ORIGINAL RESEARCH

Self-Motivation Is Associated With Phosphorus Control in End-Stage Renal Disease

Ebele M. Umeukeje, MD,†† *Joseph R. Merighi, PhD,*‡ *Teri Browne, PhD,*§ *Jacquelyn N. Victoroff, BS,*¶ *Kausik Umanath, MD,*** *Julia B. Lewis, MD,*†† *T. Alp Ikizler, MD,*†† *Kenneth A. Wallston, PhD,*†† *and Kerri Cavanaugh, MD, MHS*††

Objective: Hyperphosphatemia is common in end-stage renal disease and associates with mortality. Phosphate binders reduce serum phosphorus levels; however, adherence is often poor. This pilot study aims to assess patients' self-motivation to adhere to phosphate binders, its association with phosphorus control, and potential differences by race.

Design and Methods: Cross sectional design. Subjects were enrolled from one academic medical center dialysis practice from July to November 2012. Self-motivation to adhere to phosphate binders was assessed with the autonomous regulation (AR) scale (range: 1-7) and self-reported medication adherence with the Morisky Medication Adherence Scale. Linear regression models adjusting for age, sex, health literacy, and medication adherence were applied to determine associations with serum phosphorus level, including any evidence of interaction by race.

Results: Among 100 participants, mean age was 51 years (±15 years), 53% were male, 72% were non-white, 89% received hemodialysis, and mean serum phosphorus level was 5.7 ± 1.6 mg/dL. More than half (57%) reported the maximum AR score (7). Higher AR scores were noted in those reporting better health overall ($P = .001$) and those with higher health literacy ($P = .01$). AR score correlated with better medication adherence ($r = 0.22$; $P = .02$), and medication adherence was negatively associated with serum phosphorus ($r = -0.40$; $P < .001$). In subgroup analysis among non-whites, higher AR scores correlated with lower serum phosphorus (high vs lower AR score: 5.55 [1.5] vs 6.96 [2.2]; $P = .01$). Associations between AR score (β 95% confidence interval: −0.37 [−0.73 to −0.01]; $P = .04$), medication adherence (β 95% confidence interval: −0.25 [−0.42 to −0.07]; $P = .01$), and serum phosphorus persisted in adjusted analyses.

Conclusions: Self-motivation was associated with phosphate binder adherence and phosphorus control, and this differed by race. Additional research is needed to determine if personalized, culturally sensitive strategies to understand and overcome motivational barriers may optimize mineral bone health in end-stage renal disease.

Published by Elsevier Inc. on behalf of the National Kidney Foundation, Inc.

Introduction

HYPERPHOSPHATEMIA IS A component of chronic kidney disease that is associated with mineral and bone disorders[1] and has been linked to poor outcomes among patients receiving dialysis.[2] Racial and ethnic disparities exist in the treatment of end-stage renal disease (ESRD),[3] and hyperphosphatemia is more common and more severe in non-whites compared to whites.[4] Hyperphosphatemia can be effectively managed through diet and medication treatments,[2] but the management is often limited by poor adherence.[5]

Nonadherence in ESRD is associated with increased morbidity and mortality[6–8]; however, its importance is often underestimated. Nonadherence in the ESRD population ranges from 22% to 74% and affects all areas of phosphorus management self-care.[9] Modifiable psychosocial factors have been identified as predictors of nonadherence to phosphate binders[5] and include depressive symptoms,[10,11] medication beliefs,[12] and knowledge.[13,14]

Another potential key factor is a person's sense of autonomous regulation (AR).[15] Patients who view medication adherence as positive are more likely to participate in the behavior.[16] A positive attitude has been shown to be one of the key factors that lessens the burden of treatment and improves adherence in complex patients with chronic conditions.[17] When patients are empowered to make their own health behavior choices, and these positive health behaviors

*Division of Nephrology and Hypertension, Vanderbilt University, Nashville, Tennessee.
†Vanderbilt Center for Kidney Disease, Nashville, Tennessee.
‡School of Social Work, University of Minnesota, Saint Paul, Minnesota.
§College of Social Work, University of South Carolina, Columbia, South Carolina.
¶School of Medicine, University of Washington, Seattle, Washington.
**Division of Nephrology and Hypertension, Henry Ford Hospital, Detroit, Michigan.
††Vanderbilt University School of Nursing, Nashville, Tennessee.

Financial Disclosure: See Acknowledgments on page XXX.

This work was presented in part as an abstract and poster presentation at the National Kidney Foundation Clinical Meeting April 2013 (Orlando, Florida), AJKD 2013; 61 (4): B96.

