KI REPORTS
KIReports.org
RESEARCH LETTER

Health Competence Is a Determinant of Exercise Frequency in Older Adults With CKD

Devika Nair[1,2,3], Jonathan S. Schildcrout[4], Heather L. Prigmore[4], Robert Greevy[4], Ricardo J. Trochez[2], Justin M. Bachmann[5,6], Ebele M. Umeukeje[1,2], Rachel B. Fissell[1,2], Warren D. Taylor[7,8], Sunil Kripalani[2,9] and Kerri L. Cavanaugh[2,3]

[1]Division of Nephrology and Hypertension, Department of Medicine, Vanderbilt University Medical Center, Nashville, Tennessee, USA; [2]Vanderbilt Center for Health Services Research, Nashville, Tennessee, USA; [3]Veterans Affairs Tennessee Valley Health System, Nashville, Tennessee, USA; [4]Department of Biostatistics, Vanderbilt University Medical Center, Nashville, Tennessee, USA; [5]Division of Cardiovascular Medicine, Department of Medicine, Vanderbilt University Medical Center, Nashville, Tennessee, USA; [6]Department of Biomedical Informatics, Vanderbilt University Medical Center, Nashville, Tennessee, USA; [7]Department of Psychiatry and Behavioral Sciences, Vanderbilt University Medical Center, Nashville, Tennessee, USA; [8]Geriatric Research, Education, and Clinical Center, Veterans Affairs Tennessee Valley Health System, Nashville, Tennessee, USA; and [9]Division of General Internal Medicine and Public Health, Section of Hospital Medicine, Vanderbilt University Medical Center, Nashville, Tennessee, USA

Correspondence: Devika Nair, Division of Nephrology and Hypertension, Department of Medicine, Vanderbilt University Medical Center, 2525 West End Avenue, Office 416, Suite 450, Nashville, Tennessee 37203, USA. E-mail: devika.nair@vumc.org

Received 4 December 2023; revised 14 May 2024; accepted 20 May 2024; published online 31 May 2024

Kidney Int Rep (2024) **9**, 2567–2570; https://doi.org/10.1016/j.ekir.2024.05.026
KEYWORDS: activation; exercise; geriatric

INTRODUCTION

Adults aged >60 years comprise the fastest-growing population with chronic kidney disease (CKD) in the United States. Older adults with advanced CKD face high mortality rates because of hospitalizations owing to cardiovascular diseases and high morbidity owing to falls and frailty.[1] Exercise, or structured physical activity, can benefit both cardiovascular mortality and physical frailty, but many exercise interventions for adults with CKD are hindered by nonadherence and dropout.[2] Engagement in interventions may be improved by applying principles of behavior change. Self-efficacy, or the belief in the ability to achieve a goal, is a central concept in theories of behavior change.[3] Individuals reporting greater confidence in the ability to execute a behavior are more likely to succeed. Importantly, self-efficacy is modifiable and can be improved with counseling and coaching.[3,4]

Health competence, an underinvestigated construct similar to self-efficacy, is the belief in the ability to execute behaviors specific to health management.[5] Health competence can be improved with targeted behavioral interventions. Incorporating counseling or coaching into exercise interventions may increase health competence and improve adherence to exercise prescriptions. We tested whether higher health competence would associate with increased exercise frequency among adults aged ≥60 years with stage 3B-5 nondialysis CKD in a cohort of adults hospitalized for cardiovascular events.

RESULTS

This study analyzed a subsample of the Vanderbilt Inpatient Cohort Study, aimed to identify the predictive validity of patient-reported measures (Supplementary Figure S1).[6] Table 1 shows participants' demographic and clinical characteristics (stratified by low, medium, and high health competence), measured using the 2-item Perceived Health Competence Scale (Supplementary Survey 1). The sample's median age was 71 years, 48% participants were men, and 13% were identified as Black. Median estimated glomerular filtration rate was 33 ml/min per 1.73 m^2. In addition,58% and 87% had diabetes mellitus and hypertension, respectively. Approximately 69% reported performing no moderate-to-strenuous exercise per week, measured using a validated single-item question (Supplementary Survey 2, Supplementary Figure S2).

