures of CKD. A creatinase enzymatic method was implemented to assess serum- and urine-derived creatinine using the Roche Modular P Chemistry Analyzer (Roche Diagnostics, Indianapolis, IN). The ProcSpec nephelometric analyzer was used to quantify urine albumin (Dade Behring GmbH, Marburg, Germany). Estimated GFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-Epi) creatinine-cystatin C equation (Inker et al., 2012). Participants of HCHS/SOL were defined as having prevalent CKD if a low eGFR value was evident ($< 60\,ml/min/1.73m^2$) or if the urine ACR was elevated ($\geq 30\,mg/g$).

2.2.3. Cardiovascular health: Life's Simple 7 (LS7)

AHA specifications were used to operationalize cardiovascular health indicators of smoking, diet, physical activity, body mass index (BMI), fasting plasma glucose, serum cholesterol, and blood pressure (González et al., 2016; Lloyd-Jones et al., 2010). Using these specifications, a 3-category scheme of Poor (0), Intermediate (1), or Ideal (2) (see Table 1) was applied to code each indicator. A summation across the seven indicators was computed to derive a total CVH score ranging from 0 to 14, with higher scores indicative of better CVH. We also considered an LS7 index (range 0–7) based on the number of indicators coded as Ideal. Lastly, a dichotomous LS7 CVH cut-point (≥ 4 Ideal Indicators) was generated given its documented link with cardio-protection and reduced 20-year incidence of coronary heart disease (Ford et al., 2012; Laitinen et al., 2012).

Protocols implemented to evaluate cardiovascular health (i.e., LS7) metrics have been described in detail elsewhere (Daviglus et al., 2012;

Table 1
Definitions for the 3-category indicator of cardiovascular health, per AHA specifications.

Cardiovascular health-LS7 indicators	Poor	Intermediate	Ideal
3 health behaviors			
Diet[a]	0–1	2–3	4–5
Physical activity	None	1–149 min/wk. moderate, or 1–74 min/wk. vigorous, or 1–149 min/wk. combined intensity	≥150 min/wk. moderate, or ≥75 min/wk. vigorous, or ≥150 min/wk. combined intensity
Smoking	Current smoker	Former smoker who quit ≤12 months ago	Never smoked or quit > 12 months ago
4 biological markers			
BMI (kg/m^2)	≥30 or < 18.5	≥25 to < 30	< 25, but ≥18.5
Blood pressure (mm Hg)	≥140 or ≥90 mmHg	120–193/80–89 mmHg or treated to control	< 120/ < 80 mmHg
Cholesterol (mg/dL)	≥240 mg/dl	200 to < 240 mg/dl or treated to control	< 200 mg/dL
Fasting glucose (mg/dL)	≥126 mg/dl	≥100 to < 126 or treated to control	< 100 mg/dL

[a] AHA Diet score includes 5 criteria: ≥4.5 servings/day Fruits & Vegetables; ≥7-oz servings/week Fish; ≥3 servings/day Grain; ≤4.5 servings/week sweetened beverages; and < 1500 mg/day sodium.

Sorlie et al., 2010). Briefly, smoking status was self-reported to capture former and current smokers. Dietary intake considering 5 food categories of fruits/vegetables, fish, grains, sweetened beverages, and sodium were evaluated using two 24-h dietary recalls. A modified version of the Global Physical Activity Questionnaire (GPAQ) was used to capture self-reported engagement in physical activity by tapping into domains related to work, transport, and leisure. Biomarkers considered were body mass index (BMI), total cholesterol, fasting blood glucose, and blood pressure. BMI considered objective measures of weight (nearest 0.1 kg) and height (nearest centimeter) taken by trained research staff and reported as kg/cm^2. Blood was drawn to obtain lipid profiles and fasting glucose values after a 12-h fasting protocol. The cholesterol oxidase enzymatic method was employed to quantify total cholesterol and the hexokinase enzymatic method was employed when measuring fasting blood glucose (Roche Diagnostics, Roche Diagnostics, Indianapolis, IN). Three blood pressure readings were taken from HCHS/SOL participants and mean values were obtained by averaging across all readings. When identifying those with pre-existing diabetes, hypercholesterolemia, and hypertension, we also considered self-reported use of prescribed medication. Values for CVH indicators were obtained between 2008 and 2011 during the HCHS/SOL baseline clinical exam.

