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Independent Correlates of Chronic Kidney Disease Awareness among Adults with Type 2 Diabetes

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Abstract

Background—Chronic Kidney Disease (CKD) is usually silent until advanced stages. Awareness of CKD is important to mitigate poorer outcomes. This study aims to understand the relationship(s) between CKD self-awareness and diagnosed CKD.

Methods—The study included 345 adults with type 2 diabetes from two primary care settings. Participants completed surveys assessing demographic information, self-care behaviors and comorbidities. Biological data was taken from medical records. CKD was diagnosed as eGFR ≤ 59 ml/min. CKD awareness was defined by a positive response to “has a doctor, nurse or other health professional ever told you that you have a kidney disease?” and/or “have you ever had kidney failure that required dialysis or a kidney transplant?”. Logistic regression models were used to examine the association between CKD awareness and clinical/socio-demographic variables.

Results—31% of study patients had CKD based on eGFR (of which only 63% were aware). Stepwise regression showed that non-Hispanic blacks (OR=3.49, $p=0.04$), those with college education (OR=8.02, $p=0.01$), history of myocardial infarction (OR=10.12, $p=0.002$) or hypertension (OR=23.25, $p=0.02$), and those with Medicare, VA insurance, or other insurance (OR=8.08, 8.72, 101.47, respectively, $p<0.01$) were significantly more likely to be aware of CKD. Those with a history of stroke or depression (OR=0.21, 0.28, respectively, $p=0.03$, $p=0.04$) were significantly less likely to be aware of CKD.

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Conclusion—CKD awareness was found to be lower than diagnosed CKD rates. Factors associated with awareness include race, educational status and cardiovascular disease. Targeted strategies to increase CKD awareness may lead to improved health outcomes.

INTRODUCTION

Chronic kidney disease (CKD) is a disease of public health significance affecting an estimated 13% of the US population (1). It may progress to **End Stage Renal Disease (ESRD)**, with greater than 110,000 patients requiring maintenance dialysis therapy annually, at considerable expense (2). In addition, CKD patients have been shown to carry a high risk for cardiovascular disease and mortality (3, 4). As with other chronic medical conditions, progression of kidney disease to end organ damage with its related complications can be mitigated by disease awareness and education (5, 6), engagement with healthcare resources and adherence to appropriate medical therapy. However, the level of recognition of CKD (7) as well as patient awareness of their CKD and its risk factors remains at low levels, with overall CKD awareness reported at 3.7%; 3.5%; 7.8% and 41.7% for CKD stages I, II, III, and IV respectively in a US study (1,8).

Diabetes Mellitus is also a chronic medical condition affecting multiple organ systems and with an estimated prevalence among adults in the United States between 5.8 to 12.9% (1). Due to its micro-vascular and macro-vascular complications, diabetes accounts for almost 14% of United States health care expenditures (5), a significant percentage of which is related to complications such as end-stage renal disease. Diabetic nephropathy alone reportedly contributes about US\$16.8 billion to the overall annual healthcare costs in the US (9), and on average, patients with diabetes have medical expenditures 2.3 times higher than their counterparts without the condition (10). Diabetic nephropathy is therefore considered a significant health concern especially considering that diabetic-renal disease can directly lead to ESRD with annually renewable health care spending incurred by renal replacement therapy.

Given the finding that even at a stage 4, CKD awareness is low (41.7%), it is unclear why awareness of this chronic disease is lower than other chronic medical conditions. For example, diabetes has been established as an independent risk factor for CKD(11), and awareness rates for type 2 diabetes have been documented between 65–90%. (12–14) A study performed among patients who were reportedly well-engaged with a healthcare provider system found greater than 70% of patients correctly identified that they had “high cholesterol” and greater than 90% correctly confirmed personal diagnoses of hypertension (HTN) respectively (12). Studies have found awareness of diabetes-related complications does vary, but remains higher than early stage CKD awareness (3–8%). (15) For example, an Irish study which enrolled 258 patients showed patient awareness rates for comorbid cardiovascular (CVD), retinopathy, stroke, peripheral vascular disease (PVD) and amputation were 53.5%, 61.2%, 17.1%, 16.3% and 12% respectively. (16)

Studies have investigated clinical factors, health behaviors, health insurance, income, and access to prescription coverage and physician care to explain CKD awareness levels. (15,17–21) While clinical factors, such as comorbidities and increased severity help explain higher

awareness, demographic variables have largely shown little influence. (15,17–19) Having a routine provider was not associated with CKD awareness, suggesting access alone is not the limiting factor. (15,20–21) In addition, while quality of the healthcare system, for instance, documentation of healthcare providers failing to recognize progressive CKD, may help explain low awareness, there has been no comparison of awareness to diagnosis to understand if this is the most important area for intervention. (22–23) This study investigated a sample of patients with access to healthcare and a background diagnosis of diabetes to understand the association between CKD diagnosis and awareness, and understand individual level factors influencing CKD awareness.

