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Gaining the Patient Reported Outcomes Measurement Information System (PROMIS) Perspective in Chronic Kidney Disease: a Midwest Pediatric Nephrology Consortium study

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Abstract

Background and Objectives—Chronic kidney disease is a persistent chronic health condition commonly seen in pediatric nephrology programs. Our study aims to evaluate the sensitivity of the Patient Reported Outcomes Measurement Information System (PROMIS) pediatric instrument to indicators of disease severity and activity in pediatric chronic kidney disease.

Methods—This cross sectional study included 233 children 8–17 years old with chronic kidney disease from 16 participating institutions in North America. Disease activity indicators, including hospitalization in the previous 6 months, edema, and number of medications consumed daily, as well as disease severity indicators of kidney function and coexisting medical conditions were captured. PROMIS domains, including depression, anxiety, social-peer relationships, pain interference, fatigue, mobility, and upper extremity function, were administered via web-based questionnaires. Absolute effect sizes (AES) were generated to demonstrate the impact of disease on domain scores. Four children were excluded because of missing GFR estimations.

Results—221 of the 229 children included in the final analysis completed the entire PROMIS questionnaire. Unadjusted PROMIS domains were responsive to chronic kidney disease activity indicators and number of coexisting conditions. PROMIS domain scores were worse in the presence of recent hospitalizations (depression AES 0.33, anxiety AES 0.42, pain interference AES 0.46, fatigue AES 0.50, mobility AES 0.49), edema (depression AES 0.50, anxiety AES 0.60, pain interference AES 0.77, mobility AES 0.54) and coexisting medical conditions (social peer-relationships AES 0.66, fatigue AES 0.83, mobility AES 0.60, upper extremity function AES 0.48).

Conclusions—The PROMIS pediatric domains of depression, anxiety, social-peer relationships, pain interference, and mobility were sensitive to the clinical status of children with chronic kidney disease in this multi-center cross sectional study. We demonstrated that a number of important clinical characteristics including recent history of hospitalization and edema affected patient perceptions of depression, anxiety, pain interference, fatigue and mobility. The PROMIS instruments provide a potentially valuable tool to study the impact of chronic kidney disease. Additional studies will be required to assess responsiveness in PROMIS score with changes in disease status over time.

Keywords

Patient reported outcomes; quality of life; transplant; end stage kidney disease; chronic kidney disease; pediatrics; children

INTRODUCTION

Individuals with chronic kidney disease represent a growing population in adult and pediatric practices. This has resulted in a drive to optimize patient care and outcomes [1]. Chronic kidney disease in children encompasses a broad range of etiologies including congenital anomalies of the kidney and urinary tract, cystic kidney diseases and glomerulopathies. In addition to the clinical measures of kidney function, assessment of health-related quality of life through patient reported outcomes can elucidate and quantify the patient perspective on health and disease.

The impact of chronic kidney disease on the health-related quality of life of pediatric patients has been increasingly studied over the past several years. Patients with end stage kidney disease receiving dialysis have been shown to have significantly lower health-related quality of life in all domains measured on the generic Pediatric Inventory of Quality of Life Scales (Peds QL 4.0™) and the end stage kidney disease specific PedsQL 3.0™ [2–4]. Studies examining the impact of renal transplant on the health-related quality of life of patients have yielded divergent results [2, 5, 6]. Gerson et al recently demonstrated through the use of the PedsQL 4.0™ that children with mild to moderate chronic kidney disease had significantly lower physical, emotional, school, and social domain scores [7]. Each of these studies has confirmed the negative impact of chronic kidney disease on health-related quality of life in children.