Address correspondence to Kerri Cavanaugh, MD, MHS, Division of Nephrology and Hypertension, Vanderbilt University Medical Center, 1161 21st Avenue, MCN S-3223, Nashville, TN 37232. E-mail: kerri.cavanaugh@vanderbilt.edu

Published by Elsevier Inc. on behalf of the National Kidney Foundation, Inc.
1051-2276/$36.00
http://dx.doi.org/10.1053/j.jrn.2015.03.001

are aligned with the patient's attitude about the behavior, these changes are more likely to persist.[15] In addition to attitudes, self-determination theory includes persons' self-efficacy to perform the behavior as well as their perception of their provider's support (Fig. 1). Patient characteristics including age, sex, and race may influence attitudes. Examining these factors may assist in our understanding of adherence to phosphate binder therapy.

The objective of this pilot study was to examine dialysis subjects' self-motivation to adhere to phosphate binder medication therapy and its association with medication adherence and also phosphorus control. We hypothesized that dialysis subjects with higher AR scores would report higher adherence to their phosphate binders and also have lower serum phosphorus levels. Racial influences on these measures were also examined. We hypothesized that self-motivation to adhere to phosphate binders would differ between white and non-white subjects.

Study Population and Methods

Design, Participants, and Setting

In this cross-sectional study, adult subjects receiving dialysis treatment for ESRD were recruited from 3 dialysis units affiliated with a large, urban, tertiary care academic medical center from July to November 2012. Subjects were eligible for participation if they were 18 years or older, English speaking, and currently prescribed phosphate binder medication therapy. Exclusion criteria included uncorrectable poor vision and an existing diagnosis of psychosis or dementia. This study was approved by the institutional review board at our institution. All participants provided written informed consent and were offered $5 for their time.

Variables and Data Sources and Measurement

Surveys were administered to each subject during a face-to-face interview, most commonly during their dialysis treatment. The time needed to complete the surveys ranged from 20 to 45 minutes. Evaluation of dialysis subjects' self-motivation to adhere to phosphate binders was determined using a version of the AR scale adapted specifically to assess self-motivation to adhere to these medications (Table S1).[18] The AR scale has 6 items and responses range from 1 (not at all true) to 7 (very true). The overall AR score is the calculated mean of the 6 items. As is common with other scales that assess patients' perceptions of care, high attitudes are attributed to an overall score of 7 and lower attitudes with any overall score <7.[19]

The Morisky Medication Adherence Scale,[20] adapted to reference phosphate binders, was used to determine self-reported medication adherence. This 8-item scale has been shown to have good internal consistency ($\alpha = 0.83$) and good concurrent and predictive validity in predicting medication adherence assessed using objective methods in a low-income patient population with hypertension.[20] The scale ranges from 0 to 8, and previous studies suggest that high, medium, and low adherence are defined as scores of 8, 6 to 7, and <6, respectively.[20]

Additional measures included patient demographics and health literacy. Demographics were self-reported including age, sex, and race. Race was dichotomized into 2 groups: whites and non-whites. Health literacy was assessed using the short form of the test of functional health literacy in adults.[21] It is a timed, 7-minute test comprising 36 questions, with a total score range from 0 to 36. Limited health literacy (eg, $<$9th grade reading level) is reflected by a score

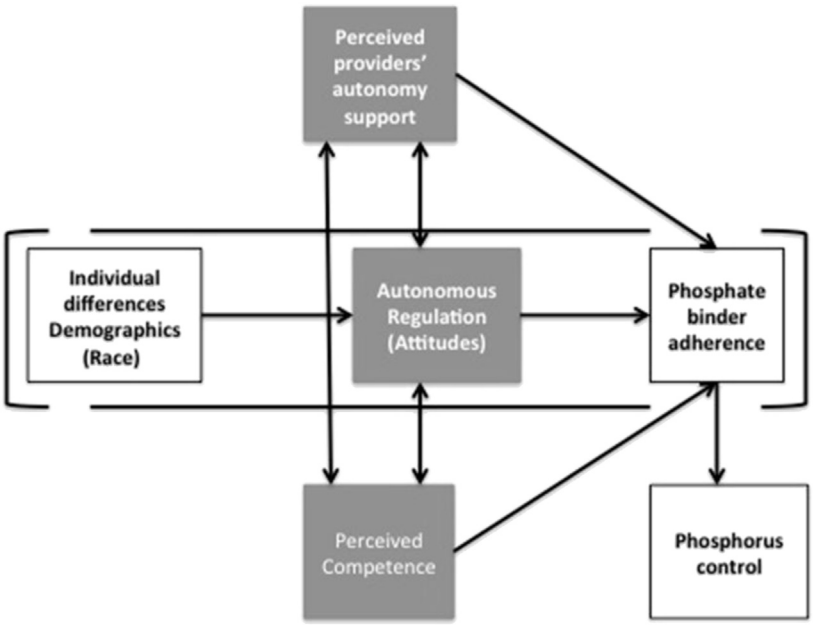

Figure 1. Conceptual model of self-motivation and medication adherence.