2.2.4. Covariates

Covariates included baseline age [in years], sex [male; female], formal education [< high school (HS); HS graduate/general education degree (GED); > HS], annual household income [< $20,000; $20,000 to $50,000; > $50,000; not reported], marital status [single; married/living as married/living with a partner; separated, divorced or widowed], healthcare insurance status [has health insurance; does not have health insurance], nativity status [U.S.-born; foreign-born > 10 years in U.S.; foreign born ≤10 years in U.S.], language of HCHS/SOL interview (English; Spanish), Hispanic/Latino heritage group [Mexican; Cuban; Puerto Rican; Dominican; Central American; South American; or other], and site of recruitment. We also adjusted for immigrant generational status—1st generation vs. 2nd generation or higher. Information to derive generational status was collected at the baseline HCHS/SOL exam and combined participant information on country of origin and that reported for their parents and grandparents; for instance, a foreign-born participant with foreign-born parents was classified as first generation.

In addition to considering demographic factors when modeling the association of positive affect and cardiovascular health, we also included covariates capturing prevalent coronary heart disease (CHD), subjective physical health as measured by the 12-item Short Form Survey (SF-12) (Ware et al., 1996), kidney function (eGFR and ACR), and negative affect. A composite score for negative affect was derived using available negatively worded items (8-total) from the 10-item CES-D scale. Negative affect is often included as a covariate when exploring the influence of emotional well-being on health to discount the notion that levels of positive emotion merely capture absence of distress. Indeed, we are interested in the independent influence of positive affect over and above contributions of psychological distress.

2.3. Statistical methods

All analyses were performed using SAS 9.3 software (SAS Institute, Cary, NC). Analyses employed complex survey-specific procedures to properly account for cluster sampling and the use of stratification in sample selection (LaVange et al., 2010; Sorlie et al., 2010). With the exception of income, observations with missing data were excluded from analyses. Descriptive characteristics of the sample are presented by tertiles of positive affect, i.e., low (0–3), moderate (4–5), and high (6). Group differences in participant characteristics across tertiles of positive affect were examined using an F-test or χ-test as appropriate.

Multivariable regression models were used when testing the association of positive affect and cardiovascular health in HCHS/SOL participants with CKD. Across models, the independent variable of positive affect was treated as a continuous score ranging from 0 (*low*) to 6 (*high*) modeling the effects of a 1-unit increase in positive affect. Three CVH scoring methods were applied, i.e., continuous (0–14 and 0–7 points) and dichotomous (≥4 Ideal). Operationalization of CVH and associated variable distribution dictated whether we used multivariate linear or logistic regression. Three separate models were constructed with well-ordered inclusion of covariates. Model 1 adjusted for age, sex, Hispanic/Latino heritage, and study center. Model 2 additionally adjusted for education, income, marital status, health insurance status, nativity status, immigrant generational status (1st generation vs. 2nd generation or higher), and language of interview. Model 3 additionally adjusted for self-rated physical health, prevalent CHD, and negative affect. Model 4 additively considered kidney function defined by values of eGFR and log transformed urine ACR. A similar technique was applied to explore the relationship of positive affect and CVH in participants without CKD to explore stability of the association. A 2-sided hypothesis test was stipulated throughout at an α-level of 0.05.

Effect modification was explored to inform whether stratified analyses were warranted through inclusion of interaction terms testing the stability of adjusted associations between positive affect and cardiovascular health by age, sex, and Hispanic/Latino background; separate models were used for each of the hypothesized modifiers.

3. Results

3.1. Characteristics of the study sample

Table 2 presents descriptive characteristics for study participants with CKD according to level of positive affect. Overall, 1712 participants screened positive for CKD. Participants ranged in age from 18 to

Table 2
Descriptive statistics for sample demographic characteristics, kidney function, and cardiovascular health variables, by optimism tertile for participants with CKD: HCHS/SOL (1712), U.S. 2008–2011.