The Patient Reported Outcomes Measurement Information System (PROMIS) project was established as part of the National Institutes of Health Roadmap Initiative to create item banks for both adults and children, which are publically available, efficient, precise, and valid across a variety of diseases to assess patient reported outcomes (www.nihpromis.org). In the initial phase of PROMIS, 9 item banks specific to selected symptoms and quality of life were developed using qualitative and quantitative methods to measure child self-reported outcomes: depression, anxiety, social-peer relationships, pain interference, fatigue, mobility, upper extremity function, anger, and asthma impact in children 8–17 years old [8–12]. Previously most health-related quality of life research instruments utilized classical test theory in their development [13], but the PROMIS instrument was developed using newer psychometric techniques also referred to as item response theory [14]. Item response theory has allowed PROMIS to create banks of items that measure an underlying trait (e.g., Fatigue) and gives the user (researcher, clinician) the option to use any subset of the items in the bank to measure the trait. Any subset of the items can be combined to generate a score (PROMIS score) that is comparable with other studies using items from the bank. PROMIS also developed item banks that do not require attribution of a symptom to a disease. This allows comparison of scores across diseases or for patients with multiple chronic diseases. Currently, the PROMIS item banks are undergoing validity studies in a variety of populations including children with asthma, sickle cell disease, cancer, nephrotic syndrome, inflammatory bowel disease, and obesity [15–17]. The validation of the PROMIS instrument becomes particularly important in pediatric clinical research and pediatric therapeutics as patient reported outcomes are becoming standard clinical trial endpoints and their use is encouraged by the Food and Drug Administration [18].

This study aims to evaluate the sensitivity of the PROMIS instruments to pediatric chronic kidney disease severity (Stage I–III, Stage IV–V, and Renal Transplant), and activity indicators, such as edema and recent hospitalizations. We hypothesized that the PROMIS instruments would demonstrate worse patient reported outcomes in children with a greater degree of chronic kidney disease severity and activity.

METHODS

This cross sectional study was conducted by the Midwest Pediatric Nephrology Consortium (MWPNC) and included 233 pediatric patients from 16 participating member institutions. Each site obtained individual institutional IRB approval. Parents and children gave informed consent and assent respectively, prior to performing the study.

Training study team members

Research personnel at each site received web-based training in study procedures; the study operations manual was a reference tool for study conduct, quality control, and recruitment. Ongoing education of site personnel occurred during investigator and coordinator conference calls.

Eligibility

The PROMIS kidney cohort study included children 8–17 years old with chronic kidney disease defined as having end stage kidney disease requiring dialysis, a kidney transplant, or estimated glomerular filtration rate (eGFR) < 90 ml/min/1.73m^2 [19]. Eligibility criteria included the ability to speak and read English. Exclusion criteria included co-existing medical, psychiatric, or cognitive impairments that would prevent the patient from answering the computerized questionnaire. Children with nephrotic syndrome were not included in this analysis as this population has been previously reported [16].

Study Procedures

The parent completed the Family and Medical Information form, which included relationship to child, guardian education level, socioeconomic, and disease specific questions. Child characteristics included: gender, age, race, ethnicity, disease etiology, dialysis, transplant, co-existing conditions, hospitalizations in the previous 6 months, surgery in the previous 12 months, number of medications, corticosteroid therapy, self-rated edema status, and the guardian's perception of the child's weight status (underweight, healthy weight or overweight). Clinical data such as diagnosis and eGFR were obtained from the patient medical record by the local investigators. Chronic kidney disease stage was assigned based on eGFR as defined by the Kidney Disease Outcomes Quality Initiative [20].

The children completed the domains related to depression, anxiety, social-peer relationships, pain interference, fatigue, mobility, and upper extremity function. The definitions of the domains are located at http://www.nihpromis.org/measures/domainframework2. All of the PROMIS items use the context statement "In the past 7 days." Responses include five options ranging from "never" to "almost always" in the majority of domains and from "with no trouble" to "not able to do" for the physical functioning measures. Each pediatric

PROMIS domain generates a T-score where 50 is the mean and 10 the standard deviation in the initial PROMIS calibration population. Higher scores indicate more of the measured symptom, thus signifying worse symptoms of depression, anxiety, fatigue, and pain interference and better functioning for mobility, upper extremity function, and peer relationships. These measures have been previously tested in a large group of children and adolescents, confirming their unidimensionality and the extent to which each item was associated with the measured variable (www.assessmentcenter.net) [8, 10–12, 14]. The trait-level-specific reliabilities of scores on the pediatric PROMIS measures have been ≥ 0.85 in a 2 to 4 standard deviation score range of the domains being measured [10–12, 14].