METHODS

Sample Characteristics and Settings

Three hundred and forty five (345) participants were recruited from two primary care settings in the Southeastern United States. Inclusion criteria included age greater than 18 years, having been seen previously at either the academic medical center or Veterans Affairs medical center, and having been diagnosed with type 2 diabetes. Research coordinators approached eligible patients in the waiting room and explained the study procedures. Those interested were given a self-administered survey to complete, which included demographic measures, self-care behaviors, and comorbidities. Biological measures were then abstracted from the medical record, including HbA1c, blood pressure, lipids, and eGFR. No incentive was provided to participants for completion of the survey. All study procedures were approved by the local Institutional Review Board and Veterans Affairs Research and Development Committee.

Variables

The main variable of interest in this study was CKD awareness. Awareness was defined as a positive response to either or both previously validated questions: ‘Has a doctor, nurse, or other health professional ever told you that you have kidney disease? Do not include kidney stones, bladder infection or incontinence.’ Or ‘Have you ever had kidney failure that required dialysis or a kidney transplant?’ (24) To be as comprehensive as possible regarding those aware of kidney problems or disease, the CKD awareness variable was created to allow a yes answer to either question indicate awareness. A second variable of interest was CKD diagnosis, defined by an eGFR in the past 6 months equal to or less than 59 ml/min.

Self-reported demographic variables were used as possible covariates in models. Variables were chosen based on prior literature noting the importance of these factors on both CKD diagnosis, and awareness or knowledge of disease. Previously validated questions measured age, gender, race/ethnicity, marital status, educational attainment, annual income, health insurance status and comorbid conditions. (24) Age was categorized into 18–49 years, 50–64 years, 65–74 years, and 75–89 years. Race/ethnicity was categorized into non-Hispanic white, non-Hispanic black, and Hispanic/Other. Marital status was categorized into never married, married, separated, divorced, and widowed. Education was categorized into less than high school, high school diploma, college, or graduate school. Household income was categorized into \$0–\$9,999, \$10,000–\$14,999, \$15,000–\$19,999, \$20,000–\$24,999,

\$25,000–\$34,999, \$35,000–\$49,999, \$50,000–\$74,999, and \$75,000 or greater. Insurance was categorized into none, private, Medicare, Medicaid, VA, or other. Comorbidities were collected by respondents answering yes/no to questions regarding whether a ‘doctor, nurse, or other health professional has ever told you that you have...’, with options including hypertension, hyperlipidemia, myocardial infarction, angina, stroke, asthma, cancer, chronic pulmonary disease, connective tissue disease, or depression. (24)

Statistical Analysis

First, chi-square and t-tests were used to examine differences in demographic characteristics by CKD awareness and CKD diagnosis. Secondly, a chi-square test was performed between CKD awareness and CKD diagnosis in the overall population. Finally, a stepwise regression using backward elimination was used to investigate the independent correlates of CKD awareness. Variables significant at the $p=0.20$ or better were kept in the model.

RESULTS

Of 345 patients sampled, 31% had CKD based on eGFR levels, however, only 63% of those diagnosed with CKD reported awareness.

Table 1 shows the sample demographics by CKD diagnosis, and Table 2 shows the sample demographics by CKD awareness. There were statistically significant differences by diagnosis for age ($p=0.001$), race ($p=0.04$), and diagnosis of myocardial infarction ($p=0.002$), angina ($p=0.001$), and stroke ($p=0.01$). There were statistically significant differences by awareness for site ($p=0.02$), gender ($p=0.04$), insurance type ($p=0.05$), and diagnosis of hypertension ($p=0.005$), hyperlipidemia ($p=0.04$), myocardial infarction ($p=0.001$), and angina ($p=0.001$).

Table 3 shows the independent predictors of reporting CKD awareness. Being non-Hispanic black ($OR=3.49$, $p=0.04$), having a college education ($OR=8.02$, $p=0.01$), having a history of myocardial infarction ($OR=10.12$, $p=0.002$) or hypertension ($OR=23.25$, $p=0.02$), and having Medicare, VA insurance, or other insurance ($OR=8.08$, 8.72 , 101.47 , respectively, $p<0.01$) were significantly more likely to be aware of CKD. Those with a history of stroke or depression ($OR=0.21$, 0.28 , respectively, $p=0.03$, $p=0.04$) were significantly less likely to be aware of CKD. The model after backward elimination explained approximately 32% of the variance in CKD awareness.