Characteristics		Total sample N = 1712	Positive affect (PA)[a]			*p*
			Low n = 562	Moderate n = 553	High n = 597	
Age, *M* (SE)		49.1 (0.65)	50.0 (0.97)	47.0 (1.2)	50.4 (1.1)	< 0.001
Sex, N (%)						0.04
Female		1055 (56.2)	372 (60.8)	339 (57.7)	344 (50.8)	
Hispanic background, N (%)						0.17
Central American		159 (7.0)	50 (6.8)	49 (6.6)	60 (7.4)	
Cuban		241 (22.0)	91 (23.8)	75 (19.2)	75 (23.0)	
Dominican		142 (9.6)	42 (8.6)	50 (9.0)	50 (10.9)	
Mexican		664 (35.0)	197 (30.8)	213 (38.8)	254 (35.2)	
Puerto Rican		391 (20.0)	153 (25.3)	128 (19.3)	110 (16.2)	
South American		77 (3.6)	20 (2.2)	25 (4.5)	32 (4.0)	
More than one/Other		38 (2.9)	9 (2.5)	13 (2.8)	16 (3.4)	
Annual family income, N (%)						0.09
< $20,000		873 (48.7)	303 (50.5)	284 (49.9)	286 (46.0)	
$20,000–$50,000		566 (34.2)	179 (34.2)	186 (34.1)	201 (34.3)	
> $50,000		122 (8.0)	24 (4.2)	39 (8.1)	59 (11.2)	
Not reported		151 (9.2)	56 (11.1)	44 (8.0)	51 (8.5)	
Educational attainment, N (%)						
< High School or GED		777 (40.9)	283 (47.5)	238 (38.1)	256 (37.7)	0.03
High School		382 (23.6)	116 (21.5)	135 (27.5)	131 (21.8)	
> High School		553 (35.5)	163 (31.0)	180 (34.4)	210 (40.5)	
Marital status, N (%)						0.19
Single		403 (29.3)	138 (30.5)	138 (31.3)	127 (26.4)	
Married/Living with a partner		871 (48.9)	267 (43.9)	275 (49.3)	329 (52.8)	
Separated, divorced, or widow		438 (21.8)	157 (25.6)	140 (19.4)	141 (20.8)	
Nativity status, N (%)						0.01
U.S. Born		255 (17.9)	89 (20.5)	95 (20.3)	71 (13.3)	
Foreign-born > 10 years in U.S.		288 (21.7)	73 (15.7)	98 (24.0)	117 (24.7)	
Foreign-born ≤10 years in U.S.		1169 (60.5)	400 (63.8)	360 (55.7)	409 (62.1)	
Spanish language Interview, N (%)		1387 (79.2)	443 (77.2)	449 (80.7)	495 (79.5)	0.60
Immigrant generation, N (%)						0.07
1st Generation		1426 (80.8)	465 (78.1)	449 (78.8)	512 (85.1)	
2nd Generation or higher		286 (19.2)	97 (21.9)	104 (21.2)	85 (14.9)	
Has health insurance, N (%)		1027 (61.6)	338 (59.1)	318 (58.8)	371 (66.4)	0.09
Current smoker, N (%)		329 (20.2)	136 (24.9)	110 (20.0)	83 (16.2)	< 0.001
Alcohol intake, N (%)						0.84
Never		393 (22.8)	129 (21.0)	130 (22.3)	134 (24.7)	
Former		681 (38.0)	226 (39.1)	219 (38.9)	236 (36.2)	
Current		638 (39.2)	207 (39.9)	204 (38.9)	227 (39.1)	
Prevalent CHD, N (%)		248 (13.4)	82 (14.1)	85 (14.1)	81 (12.2)	0.72
Hypertension, N (%)		958 (52.5)	333 (55.1)	286 (45.9)	339 (56.5)	0.03
Diabetes, N (%)		794 (41.9)	271 (45.5)	253 (39.5)	270 (41.1)	< 0.001
Body mass index, *M* (SD)		31.1 (0.25)	31.74 (0.42)	31.27 (0.49)	30.48 (0.35)	< 0.001
Waist circumference, *M* (SE)		102.5 (0.60)	103.5 (0.99)	102.6 (1.2)	101.6 (0.91)	< 0.001
C-reactive protein, M (SE)		6.3 (0.56)	6.2 (0.48)	7.3 (1.5)	5.4 (0.44)	< 0.001
Medication use, N (%)	ACE inhibitor/ARB	410 (21.7)	141 (21.0)	118 (19.4)	151 (24.4)	0.30
	Statin	386 (20.0)	139 (22.4)	116 (18.0)	131 (19.7)	0.45
	Antiplatelet agent	56 (3.4)	24 (4.8)	14 (3.0)	18 (2.5)	0.26
Negative affect, *M* (SE)		6.2 (0.20)	8.2 (0.35)	6.6 (0.31)	4.1 (0.23)	< 0.001
Kidney function indicators						
Urine ACR, mg/g, *median* (interquartile range)		60.1 (35.7158.3)	67.1 (36.3179.0)	57.6 (36.0,136.9)	58.9 (34.8149.5)	< 0.0001
eGFR, *M* (SE)		92.0 (1.1)	89.2 (1.8)	93.9 (1.9)	92.7 (1.9)	< 0.001
Cardiovascular health						
Overall CVH 0–14, *M* (SE)		7.4 (0.1)	6.9 (0.1)	7.6 (0.2)	7.49 (0.2)	< 0.001
Ideal CVH 0–7, *M* (SE)		2.7 (0.1)	2.4 (0.1)	2.9 (0.1)	2.71 (0.1)	< 0.001
≥4 Ideal CVH indicators, N (%)		358 (27.3)	99 (19.7)	131 (34.8)	128 (27.0)	< 0.001
Ideal status for individual CVH indictors, N (%)						
BMI		265 (18.3)	83 (16.9)	100 (21.7)	82 (16.3)	0.20
Blood pressure		400 (27.4)	115 (22.8)	142 (32.3)	143 (26.8)	0.06
Cholesterol		627 (42.8)	205 (42.6)	204 (43.6)	218 (42.3)	0.95
Fasting Glucose		653 (43.8)	201 (39.1)	217 (47.5)	235 (44.5)	0.16
Diet		41 (2.3)	8 (0.9)	15 (3.3)	18 (2.5)	0.19