Tables 2 and Supplementary Tables S3 and S4 illustrate the associations between health competence and exercise frequency in unadjusted and adjusted models. In each model, health competence had

Table 1. Characteristics of analytical cohort

Variable	N	Low PHCS-2 score (2–4) (N = 48)	Medium PHCS-2 score (5–7) (N = 155)	High PHCS-2 score (8–10) (N = 155)	Total (N = 368)	Missing (N = 10)
Age (yr)	368	68 (64, 76)	71 (65, 76)	71 (64, 76)	71 (65, 76)	72 (70, 76)
Gender	368					
Man		44 (21)	48 (74)	48 (74)	48 (175)	60 (6)
Woman		56 (27)	52 (81)	52 (81)	52 (193)	40 (4)
Hispanic or Latino?	368					
Yes		2.08 (1)	2.58 (4)	0.65 (1)	1.63 (6)	0.00 (0)
No		97.92 (47)	97.42 (151)	98.06 (152)	97.83 (360)	100.00 (10)
Don't know/not sure		0.00 (0)	0.00 (0)	1.29 (2)	0.54 (2)	0.00 (0)
Race	368					
White		87.50 (42)	85.81 (133)	83.23 (129)	84.51 (311)	70.00 (7)
Black or African American		4.17 (2)	14.19 (22)	14.19 (22)	13.32 (49)	30.00 (3)
Asian		2.08 (1)	0.00 (0)	0.65 (1)	0.54 (2)	0.00 (0)
Native Hawaiian or Other Pacific Islander		0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
American Indian or Alaska Native		2.08 (1)	0.00 (0)	1.29 (2)	0.82 (3)	0.00 (0)
Other		4.17 (2)	0.00 (0)	0.00 (0)	0.54 (2)	0.00 (0)
Refused		0.00 (0)	0.00 (0)	0.65 (1)	0.27 (1)	0.00 (0)
Employment	368					
Employed for wages (full-time or part-time)		4.17 (2)	7.10 (11)	13.55 (21)	9.24 (34)	0.00 (0)
Self-employed		2.08 (1)	3.23 (5)	1.29 (2)	2.17 (8)	0.00 (0)
Out of work for more than 1 yr		0.00 (0)	0.65 (1)	0.00 (0)	0.27 (1)	0.00 (0)
Out of work for less than 1 yr		0.00 (0)	0.00 (0)	0.65 (1)	0.27 (1)	0.00 (0)
A homemaker		2.08 (1)	5.16 (8)	2.58 (4)	3.53 (13)	0.00 (0)
Retired		66.67 (32)	63.87 (99)	69.03 (107)	66.58 (245)	70.00 (7)
Unable to work (disabled)		25.00 (12)	20.00 (31)	12.90 (20)	17.93 (66)	30.00 (3)
Highest grade or yr of school completed?	368	12 (12, 16)	12 (12, 15)	13 (12, 15)	13 (12, 15)	14 (12, 16)
Marital status	368					
Married		50.00 (24)	55.48 (86)	53.55 (83)	53.80 (198)	50.00 (5)
Separated		0.00 (0)	1.29 (2)	0.65 (1)	0.82 (3)	0.00 (0)
Divorced		14.58 (7)	14.19 (22)	17.42 (27)	16.03 (59)	30.00 (3)
Widowed		31.25 (15)	23.23 (36)	21.94 (34)	23.64 (87)	20.00 (2)
Single/never married		4.17 (2)	3.87 (6)	4.52 (7)	4.08 (15)	0.00 (0)
A member of an unmarried couple		0.00 (0)	1.94 (3)	1.94 (3)	1.6 (6)	0.00 (0)
Annual household income	343					
Less than $25,000		35.7 (15)	38.9 (58)	31.0 (44)	35.8 (123)	60.0 (6)
$25,000–$49,999		42.9 (18)	36.9 (55)	36.6 (52)	36.7 (126)	10.0 (1)
$50,000–$74,999		11.9 (5)	10.7 (16)	18.3 (26)	14.0 (48)	20.0 (2)
$75,000 or more		9.5 (4)	13.4 (20)	14.1 (20)	13.1 (45)	10.0 (1)
History of diabetes	368					
No		35 (17)	41 (63)	45 (69)	41.8 (154)	50 (5)
Yes		65 (31)	59 (92)	55 (86)	58.1 (214)	50 (5)
History of hypertension	368					
No		21 (10)	12 (19)	11 (17)	12.7 (47)	10 (1)
Yes		79 (38)	88 (136)	89 (138)	87.2 (321)	90 (9)
Reason for hospitalization	368					
Acute coronary syndrome		12.5 (6)	25.8 (40)	37.4 (58)	29.3 (108)	40.0 (4)
Heart failure		83.3 (40)	63.2 (98)	50.3 (78)	59.8 (220)	40.0 (4)
Both heart failure and acute coronary syndrome		4.2 (2)	11.0 (17)	12.3 (19)	10.8 (40)	20.0 (2)
Short portable mental status questionnaire (cognition) score	361	1 (1, 2)	1 (1, 2)	1 (1, 2)	1 (1, 2)	2 (2, 2)
Elixhauser comorbidity score	368	16 (13, 21)	17 (11, 24)	17 (11, 24)	17 (11, 23)	20 (16, 24)
PHCS-2 score	358	3 (2, 4)	6 (6, 7)	10 (9, 10)	7 (6, 9)	NA
eGFR	368	33 (25, 39)	33 (23, 40)	33 (23, 40)	33 (23, 40)	25 (24, 27)
CKD stage	368					
Stage 3B		60.4 (29)	56.8 (88)	58.7 (91)	57.0 (210)	20.0 (2)
Stage 4		31.2 (15)	30.3 (47)	28.4 (44)	30.4 (112)	60.0 (6)
Stage 5		8.3 (4)	12.9 (20)	12.9 (20)	12.5 (46)	20.0 (2)

