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National Estimates of Mental Health Needs Among Adults With Self-Reported CKD in the United States



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Introduction: Among adults with chronic kidney disease (CKD), comorbid mental illness is associated with poorer health outcomes and can impede access to transplantation. We provide the first US nationally representative estimates of the prevalence of mental illness and mental health (MH) treatment receipt among adults with self-reported CKD.

Methods: Using 2015 to 2019 National Survey on Drug Use and Health (NSDUH) data, we conducted an observational study of 152,069 adults (age ≥ 22 years) reporting CKD ($n = 2544$), with no reported chronic conditions ($n = 117,235$), or reporting hypertension (HTN) or diabetes mellitus (DM) but not CKD (HTN/DM, $n = 32,290$). We compared prevalence of (past-year) any mental illness, serious mental illness (SMI), MH treatment, and unmet MH care needs across the groups using logistic regression models.

Results: Approximately 26.6% of US adults reporting CKD also had mental illness, including 7.1% with SMI. When adjusting for individual characteristics, adults reporting CKD were 15.4 percentage points (PPs) and 7.3 PPs more likely than adults reporting no chronic conditions or HTN/DM to have any mental illness ($P < 0.001$) and 5.6 PPs ($P < 0.001$) and 2.2 PPs ($P = 0.01$) more likely to have SMI, respectively. Adults reporting CKD were also more likely to receive any MH treatment (21% vs. 12%, 18%, respectively) and to have unmet MH care needs (6% vs. 3%, 5%, respectively).

Conclusion: Mental illness is common among US adults reporting CKD. Enhanced management of MH needs could improve treatment outcomes and quality-of-life downstream.

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KEYWORDS: chronic kidney disease; mental illness; mental health treatment

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CKD, which affects 1 in 7 adults in the United States, is associated with poor health and quality-of-life outcomes.¹ Studies suggest that individuals with CKD and comorbid mental illness fare worse, with 11% to 66% higher risk of death,²⁻⁴ up to 90% higher risk of hospitalization,⁴⁻⁶ more rapid progression of CKD toward kidney failure,⁶⁻⁸ and other poorer outcomes,^{4,9-11} relative to individuals with CKD without comorbid mental illness.

Among individuals with progressing CKD or kidney failure requiring kidney replacement therapy (hereafter “kidney failure”), comorbid MH conditions may also affect courses of treatment. Transplantation and home

dialysis (peritoneal dialysis and home hemodialysis) are contraindicated for individuals with severe mental illness that impairs functioning.¹²⁻¹⁵ Yet, these treatments are more cost-effective and associated with a better quality-of-life relative to conventional in-center hemodialysis.¹⁶⁻²⁰ Thus, patients with advanced CKD who receive inadequate support in managing MH conditions will often be considered unsuitable candidates for transplant or home dialysis treatment, leading to substantially increased cost of treatment and diminished flexibility and convenience for patients and their caregivers.²¹

Although evidence on the effectiveness of interventions to address MH comorbidities in the CKD population remains limited,²² some studies suggest that comprehensive care management programs and psychological distress screening for patients with early stage CKD could improve CKD care delivery.^{23,24} In addition, several clinical trials have revealed that integrated care that more holistically addresses physical

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health and MH comorbidities in the general population can yield better improvements in medical outcomes (e.g., improved prescribing, treatment adherence) compared with standard treatment.^{25,26} Calls for implementing such approaches in CKD care are increasingly common.^{15,27}

Despite the associations between comorbid MH conditions and outcomes for individuals with CKD and the consequences these conditions have for patients' courses of treatment, surveillance efforts are hindered by the absence of nationally representative data on the prevalence of MH conditions or MH treatment use among adults with CKD in the United States. Data including depression plus other MH conditions are particularly rare. We fill this gap by studying MH illness and treatment outcomes in a US nationally representative sample of adults with self-reported CKD using recent data from the NSDUH.

METHODS

Data and Analytical Sample

We used data from the 2015 to 2019 NSDUH. NSDUH is an annual, U.S. nationally representative survey administered by the Substance Abuse and Mental Health Services Administration (U.S. Department of Health and Human Services) about MH disorders, substance use disorders, and treatment.²⁸ Approximately 70,000 noninstitutionalized adolescents and adults (age 12+) are selected by multistage-stratified sampling. Data are collected through in-person interviews with computer-assisted interviewing methods, which encourage accurate reporting around stigmatized conditions and behaviors (e.g., mental illness).²⁹ Weighted response rates ranged from 64% to 70% across the study years.

Our sample included adults aged 22 years and older because in the U.S., younger individuals with CKD (and particularly those with advanced CKD) receive care in distinct pediatric treatment systems and, often, in different facilities than adult patients.^{30,31} After further excluding adults with missing data [0.18% ($n = 273$)], our analytical sample included $n = 152,069$ adults.