In order to decrease the response burden, a sampling plan was devised and is summarized in Table 1. Briefly, participants were randomly assigned to one of two study arms by the Assessment Center after they were registered to take the survey, which included the assignment of the long form for either the pain interference or fatigue domain and the short or long form version of all the other domains. Using this strategy, children completed 70 to 90 questions over 30 to 40 minutes.

Statistical analysis

Frequencies and percentages were calculated for demographic and clinical characteristics. Means and standard deviations were calculated for eGFR scores and number of medications. For the purpose of domain analysis, chronic kidney disease was divided in stage I–III, stage IV–V, and renal transplant. Mean scores as well as standard deviations were calculated for each of the 7 domains by long and short-form. To assess the association of long versus short-form scores, Pearson's correlations were calculated where applicable. The long and short form domain scores for all domains were very highly correlated with Pearson's r ranging 0.95–1.0. Consequently, short-form mean scores are presented in this manuscript and compared across the study sample by chronic kidney disease stage with greater stage showing an increase in disease severity, indicating poorer kidney function and transplant status. Mean scores were also compared across the disease activity indicators of recent hospitalization, recent surgery, edema status and number of coexisting medical conditions. Because the domain variables were not normally distributed, comparisons were also performed using non-parametric Wilcoxon test for two-sample comparison and Kruskal-Wallis test for multiple-sample comparison. Published guidelines were used to define the magnitude of absolute effect sizes (AES) based on the ranges of Cohen's d values: "small"=0.0–0.4, "medium" =0.5–0.7 and "large" ≥0.8 [21]. For variables with more than one category, Cohen's d was calculated using the categories with the highest and lowest means. Simultaneous regression analyses were conducted to assess and interpret the association of child characteristics with each of the 5 domains with complete scores. All statistical analyses were conducted using SAS v9.2.

Results

Child demographic and disease characteristics and guardian demographic are presented in Table 2. Four children were excluded because of missing GFR estimations. There were 229 children in the final analysis including those with chronic kidney disease stage I–III (N=106,

46%), stage IV–V (N=38, 17%), and renal transplant (N=85, 37%). Underlying chronic kidney disease etiology included congenital urologic abnormalities (N=114, 50%), glomerular disease (N=68, 30%), and other (N=47, 21%). About one-third of the children reported recent hospitalizations (N=75, 33%). Twelve percent (N=27) reported presence of edema, 11 had glomerular disease and 16 had non-glomerular disease. Fifty (22%) children reported 2 or more co-existing medical conditions. A total of 8 children were missing one or more of the PROMIS domain scores. Four children had missing scores for one of the PROMIS domains and four children ended the survey early. Missing data, from either incomplete assessments or missing a single domain, was not associated with any of the following explanatory variables of interest: CKD stage, transplant, hospitalizations, surgery, edema, number of medications, and coexisting medical conditions, or by patient age. Tables 3 and 4 show the actual number of children that completed each domain.

Analysis of Disease Characteristics and PROMIS domains

Table 3 shows domain scores for depression, anxiety, and social-peer relationships. Markers of disease activity including recent hospitalizations and edema predicted worse scores. Patients who experienced recent hospitalizations had worse depression and anxiety scores (AES 0.33 and 0.42, respectively). The presence of edema was also associated with more difficulties with depression and anxiety (AES 0.50 and 0.60, respectively). Co-existing conditions were also associated with worse social-peer relationship scores (AES 0.66).