(*continued on next page*)

Table 2 (*continued*)

Characteristics	Total sample N = 1712	Positive affect (PA)[a]			p
		Low n = 562	Moderate n = 553	High n = 597	
Physical activity	948 (56.0)	290 (52.6)	316 (58.5)	342 (56.6)	0.36
Smoking	1334 (76.8)	403 (70.0)	430 (77.6)	501 (82.0)	0.004

[a] For positive affect: low 0–3; moderate 4–5; high 6.

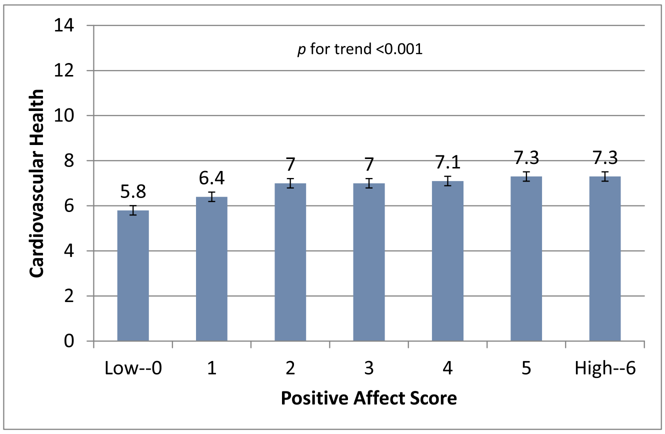

Fig. 1. Cardiovascular health by positive affect scores among Hispanics/Latinos with Chronic Kidney Disease, HCHS/SOL (N = 1712), U.S. 2008–2011.

74 years (M = 49.1, SE = 0.65) with a near equal distribution by sex (56.2% female). Heterogeneity in heritage was evident with 35.0% identifying as Mexican, 22.0% Cuban, 20.0% Puerto Rican, 9.6% Dominican, 7.0% Central American and 3.6% South American. Overall, 40.9% had less than a high school education and 48.7% reported an annual household income below $20,000. As compared to individuals with lower levels of positive affect, those with higher levels of positive affect were more likely to be male, have higher socioeconomic standing as indicated by educational status and annual household income, and more likely to be foreign born with residence in the U.S. for > 10 years. No significant difference was evident in positive affect scores by immigrant generation. Individuals with higher optimism scores also displayed more favorable health profiles as denoted by prevalent diabetes mellitus, values of BMI, waist circumference, and C-reactive protein (Table 2). Fig. 1 presents averages for cardiovascular health by positive affect scores among HCHS/SOL participants with CKD.

4. Discussion

In the first study of Hispanics/Latinos of diverse heritage backgrounds, we found that higher positive affect scores were associated with better cardiovascular health scores among those with prevalent CKD with no evident effect modification by age, sex, or heritage background. This association remained significant after adjustment for demographic factors, comorbid medical conditions, kidney function, and negative affect. These findings are important because moderate difference in CVH scores can translate into a significant reduction in subsequent deaths at the population level.

Emotion research supports the notion that despite the presence of debilitating health-related stress, daily experiences of positive emotion are common and can be augmented. Surprisingly though, the literature on the influence of positive psychological attributes on cardiovascular health in patients with CKD is virtually non-existent. This is despite the growing number of studies that document health benefits of positive psychological attributes, particularly in the field of cardiovascular epidemiology (Kubzansky et al., 2018; Judith T Moskowitz et al., 2017; Nikrahan et al., 2016). A 2012 systematic review documents a robust positive association between positive psychological assets and cardiovascular health when considering metrics of atherosclerosis, circulating inflammation (e.g., C-Reactive Protein), heart rate variability (HRV), and traditional CVD risk factors, among others (Boehm and Kubzansky, 2012). In a longitudinal population-based study of 1739 adults with 10-years of follow up, a 22% lower incidence rate for coronary heart disease was evident for each unit increase in positive emotion, independent of demographic factors, traditional risk factors, and negative emotion (Davidson et al., 2010). A majority of studies adjust for depression and related indicators of negative emotion to test the clinically relevant and independent contributions of positive psychological assets. Psychological assets may serve as a novel therapeutic target to improve cardiovascular health in Hispanic/Latino adults with CKD who are experiencing rising health disparities—given independent contributions to cardiac health above that conferred by negative affect and traditional risk factors. Although the literature documents protective health effects of positive affect, important empirical queries remain as to what specific populations benefit most (e.g., healthy vs. clinical samples) and what disease types are most pertinent.