We used respondents' self-reported chronic conditions to identify the following 3 patient groups for comparison in our analyses: (1) adults with no reported chronic conditions ($n = 117,235$); (2) adults reporting HTN and/or diabetes but not CKD ("HTN/DM," $n = 32,290$); and (3) adults reporting CKD ("CKD," $n = 2544$). HTN, diabetes, CKD, and other comorbid conditions were identified using the survey item: "Please read the list and type in the numbers of all of the conditions that a doctor or other health care

professional has ever told you that you had."²⁹ The group of adults reporting CKD includes all stages of CKD and kidney failure, as NSDUH does not collect information on biomarkers, estimated glomerular filtration rate, or self-reported kidney disease stage. HTN/DM was chosen as a comparison group for the CKD group because many patients experience these conditions before progressing toward kidney failure.¹

Outcomes

There were 2 dichotomous measures used to assess the prevalence of MH conditions, denoting those who had the following: (i) past-year any mental illness and/or (ii) past-year SMI. Any mental illness and SMI are indicators generated in the NSDUH from a prediction model based on the 2008 to 2012 Mental Health Surveillance Study. Through this study, the Substance Abuse and Mental Health Services Administration modeled the presence of any or severe mental illness, diagnosed by structured clinical interviews in a sample of NSDUH respondents, as functions of other observed respondent characteristics.²⁹ Previous research has found that this model is valid and that it effectively adjusts for potential selection, noncoverage, and nonresponse biases.^{32,33} Correspondingly, the NSDUH has used the model to generate indicators of past-year any mental illness and SMI for the respondents. Detailed information about the Mental Health Surveillance Study and the prediction model is presented in the [Supplementary Methods](#).

To assess MH treatment and perceived unmet treatment need, we used dichotomous indicators for those reporting the following: (i) any past-year MH treatment and (ii) past-year unmet MH care needs. MH treatment reflected having any inpatient, outpatient, or prescription treatment for "problems with emotions, nerves, or MH" in the past 12 months.²⁹ Unmet MH care needs was defined as "feeling a perceived need for MH treatment/counseling that was not received" in the past 12 months.²⁹

Covariates

We use Andersen's Behavioral Model of Health Care Utilization and the literature to identify relevant covariates.³⁴ Predisposing measures included respondent sex, age, and race/ethnicity (non-Hispanic White [reference (ref.)], non-Hispanic Black, Hispanic, other). Enabling characteristics included health insurance status (private [ref.], Medicaid, Medicare, Tricare/Champus/Veterans Affairs/Military Health, Uninsured, Other), family income (<100% federal poverty level [ref.], 100% to 200% federal poverty level, >200% federal poverty level), employment (employed full time or part time [ref.], unemployed, not in labor force, or

other), education (less than high school [ref.], high school graduate, some college/college graduate, or higher), and family receipt of any governmental assistance, including Supplemental Security Income, food stamps, cash assistance, and noncash assistance. Need-related characteristics comprised self-rated health (excellent/very good/good [ref.], fair/poor) and indicators for chronic conditions and substance use behaviors. To measure chronic conditions, we included indicators reflecting that the respondent had ever been told by a doctor or other health care professional they have the following: a heart condition, chronic obstructive pulmonary disease, chronic bronchitis, cirrhosis of the liver, hepatitis B or C, asthma, HIV or AIDS, and cancer (each yes/no). Measures of substance use behaviors included current smoking status, current alcohol use, and lifetime use of an illicit drug.

Statistical Analysis

We first compared outcome measures and covariates among adults reporting CKD, HTN/DM, and no chronic conditions using Pearson χ^2 statistics, adjusted for survey design. Next, we estimated logistic regression models comparing the likelihood of our outcome measures among adults reporting HTN/DM and adults reporting no chronic conditions, relative to adults reporting CKD (ref.). We modeled outcomes without adjustment and then adjusted regression models in a stepwise manner, having prespecified model specifications. Next, we adjusted regressions for predisposing and enabling characteristics; these models were of principal interest for our MH prevalence outcomes. Third, our regression models controlled for predisposing, enabling, and need-related characteristics; these models were of principal interest for our MH treatment and perceived unmet treatment need outcomes. All models included year fixed effects, accounting for unobserved differences across years in our outcome measures. In supplemental analyses, we also explored the proportions of adults in each group with any mental illness or SMI who reported receiving any MH treatment in the past year.

Analyses were conducted in Stata version 16.1 (StataCorp LLC, College Station, TX), applying “svy” procedures to adjust standard errors for sampling weights and “margins” commands to estimate marginal effects. The Emory University Institutional Review Board determined that this study was exempt approved.

RESULTS

Sample Characteristics

Adults reporting CKD were more likely than adults reporting no chronic conditions or HTN/DM to have

any mental illness (27% vs. 17% or 20%, respectively) or SMI (7% vs. 4% or 5%, respectively) (Table 1). Similarly, a higher percentage of adults reporting CKD received any MH treatment (21% vs. 12% or 18%, respectively). Despite their greater likelihood of receiving MH treatment, adults reporting CKD were still more likely than adults reporting HTN/DM to report unmet MH care needs (6% vs. 5%).

Relative to adults with HTN/DM or no chronic conditions, adults reporting CKD were older and more likely to be non-Hispanic White. Adults reporting CKD were also more likely to have Medicaid or Medicare, less likely to be employed or have family income $\geq 200\%$ federal poverty level, and less likely to have a college degree. Furthermore, adults reporting CKD reported poorer health status and lower likelihoods of using alcohol or illicit drugs.

Past-Year Any Mental Illness

Table 2 illustrates the average marginal effects—that is, the average differences in the predicted probability—of any mental illness and SMI in the past year for adults reporting CKD, no chronic conditions, or HTN/DM from unadjusted models, models adjusting for predisposing and enabling characteristics, and models adjusting for predisposing, enabling, and need-related characteristics. Corresponding predicted probabilities (adjusted models) are presented in Figure 1.

In our unadjusted model, 26.6% of adults reporting CKD had any mental illness; this was 10.0 and 7.1 PPs higher than the proportions with any mental illness among adults reporting no chronic conditions or HTN/DM, respectively (both $P < 0.001$; model 1). In our model of principal interest (model 2), adjusting for predisposing and enabling characteristics, these differences were exacerbated; adults reporting CKD were 15.4 PPs and 7.3 PPs more likely than adults reporting no chronic conditions or HTN/DM to have any mental illness, respectively ($P < 0.001$). When further controlling for need-related factors (model 3), these differences were reduced to 6.3 ($P < 0.001$) and 2.7 PPs ($P = 0.02$), respectively.

