Associations between psychological distress and health-related behaviors among adults with chronic kidney disease

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ABSTRACT

Chronic kidney disease (CKD) affects 15% of the US general population, and this rate is projected to increase. A healthy lifestyle is important for individuals with CKD to reduce risk for CKD progression and adverse heath events. Adults with CKD also have high rates of psychological distress, which may be associated with unhealthy behaviors. Using the 2013–2017 public use data files of the US National Health Interview Survey, we compared health behaviors (smoking, alcohol use, and physical activity [PA]) and psychological distress (assessed with the Kessler-6 scale) between adults with a CKD diagnosis in the preceding year and a matched sample of adults without a CKD diagnosis. We then examined the association between psychological distress and health behaviors among adults with CKD (n = 3923) using multinomial logistic regression models. Compared to those without CKD, those with CKD had lower rates of smoking, heavy alcohol use, and engagement in any type of PA 3 + times a week and higher rates of psychological distress. In addition to the health concerns posed by the high smoking rate (17%) and low physical activity rate (34%) among those with CKD, smoking and lack of PA were associated with greater risk of mild-moderate and/or serious psychological distress. Compared to no unhealthy behaviors, 2–3 unhealthy behaviors were associated with 4.72 (95% CI = 2.97–7.48) times greater risk of serious psychological distress. Adults with CKD and unhealthy behaviors need help with lifestyle modifications and assessment and treatment of psychological distress to reduce CKD progression and prevent other health complications.

1. Introduction

Chronic kidney disease (CKD) is a significant public health issues and increasing in the United States and globally. CKD affects 15% of the US general population and is more prevalent among African Americans, Hispanics, and American Indians/Alaska Natives than non-Hispanic Whites (National Institute of Diabetes and Digestive and Kidney Disease, 2016; United States Renal Data System, 2018). Those with early-stage CKD are at high risk of progressive kidney failure and end-stage renal disease (ESRD), and CKD patients in all stages are at high risk of other adverse health events (United States Renal Data System, 2018). Thus, individuals with CKD are urged to adhere to a healthy lifestyle to reduce disease progression and other health complications.

Compared to current smokers, nonsmokers had reduced risk of CKD progression and atherosclerotic and nonatherosclerotic events and lower all-cause mortality (Ricardo et al., 2015; Xia et al., 2017; Bundy et al., 2018). Engaging in any type of exercise training, regardless of

intensity or duration, increased exercise capacity, cardiorespiratory fitness, muscle strength, and functional capacity and was associated with reduced all-cause mortality in adults with CKD (Ricardo et al., 2015; Barcellos et al., 2015; Gould et al., 2014; Heiwe and Jacobson, 2014; Howden et al., 2015a; Roshanravan et al., 2017; MacKinnon et al., 2018). A healthy diet and reduced caloric intake are generally associated with delayed CKD progression and prevention of complications (Jain and Reilly, 2014; Kelly et al., 2017; Rysz et al., 2017), although Ricardo et al. (2015) found that body mass index (BMI) $\geq 25 \, kg/m^2$ was associated with reduced risk of CKD progression, adverse cardiovascular events, and all-cause mortality.

Evidence on alcohol consumption and CKD has been conflicting. Prospective studies found that moderate-heavy alcohol use (White et al., 2009) or alcohol use disorder (Pan et al., 2018) was associated with an increased incidence of CKD onset/new diagnosis. However, another prospective study found that over follow-up (median period = 5.5 years), persistent alcohol intake, compared to no intake,

among individuals with CKD was associated with lower all-cause mortality (Bundy et al., 2018). Other studies also found that low-to-moderate wine and other alcohol consumption has been associated with slowing CKD progression (Chauveau et al., 2018; Koning et al., 2015; Migliori et al., 2015; Tsuruya et al., 2017), but heavy alcohol consumption may increase CKD patients' risk of sleep disturbance, poor nutritional intake, liver disease, and medication and dialysis non-compliance (Hegde et al., 2000; Merlino et al., 2006).

Adopting and maintaining healthy behaviors are closely associated with psychological factors. For example, among the general population, many studies show that smoking uptake, persistent smoking, quit attempts, and cessation/relapse are highly correlated with symptoms of depression and anxiety (Fluharty et al., 2017; Mathew et al., 2017). Although a chronic disease diagnosis has been associated with reduced smoking and drinking among older adults (Choi and DiNitto, 2015; Xiang, 2016), depression is a barrier to behavior change (Xiang, 2016; Clayborne and Colman, 2018). Adults with depression also spend significantly less time in any type of physical activity and more time in sedentary behaviors than their nondepressed counterparts (Schuch et al., 2017; Song et al., 2012). Depression is also associated with failure to complete exercise interventions (Batra et al., 2016; Swardfager et al., 2016). Compared to adults without chronic disease, those with chronic diseases (e.g., diabetes, chronic obstructive pulmonary disease) have higher psychological distress, which is associated with insufficient physical activity and other unhealthy behaviors including smoking (Shin et al., 2012; Paine et al., 2019). For example, participants with diabetes in the 2007 California Health Interview Survey had 1.8 greater odds of having serious psychological distress (measured with the Kessler-6 scale), while those reporting "regular" physical activity had 0.5 odds of serious psychological distress regardless of diabetes (Shin et al., 2012). A study also found that US adults with comorbid lifetime diagnosis of a selected chronic disease and serious psychological distress reported more frequent activity limitation than those with only a lifetime diagnosis of a chronic condition (McKnight-Eily et al., 2009). While cross-sectional studies do not allow for determining causality, these relationships are likely bidirectional, with psychological distress being a key factor impacting health behavior and behavior change and engagement in healthy behaviors protecting against psychological distress (Hoang et al., 2019).