Table 4 includes domain scores for pain interference, fatigue, mobility and upper extremity function separately. Chronic kidney disease severity was associated with worse mobility (AES 0.41) scores. Markers of disease activity including recent hospitalizations and edema predicted worse domain scores. Recent hospitalization was associated with worse scores pain interference (AES 0.46), fatigue (AES 0.50), and mobility (AES 0.49). The presence of edema was associated with significantly worse scores in pain interference (AES 0.77), mobility (AES 0.54) and was borderline with fatigue (AES 0.63, p=0.05). The number of coexisting medical conditions was associated with worse fatigue (AES 0.83), mobility (AES 0.60) and upper extremity function (AES 0.48).

Children with glomerular disease were analyzed separately as a sensitivity analysis (data not shown). The domain scores did not differ significantly between children with glomerular diseases and the remainder of the study population with the exception of upper extremity function where children with glomerular disease had significantly better function ($p<0.05$).

Figure 1 shows a comparison between the children with chronic kidney disease reported in this manuscript and those with nephrotic syndrome previously reported [16]. The domain scores did not differ significantly between children with chronic kidney disease and children with nephrotic syndrome except in upper extremity functioning where children with nephrotic syndrome had significantly better function ($p<0.05$).

Multivariate Results

Multivariate results are reported in Table 5. Overall, the PROMIS instruments were sensitive to markers of chronic kidney disease activity including recent hospitalization and edema. Children with hospitalization in the past 6 months had a 4-point worse score for

depression and a 5-point worse score for anxiety ($p<0.05$, Table 5). Children with edema on average had a 6-point worse score for depression, 6-point worse score for anxiety, and 4-point worse score for mobility ($p<0.05$, Table 5). Co-existing medial conditions also predicted worse PROMIS scores. Those with two or more co-existing medical conditions had on average a 4-point worse score in depression, 5-point worse score in anxiety, 8-point worse score in social-peer relationships, 4-point worse score in mobility, and 3-point worse score in upper extremity function ($p<0.05$).

DISCUSSION

As children with chronic kidney disease survive into adulthood, the impact of chronic illness on their health-related quality of life has been increasingly recognized and studied, yet not routinely addressed in clinical practice. We present a multi-center study evaluating the PROMIS instrument as a measure of patient reported outcomes in children with chronic kidney disease. We demonstrate that the PROMIS instrument distinguishes between children with chronic kidney disease with and without markers of disease activity. We also report a novel finding demonstrating the importance of co-existing medical conditions on the patient reported outcomes of patients with chronic kidney disease. The PROMIS instruments are potentially valuable tools for researchers who seek to study the impact of chronic kidney disease on children.

Recent studies have indicated that children with chronic kidney disease or nephrotic syndrome are vulnerable to health-related quality of life challenges involving impact on physical, school, emotional, and social functioning [7, 16, 22]. In children who are initiating dialysis, psychological problems have been identified and often persist into adulthood [23, 24]. However there are limited studies offering insight into the characteristics of the disease experience that may impact health-related quality of life. Our group has recently reported on the importance of edema in children with nephrotic syndrome and its impact on patient reported outcomes as a measure of health-related quality of life [16]. Previous studies in children with chronic kidney disease that investigated these issues have focused on long-term factors associated with chronic kidney disease such as short stature and anemia [25, 26], but have not investigated distinct near and long-term factors influencing patient reported outcomes. In this study, we show that the PROMIS instrument identified specific near and long-term factors affecting patient reported outcomes including hospitalization in the past 6 months, current edema status, and co-existing conditions.

The need for hospitalization often represents a worsening of clinical status, but also represents a significant upheaval in a child's life with separation from their normal routine and interaction with friends, family, and school. Our study demonstrated that children with chronic kidney disease who have been hospitalized in the past 6 months had significantly worse scores for depression, anxiety, pain, fatigue, and mobility. Furthermore, in multivariate analysis, the need for hospitalization remained predictive of worse depression and anxiety in children with chronic kidney disease. These results are consistent with previous reports showing that children with chronic kidney disease had significant psychosocial burdens [7, 22, 27, 28].