Past-Year SMI

Adults reporting CKD were also more likely than adults reporting no chronic conditions or HTN/DM to have SMI. The unadjusted predicted probability of having SMI among adults reporting CKD was 7.1%, 3.5 and 2.1 PPs higher than among adults reporting no chronic conditions ($P < 0.001$) or HTN/DM ($P = 0.001$), respectively (model 4). When adjusting for predisposing and enabling characteristics, these differences widened to 5.6 ($P < 0.001$) and 2.2 PPs ($P = 0.01$), respectively. After further controlling for need-related

Table 1. US national sample characteristics by adult patient group, 2015 to 2019

Outcomes (weighted %)	NCC (n = 117,235)	HTN/DM (n = 32,290)	CKD (n = 2544)
Past-year any mental illness ^{a,b}	17	20	27
Past-year SMI ^{a,b}	4	5	7
Past-year any MH treatment ^{a,c,d}	12	18	21
Past-year unmet MH care needs	5	5	6
Covariates (weighted %)			
Predisposing characteristics			
Male ^e	49	46	44
Age, ^{a,b} yr old			
22–29	22	3	4
30–49	45	21	17
50–64	23	36	27
65+	10	40	52
Race/ethnicity ^{a,f}			
Non-Hispanic White	61	67	70
Hispanic	18	12	12
Non-Hispanic Black	11	14	12
Other	9	7	6
Enabling characteristics			
Insurance ^{a,b}			
Private insurance	68	67	59
Medicaid/CHIP	12	12	18
Medicare	4	12	18
Tricare, Champus, VA, Military health	2	2	1
Uninsured	13	5	4
Other insurance	2.4	1.3	0.6
Family income, ^{a,b} FPL			
<100%	13	12	15
100%–200%	19	21	25
>200%	68	67	61
Received any governmental assistance ^{a,b}	17	19	24
Employment status ^{a,b}			
Employed full time or part time	72	49	31
Unemployed	5	3	2
Other/not in labor force	24	49	67
Education ^{a,f}			
Less than high school	12	13	14
High school graduate	23	26	27
Some college	29	31	33
College graduate or higher	36	30	26
Need-related characteristics			
Self-rated fair or poor health ^{a,b,g}	8	25	46
Ever told had one or more other chronic conditions (excl. diabetes, high blood pressure, and CKD) ^{b,h}		38	61
Smoking status ^a			
Never smoked	39	37	36
Current smoker	22	15	15
Former smoker	40	48	50
Alcohol use ^{a,b}			
Never used	13	14	18
Current user	60	48	36

(Continued)

Table 1. (Continued) US national sample characteristics by adult patient group, 2015 to 2019

Outcomes (weighted %)	NCC (n = 117,235)	HTN/DM (n = 32,290)	CKD (n = 2544)
Former user	27	38	46
Ever used illicit drug ^{a,c}	53	47	42

CKD, adults with chronic kidney disease; excl., excluding; FPL, federal poverty level; HTN/DM, adults with hypertension and/or diabetes but not chronic kidney disease; MH, mental health; NCC, no chronic conditions; SMI, serious mental illness.

^aFor comparisons between NCC and CKD: $P < 0.001$.

^bFor comparisons between HTN/DM and CKD: $P < 0.001$.

^cFor comparisons between HTN/DM and CKD: $P < 0.01$.

^dAny mental treatment include any use of inpatient, outpatient, and prescription medication treatment for MH.

^eComparison excludes NCC. Chronic conditions include heart condition, chronic obstructive pulmonary disease, chronic bronchitis, cirrhosis, hepatitis B or C, asthma, HIV or AIDS, and cancer.

^fFor comparisons between HTN/DM and CKD: $P < 0.05$.

^gVersus excellent/very good/good.

^hComparison excludes NCC. Chronic conditions include heart condition, chronic obstructive pulmonary disease, chronic bronchitis, cirrhosis, hepatitis B or C, asthma, HIV or AIDS, and cancer.

Hypertension, diabetes, CKD, and other comorbid conditions identified using survey item: “Please read the list and type in the numbers of all of the conditions that a doctor or other health care professional has ever told you that you had.” Reporting the results of tests for equivalence based on Pearson χ^2 statistics corrected for survey design, excluding missing values.

characteristics, the difference in the likelihood of having SMI between adults reporting CKD and adults reporting no chronic conditions remained significant (average marginal effect = 1.7 PPs, $P < 0.01$); the difference between adults reporting CKD and adults reporting HTN/DM was no longer significant (average marginal effect = 0.3 PPs, $P = 0.53$).

Past-Year MH Treatment

Table 3 illustrates unadjusted and adjusted differences in MH treatment and perceived unmet MH care needs in the past year among adults reporting CKD, no chronic conditions, or HTN/DM. Corresponding predicted probabilities (adjusted models) are presented in Figure 2.

The unadjusted predicted probability of adults reporting CKD receiving any MH treatment in the past year was 20.8%. Relative to adults reporting no chronic conditions, adults reporting CKD were 8.9 and 10.6 PPs more likely to receive any MH treatment in the unadjusted model (model 7) and when adjusting for predisposing and enabling characteristics (model 8), respectively (both $P < 0.001$). After further adjusting for need-related characteristics (model 9), this difference remained significant (5.3 PPs, $P < 0.001$).