Adults with CKD have high rates of psychological distress, especially depression and anxiety (Palmer et al., 2013; Zalai et al., 2012; Goh and Griva, 2018), but no study has examined the relationship between their psychological distress and health behaviors. In this study, we compared a nationally representative sample of adults (18+ years) with a self-reported past-year CKD diagnosis to a sample matched on socio-demographic and health statuses but without CKD on health behaviors and psychological distress. We then examined associations between psychological distress and smoking, drinking, and leisure-time physical activity (PA hereafter) among those with a CKD diagnosis. We hypothesized that mild-moderate and serious psychological distress, compared to no distress, will be significantly associated with these health behaviors, independently and in combination with each other, controlling for socioeconomic factors and diagnosed medical conditions other than CKD. The findings may help identify adults with CKD who need help to increase healthy behaviors and reduce psychological distress.

2. Methods

2.1. Data and sample

We utilized the 2013–2017 public use data files of the National Health Interview Survey (NHIS), an annual, cross-sectional household survey which is the principal source of information on the health and healthcare access of the civilian, noninstitutionalized US population (National Center for Health Statistics, 2018). For each sampled household, interviews were conducted (mostly face-to-face) with an adult family member who answered questions about each family member's demographic and health status characteristics. The NHIS also collects more detailed health and lifestyle data from one Sample Adult from each household, which was used in the present study. Combining all five years of annual NHIS data resulted in a sample of 164,696 adults aged 18 to 85+ years (NHIS public use data sets do not provide the chronological age of those aged ≥85 years). Of these, 3923 reported a CKD diagnosis in the preceding 12 months. In the present study, utilizing a matched case-control design, we matched respondents who reported a CKD diagnosis to those who did not report a CKD diagnosis on demographic and other health conditions and then compared them with respect to their health behaviors and psychological distress (N = 7616). We then focused on those who reported a CKD diagnosis (N = 3923) to examine associations between their psychological distress and health behaviors. The study utilized publicly available, anonymized datasets and thus was exempt from human subjects review by the authors' institutions.

2.2. Measures

Adults with CKD were those who responded 'yes' to having 'weak or failing kidneys' diagnosed by a physician or other healthcare provider in the 12 months preceding the interview. (Stage of CKD and whether the diagnosis was new or ongoing were not ascertained.)

Psychological distress was assessed with the Kessler-6 screen (K6), a global measure of distress that includes depressive and anxiety-related symptomology over the 4-week period prior to test administration (Kessler et al., 2003). Cronbach's α for the six items among the sample persons with a CKD diagnosis in this study was 0.88. Scores of 13–24 suggest serious mental illness, defined as meeting diagnostic criteria for a *DSM-IV* disorder and experiencing significant impairment in functioning. Scores of 8–12 suggest mild-moderate mental illness, i.e., a high probability of a diagnosable mental illness but with less severe impairment in functioning (Kessler et al., 2008). Thus, in this study, we categorized K6 scores of 0–7 as no distress, 8–12 as mild-moderate distress, and 13–24 as serious distress.

Health behaviors: (1) Smoking status was noted as current smoker (i.e., smoked every day or somedays), former smoker, and never smoker. (2) For alcoholic beverage consumption (including liquor such as whiskey or gin, beer, wine, wine coolers, and any other type of alcoholic beverage), we grouped respondents into five categories: lifetime abstainer (< 12 drinks in lifetime [reference group]); ex-drinker (alcohol use prior to past year but no past year use); current infrequent (< 12 drinks in past year) or light drinker (≤3 drinks per week in past year); current moderate drinker (> 3 drinks to14 drinks per week for males or > 3 drinks per week to 7 drinks per week for females); and current heavy drinker (> 14 drinks per week in past year for males or > 7 drinks per week in past year for females). (3) PA was measured using the number of days in a week the respondent engaged in vigorous, light-to-moderate, or muscle strengthening PA (exercise, sports, physically active hobbies, etc.) for at least 10 min. We defined regular PA as engaging in any type of PA at least three times a week. (4) We created a combined unhealthy behavior score by assigning one point each for current smoking, heavy drinking, and PA < 3 times a week and adding the points (0–3) for each respondent. Additionally, BMI (< 18.5 [underweight], 18.5–24.99 [normal], 25–29.99 [overweight], ≤30 [obese]) was examined for descriptive purposes only.