Edema represents one of the most visibly evident symptoms of chronic kidney disease. The impact of edema on patients includes physical appearance, mobility challenges, and pain. Our team recently reported worse health-related quality of life in children with nephrotic syndrome with edema in the domains of anxiety, pain interference, fatigue, and mobility [16]. PROMIS scores demonstrated similar findings in children with chronic kidney disease showing that the presence of edema was associated with worse depression, anxiety, pain, fatigue, and mobility. It is understandable that children would have issues with pain, fatigue, and mobility as the presence of edema can directly contribute to these physical attributes. The depressive and anxiety symptoms may reflect the loss of disease control that edema represents. The impact of treatment on patient reported outcomes in edematous children remains to be explored.

The importance of co-existing conditions in patients with chronic kidney disease may go unrecognized in the midst of subspecialty care. Gerson et al demonstrated that children with comorbidities had a worse parent-proxy physical, social and emotional scores and children self-reported worse social scores [7]. In our study, other health conditions were present in nearly 50% of participants. Our data confirm the findings of Gerson et al showing worse social-peer interactions. Our study also found worse depression, anxiety, fatigue and mobility for patients with increasing number of co-existing conditions in multivariate analysis. Taken together these studies emphasize the importance of focusing on the whole patient since the pediatric nephrology practice often serves as the medical home for patients with chronic kidney disease.

Interestingly, we did not demonstrate a significant difference between individuals with end stage kidney disease, pre-end stage kidney disease, and kidney transplant with respect to self-reported quality of life. The literature on this topic has shown mixed results when comparing patients with renal transplant to children with varying degrees of chronic kidney disease and those on dialysis. In studies that have relied on child self-report it is typical not to find significant differences in health related quality of life after renal transplant as compared to children prior to transplant [4, 27, 29]. One may postulate that the small sample size of end stage kidney disease patients in our study may explain the lack of significant differences across chronic kidney disease severity. Overall, however, our findings suggest that the impact of chronic kidney disease on the health related quality of life in children lies with markers of disease activity that directly impact a child including the presence of edema and recent hospitalizations.

Limitations of this study should be noted. This study utilized a within-patient comparison and did not include healthy controls. This shows the strength of the PROMIS instrument in that it is able to detect clinically meaningful differences within disease specific patient samples. There are studies currently underway to characterize the PROMIS instrument in healthy subjects as well as to characterize minimally important differences that can be used to inform analysis of longitudinal within patient comparisons. The PROMIS instrument is limited by the age of patients that can provide self-report and was designed for children ages 8–17 years. At the time of this study only an English version of the Pediatric PROMIS instrument was available. Following the launch of this project, PROMIS parent proxy-report

items have been developed for age 5 – 17 years. These resources will enrich future research. Lastly, this study was cross-sectional and does not document longitudinal changes.

Among the strengths of this study is the inclusion of patients from a wide variety of socio-economic and clinical backgrounds. This represents one of the broadest patient samplings studying patient reported outcomes in children with chronic kidney disease.

Conclusion

This is the first step in the validation process for the pediatric PROMIS instrument in chronic kidney disease. Future prospective longitudinal studies, healthy control samples, cross-disease and cross-instrument comparisons will be necessary to identify the best use of PROMIS in pediatric kidney disease research and patient care environments. This study demonstrated that the pediatric PROMIS instrument was sensitive to differences in clinical status within a sample of children with chronic kidney disease. The scores were worse with clinical indicators of disease activity and with co-existing conditions. Future work will need to advance the investigation of the pediatric PROMIS self-report in longitudinal analysis, initiate assessment of the parent proxy instrument, and comparison to legacy instruments.