Relative to adults reporting HTN/DM, adults reporting CKD were 2.9 ($P = 0.003$) and 2.6 ($P = 0.01$) PPs more likely to receive any MH treatment in models 7 and 8, respectively. In model 9, there was no difference in the likelihood of receiving any MH treatment between these groups (average marginal effects = 0.1 PPs, $P = 0.93$).

In supplemental analyses, we performed unadjusted comparisons of MH treatment outcomes among

Table 2. Correlates of past-year any mental illness and SMI, multivariable logistic regression models, average marginal effects

Variable	Past-year any mental illness									Past-year SMI														
	Model 1: unadjusted (n = 152,069)			Model 2: adjusting for predisposing and enabling characteristics (n = 151,982)			Model 3: adjusting for predisposing, enabling, and need-related characteristics (n = 151,963)			Model 4: unadjusted (N = 122,062)			Model 5: adjusting for predisposing and enabling characteristics (n = 121,994)			Model 6: adjusting for predisposing, enabling, and need- related characteristics (n = 121,979)								
	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value						
Variables of interest (ref. = CKD)																								
No chronic conditions	-10.0	-12.3	-7.7	<0.001	-15.4	-17.9	-12.9	<0.001	-6.3	-8.6	-4.1	<0.001	-3.5	-4.7	-2.3	<0.001	-5.6	-7.2	-4.0	<0.001	-1.7	-2.9	-0.6	0.01
HTN/DM	-7.1	-9.3	-4.9	<0.001	-7.3	-9.7	-4.8	<0.001	-2.7	-4.9	-0.5	0.02	-2.1	-3.3	-0.9	0.001	-2.2	-3.8	-0.6	0.01	-0.3	-1.4	0.7	0.53
Predisposing characteristics																								
Male					-6.0	-6.5	-5.5	<0.001	-7.3	-7.8	-6.7	<0.001					-1.7	-2.0	-1.4	<0.001	-2.1	-2.4	-1.8	<0.001
Age (ref. = 22–29 yr old)																								
30–49 yr old					-4.9	-5.6	-4.2	<0.001	-4.4	-5.0	-3.7	<0.001					-2.0	-2.5	-1.4	<0.001	-1.7	-2.2	-1.2	<0.001
50–64 yr old					-13.1	-13.9	-12.2	<0.001	-12.5	-13.3	-11.7	<0.001					-4.8	-5.4	-4.2	<0.001	-4.4	-5.0	-3.9	<0.001
65+ yr old					-19.8	-20.7	-19.0	<0.001	-16.8	-17.7	-15.9	<0.001					-7.4	-8.0	-6.8	<0.001	-6.3	-6.8	-5.7	<0.001
Race/ethnicity (ref. = non-Hispanic White)																								
Hispanic					-7.6	-8.4	-6.8	<0.001	-4.8	-5.6	-3.9	<0.001					-2.6	-3.0	-2.2	<0.001	-1.5	-1.9	-1.1	<0.001
Non-Hispanic Black					-8.5	-9.2	-7.7	<0.001	-6.4	-7.2	-5.6	<0.001					-3.0	-3.3	-2.7	<0.001	-2.2	-2.5	-1.8	<0.001
Other					-5.7	-6.7	-4.8	<0.001	-2.8	-3.9	-1.8	<0.001					-2.2	-2.6	-1.7	0.31	-1.2	-1.6	-0.8	<0.001
Enabling characteristics																								
Insurance (ref. = private)																								
Medicaid					5.9	4.8	7.0	<0.001	3.5	2.6	4.5	<0.001					1.8	1.3	2.4	<0.001	0.9	0.4	1.4	0.001
Medicare					5.2	3.3	7.2	<0.001	2.8	1.1	4.5	0.002					2.0	1.0	3.0	<0.001	0.8	-0.1	1.7	0.09
Tricare, Champus, VA, Military health					4.3	2.3	6.3	<0.001	3.7	1.8	5.6	<0.001					2.9	1.9	4.0	<0.001	2.7	1.7	3.8	<0.001
Uninsured					2.2	1.3	3.2	0.87	1.3	0.4	2.2	0.01					1.2	0.6	1.7	<0.001	0.8	0.3	1.3	0.003
Other					0.1	-1.5	1.7	<0.001	-0.2	-1.8	1.4	0.81					0.3	-0.3	1.0	<0.001	0.2	-0.4	0.9	0.49
Family income (ref. = <100% FPL)																								
100%–200% FPL					0.7	-0.4	1.8	<0.001	0.4	-0.7	1.5	0.47					-0.2	-0.7	0.3	0.35	-0.3	-0.8	0.1	0.15
>200% FPL					-1.6	-2.4	-0.8	<0.001	-1.7	-2.6	-0.8	0.001					-0.9	-1.3	-0.5	<0.001	-0.9	-1.3	-0.5	<0.001
Family received government assistance					5.3	4.5	6.1	<0.001	2.9	2.1	3.7	<0.001					1.9	1.4	2.4	<0.001	1.0	0.6	1.5	<0.001
Employment status (ref. = employed full time or part time)																								
Unemployed					5.1	3.6	6.5	<0.001	4.5	3.1	5.9	<0.001					1.8	1.1	2.4	<0.001	1.5	0.9	2.1	<0.001
Other/not in labor force					3.8	3.2	4.5	<0.001	2.7	2.1	3.4	<0.001					1.9	1.5	2.2	<0.001	1.4	1.1	1.7	<0.001
Education (ref. = less than high school)																								
High school graduate					1.0	0.0	1.9	0.04	1.4	0.5	2.3	0.002					0.8	0.4	1.2	0.001	0.8	0.4	1.3	<0.001
Some college					4.5	3.5	5.4	<0.001	4.6	3.6	5.5	<0.001					2.4	1.9	2.8	<0.001	2.3	1.8	2.7	<0.001
College graduate or higher					3.3	2.1	4.4	<0.001	5.0	3.9	6.1	<0.001					1.2	0.7	1.7	<0.001	1.8	1.3	2.2	<0.001