A critical query that our study begins to inform is the plausible influence of emotions on health outcomes—i.e., additional negative physiological deterioration in the presence of an already compromised biological system. There are viable biological explanations for this observation as emotion may be particularly influential when health has been compromised and immune defenses are reduced to insufficient levels. More research in the area is necessary. Presently, a multipronged process is hypothesized to underlie the pathway through which positive emotion protects against incidence and progression of clinical heart disease, i.e., through promotion of healthy behaviors, augmentation of restorative biological processes, and increased psychosocial and coping resources.

The bulk of the evidence on the link between emotion and health outcomes in adults with CKD has focused on psychopathology and the detrimental effects of disorders such as depression, anxiety, and stress (Fischer et al., 2011; Fischer et al., 2012; Kimmel, 2002). Studies consistently document that negative psychological attributes are associated with compromised kidney function, more rapid progression from asymptomatic and early-stage disease to kidney failure requiring renal replacement therapy, and greater risk for an acute cardiac event (Kimmel, 2002). For instance, in 267 non-dialysis dependent VA outpatients, the risk for an adverse outcome within a 1-year period (i.e., initiation of dialysis therapy, hospitalization, or death) was documented as 1.86 times higher among CKD patients with major depression (Hedayati et al., 2010). Finally, a recent meta-analysis reports a 59% increase risk for death in adults with CKD and comorbid depression when compared to those with little or no depressive symptoms (Palmer et al., 2013). The detrimental effects of psychological distress for kidney function and disease progression are well established. There is an urgent need, however, to begin an in-depth study of positive psychological attributes and whether these possess cardioprotective qualities that can promote better health outcomes and increased quality of live in adults with CKD. This requires a paradigm shift that acknowledges intrinsic attributes of fortitude and resilience.

The present study has multiple strengths. This is the first study to explore the association of positive emotion and cardiovascular health in a richly characterized sample of Hispanic/Latino adults with CKD. It included a large heterogeneous sample of Hispanic/Latino adults that allowed for testing of effect modification by heritage background. The study was also powered to adjust for important confounders unique to the Hispanic/Latino population, including nativity status and language preference. Limitations include the cross-sectional nature of the analyses, which does not allow for causal inferences. In addition, since only two items of the CES-D were used to compute positive emotion scores, future research should employ more comprehensive instruments such as the Positive and Negative Affect Schedule (PANAS) (Watson and Clark, 1999) or the Profile of Mood States (POMS) (McNair et al., 1992) that capture multiple domains of positive emotion including low (e.g., calm) and high (e.g., excited) arousal states. Furthermore, when deriving CVH profiles, diet and physical activity were assessed through self-report and are subject to measurement error. We also did not have information on documentation status or length of CKD diagnosis. Finally, generalizability is limited to those with early-stage CKD as more severe cases are absent from this cohort.

4.2. Positive affect and cardiovascular health in Hispanics/Latinos with CKD

As effect modification was not evident by sex, age, or Hispanic heritage group, Table 3 presents pooled estimates for the association between positive affect and CVH in HCHS/SOL individuals with CKD. Some preservation of CVH was evident with a total of 371 (21%) having ≥4 indicators as Ideal. Regardless of how CVH was operationalized, a significant positive association was evident between positive affect and CVH profiles. In multivariable adjusted models (i.e., Model 3), each unit increase in positive affect was associated with a higher cardiovascular health score when modeling the LS7 index as a continuous outcome, i.e., overall CVH 0–14 (β = 0.10, 95% CI 0.01, 0.19) and Ideal CVH 0–7 (β = 0.06, 95% CI = 0.01, 0.11). Associations were maintained after additional adjustment for measures of kidney function in Model 4. These findings were replicated when treating CVH as a dichotomous outcome. A 1-unit increase in positive emotion was associated with 1.15 times the odds of having ≥4 (vs. < 4) ideal CVH indicators independent of demographic, medical comorbidities, and negative affect.

Finally, in sensitivity analyses that stratified by nativity and generational status, the parameter estimates for the association of positive affect and CVH remained unchanged in terms of magnitude and directionality of the association (results not shown).

5. Conclusion

This is one of the few studies to examine the association of positive emotion with AHA's Life Simple 7's (Lloyd-Jones et al., 2010) in a diverse sample of Hispanic/Latino adults with CKD. Replication and prospective studies are needed to more precisely define the relationship between positive emotion and CVH in adults with CKD to more fully elucidate whether emotional wellbeing is a potential therapeutic target for intervention. A randomized trial would be the gold standard to determine whether a causal effect is evident and whether an intervention to boost positive emotion results in better health outcomes in individuals with CKD. It is important that we continue to explore additional domains of emotional well-being (e.g., optimism, gratitude) that may impact CVH in Hispanic/Latinos adults with CKD and the biobehavioral mechanisms involved.