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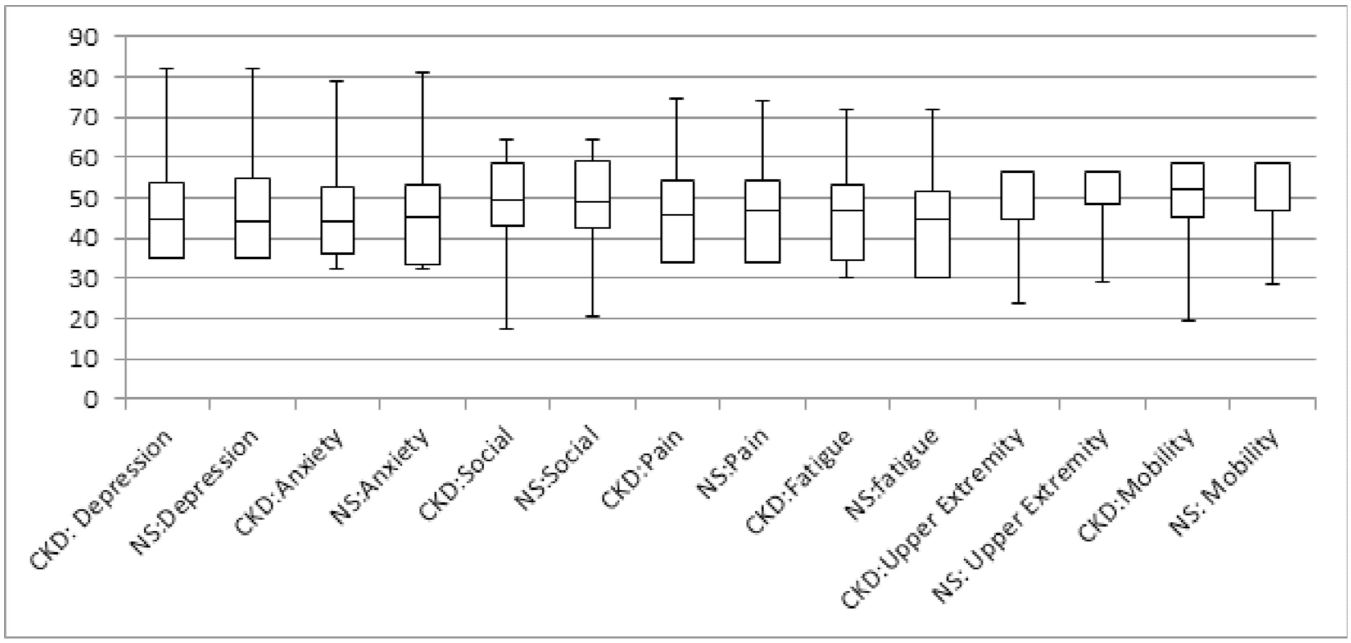

Figure 1.
Comparison of PROMIS scores in children with Chronic Kidney Disease (CKD) to those with Nephrotic Syndrome (NS)

Table 1

PROMIS Domain Randomization Scheme.

Form Administered	Pain Interference*	Fatigue*	Social-Peer	Depression	Anxiety	Mobility	Upper Extremity Function
None	50%	50%					
Short Form			100%	50%	50%	50%	50%
Long Form	50%	50%		50%	50%	50%	50%

* The randomization scheme allocated participants to either the lon form for the Pain domain or the long form for the Fatigue domain

Table 2

Patient Demographics.

Child Demographics	***N = 229*** ***n* (%)**
Gender	
Male	140 (61.1)
Child's Age (yrs)	
8–12	80 (34.9)
13–17	149 (65.1)
Child's Race	
White	146 (63.8)
Black or African-American	49 (21.4)
Asian	8 (3.5)
Other, Multiple Races	26 (11.4)
Child's Ethnicity	
Non Hispanic	213 (93.0)
Hispanic	16 (7.0)
eGFR (n), Mean, (SD) *	(n=229), 57 (39)
Disease etiology	
Congenital Urology	114(49.8)
Glomerular Nephritis, Vasculitis	68 (29.7)
Other	47 (20.5)
CKD Severity	
Stage I–III	106 (46.2)
StageIV–V	38 (16.6)
Renal Transplant	85 (37.1)
Co-Existing conditions (#)	
None	110 (48.0)
One	69 (30.1)
≥ Two	50 (21.8)
Co-Existing conditions: **	
Asthma	34 (14.9)
ADD/ADHD	29 (12.7)
Mental Disorders	16 (7.0)
Overweight	18 (7.9)
Premature birth	42 (18.3)
Rheumatic disease	13 (5.7)
Hospitalized in the past 6 months	75 (32.8)
Edema Status	
None	197 (86.0)
Yes	27 (11.8)
Active edema	28 (12.0)