Covariates were: (1) the number (0–8) of chronic medical conditions other than CKD (hypertension, heart disease, stroke, diabetes, liver disease, lung disease, arthritis, and cancer) with which the respondent had ever been diagnosed and the number they had difficulty managing; (2) age; (3) gender; (4) race/ethnicity (non-Hispanic White [reference group], non-Hispanic Black, Hispanic, Asian, American Indian/Alaska Native, and multiracial/unknown); (5) marital status (married/partnered [reference group], divorced/separated, widowed, and never

married); (6) education (bachelor's degree vs. no degree); (7) past-year work status (worked vs. did not work); and (8) ratio of family income to the poverty threshold (< 200%, 200–399%, ≥400% [reference group], and missing).

2.3. Data analysis

All analyses were conducted with Stata 15/MP. First, we used Stata's ccmatch function (Cook, 2012) to match adults with and without CKD one-on-one based on age, gender, race/ethnicity, work status, family income, and the number of chronic medical conditions other than CKD, resulting in a sample of 3808 adults without CKD matched with 3808 adults with CKD. We then used χ^2 tests and confidence intervals to compare health behaviors and K6 scores between these two groups. To account for NHIS's stratified, multi-stage probability sampling design and to ensure that variance estimates incorporate the full sampling design, Stata's svy function was used for all analyses. Second, we used χ^2 and independent-samples *t*-tests and confidence intervals to compare sociodemographic, health status, and health behavior characteristics among adults with CKD grouped by their K6 score (no, mild-moderate, and serious distress). We tested study hypotheses using multinomial logistic regression with the three levels of K6 scores as the dependent variable (no distress was the reference group). In Model 1, we examined associations of the three levels of K6 scores with smoking, drinking, and PA (engagement in any type of PA 3+ times a week) independently. As a sensitivity analysis, we examined engagement in each type of PA—vigorous, light-to-moderate, and strengthening PA—3+ times a week in three separate multinomial logistic regression models. Since results for each type of PA were similar to those from any PA engagement, we report the model with any PA engagement only. In Model 2, we examined associations of the three levels of K6 scores with the combined unhealthy behavior score (0, 1, 2–3). Variance inflation factor diagnostics, using a cut-off of 2.50 (Allison, 2015), showed that multicollinearity among the independent variables and covariates (listed in the Measures section) was not a concern. Multinomial logistic regression results are presented as relative risk ratios (RRR) with 95% confidence intervals (CI).

3. Results

3.1. Health behaviors and psychological distress among adults with and without past-year CKD

Matched sample comparisons (see Table 1) show that 17.3% (95% CI = 15.8–18.9) of those with CKD and 18.9% (95% CI = 17.4–20.6) of those without CKD were current smokers. More than three-quarters of smokers with and without CKD smoked daily. Regarding alcohol use, 2.4% (95% CI = 1.9–3.1) of those with CKD and 4.7% (95% CI = 3.9–5.7) of those without CKD were heavy drinkers. Only one third of those with CKD (33.6% [95% CI = 31.5–35.8]) reported engaging in any type of PA 3+ times weekly, which was lower than the rates among those without CKD (43.4% [41.1–45.6]). A majority of those with and without CKD reported no engagement at all, and about one in ten of each group reported engagement 1–2 times a week. BMI distributions show that the rate of obesity was 43.3% (95% CI = 41.1–45.5) among those with CKD and 39.1% (95% CI = 37.0–41.2) among those without CKD. As expected, those with CKD had higher K6 scores (15.2% [95% CI = 13.8–16.7] and 10.6% [95% CI = 9.4–11.9]) scored in the mild-moderate and serious distress ranges, respectively) compared to 7.2% [95% CI = 6.9–7.3] and 3.4% [95% CI = 3.2–3.5], respectively, of those without CKD.

3.2. Sociodemographic and health characteristics of adults with CKD by K6 levels

Table 2 shows that about half of adults with CKD were aged 65+

Table 1

Case-controlled comparison of health behaviors and psychological distress between adults with and without past-year CKD diagnosis (weighted column % with 95% confidence intervals).