DISCUSSION

Using a population of patients with diabetes, self-reported awareness of CKD was lower than expected when compared to diagnosis based on stage 3 or higher CKD (63% in this population of adults with diabetes). Factors associated with awareness include socio-economic variables (race, educational status) and a history of medical co-morbidities, including cardiovascular disease. These results agree prior studies indicating low awareness of CKD relative to other chronic medical conditions, but add to the literature by providing information relative to clinical indicators of diagnosis, and provide information on individual level factors that influence awareness.

In this sample, only about 2/3rd of the patients with CKD indicated awareness of their CKD status. All the patients considered having CKD in this study had estimated glomerular filtration rates, eGFR $\leq$ 59 ml/min, which would be considered advanced kidney disease, and would lead to the higher expected awareness rate. Though lower than expected, this rate is higher than prior studies on CKD awareness, suggesting those with co-morbid diabetes may be more aware of their CKD status. This higher awareness may be in part due to consistent access with the healthcare system for their diabetes care, or may be due to increased awareness of CKD as a complication of their disease. Further research should attempt to quantify reasons for differences in awareness between groups and ways to assist patients in understanding the importance of being aware of their CKD status. Given the relatively low awareness even in patients that are currently accessing health care, individual level factors that could influence their awareness should be considered. Psychosocial factors, such as denial, worry, fatalistic attitudes, health literacy, or social support, are areas that may have important influence on levels of awareness, and can be addressed through interventions once better understood. (25)

Contrary to prior work finding little influence of sociodemographic factors on awareness, this study found key demographic and clinical factors associated with higher awareness. Non-Hispanic black race was associated with higher CKD awareness, which may be a result of family history of ESRD and an increased awareness of the need for testing for kidney disease or failure. (26) Those with a college education, health insurance coverage by Medicare and the VA, and those with comorbid hypertension or myocardial infarction were also more likely to be aware of their CKD status. This may be because those with more education have a better understanding of the importance of disease awareness, those with Medicare and VA coverage have specific guidelines in place regarding patient care, and individuals with other significant co-morbidities presumably have more physician oversight or providers may consider these patients at increased CKD risk, which may result in heightened testing. In contrast, co-morbidities such as stroke and depression predicted lower awareness. Existing evidence in the literature of an independent association between awareness of CKD and depressive symptoms revealed that those aware of their CKD status were 1.66 times more likely to have depressive symptoms. (27) Thus, this is an important relationship to better understand, especially given patients who are depressed may avoid certain behaviors that could worsen their underlying kidney disease. Additional work should be done to confirm these hypotheses, and gather a more comprehensive understanding of factors influencing those aware of their CKD status, in addition to those that are not aware.

Limitations of this study include the cross-sectional design of the study, precluding statements regarding causality. Secondly, it is possible that some CKD patients remained unrecognized due to lack of data on albuminuria, which typically suggests kidney disease. Despite this, we believe our study results to be representative or even slightly underestimated because diagnosed CKD cannot be reversed.

In conclusion, CKD awareness appears to be at a low level when compared with awareness rates of other chronic conditions, though higher in patients with diabetes than in the general population. The reasons for these findings need to be explored further, including investigating how to improve education for patients with diabetes and comorbid history of

stroke or depression about their CKD status. Future studies should focus on individual factors influencing CKD awareness, in addition to health system level factors.

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Highlights

- Chronic Kidney Disease (CKD) is under recognized, especially in diabetes.
- Evaluated independent correlates of CKD awareness in adults with diabetes (n=345)
- 31% of study patients had CKD based on eGFR but only 63% of them were aware
- Factors associated with awareness included race, educational status and cardiovascular disease

Table 1

Sample Demographics by estimated Glomerular Filtration Rate (eGFR) (n=345)