Abbreviations

ACR	albumin-to-creatinine ratio
AHA	American Heart Association
BMI	body mass index
CES-D	Center for Epidemiologic Studies Depression Scale
CHD	coronary heart disease
CKD	chronic kidney disease
CVH	cardiovascular health
eGFR	estimated glomerular filtration rate
GED	general education degree
GPAC	Global Physical Activity Questionnaire
HCHS/SOL	Hispanic Community Health Study/Study of Latinos
UACR	urine albumin-to-creatinine ratio

Declaration of Competing Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Acknowledgements

The authors thank the staff and participants of HCHS/SOL for their important contributions. A complete list of staff and investigators has been provided by Sorlie P., et al. in Ann Epidemiol. 2010 Aug; 20: 642-649 and is also available on the study website http://www.cscc.unc.edu/hchs/.

Funding

Research reported in this publication was supported, in part, by the National Heart, Lung, and Blood Institute under award number 1K01HL130712-01A3, the National Institute on Minority Health and Health Disparities of the National Institutes of Health under award number U54MD012523, and the National Institute of Diabetes and Digestive and Kidney Diseases (K24-DK092290). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The Hispanic Community Health Study/Study of Latinos was carried out as a collaborative study supported by contracts from the National Heart, Lung, and Blood Institute (NHLBI) to the University of North Carolina (N01-HC65233), University of Miami (N01-HC65234), Albert Einstein

Table 3
Multivariate regression modeling the association of a 1-unit increase in positive affect and cardiovascular health AMONG Hispanics/Latinos with chronic kidney disease, HCHS/SOL (N = 1712), U.S. 2008–2011.

Outcome	Model 1		Model 2		Model 3		Model 4	
	β Coefficient or OR (95% CI)	p	β Coefficient or OR (95% CI)	p	β Coefficient or OR (95% CI)	P	β Coefficient or OR (95% CI)	p
CVH (0–14) Continuous	0.18 (0.09,0.27)	< 0.001	0.14 (0.05,0.23)	0.002	0.10 (0.01,0.19)	0.04	0.08 (−0.01,0.17)	0.082
CVH (0–7) Continuous	0.09 (0.04,0.14)	< 0.001	0.07 (0.02,0.12)	0.005	0.06 (0.01,0.11)	0.04	0.05 (−0.01,0.10)	0.051
CVH ≥4 Ideal Indicators	1.21 (1.09,1.35)	< 0.001	1.16 (1.04,1.29)	0.008	1.17 (1.04,1.31)	0.009	1.15 (1.03,1.29)	0.02

Model 1: age, sex, Hispanic/Latino heritage group, study center.
Model 2: Model 1 + socio-economic status (income, education), marital status, health insurance, nativity status, immigrant generation, and language preference.
Model 3: Model 2 + Physical health component of SF-12, prevalent CHD, and negative affect.
Model 4: Model 3 + eGFR and log-UACR.

College of Medicine (N01-HC65235), Northwestern University (N01-HC65236), and San Diego State University (N01-HC65237). The following Institutes/Centers/Offices contribute to the HCHS/SOL through a transfer of funds to the NHLBI: National Center on Minority Health and Health Disparities, the National Institute of Deafness and Other Communications Disorders, the National Institute of Dental and Craniofacial Research, the National Institute of Diabetes and Digestive and Kidney Diseases, the National Institute of Neurological Disorders and Stroke, and the Office of Dietary Supplements.

References

Alani, H., Tamimi, A., Tamimi, N., 2014. Cardiovascular co-morbidity in chronic kidney disease: current knowledge and future research needs. World Journal of Nephrology 3 (4), 156.

Boehm, J.K., Kubzansky, L.D., 2012. The heart's content: the association between positive psychological well-being and cardiovascular health. Psychol. Bull. 138 (4), 655–691. https://doi.org/10.1037/a0027448.

Davidson, K.W., Mostofsky, E., Whang, W., 2010. Don't worry, be happy: positive affect and reduced 10-year incident coronary heart disease: the Canadian Nova Scotia Health Survey. Eur. Heart J. 31 (9), 1065–1070.

Daviglus, M.L., Talavera, G.A., Aviles-Santa, M.L., Allison, M., Cai, J., Criqui, M.H., ... Stamler, J., 2012. Prevalence of major cardiovascular risk factors and cardiovascular diseases among Hispanic/Latino individuals of diverse backgrounds in the United States. Jama-Journal of the American Medical Association 308 (17), 1775–1784.