	Without CKD N = 3808	With CKD N = 3808
Smoker		
Never	47.5 (45.3–49.7)	45.4 (43.3–47.6)
Former	33.6 (31.6–35.6)	37.3 (35.2–39.5)
Current	18.9 (17.4–20.6)	17.3 (15.8–18.9)
Of current smokers		
Smoked everyday	79. 5 (75.3–83.1)	77.9 (73.4–81.7)
Smoked some days	20.6 (16.9–24.7)	22.2 (18.3–26.6)
Alcohol use		
Lifetime abstainer	20.5 (18.3–22.2)	24.1 (22.3–26.0)
Ex-drinker	26.4 (24.6–28.2)	32.4 (30.4–34.5)
Current infrequent/light drinker	37.2 (35.2–39.2)	34.8 (32.8–36.9)
Current moderate drinker	11.2 (10.0–12.6)	6.2 (5.2–7.3)
Current heavy drinker	4.7 (3.9–5.7)	2.4 (1.9–3.1)
Leisure-time physical activity (times per week)		
Vigorous activity		
Never or < 3 times	77.6 (75.5–79.5)	80.6 (78.8–82.3)
3+ times	16.1 (14.5–17.9)	11.8 (10.5–13.3)
Unable to do	6.3 (5.3–7.5)	7.6 (6.6–8.9)
Light-to-moderate activity		
Never or < 3 times	60.5 (58.2–62.6)	67.0 (64.8–69.0)
3+ times	35.7 (33.6–38.0)	27.3 (25.3–29.4)
Unable to do	3.8 (3.1–4.7)	5.8 (4.8–6.9)
Strengthening activity		
Never or < 3 times	83.2 (81.5–84.9)	84.9 (83.3–86.3)
3+ times	11.9 (10.5–13.5)	9.2 (8.0–10.4)
Unable to do	4.8 (3.9–5.9)	5.98 (5.0–7.1)
Any of the above activities 3+ times per week	43.4 (41.1–45.6)	33.6 (31.5–35.8)
Body mass index (BMI)		
Underweight	1.4 (1.0–2.0)	3.0 (2.3–3.9)
Normal	25.6 (23.8–27.4)	23.9 (22.1–25.8)
Overweight	34.0 (31.9–36.1)	29.9 (27.9–31.9)
Obese	39.1 (37.0–41.2)	43.3 (41.1–45.5)
Psychological distress (K6 score) (%)		
No distress	89.5 (89.3–89.8)	74.3 (72.4–76.0)
Mild-moderate distress	7.2 (6.9–7.3)	15.2 (13.8–16.7)
Serious distress	3.4 (3.2–3.5)	10.6 (9.4–11.9)

years, but the serious distress group was the youngest with an average age of 56.2 years. Compared to the no distress group, the serious distress group included a lower proportion of non-Hispanic Blacks, but higher proportions of the other racial/ethnic minority groups and divorced/separated and never married individuals. Compared to the no distress group, both the mild-moderate and serious distress groups were less likely to work in the preceding year and more likely to have family income < 200% of poverty. More than half (51.2% [95% CI = 44.8–57.5]) of the serious distress group had family income < 200% of poverty.

Despite their younger ages, the mild-moderate and serious distress groups had more chronic medical conditions (i.e., heart, liver, and lung diseases, arthritis, and stroke) and conditions they had difficulty managing than the no distress group. The mild-moderate and serious distress groups did not differ on the number of chronic medical conditions and conditions they had difficulty managing. However, additional analysis found that a quarter of the serious distress group compared to < 12% of the mild-moderate distress group reported having difficulty managing their depression/anxiety symptoms in the preceding year.

3.3. Health behaviors among adults with CKD by K6 levels

Table 3 shows that compared to 13.2% (95% CI = 11.7–14.9) of the no distress group, 25.2% (95% CI = 20.8–30.0) of the mild-moderate group and 35.6% (95% CI = 30.2–41.4) of the serious distress group

Table 2

Sociodemographic and health characteristics of adults with past-year CKD diagnosis by psychological distress level (weighted column % with 95% confidence intervals if not otherwise specified).