eGFR, estimated glomerular filtration rate; NA, not applicable; PHCS-2, Perceived Health Competence Scale-2.
Statistics presented: median (interquartile range); % (N).

Table 2. Binominal regression of association between health competence and exercise frequency (unadjusted)

Variable	Level	Odds ratio	95% CI	*P*-value
PHCS-2	NA	1.50	(1.11, 2.03)	0.0095

CI, confidence interval; NA, not applicable; PHCS-2, Perceived Health Competence Scale-2.

significant associations with exercise frequency, and its moderate effect size persisted, even after covariate adjustment. After adjusting for age, gender, education, income, reason for hospitalization, comorbidities, and cognition, our overdispersed binomial regression model found that a 3-unit (interquartile range) higher health competence score was associated with a 50% increase in odds of exercise frequency on a given day by 50% (odds ratio 1.50; 95% confidence interval [CI]: 1.06–2.10) (Supplementary Table S4). We also found that an 11-year higher age was associated with 67% higher odds of exercise on a given day (odds ratio 1.67; 95% CI: 1.2–2.33) (Supplementary Table S4).

Two subsequent sensitivity analyses, adjusting for the same covariates, were consistent with our primary results. In a linear regression model using days of exercise as an outcome, a 3-unit higher health competence score was associated with, on average, exercising 0.31 more days per week (95% CI: 0.03–0.59) (Supplementary Table S1). Using a logistic regression model, a 3-unit higher health competence score was associated with 41% higher odds of engaging in at least 1 day of exercise per week (odds ratio 1.41, 95% CI: 1.01–1.98) (Supplementary Table S2).

DISCUSSION

Many older adults with advanced CKD face frailty, struggle to meet physical activity recommendations, and remain at high risk for cardiovascular mortality. Most exercise interventions for older adults, including with CKD, do not apply principles of behavior change and are thus limited by non-adherence.[2] In our cohort of adults aged ≥60 years with advanced CKD, those who reported higher health competence also reported engaging more frequently in moderate-to-strenuous exercise. This provides initial evidence that health competence may be a potential target to improve adherence to exercise interventions for this group.

The concept of self-efficacy is gaining recognition in kidney disease care. Patient activation, a construct that incorporates self-efficacy and measures the knowledge, skill, and confidence to execute a health behavior, was recently incorporated into kidney disease policy.[7] Research demonstrating associations between patient activation and health behaviors in kidney disease is nascent. However, self-efficacy is consistently associated with an increased frequency of positive health behaviors in kidney disease and other populations ($r^2 = 0.17$–0.40).[8] Designing interventions that target psychological constructs that overlap with self-efficacy, such as patient activation and health competence, may be a key to achieving durable behavior change, including as applicable to exercise in kidney disease.

Within our cohort, having an older age was associated with reports of increased exercise frequency. This contrasts with literature that demonstrates that older adults struggle to meet exercise guidelines.[1,2] This result may be due to survivorship bias, in that these are adults who are hospitalized later in life (reflected by their advanced age) due to exercise mitigating their risk for earlier hospitalization.

The primary strengths of this analysis are (i) its use of a validated patient-reported measure that is under-investigated in kidney disease and feasible to be administered to patients efficiently (using the 2-item Perceived Health Competence Scale),[5] and (ii) the identification of health competence as a potential, modifiable target for exercise interventions in older adults with CKD.

This analysis also has limitations. Analyses were conducted among participants who had already experienced a cardiovascular event, an outcome that exercise is known to reduce. This suggests that participants may have other characteristics or comorbidities that predisposed them to experience cardiovascular events despite adequate exercise frequency. Other analyses from this cohort demonstrate a reduced mortality risk with exercise (hazard ratio 0.86 per 3-day higher exercise frequency score, 95% CI: 0.77–0.96),[9] demonstrating that exercise still has long-term benefits in this population.

Because the parent cohort's aim was to identify the prognostic utility of patient-reported measures, it does not contain objective measures of physical function in all patients. We were unable to adjust for this and test whether it was a residual confounder. Importantly, our primary aim was to test whether an understudied, modifiable psychological construct (health competence) was associated with our outcome of interest and to quantify the strength of this association. We recognize the importance of including objective measures of physical function in future analyses relating to this question. However, we believe this does not diminish the importance of health competence, as it is more modifiable than an individual's physical functional status.