	No CKD	CKD	P value
Site			
MUSC	69.1	30.9	
VA	68.8	31.2	0.94
Age			
18–49	75.0	25.0	
50–64	77.1	22.9	
65–74	67.0	33.0	
75–89	48.4	51.6	0.001
Gender (Female)	69.8	30.2	0.81
Marital status			
Never married	34 (76)	11 (24)	
Married	112 (70)	49 (30)	
Separated	19 (66)	10 (34)	
Divorced	41 (67)	20 (33)	
Widowed	31 (65)	17 (35)	0.81
Race			
NHW	79 (61)	50 (39)	
NHB	150 (73)	55 (27)	
HAA	10 (83)	2 (17)	0.04
Education			
<High school	57.1	42.9	
High school	73.3	26.7	
College	67.9	32.1	
Graduate school	77.8	22.2	0.11
Income			
0–9999	66.2	33.9	
10,000	65.2	34.8	
15,000	63.4	36.6	
20,000	57.6	42.4	
25,000	64.7	35.3	
35,000	83.3	16.7	
50,000	74.2	25.8	
75,000	81.0	19.1	0.18
Insurance			
none	84.6	15.4	
Private	84.2	15.8	
Medicare	60.3	39.7	
Medicaid	65.0	35.0	
Veterans Affair	66.2	33.8	

	No CKD	CKD	P value
Other	80.0	20.0	0.06
Comorbidities			
Hypertension	67.7	32.3	0.14
Hyperlipidemia	68.9	31.2	0.08
Myocardial Infarction	51.8	48.2	0.002
Angina	48.9	51.1	0.001
Stroke	53.9	46.2	0.01
Asthma	73.1	26.9	0.42
Cancer	61.3	38.8	0.08
COPD	68.1	31.9	0.83
Connective tissue disease	68.4	31.6	0.74
Depression	67.2	32.8	0.59

Table 2

Sample Demographics by Chronic Kidney Disease awareness (n=345)

	Not Aware	Aware	P value
Site			
MUSC	83.7	16.3	0.02
VA	74.0	26.0	
Age			
18–49	81.5	18.4	0.34
50–64	82.5	17.5	
65–74	76.0	24.0	
75–89	72.6	27.4	
Gender (Female)	85.3	14.8	0.04
Marital status			
Never married	80.9	19.2	0.76
Married	77.1	22.9	
Separated	86.7	13.3	
Divorced	76.9	23.1	
Widowed	81.3	18.8	
Race			
NHW	74.4	25.6	0.18
NHB	81.1	18.9	
HAA	91.7	8.3	
Education			
<High school	79.0	21.1	0.98
High school	79.2	20.8	
College	79.5	20.6	
Graduate school	76.3	23.7	
Income			
0–9999	80.9	19.1	0.72
10,000	83.7	16.3	
15,000	78.6	21.4	
20,000	80.0	20.0	
25,000	70.4	29.6	
35,000	83.8	16.2	
50,000	73.5	26.5	
75,000	81.0	19.1	
Insurance			
none	84.6	15.4	
Private	94.7	5.3	
Medicare	78.7	21.3	
Medicaid	81.3	18.8	
Veterans Affairs	72.1	27.9	

	Not Aware	Aware	P value
Other	84.6	15.4	0.05
Comorbidities			
Hypertension	76.6	23.4	0.005
Hyperlipidemia	76.6	23.4	0.04
Myocardial Infarction	57.9	42.1	0.001
Angina	66.3	33.7	0.001
Stroke	72.2	27.8	0.18
Asthma	78.6	21.4	0.92
Cancer	74.1	25.9	0.21
COPD	77.6	22.4	0.74
Connective tissue disease	77.1	22.9	0.26
Depression	78.7	21.3	0.92

Table 3

Stepwise regression (backward elimination) for association between CKD awareness and independent correlates

Variable Kept in Model	Odds ratio	p-value	95% CI
Non-Hispanic Black	3.49	0.041	1.051, 11.625
Education			
High school	2.90	0.172	0.628, 13.442
College Education	8.02	0.012	1.573, 40.884
Graduate Education	10.61	0.066	0.856, 131.400
Comorbidities			
Stroke	0.21	0.029	0.054, 0.857
Myocardial Infarction	10.12	0.002	2.323,44.156
Asthma	3.33	0.141	0.671,16.519
Depression	0.28	0.049	0.084,0.994
Hypertension	23.25	0.020	1.650,327.533
Income	0.18	0.141	0.019,1.750
Insurance			
Medicare	8.08	0.017	1.460, 44.806
Veteran Affairs	8.72	0.007	1.825,41.66
Other insurance	101.47	0.003	4.793,2148
Marital Status			
Never married	0.13	0.048	0.017,0.98
Married	0.03	0.014	0.002,0.516
Separated	0.09	0.041	0.105, 0.904
Divorced	0.13	0.076	0.013,1.232
Age 75–89	0.29	0.057	0.084,1.03