Desai, N., Lora, C.M., Lash, J.P., Ricardo, A.C., 2019 Jan 1. CKD and ESRD in US Hispanics. Am. J. Kidney Dis. (1), 102–111.

Fabrazzo, M., De Santo, R.M., 2006. Depression in chronic kidney disease. Semin. Nephrol. 26 (1), 56–60. https://doi.org/10.1016/j.semnephrol.2005.06.012.

Fischer, M.J., Kimmel, P.L., Greene, T., Gassman, J.J., Wang, X., Brooks, D.H., ... Cooper, L.A., 2011. Elevated depressive affect is associated with adverse cardiovascular outcomes among African Americans with chronic kidney disease. Kidney Int. 80 (6), 670–678.

Fischer, M.J., Xie, D., Jordan, N., Kop, W.J., Krousel-Wood, M., Tamura, M.K., ... Strauss, L., 2012. Factors associated with depressive symptoms and use of antidepressant medications among participants in the Chronic Renal Insufficiency Cohort (CRIC) and Hispanic-CRIC Studies. Am. J. Kidney Dis. 60 (1), 27–38.

Ford, E.S., Greenlund, K.J., Hong, Y., 2012. Ideal cardiovascular health and mortality from all causes and diseases of the circulatory system among adults in the United States. Circulation 125 (8), 987–995. https://doi.org/10.1161/CIRCULATIONAHA.111.049122.

Go, A.S., Chertow, G.M., Fan, D., McCulloch, C.E., Hsu, C.-y., 2004. Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization. N. Engl. J. Med. 351 (13), 1296–1305.

González, H.M., Tarraf, W., Rodríguez, C.J., Gallo, L.C., Sacco, R.L., Talavera, G.A., ... Davis, S., 2016. Cardiovascular health among diverse Hispanics/Latinos: Hispanic Community Health Study/Study of Latinos (HCHS/SOL) results. Am. Heart J. 176, 134–144.

Gruber, J., Moskowitz, J.T., 2014. Positive Emotion: Integrating the Light Sides and Dark Sides.

Hedayati, S.S., Bosworth, H.B., Briley, L.P., Sloane, R.J., Pieper, C.F., Kimmel, P.L., Szczech, L.A., 2008. Death or hospitalization of patients on chronic hemodialysis is associated with a physician-based diagnosis of depression. Kidney Int. 74 (7), 930–936.

Hedayati, S.S., Minhajuddin, A.T., Afshar, M., Toto, R.D., Trivedi, M.H., Rush, A.J., 2010. Association between major depressive episodes in patients with chronic kidney disease and initiation of dialysis, hospitalization, or death. Jama 303 (19), 1946–1953.

Hernandez, R., Kershaw, K.N., Siddique, J., Boehm, J.K., Kubzansky, L.D., Diez-Roux, A., ... Lloyd-Jones, D.M., 2015. Optimism and cardiovascular health: multi-ethnic study of atherosclerosis (MESA). Health Behavior and Policy Review 2 (1), 62–73.

Hoogwegt, M.T., Versteeg, H., Hansen, T.B., Thygesen, L.C., Pedersen, S.S., Zwisler, A.-D., 2013. Exercise mediates the association between positive affect and 5-year mortality in patients with ischemic heart disease. Circulation: Cardiovascular Quality and Outcomes 6 (5), 559–566.

Inker, L.A., Schmid, C.H., Tighiouart, H., Eckfeldt, J.H., Feldman, H.I., Greene, T., ... Zhang, Y.L., 2012. Estimating glomerular filtration rate from serum creatinine and cystatin C. N. Engl. J. Med. 367 (1), 20–29.

Kimmel, P.L., 2002. Depression in patients with chronic renal disease - what we know and what we need to know. J. Psychosom. Res. 53 (4), 951–956. doi:Pii S0022-3999(02)00310-0. https://doi.org/10.1016/S0022-3999(02)00310-0.

Kop, W.J., Seliger, S.L., Fink, J.C., Katz, R., Odden, M.C., Fried, L.F., ... Gottdiener, J.S., 2011. Longitudinal association of depressive symptoms with rapid kidney function decline and adverse clinical renal disease outcomes. Clin. J. Am. Soc. Nephrol. 6 (4), 834–844.

Kubzansky, L.D., Boehm, J.K., Segerstrom, S.C., 2015. Positive psychological functioning and the biology of health. Soc. Personal. Psychol. Compass 9 (12), 645–660.

Kubzansky, L.D., Huffman, J.C., Boehm, J.K., Hernandez, R., Kim, E.S., Koga, H.K., ... Labarthe, D.R., 2018. Positive psychological well-being and cardiovascular disease: JACC health promotion series. J. Am. Coll. Cardiol. 72 (12), 1382–1396.