	No distress (K6 < 8) 2877;74.3%	Mild-moderate (MM) distress (K6 = 8–12) 592; 15.2%	Serious distress (K6 ≥ 13) 454; 10.6%
Age (M,SE)	63.93 (0.41)	59.66 (0.79)	56.17 (1.00)
Age group (yrs)			
18–39	10.7 (9.2–12.4)	12.6 (9.6–16.5)	14.1 (10.2–19.2)
40–54	15.4 (13.6–17.5)	20.7 (16.5–25.7)	26.6 (21.5–32.3)
55–64	17.8 (16.0–19.7)	28.1 (23.1–33.6)	32.2 (26.7–38.2)
65–74	25.4 (23.5–27.4)	19.9 (16.2–24.2)	15.3 (11.6–19.8)
75 +	30.7 (28.6–32.9)	18.7 (14.9–23.3)	11.9 (8.0–17.4)
Female	51.8 (49.3–54.3)	55.5 (50.0–60.9)	58.0 (51.6–64.1)
Race/ethnicity			
Non-Hispanic White	65.9 (63.4–68.3)	63.8 (58.5–68.8)	63.5 (57.2–69.3)
Non-Hispanic Black	14.7 (13.1–16.5)	14.7 (11.4–18.7)	10.0 (7.3–13.6)
Hispanic	13.8 (11.9–16.0)	15.8 (12.3–20.1)	16.7 (12.5–21.9)
Non-Hispanic Asian	3.2 (2.4–4.2)	2.5 (1.3–4.7)	1.8 (0.7–4.4)
American Indian/Alaska Native	0.9 (0.5–1.3)	0.8 (0.3–1.8)	2.4 (0.6–9.1)
Multiracial/other	1.6 (1.2–2.3)	2.4 (1.4–4.1)	5.6 (3.3–9.3)
Marital status (%)			
Married/partnered	53.8 (51–3-56.2)	51.7 (46.1–57.2)	41.3 (35.2–47.7)
Divorced/separated	16.6 (14.9–18.4)	21.0 (17.4–25.2)	30.1 (25.5–35.2)
Widowed	17.1 (15.6–18.8)	13.9 (10.8–17.7)	11.4 (8.2–15.6)
Never married	12.5 (11.1–14.2)	13.4 (10.3–17.3)	17.2 (13.2–22.2)
Education			
< High school	23.5 (21.5–25.6)	35.4 (30.1–41.1)	41.4 (35.3–47.9)
High school	25.6 (23.5–27.9)	23.3 (19.0–28.2)	24.0 (18.8–30.0)
Some college	30.2 (28.1–32.5)	30.1 (25.3–35.4)	26.2 (21.0–32.1)
College or higher	20.7 (18.8–22.7)	11.2 (8.4–14.7)	8.4 (5.9–11.8)
% worked in past year	28.4 (26.1–30.8)	21.7 (17.4–26.7)	16.1 (12.4–20.6)
Family income (% of poverty)			
< 200	35.7 (33.3–38.1)	47.7 (42.4–53.1)	51.2 (44.8–57.5)
200–399	27.2 (25.0–29.4)	24.5 (20.0–29.7)	23.7 (18.7–29.7)
400 +	28.1 (25.8–30.4)	19.3 (15.5–23.9)	16.4 (12.8–20.7)
Missing	9.1 (7.8–10.6)	8.4 (5.8–12.1)	8.7 (5.3–13.8)
Health status			
No. of diagnosed medical conditions (M,SE)	2.82 (0.04)	3.29 (0.08)	3.43 (0.10)
Diabetes	37.8 (35.5–40.3)	41.6 (36.1–46.7)	43.5 (37.8–49.5)
Hypertension	74.0 (71.8–76.1)	79.8 (75.2–83.7)	76.9 (71.0–81.9)
Heart disease	42.2 (39.7–44.5)	48.8 (43.3–54.3)	55.5 (49.4–61.4)
Stroke	13.9 (12.3–15.7)	15.21 (11.9–19.3)	19.2 (15.2–24.0)
Liver disease	6.4 (5.3–7.7)	11.7 (8.5–15.9)	12.6 (9.1–17.1)
Lung disease	24.7 (22.9–26.6)	39.3 (34.3–44.6)	44.1 (38.4–49.9)
Arthritis	16.7 (15.2–18.4)	27.1 (22.6–32.2)	29.0 (23.9–34.7)
Cancer	25.5 (23.5–27.7)	21.8 (17.8–26.4)	21.2 (16.5–26.8)
No. of above medical conditions difficult to manage (M,SE)	0.95 (0.03)	1.66 (0.08)	1.71 (0.10)
Had difficulty managing depression/anxiety	2.5 (1.9–3.3)	11.7 (8.9–15.1)	24.9 (19.8–30.9)

were current smokers. Additional analysis found that more than one-half of all current smokers had an unsuccessful quit attempt in the past year. There were more ex-drinkers in the serious distress group than in the no distress group, but the two groups did not differ on heavy drinking. The serious distress group was least likely to engage in any type of PA 3 + times a week (19.6% [95% CI = 15.3–24.6]) compared to the no distress (36.0% [95% CI = 33.5–38.5%]) and mild-moderate distress groups (31.3% [95% CI = 26.7–36.4]). Data also show that almost 30% of the serious distress group engaged in 2–3 unhealthy behaviors (mostly smoking and lack of regular PA), compared to < 10% of the no distress group and < 17% of the mild-moderate distress group. More than 40% of all three groups were obese.

3.4. Associations between K6 levels and health behaviors among adults with CKD

Model 1 in Table 4 shows that compared to never smokers, current smokers were at 1.72 (95% CI = 1.18–2.49) and 2.16 (95% CI = 1.50–3.12) times greater risk of mild-moderate and serious distress, respectively, while those who did any PA 3 + times a week, compared to those who did no PA, had 0.46 (95% CI = 0.33–0.66) times lower risk of serious distress. Alcohol use was not significantly

associated with K6 levels. Model 2 in Table 4 shows that compared to no unhealthy behaviors, 2–3 unhealthy behaviors were associated with 1.76 (95% CI = 1.15–2.70) times greater risk of mild-moderate distress; one unhealthy behavior was associated with 2.34 (95% CI = 1.57–3.47) times greater risk of serious distress; and 2–3 un-healthy behaviors were associated with 4.72 (95% CI = 2.97–7.48) times greater risk of serious distress.