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Table 2. (Continued) Correlates of past-year any mental illness and SMI, multivariable logistic regression models, average marginal effects

Variable	Past-year any mental illness									Past-year SMI									
	Model 1: unadjusted (n = 152,069)			Model 2: adjusting for predisposing and enabling characteristics (n = 151,982)			Model 3: adjusting for predisposing, enabling, and need-related characteristics (n = 151,963)			Model 4: unadjusted (N = 122,062)			Model 5: adjusting for predisposing and enabling characteristics (n = 121,994)			Model 6: adjusting for predisposing, enabling, and need- related characteristics (n = 121,979)			
	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	
Need-related characteristics																			
Self-rated fair or poor health (vs. excellent/very good/ good)							14.1	13.0	15.3	<0.001						4.8	4.2	5.4	<0.001
Ever told had one or more other chronic conditions (heart condition, chronic obstructive pulmonary disease, chronic bronchitis, cirrhosis of the liver, hepatitis B or C, asthma, HIV or AIDS, cancer)							5.5	4.5	6.5	<0.001						2.2	1.6	2.8	<0.001
Smoking status (ref. = never smoked)																			
Current smoker							3.9	3.2	4.6	<0.001						1.3	0.8	1.7	<0.001
Former smoker							0.7	0.0	1.4	0.05						0.0	-0.3	0.3	0.83
Alcohol use (ref. = never used)																			
Current user							0.4	-0.6	1.3	0.42						0.0	-0.3	0.9	0.28
Former user							1.9	0.9	2.9	<0.001						0.9	0.3	1.5	0.004
Ever used illicit drug							10.1	9.4	10.7	<0.001						3.4	3.1	3.8	<0.001

AME, average marginal effect; CKD, adults with chronic kidney disease; FPL, federal poverty level; HTN/DM, adults with hypertension and/or diabetes but not CKD; ref., reference; SMI, serious mental illness. Hypertension, diabetes, CKD, and other comorbid conditions identified using survey item: "Please read the list and type in the numbers of all of the conditions that a doctor or other health care professional has ever told you that you had." AMEs and 95% CIs presented in percentage points. All models include year fixed effects. Differences in sample size are due to missing values in covariates.

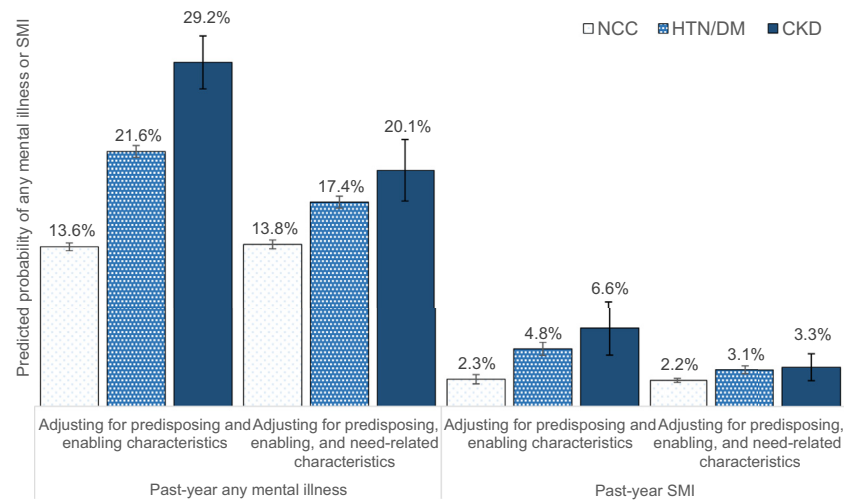


Figure 1. Predicted probabilities of any mental illness and SMI across U.S. adult groups, 2015 to 2019. Hypertension, diabetes, CKD, and other comorbid conditions identified using survey item: “Please read the list and type in the numbers of all of the conditions that a doctor or other health care professional has ever told you that you had.” Predicted probabilities, presented with 95% CIs, generated using the results of multivariable logistic regression models. Predisposing measures included respondent sex, age, and race/ethnicity. Enabling characteristics included health insurance status, family income, employment, education, and if the family received any governmental assistance. Need-related characteristics comprised self-rated health and indicators for chronic conditions and substance use behaviors. All models include year fixed effects. CKD, adults with chronic kidney disease; HTN/DM, adults with hypertension and/or diabetes but not chronic kidney disease; NCC, adults with no chronic condition identified; SMI, serious mental illness.

subgroups with and without any mental illness or SMI (Supplementary Table S1). Among individuals with any mental illness, 48% of adults reporting CKD had any MH treatment in the past year versus 38% of adults reporting no chronic conditions and 50% of adults reporting HTN/DM. Among individuals with SMI, 79% of adults reporting CKD had any MH treatment versus 60% of adults reporting no chronic conditions and 73% of adults reporting HTN/DM.

Past-Year Unmet MH Care Needs

The predicted probability of perceived unmet MH care needs was highest among adults reporting CKD in all models (7–9). The differences versus adults reporting no chronic conditions were statistically significant only in the model adjusting for predisposing and enabling characteristics but not need-related characteristics (5.9% vs. 2.7%, $P < 0.001$; Figure 2). We observed no statistically significant differences between adults reporting CKD or HTN/DM in perceived unmet MH care needs.