Child Demographics	***N = 229*** ***n* (%)**
Surgery in the past 12 months	77 (33.6)
# of medications per day (n), Mean(SD))	(n=227), 5.1 (3.3)
Steroid Therapy (All)	
None	146 (63.8)
Alternating day	19 (8.2)
Daily or more than once/day	59 (25.8)
Parent Report of overweight child	18 (7.9)
Guardian Demographics	
Relationship to Child	
Parent	215 (94.0)
Grandparent	9 (3.9)
Guardian or Other	5 (2.2)
Education Level	
< High school	17 (7.4)
High school degree/GED	65 (28.4)
Some college/technical degree	68 (29.7)
College degree or more	79 (34.5)

*eGFR= estimated glomerular filtration rate

**Parents reported > 1 condition; there were many other conditions in lower frequency (<3%) than listed conditions.

CKD, chronic kidney disease; ADD/ADHD, attention deficit disorder/attention deficit hyperactivity disorder

Table 3

Bivariate Analysis for the PROMIS Domains of Depression, Anxiety, and Social-Peer Relationships

	Depression			Anxiety			Social-Peer Relationships		
	n	Mean(SD)	Effect size |d|	n	Mean (SD)	Effect size |d|	n	Mean (SD)	Effect size |d|
CKD Cohort (N=233)	224	46.6 (10.6)		226	45.2 (10.6)		227	49.7 (10.5)	
CKD Severity/Modality									
Stage 1–3	104	47.1 (11.4)		104	45.7 (10.9)		105	49.5 (11.1)	
Stage 4–5	37	46.2 (8.4)	0.09	38	44.5 (8.8)	0.11	37	52.4 (8.2)	0.36
Renal Transplant	83	46.1 (10.6)		84	44.9 (11.1)		85	48.7 (10.4)	
Hospitalized in the past 6 months									
Yes	73	48.9 (11.5)†	0.33	74	48.2 (11.4)††	0.42	75	48.6 (10.9)	0.16
No	151	45.4 (10.0)		152	43.8 (10.0)		152	50.3 (10.2)	
Surgery in the past 12 months									
Yes	75	46.3 (11.1)	0.04	77	44.9 (11.6)	0.06	77	50.1 (11.1)	0.06
No	149	46.7 (10.4)		149	45.4 (10.2)		150	49.5 (10.1)	
Active Edema									
Yes	26	51.3 (11.4)†	0.50	27	50.7 (11.4)††	0.60	27	48.4 (11.5)	0.14
No	194	45.9 (10.4)		195	44.5 (10.3)		196	49.9 (10.4)	
Coexisting medical conditions									
None	106	46.2 (9.5)		108	44.0 (10.1)		108	51.4 (10.2)†††	
One	68	45.3 (10.3)	0.36	68	45.2 (10.4)	0.38	69	50.9 (9.9)	0.66
Two	50	49.1 (12.9)		50	48 (11.7)		50	44.5 (10.3)	

Significance of mean difference measured by Wilcoxon or Kruskal-Wallis test:

† Difference between groups significant at p<.05

†† Difference between groups significant at p<.01

††† Difference between groups significant at p<.001

Table 4

Bivariate Analysis for Pain Interference, Fatigue, and Upper Extremity

	Pain Interference			Fatigue			Mobility			Upper Extremity Function		
	n	Mean(SD)	Effect size |d|	n	Mean (SD)	Effect size |d|	n	Mean (SD)	Effect size |d|	n	Mean (SD)	Effect size |d|
CKD Cohort	109	46.4 (10.3)		117	45.6 (10.8)		226	50.8 (8.3)		227	50.5 (8.1)	
CKD Severity												
Stage 1–3	54	43.9 (9.1)		50	46.9 (11.4)		105	52.5 (7.5)†		105	51.0 (8.4)	
Stage 4–5	18	49.3 (7.2)	0.53	20	46.9 (10.2)	0.30	38	49.6 (9.0)	0.41	38	50.1 (8.0)	0.12
Renal Transplant	37	48.8(12.4)		47	43.7 (10.4)		83	49.1 (8.4)		84	50.0 (7.9)	
Hospitalized in past 6 months												
Yes	38	49.4 (12.2)†	0.46	36	49.3(11.4)†	0.50	74	48.1(8.9)†††	0.49	74	49.7 (8.1)	0.15
No	71	44.8 (8.8)		81	44.0 (10.2)		152	52.1(7.7)		153	50.9(8.1)	
Surgery within 12 mos												
Yes	38	48.4 (11.5)	0.30	39	45.7 (12.4)	0.01	77	48.7(9.1)†	0.40	77	49 (8.7)	0.28
No	71	45.3 (9.5)		78	45.6 (10.0)		149	51.9 (7.7)		150	51.2 (7.7)	
Active Edema												
Yes	16	53.0 (8.1)††	0.77	11	51.6 (12.6)	0.63	27	46.9 (8.5)††	0.54	27	49.1 (8.6)	0.19
No	90	45.1 (10.2)		105	44.9 (10.5)		195	51.4 (8.0)		196	50.6 (8.0)	
Coexisting medical conditions												
None	54	45.2 (9.8)		55	42.9 (10.1)††		107	52.8 (7.2)††		108	51.5 (7.4)††	
One	29	47.0 (10.4)	0.28	40	46.0 (10.3)	0.83	69	49.7 (8.6)	0.60	69	50.8 (8.0)	0.48
Two	28	48.1 (11.2)		22	51.9 (11.1)		50	47.9 (9.1)		50	47.7 (9.2)	

Significance of mean difference by Wilcoxon or Kruskal-Wallis test:

† Difference between groups significant at p<.05

†† Difference between groups at p<.01

††† Difference between groups at p<.001

CKD, chronic kidney disease

Table 5

Multivariate Analysis of Factors Predicting Domain Scores

	Depression	Anxiety	Social-Peer Relationships	Mobility	Upper Extremity Function
	β(SE)	β(SE)	β(SE)	β(SE)	β(SE)
CKD Stage 4–5	−1.9 (2.1)	−2.6 (2.1)	3.9 (2.1)	−0.1 (1.5)	0.4 (1.6)
Renal Transplant	−1.6 (1.7)	−1.9 (1.7)	−0.2 (1.6)	−1.3 (1.3)	0.4 (1.3)
Hospitalized in the past 6 months	3.8 (1.8)*	5.3 (1.7)*	−2.4 (1.7)	−2.3 (1.3)	−0.2 (1.4)
Surgery in the past 12 months	−2.3 (1.7)	−2.8 (1.6)	2.6 (1.6)	−1.1 (1.2)	−1.4 (1.3)
Active Edema	5.6 (2.3)*	6.0 (2.2)*	−2.9 (2.2)	−4.2 (1.6)*	−1.8 (1.7)
Number of medications	0.1 (0.3)	0.02 (0.3)	−0.04 (0.2)	−0.2 (0.2)	−0.2 (0.2)
Coexisting medical conditions					
One	−0.5(1.7)	1.3 (1.6)	−0.7 (1.6)	−2.7 (1.2)*	−0.2 (1.3)
Two or more	4.2(1.9)*	4.9(1.8)*	−7.8(1.8)*	−4.2(1.4)*	−3.4(1.5)*

* p<.05

CKD, chronic kidney disease