Of the covariates, the number of chronic medical conditions that were difficult to manage and family income < 200% of poverty were associated with higher risk of both mild-moderate and serious distress as compared to no distress; while divorced/separated people, compared to married/partnered people, had higher risk of serious distress only. Older age and employment during the preceding year were associated with lower risk of both mild-moderate and serious distress, and being non-Hispanic Black was associated with lower risk of serious distress only.

4. Discussion and conclusions

Our findings show mild-moderate and serious levels of psychological distress among a quarter of adults with CKD, compared to < 11% among the matched sample without CKD. The rates for those with CKD

Table 3
Health behaviors among adults with past-year CKD diagnosis by psychological distress level (weighted column % with 95% confidence intervals).

	No distress (K6 < 8) 2877; 74.25%	Mild-moderate (MM) distress (K6 = 8–12) 592; 15.18%	Serious distress (K6 ≥ 13) 454; 10.57%
Smoker			
Never	47.6 (45.1–50.2)	41.1 (35.8–46.6)	37.0 (31.5–42.8)
Former	39.2 (36.8–41.7)	33.8 (28.2–39.2)	27.4 (21.9–33.6)
Current	13.2 (11.7–14.9)	25.2 (20.8–30.0)	35.6 (30.2–41.4)
Of current smokers			
Smoked everyday	79.0 (73.0–84.0)	72.9 (62.5–81.3)	79.9 (71.5–86.2)
Smoked some days	21.0 (16.1–27.0)	27.1 (18.7–37.5)	20.2 (13.8–28.5)
Alcohol use			
Lifetime abstainer	24.6 (22.6–26.7)	23.5 (19.2–28.4)	23.8 (18.8–29.7)
Ex-drinker	30.9 (28.7–33.2)	36.5 (31.3–42.0)	37.0 (30.8–43.6)
Current infrequent/light drinker	35.7 (33.4–38.1)	32.4 (27.3–38.0)	31.9 (26.5–37.8)
Current moderate drinker	6.7 (5.1–8.1)	4.7 (3.0–7.3)	3.6 (2.0–6.1)
Current heavy drinker	2.1 (1.5–2.8)	2.9 (1.6–5.1)	3.8 (2.0–7.0)
Leisure time physical activity (times per week)			
Vigorous activity			
Never or < 3 times	81.4 (79.3–83.3)	79.1 (73.9–83.4)	75.5 (69.7–80.5)
3+ times	12.6 (11.1–14.4)	10.6 (7.7–14.2)	6.3 (4.0–9.8)
Unable to do	6.0 (5.0–7.2)	10.4 (7.1–15.0)	18.2 (13.6–24.0)
Light-to-moderate activity			
Never or < 3 times	66.1 (63.6–68.5)	68.0 (62.3–73.1)	71.5 (65.6–76.7)
3+ times	29.5 (27.2–32.0)	24.0 (19.7–28.8)	15.7 (12.0–20.4)
Unable to do	4.4 (3.5–5.4)	8.0 (5.1–12.5)	12.8 (8.8–18.3)
Strengthening activity			
Never or < 3 times	85.8 (84.1–87.4)	82.2 (72.1–86.3)	82.2 (76.7–86.6)
3+ times	9.7 (8.4–11.1)	9.8 (7.2–13.3)	4.4 (2.8–6.7)
Unable to do	4.6 (3.6–5.7)	8.0 (5.0–12.5)	13.5 (9.3–19.1)
Any of the above physical activities 3+ times per week	36.0 (33.5–38.5)	31.3 (26.7–36.4)	19.6 (15.3–24.6)
Combined unhealthy behavior[a] score			
0 (no unhealthy behavior)	30.9 (28.5–33.5)	20.9 (17.0–25.4)	11.3 (8.2–15.4)
1 unhealthy behavior	59.2 (56.6–61.7)	62.3 (57.1–67.3)	58.9 (52.9–64.6)
2 unhealthy behaviors	9.7 (8.4–11.3)	16.2 (12.7–20.5)	28.5 (23.3–34.3)
3 unhealthy behaviors	0.2 (0.1–0.4)	0.6 (0.2–2.1)	1.4 (0.6–2.9)
Body mass index (BMI)			
Underweight	2.9 (2.1–4.0)	2.5 (1.3–4.6)	3.9 (1.9–7.8)
Normal	24.7 (22.5–27.0)	21.0 (16.9–25.8)	23.8 (19.2–29.2)
Overweight	30.3 (28.1–32.7)	28.5 (24.0–33.5)	26.8 (21.5–32.9)
Obese	42.1 (39.5–44.6)	48.1 (42.7–53.4)	45.5 (39.2–52.0)