DISCUSSION

Among adults with CKD or kidney failure, comorbid mental illness is associated with reduced treatment adherence and increased risk of hospitalization, readmission, and death.^{6,10,11,35} Moreover, severe mental illness that impairs functioning is often found as a contraindication to transplantation and home dialysis,^{12–15} which the Centers for Medicare and Medicaid Services (U.S. Department of Health and Human

Services) aims to help adults with CKD use more often under ongoing payment and delivery reforms.^{36,37} US leaders in nephrology and public health can look to national surveillance of MH need and use of MH treatment among US adults with self-reported CKD to help guide reforms in integrated kidney and MH care delivery.

Using NSDUH data, we provide the first nationally representative estimates of mental illness prevalence, MH treatment, and reported unmet need for MH treatment among US adults with self-reported CKD. Our findings add to a growing body of research evaluating barriers to MH care among patients with CKD and comorbid depressive symptoms.^{27,35,38–41} We extend this literature by comparing individuals with self-reported CKD with 2 relevant comparator groups—adults reporting no chronic conditions and adults reporting HTN/DM—and by including a set of comprehensive MH outcome measures in our analysis, where the prior literature has typically focused on comorbid depression only.

We find that 27% of U.S. adults reporting CKD have mental illness of some type, including 7% with SMI. These prevalence estimates are within the range of prior estimates in U.S. settings, though those were derived largely from smaller and geographically concentrated studies without comparison groups.^{11,38–40,42,43} The significant differences in any mental illness and SMI between adults reporting CKD and adults reporting no chronic conditions or HTN/DM indicate that adults reporting CKD have meaningfully greater MH needs

Table 3. Correlates of past-year any MH treatment and unmet MH needs, multivariable logistic regression models, average marginal effects

Variable	Past-year any MH treatment									Past-year unmet MH needs														
	Model 7: unadjusted (n = 152,020)			Model 8: adjusting for predisposing and enabling characteristics (n = 151,933)			Model 9: adjusting for predisposing, enabling, and need-related characteristics (n = 151,914)			Model 10: unadjusted (n = 151,800)			Model 11: adjusting for predisposing and enabling characteristics (n = 151,714)			Model 12: adjusting for predisposing, enabling, and need- related characteristics (n = 151,695)								
	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value						
Variables of interest (ref. = CKD)																								
No chronic conditions	-8.9	-10.7	-7.1	<0.001	-10.6	-12.5	-8.8	<0.001	-5.3	-7.1	-3.6	<0.001	-0.8	-2.0	0.3	0.14	-4.4	-6.0	-2.8	<0.001	-1.1	-2.3	0.2	0.09
HTN/DM	-2.9	-4.8	-1.0	0.003	-2.6	-4.5	-0.6	0.01	-0.1	-1.8	1.7	0.93	-1.0	-2.2	0.1	0.07	-1.5	-3.1	0.1	0.06	-0.1	-1.3	1.1	0.91
Predisposing characteristics																								
Male					-7.2	-7.7	-6.8	<0.001	-8.2	-8.6	-7.7	<0.001					-2.8	-3.1	-2.5	<0.001	-3.2	-3.5	-2.9	<0.001
Age (ref. = 22–29 yr old)																								
30–49 yr old					0.0	-0.6	0.6	0.90	0.2	-0.4	0.8	0.45					-4.8	-5.2	-4.4	<0.001	-4.2	-4.6	-3.8	<0.001
50–64 yr old					-3.1	-4.0	-2.3	<0.001	-3.0	-3.8	-2.2	<0.001					-8.2	-8.6	-7.7	<0.001	-7.4	-7.9	-6.9	<0.001
65+ yr old					-10.6	-11.4	-9.7	<0.001	-8.3	-9.3	-7.4	<0.001					-10.3	-10.8	-9.8	<0.001	-9.0	-9.5	-8.5	<0.001
Race/ethnicity (ref. = non-Hispanic White)																								
Hispanic					-9.5	-10.2	-8.9	<0.001	-7.4	-8.1	-6.8	<0.001					-2.8	-3.1	-2.5	<0.001	-1.8	-2.1	-1.4	<0.001
Non-Hispanic Black					-10.7	-11.2	-10.1	<0.001	-9.0	-9.6	-8.5	<0.001					-3.0	-3.4	-2.6	<0.001	-2.2	-2.5	-1.8	<0.001
Other					-10.6	-11.1	-10.0	<0.001	-8.3	-9.0	-7.7	<0.001					-2.7	-3.0	-2.3	<0.001	-1.6	-2.0	-1.1	<0.001
Enabling characteristics																								
Insurance (ref. = private)																								
Medicaid					4.6	3.6	5.7	<0.001	3.0	1.9	4.1	<0.001					1.8	1.3	2.3	<0.001	1.1	0.6	1.6	<0.001
Medicare					3.4	1.6	5.1	<0.001	2.0	0.3	3.7	0.03					1.7	0.6	2.7	0.004	0.6	-0.3	1.6	0.18
Tricare, Champus, VA, Military health					6.2	4.0	8.4	<0.001	5.9	3.7	8.0	<0.001					1.2	0.3	2.1	0.01	1.1	0.2	2.0	0.01
Uninsured					-4.1	-4.9	-3.3	<0.001	-4.6	-5.4	-3.8	<0.001					1.2	0.7	1.7	<0.001	0.9	0.4	1.4	0.001
Other					-1.0	-2.6	0.5	0.19	-1.0	-2.5	0.5	0.20					0.1	-0.6	0.8	0.83	0.0	-0.7	0.8	0.90
Family income (ref. = <100% FPL)																								
1100%–200% FPL					0.0	-0.9	0.9	1.00	-0.2	-1.1	0.6	0.61					0.5	0.0	1.0	0.06	0.4	-0.1	0.9	0.14
>200% FPL					0.2	-0.5	1.0	0.50	0.0	-0.7	0.7	0.97					-0.7	-1.3	-0.2	0.01	-0.8	-1.4	-0.3	0.01
Family received government assistance					4.9	4.0	5.7	<0.001	3.2	2.4	4.0	<0.001					2.1	1.5	2.6	<0.001	1.2	0.8	1.7	<0.001
Employment status (ref. = employed full time or part time)																								
Unemployed					3.3	2.1	4.5	<0.001	3.1	1.9	4.3	<0.001					1.2	0.4	2.0	0.003	1.0	0.3	1.8	0.10
Other/not in labor force					3.9	3.1	4.7	<0.001	3.5	2.8	4.2	<0.001					0.7	0.3	1.0	0.001	0.5	0.1	0.9	0.01
Education (ref. = less than high school)																								
High school graduate					1.9	1.1	2.7	<0.001	1.8	1.0	2.7	<0.001					0.3	-0.2	0.8	0.250	0.3	-0.2	0.7	0.25
Some college					6.0	5.2	6.8	<0.001	5.4	4.6	6.2	<0.001					2.0	1.6	2.5	<0.001	1.8	1.4	2.3	<0.001
College graduate or higher					7.7	7.0	8.5	<0.001	8.0	7.3	8.8	<0.001					3.1	2.6	3.7	<0.001	3.4	2.9	4.0	<0.001