Laitinen, T.T., Pahkala, K., Magnussen, C.G., Viikari, J.S., Oikonen, M., Taittonen, L., ... Laitinen, T., 2012. Ideal cardiovascular health in childhood and cardiometabolic outcomes in adulthood clinical perspective. Circulation 125 (16), 1971–1978.

LaVange, L.M., Kalsbeek, W.D., Sorlie, P.D., Avilés-Santa, L.M., Kaplan, R.C., Barnhart, J., ... Ryan, J., 2010. Sample design and cohort selection in the Hispanic Community Health Study/Study of Latinos. Ann. Epidemiol. 20 (8), 642–649.

Lloyd-Jones, D.M., Hong, Y.L., Labarthe, D., Mozaffarian, D., Appel, L.J., Van Horn, L., ... Plannin, A.H., A. S., 2010. Defining and setting national goals for cardiovascular health promotion and disease reduction the American Heart Association's strategic impact goal through 2020 and beyond. Circulation 121 (4), 586–613. https://doi.org/10.1161/Circulationaha.109.192703.

McNair, D.M., Lorr, M., Droppleman, L.F., 1992. Profile of Mood States. Educational and industrial testing services, San Diego, CA.

Moskowitz, J.T., Epel, E.S., Acree, M., 2008. Positive affect uniquely predicts lower risk of mortality in people with diabetes. HEALTH PSYCHOLOGY-HILLSDALE THEN WASHINGTON DC 27 (1), S73.

Moskowitz, J.T., Carrico, A.W., Duncan, L.G., Cohn, M.A., Cheung, E.O., Batchelder, A., ... Folkman, S., 2017. Randomized controlled trial of a positive affect intervention for people newly diagnosed with HIV. J. Consult. Clin. Psychol. 85 (5), 409.

Nikrahan, G.R., Suarez, L., Asgari, K., Beach, S.R., Celano, C.M., Kalantari, M., ... Huffman, J.C., 2016. Positive psychology interventions for patients with heart disease: a preliminary randomized trial. Psychosomatics 57 (4), 348–358.

Palmer, S.C., Vecchio, M., Craig, J.C., Tonelli, M., Johnson, D.W., Nicolucci, A., ... Hedayati, S.S., 2013. Association between depression and death in people with CKD: a meta-analysis of cohort studies. Am. J. Kidney Dis. 62 (3), 493–505.

Peralta, C.A., Shlipak, M.G., Fan, D., Ordoñez, J., Lash, J.P., Chertow, G.M., Go, A.S., 2006. Risks for end-stage renal disease, cardiovascular events, and death in Hispanic versus non-Hispanic white adults with chronic kidney disease. J. Am. Soc. Nephrol. 17 (10), 2892–2899.

Pressman, S.D., Cohen, S., 2005. Does positive affect influence health? Psychol. Bull. 131 (6), 925.

Radloff, L.S., 1977. The CES-D scale a self-report depression scale for research in the general population. Appl. Psychol. Meas. 1 (3), 385–401.

Seligman, M.E., 2012. Flourish: A Visionary New Understanding of Happiness and Well-being. Simon and Schuster.

Sheehan, T.J., Fifield, J., Reisine, S., Tennen, H., 1995. The measurement structure of the Center for Epidemiologic Studies Depression Scale. J. Pers. Assess. 64 (3), 507–521. https://doi.org/10.1207/s15327752jpa6403_9.

Sorlie, P.D., Aviles-Santa, L.M., Wassertheil-Smoller, S., Kaplan, R.C., Daviglus, M.L., Giachello, A.L., ... Heiss, G., 2010. Design and implementation of the Hispanic Community Health Study/Study of Latinos. Ann. Epidemiol. 20 (8), 629–641. https://doi.org/10.1016/j.annepidem.2010.03.015.

Tsenkova, V.K., Dienberg Love, G., Singer, B.H., Ryff, C.D., 2008. Coping and positive affect predict longitudinal change in glycosylated hemoglobin. Health Psychol. 27 (2S), S163.

Ware, J.E., Kosinski, M., Keller, S.D., 1996. A 12-item short-form health survey - construction of scales and preliminary tests of reliability and validity. Med. Care 34 (3), 220–233. https://doi.org/10.1097/00005650-199603000-00003.

Watson, D., Clark, L.A., 1999. The PANAS-X: Manual for the Positive and Negative Affect Schedule-expanded Form.

Zhang, W., O'Brien, N., Forrest, J.I., Salters, K.A., Patterson, T.L., Montaner, J.S., ... Lima, V.D., 2012. Validating a shortened depression scale (10 item CES-D) among HIV-positive people in British Columbia, Canada. PLoS One 7 (7), e40793.