Additional limitations include that this analysis is cross-sectional, limiting the ability to rule out reverse causation between health competence and exercise frequency. Analyses were from a single academic medical center with a lower number of participants who were identified as Black, thus limiting generalizability. Although the parent study cohort was restricted to adults hospitalized for acute coronary syndrome or acute decompensated heart failure, these are the primary causes of hospitalizations for older adults with CKD.[1] Therefore, individuals with CKD in this cohort are unlikely to be significantly different from those with CKD in the general population.

Health competence, patient activation, and self-efficacy have robust evidence as drivers of behavioral change in many populations. Health competence may be a worthy target on which to base theory-based exercise interventions for older adults with CKD, a population in significant need of effective behavioral interventions to reduce frailty and cardiovascular risk.

DISCLOSURE

All the authors declared no competing interests.

ACKNOWLEDGMENTS

The content is solely the responsibility of the authors. The funding agencies were not involved in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript. The contents do not necessarily represent the official views of the National Institutes of Health.

Funding

This study was supported by grant 1K23 DK1297742 (DN), R01 HL109388 (SK), and K26DK138374 (KC). and 1K23 DK1297742 (DN).

AUTHOR CONTRIBUTIONS

DN, KLC, JSS, and SK worked on the research idea and study design. SK, JSS, and RT worked on data acquisition. DN, JSS, HLP, RG, RT, JMB, EMU, RBF, KLC, SK, and WDT worked on data analysis and interpretation. JSS, HLP, RG, and RT carried out the statistical analyses. KLC, SK, and WDT supervised or provided mentorship. Every author contributed important intellectual content during manuscript drafting or revision and accepts accountability for the overall work by ensuring that questions pertaining to the accuracy or integrity of any portion of the work are appropriately investigated and resolved.

SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Figure S1. Flow diagram of participants.

Figure S2. Distribution of exercise frequency.

Table S1. Linear regression of association between health competence and exercise frequency.

Table S2. Logistic regression of association between health competence and exercise frequency.

Table S3. Binominal regression of association between health competence and exercise frequency (adjusted for demographics).

Table S4. Binominal regression of association between health competence and exercise frequency (adjusted for demographics, cognition, and comorbidities).

Survey 1. The Perceived Health Competence Scale-2.

Survey 2. Measure of exercise frequency (taken from Exercise Vital Sign).

REFERENCES

1. Anderson S, Halter JB, Hazzard WR, et al. Prediction, progression, and outcomes of chronic kidney disease in older adults. *J Am Soc Nephrol*. 2009;20:1199–1209. https://doi.org/10.1681/ASN.2008080860
2. Heiwe S, Jacobson SH. Exercise training in adults with CKD: a systematic review and meta-analysis. *Am J Kidney Dis*. 2014;64:383–393. https://doi.org/10.1053/j.ajkd.2014.03.020
3. Bandura A. Self-efficacy: toward a unifying theory of behavior change. *Psychol Rev*. 1977;84:191–215. https://doi.org/10.1037//0033-295x.84.2.191
4. Purcell N, Zamora K, Bartenthal D, Abadjian L, Tighe J, Seal KH. How VA whole health coaching can impact Veterans' health and quality of life: a mixed-methods pilot program evaluation. *Glob Adv Health Med*. 2021;10:2164956121998283. https://doi.org/10.1177/2164956121998283
5. Smith MS, Wallston KA, Smith CA. The development and validation of the Perceived Health Competence Scale. *Health Educ Res*. 1995;10:51–61. https://doi.org/10.1093/her/10.1.51
6. Meyers AG, Salanitro A, Wallston KA, et al. Determinants of health after hospital discharge: rationale and design of the Vanderbilt Inpatient Cohort Study (VICS). *BMC Health Serv Res*. 2014;14:10. https://doi.org/10.1186/1472-6963-14-10
7. Nair D, Cavanaugh KL. Measuring patient activation as part of kidney disease policy: are we there yet? *J Am Soc Nephrol*. 2020;31:1435–1443. https://doi.org/10.1681/ASN.2019121331
8. Nair D, Cukor C, Taylor WD, Cavanaugh KL. Applying a biopsychosocial framework to achieve durable behavior change in kidney disease. *Semin Nephrol*. 2021;41:487–504. https://doi.org/10.1016/j.semnephrol.2021.10.002
9. Nair D, Schildcrout JS, Shi Y, et al. Patient-reported predictors of post-discharge mortality after cardiac hospitalization. Preprint. Posted online October 3, 2023. medRxiv. 2023. Accessed October 3, 2023. https://doi.org/10.1101/2023.10.02.23296460