(Continued on following page)

Table 3. (Continued) Correlates of past-year any MH treatment and unmet MH needs, multivariable logistic regression models, average marginal effects

Variable	Past-year any MH treatment									Past-year unmet MH needs									
	Model 7: unadjusted (n = 152,020)			Model 8: adjusting for predisposing and enabling characteristics (n = 151,933)			Model 9: adjusting for predisposing, enabling, and need-related characteristics (n = 151,914)			Model 10: unadjusted (n = 151,800)			Model 11: adjusting for predisposing and enabling characteristics (n = 151,714)			Model 12: adjusting for predisposing, enabling, and need- related characteristics (n = 151,695)			
	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	AME (%)	95% CI	P value	
Need-related characteristics																			
Self-rated fair or poor health (vs. excellent/very good/good)							7.3	6.3	8.3	<0.001						4.3	3.7	4.9	<0.001
Ever told had one or more other chronic conditions (heart condition, chronic obstructive pulmonary disease, chronic bronchitis, cirrhosis of the liver, hepatitis B or C, asthma, HIV or AIDS, cancer)							3.4	2.7	4.2	<0.001						2.5	1.9	3.2	<0.001
Smoking status (ref. = never smoked)																			
Current smoker							1.9	1.3	2.4	<0.001						0.9	0.5	1.3	<0.001
Former smoker							1.3	0.8	1.9	<0.001						0.2	-0.1	0.6	0.19
Alcohol use (ref. = never used)																			
Current user							1.7	0.8	2.6	<0.001						0.9	0.3	1.4	0.003
Former user							3.0	2.0	3.9	<0.001						0.5	0.0	1.1	0.07
Ever used illicit drug							8.3	7.7	9.0	<0.001						3.6	3.3	3.9	<0.001

AME, average marginal effect; CKD, adults with chronic kidney disease; HTN/DM, adults with hypertension and/or diabetes but not chronic kidney disease; FPL, federal poverty level; MH, mental health; ref., reference. Hypertension, diabetes, CKD, and other comorbid conditions identified using survey item: "Please read the list and type in the numbers of all of the conditions that a doctor or other health care professional has ever told you that you had." AMEs and 95% CIs presented in percentage points. All models include year fixed effects. Differences in sample size are due to missing values in covariates.

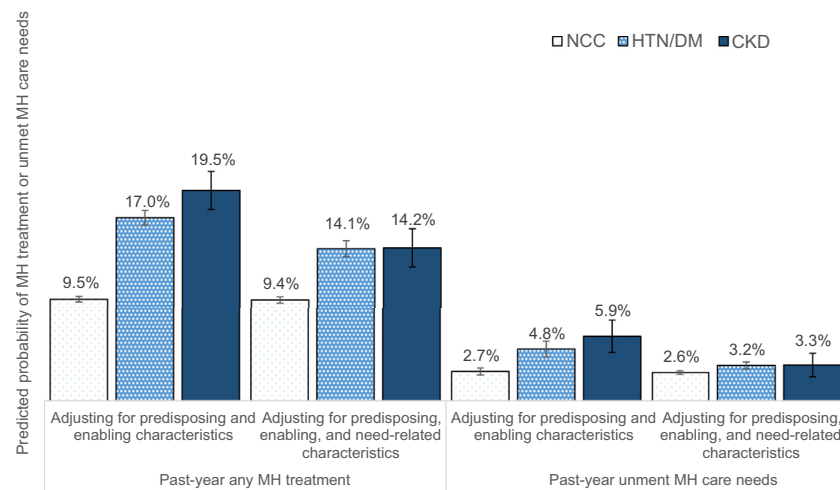


Figure 2. Predicted probabilities of MH treatment and unmet MH care needs across U.S. adult groups, 2015 to 2019. Hypertension, diabetes, CKD, and other comorbid conditions identified using survey item: “Please read the list and type in the numbers of all of the conditions that a doctor or other health care professional has ever told you that you had.” Predicted probabilities, presented with 95% CIs, generated using the results of multivariable logistic regression models. Predisposing measures included respondent sex, age, and race/ethnicity. Enabling characteristics included health insurance status, family income, employment, education, and if the family received any governmental assistance. Need-related characteristics comprised self-rated health and indicators for chronic conditions and substance use behaviors. All models include year fixed effects. CKD, adults with chronic kidney disease; HTN/DM, adults with hypertension and/or diabetes but not chronic kidney disease; MH, mental health; NCC, adults with no chronic condition identified.

than these comparator populations. Our prevalence estimates are also comparable with national estimates of the prevalence of any mental illness and SMI among adults reporting CKD across other nations, where available (e.g., Korea⁴⁴).