[a] Current smoking, current heavy drinking, and/or no physical activity or engagement in it fewer than three times per week.

are similar to clinician-rated depression found in other studies of adults with CKD (Palmer et al., 2013). The 11% rate of serious psychological distress, compared to 3% among the matched sample without CKD, is especially notable. The 17% smoking rate among those with a CKD diagnosis is also a major concern, as nicotine use has deleterious effects on CKD progression and cardiovascular events (Ricardo et al., 2015; Xia et al., 2017). Smoking despite a CKD diagnosis suggests nicotine addiction (e.g., more than half reported a failed quit attempt) or self-medication of mental distress and the need for help with these problems. The small proportion of adults with CKD who reported heavy drinking also need help because CKD is associated with lowered liver function or liver disease (Piano et al., 2017; Targher and Byrne, 2017).

Only one third of adults with CKD, compared to 43% of the matched sample, reported engaging in any type of PA 3+ times a week. The lack of physical activity (i.e., sedentary lifestyles) combined with the effects of aging (about half of adults with CKD were 65+ years) and CKD progression may lead to substantial loss of skeletal muscle mass and weakness, which increases the risk of mobility disability and disease complications (Howden et al., 2015a). Furthermore, given the high rate of other comorbid chronic health problems, including hypertension and diabetes, among adults with CKD, the lack of physical activity will be even more detrimental to their overall health and quality of life.

As hypothesized, current smoking was significantly associated with greater risk of mild-moderate and serious levels of distress among those with CKD, and regular PA was associated with decreased risk of serious distress, suggesting PA's beneficial mental health effects along with its proven physical health benefits. However, contrary to our hypothesis,

psychological distress was not associated with alcohol use patterns. As noted, studies on alcohol use and CKD progression and all-cause mortality have produced conflicting results, but the lack of association between psychological distress and heavy drinking in this study may be due to low sample power (i.e., few sample members were heavy drinkers). More research on the behavioral health effects of alcohol and other substance use (e.g., marijuana, other illicit drugs) among individuals with CKD is needed using larger samples.

The study has limitations: (1) Recall bias may have affected self reports of CKD diagnosis leading to misclassifying disease status. Greater specificity, including data on CKD stage, would have been helpful. (2) Recall and social desirability biases may have affected self reports of smoking, drinking, and PA, although all rates appear to be in the ranges of other studies using self-reported data. (3) As this study is cross-sectional, only correlation, not causality, can be inferred. Though we were unable to determine if psychological distress led to unhealthy behaviors or vice versa, the relationship is more likely bidirectional than unidirectional.

Both health behaviors and psychological distress are modifiable factors. Reducing unhealthy behaviors, maintaining or increasing healthy behaviors, reducing stress, and improving mental well-being can slow CKD progression and prevent other adverse health events. Adults with CKD may need help with lifestyle modifications. First, smoking cessation interventions using motivational interviewing and other evidence-based behavioral and pharmacologic approaches are needed to increase motivation among those reluctant to quit and improve outcomes among the many who made unsuccessful quit attempts.

Table 4

Association of psychological distress with health behaviors among adults with past-year CKD diagnosis: Multinomial logistic regression results.