Although the proportion of adults reporting CKD receiving MH treatment was higher than among adults reporting no chronic conditions or HTN/DM, this was largely explained by higher levels of physical and behavioral health comorbidities (i.e., need-related characteristics) among adults reporting CKD. One possible explanation for this finding is that providers can often recognize when patients have greater needs and may increase their effort in managing MH needs accordingly (e.g., through comprehensive care planning for individuals with advanced CKD plus other comorbid conditions). For example, among adults with kidney failure receiving chronic dialysis treatment, regular contact with a social worker—mandated by federal regulation under Medicare—may facilitate MH treatment for those with multiple comorbidities.⁴⁵ Another possible explanation for this population’s increased use of MH treatment is that those with more physical and behavioral health comorbidities may be more engaged with the health care system in general and more willing to seek MH treatment when needed. Conversely, this finding may also be explained in part by the health implications of MH treatment. For example, many drugs used to treat MH conditions, particularly those identified as SMI, may contribute to metabolic changes and weight gain and kidney dysfunction.^{46,47}

In addition to having higher rates of MH treatment use, we find that those with self-reported CKD also have greater perceived unmet needs for MH treatment; more than half (52%) of adults with self-reported CKD who also experienced mental illness and did not receive any MH treatment. These findings point to opportunities for improving protocols for addressing comorbid mental illness in CKD care. One explanation to account for the higher rates of perceived unmet need for MH treatment among those reporting CKD is this population’s high burden of contact with the health care system. Because those with CKD have frequent health care appointments and complex medical regimens to manage (e.g., pill burden), they may have less capacity or desire to seek additional treatment for perceived MH needs. These concerns and barriers to addressing MH needs may be compounded by the risks of side effects associated with many pharmaceutical treatments for MH disorders.^{46,47} To address the greater perceived unmet need for care among those with CKD, provider leadership should consider adopting integrated care models (e.g., routine psychological screening, referral, and counseling services in CKD clinics) and multidisciplinary disease management approaches. Previous studies have suggested that comprehensive care management programs and psychological distress screening for patients with early stage CKD may hold promise for improving CKD care delivery.^{23,24} Likewise, studies have revealed that integrated, multimodal care models can be used effectively in caring for patients with diabetes, HTN, and other chronic illnesses^{48,49} and in

the general population.^{25,26} Although additional evidence is needed in the context of CKD care,²² these approaches have the potential to foster the provision of whole-person care that can recognize patient concerns and burdens among adults with CKD and meet their complex, intersecting physical and MH needs and preferences.

This study has several limitations. First, this study is subject to general limitations of survey data, such as recall bias and nonresponse bias. Specifically, nonresponse bias is a concern in surveys including questions on sensitive behaviors, such as substance use history. However, the computer-assisted interviewing methods of NSDUH provide greater privacy to respondents and have been found to increase disclosure of sensitive behaviors.⁵⁰ Of note, there should not be differential bias among patients with self-reported CKD and the comparison groups. Second, our measures of CKD and HTN/DM status are self-reported by respondents. Relative to adults who have CKD, adults reporting they have CKD may on average have more advanced CKD, greater health literacy, and greater access to health care services,⁵¹ including MH treatment. To avoid any potential bias stemming from misperception that our results might be representative of all US adults with CKD, our results should instead be interpreted strictly as representative of all US adults with self-reported CKD. Third, we are not able to distinguish adults reporting kidney failure from other adults reporting CKD (e.g., stage IV) in our sample, an area that merits future research. Such individuals are likely to represent a small percentage of our sample of adults reporting CKD, based on 2017 estimates (about 746,500 kidney failure cases vs. 37 million CKD cases).^{1,52} Finally, NSDUH does not include data on the severity of respondents' MH needs, the intensity or type of any MH treatment received, or the temporal order of any MH treatment received versus treatment for CKD. Thus, we cannot estimate the frequency with which kidney disease may have progressed in this population as a consequence of pharmaceutical treatment of mental illness (e.g., lithium).⁴⁷ Moreover, our study cannot identify which types of treatment may be most valuable for filling present gaps in MH treatment among adults reporting CKD.

This study presents the first U.S. national, population-level estimates of MH care needs and treatment among adults with self-reported CKD. High levels of mental illness and unmet needs for MH care among US adults with self-reported CKD point to important opportunities for more effectively integrating MH and CKD care and managing this population's MH needs. Comprehensive and integrated

care delivery models should be evaluated as tools for managing the heightened medical and MH needs of adults with CKD.

DISCLOSURE

All the authors declared no competing interests.

DATA AVAILABILITY STATEMENT

The data set analyzed under this study is publicly available from the Substance Abuse and Mental Health Data Archive at: <https://www.datafiles.samhsa.gov/dataset/national-survey-drug-use-and-health-2019-nsduh-2019-ds0001>.

SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Supplementary Methods.

Table S1. Unadjusted comparison of mental health treatment among subgroups with and without any mental illness or serious mental illness.

STROBE Statement.

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