	Model 1		Model 2	
	Mild-to-moderate vs. no distress RRR (95% CI)	Serious vs. no distress RRR (95% CI)	Mild-to-moderate vs. no distress RRR (95% CI)	Serious vs. no distress RRR (95% CI)
Smoker				
Never	Ref.	Ref.		
Former	1.04 (0.75–1.43)	0.91 (0.62–1.35)		
Current	1.72 (1.18–2.49)			
Alcohol use				
Lifetime abstainer	Ref.	Ref.		
Ex-drinker	1.20 (0.84–1.71)	1.29 (0.86–1.93)		
Current infrequent/light drinker	0.92 (0.63–1.34)	0.94 (0.63–1.40)		
Current moderate drinker	0.74 (0.40–1.38)	0.62 (0.30–1.28)		
Current heavy drinker	1.30 (0.60–2.84)	1.97 (0.88–4.43)		
Any physical activity 3+ times per week	0.91 (0.69–1.19)	0.46 (0.33–0.66)		
Combined unhealthy behavior score				
None			Ref.	Ref.
1			1.35 (0.99–1.84)	2.34 (1.57–3.47)
2 or 3			1.76 (1.15–2.70)	4.72 (2.97–7.48)
Covariates				
No. of medical conditions difficult to manage	1.54 (1.39–1.70)	1.59 (1.42–1.78)	1.55 (1.41–1.71)	1.59 (1.42–1.78)
Age (yrs)	0.97 (0.96–0.98)	0.96 (0.94–0.97)	0.97 (0.96–0.98)	0.96 (0.95–0.97)
Male (vs. female)	0.89 (0.68–1.17)	0.86 (0.62–1.19)	0.91 (0.70–1.18)	0.88 (0.65–1.19)
Race/ethnicity				
Non-Hispanic White	Ref.	Ref.	Ref.	Ref.
Non-Hispanic Black	0.85 (0.59–1.22)	0.48 (0.32–0.72)	0.83 (0.58–1.19)	0.52 (0.35–0.77)
Hispanic	1.06 (0.71–1.57)	1.05 (0.71–1.57)	1.03 (0.70–1.52)	1.06 (0.72–1.57)
Asian	0.82 (0.41–1.62)	0.68 (0.26–1.77)	0.80 (0.40–1.58)	0.69 (0.27–1.78)
American Indian/Alaska Native	1.04 (0.32–3.43)	3.38 (0.32–36.12)	1.12 (0.36–3.48)	3.44 (0.33–35.93)
Multiracial/other	1.04 (0.52–2.09)	2.21 (1.20–4.07)	0.99 (0.50–1.97)	2.15 (1.16–3.93)
College degree	0.99 (0.74–1.33)	0.76 (0.53–1.08)	0.98 (0.74–1.31)	0.75 (0.53–1.08)
Worked (vs. did not work) in past year	0.67 (0.46–0.99)	0.40 (0.27–0.60)	0.65 (0.44–0.96)	0.39 (0.26–0.59)
Marital status				
Married/partnered	Ref.	Ref.	Ref.	Ref.
Divorced/separated	1.01 (0.74–1.39)	1.77 (1.24–2.53)	1.04 (0.76–1.42)	1.80 (1.27–2.55)
Widowed	0.91 (0.61–1.34)	1.18 (0.72–1.94)	0.93 (0.63–1.36)	1.15 (0.70–1.89)
Never married	0.82 (0.53–1.25)	1.13 (0.72–1.76)	0.84 (0.55–1.28)	1.15 (0.74–1.78)
Family income (% of poverty)				
400+%	Ref.	Ref.	Ref.	Ref.
< 200%	1.58 (1.13–2.21)	1.72 (1.17–2.53)	1.63 (1.17–2.27)	1.64 (1.12–2.39)
200–399%	1.22 (0.84–1.76)	1.41 (0.91–2.19)	1.24 (0.86–1.79)	1.33 (0.86–2.06)
Missing	1.18 (0.69–1.99)	1.37 (0.73–2.57)	1.24 (0.73–2.10)	1.34 (0.72–2.52)
Model statistics	N = 3853; Design df = 904; $F_{(46,859)}$ = 9.08 $p < .001$		N = 3914; Design df = 904; $F_{(36,869)}$ = 11.00 $p < .001$	

Smoking cessation programs should give special consideration to the unique physiological and psychological challenges associated with CKD (Formanek et al., 2018).

Second, given the low rates of physical activity among adults with CKD, most need encouragement and assistance to increase their activity. Physical exercise (especially aerobic activities) has well-known benefits for people with CKD. For example, research shows that short-term supervised aerobic and resistance exercise training followed by longer-term home-based training (for a total of 12 months) and lifestyle interventions for patients with CKD stages 3 and 4 significantly increased physical activity levels and resulted in improved cardiorespiratory fitness, metabolic equivalent tasks, 6-minute walk distance, diastolic function, and weight loss (Howden et al., 2013; Howden et al., 2015b). Many individuals with CKD may not understand how regular exercise can slow muscle mass loss and weakness associated with CKD, as knowledge gaps about CKD are significant barriers to improving self-management (Lopez-Vargas et al., 2014). In particular, those recently diagnosed with CKD need accessible educational resources regarding the disease and self-management's role in slowing disease progression (Lopez-Vargas et al., 2014).

Third, although Medicare requires that social workers assess dialysis patients for depression, people in earlier CKD stages should also be regularly assessed for depression and anxiety and treated as needed, which can also aid in illness management. While pharmacotherapy is

the most prevalent treatment for depression and anxiety, given the high medication count among CKD patients, psychosocial interventions should be considered. Exercise training/interventions should be recommended given their dual physical and mental health benefits for adults with CKD and the significant association between regular physical activity and lower risk of serious psychological distress (Mitrou et al., 2013). For example, the physical benefits of exercise such as better sleep, less fatigue, and more energy positively affect mental health. Clinicians should discuss patients' barriers to engaging in physical activity, increase motivation to engage (e.g., by having an exercise partner), and make referrals to programs where patients can participate in physical activities of their choice. Cognitive behavioral therapy (CBT) and other evidence-based psychotherapy focusing on problem-solving and coping skills training should also be provided for CKD patients. A review of CBT outcomes among ESRD patients with depression found favorable effect sizes (Cohen's d: 0.67 to 0.93) (Sullivan et al., 2019). In sum, psychosocial interventions for individuals with CKD are needed to decrease smoking and drinking and to enhance physical activity and mental health in order to slow CKD progression and improve overall functioning.

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None for any author.

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