ORIGINAL RESEARCH

Sedentary Behavior in Individuals With Diabetic Chronic Kidney Disease and Maintenance Hemodialysis

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Objective: The objective of this study was to examine whether more advanced kidney failure is associated with sedentary behavior and whether demographics, comorbidity, nutritional, and inflammatory markers explain this association.

Design: Observational study.

Setting: Outpatients recruited from outpatient clinics and dialysis units.

Subjects: One hundred sixty patients with chronic kidney disease (CKD) or receiving maintenance hemodialysis (MHD).

Methods: Standardized questionnaires including Baecke physical activity questionnaire, standardized anthropometry examination, and blood draw.

Main Outcome Measure: Sedentary behavior (defined as answering "very often" for "during leisure time I watch television" or answering "never" for "during leisure time I walk") and being physically active (top 25th percentile of the total Baecke score).

Results: Nineteen percent of CKD and 50% of MHD patients were sedentary ($P < .001$) and 38.8% of CKD and 11.3% of MHD patients were physically active. In separate multivariable logistic regression models, compared with CKD patients, MHD patients were more sedentary (odds ratio 3.84; 95% confidence interval, 1.18-12.51) and less physically active (odds ratio 0.07; 95% confidence interval 0.01-0.40) independent of demographics, comorbidity, smoking, body size, serum high sensitivity C-reactive protein (hsCRP) and albumin. Congestive heart failure, peripheral vascular disease, and higher body mass index were independently associated with sedentary behavior, whereas younger age, lower body mass index, lower serum hsCRP, and higher serum albumin were associated with being physically active.

Conclusions: Sedentary behavior is highly prevalent among diabetic CKD or MHD patients. The strong association of MHD status with sedentary behavior is not explained by demographics, smoking, comorbidity, nutritional, and inflammatory markers. Interventions targeting obesity might improve sedentary behavior and physical activity, whereas interventions targeting inflammation might improve physical activity in these populations.

Introduction

BASAL METABOLIC RATE is the amount of energy expended while sitting quietly. Physical activity intensity could be defined using the metabolic intensity equivalent, the ratio of the energy expended during an activity to the energy expended at rest.[1] Hence, 1 metabolic intensity equivalent is the energy expenditure while sitting quietly. Sedentary behavior is engaging in "any walking activity characterized by an energy expenditure ≤1.5 metabolic equivalents and a sitting or reclining posture."[2]

Much of the focus on physical activity in chronic kidney disease (CKD) and the dialysis population has been on decreased physical function[3–5] and lower levels of moderate/vigorous physical activities (MVPA).[6,7] More recently, sedentary behavior (defined by sitting time,[8] television viewing time,[9] pedometer,[10] or accelerometer[11]) in CKD has been examined in cross-sectional studies. However, it is unclear whether uremia *per se* is a risk factor for sedentary behavior. Furthermore, understanding the risk factors for sedentary behavior in CKD and dialysis patients would help in devising interventional trials targeting sedentary behavior in these populations.

Baecke questionnaire,[12] a measure of habitual physical activity, includes questions about household activities, sports, and leisure time activities. It has been found to be fairly accurate in identifying individuals with low energy expenditure compared with the gold standard of doubly labeled water method.[13] We used the Baecke questionnaire to define sedentary behavior in CKD and maintenance hemodialysis (MHD) patients and examined the hypothesis that the greater prevalence of sedentary behavior in

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advanced kidney failure is independent of comorbidity, nutritional, and inflammatory markers. We also examined the factors associated with sedentary behavior in CKD and MHD populations.

Methods

The present study is a secondary analysis of 80 CKD and 80 chronic MHD participants with type 2 diabetes recruited for 3 studies. The CKD participants were included from the "*Effects of Febuxostat on Adipokines and Kidney Disease in Diabetic CKD*" study (NCT01350388). In brief, that study was a randomized controlled trial to determine whether febuxostat therapy in overweight or obese diabetic CKD patients and high serum uric acid levels impacts adipokines and markers of urinary fibrosis. The MHD population comprised 30 participants from the "*Protein intake, nutrition, and cardiovascular disease in stage V CKD*" study (NCT00566670), and 50 participants from the "*Dialysis Registry*" study (NCT02023528). The dialysis studies were observational studies. Details of these studies including the inclusion and exclusion criteria are available at clinicaltrials.gov. All studies were approved by the appropriate institutional review board.

Participants included in the present study were >18 years; diagnosed with either CKD (estimated glomerular filtration rate [eGFR] < 60 mL/minute/1.73 m^2 or eGFR 60 to <90 mL/minute/1.73 m^2 with albuminuria) or stage 5 CKD on MHD; diagnosed with type 2 diabetes; completed the Baecke Physical Activity Questionnaire; and had other relevant data available for this analysis. All participants underwent standardized study procedures conducted by the same team of trained study personnel.

Physical activity was assessed with the Baecke questionnaire,[12] a reliable and validated[13,14] measure of habitual physical activity. It was administered at baseline in the interventional CKD study and the observational dialysis registry study. Television viewing time has been used as a measure of sedentary behavior.[9,15] As sedentary behavior is engaging in activities that barely raise energy expenditure above the basal metabolic rate, we defined sedentary behavior as answering "very often" for "During leisure time I watch television" or answering "never" for "During leisure time I walk". In additional analyses, we also examined the occupation/work, sports, and leisure time activity indices derived from the Baecke questionnaire.[12]

Statistical Analysis

There were 160 participants included in the analysis. Descriptive statistics for continuous variables are shown as mean ± standard deviation or medians with 25th and 75th percentiles and categorical variables are presented as percentages. Baseline characteristics between diabetic CKD and MHD participants were compared by 2-tailed Student *t* test or Wilcoxon rank-sum test for continuous variables, and chi-squared test or Fisher exact test for categorical variables.

To examine whether the risk of sedentary behavior is higher in MHD participants compared with CKD patients, unadjusted associations of MHD status with sedentary behavior was first examined in a logistic regression model. The extent to which this association was further attenuated by demographics (age, gender, race, and education), comorbidity (history of coronary artery disease, coronary heart failure, peripheral vascular disease, stroke, and hypertension), smoking, and body size and laboratory parameters (hsCRP and serum albumin) was examined by adding serially these groups of factors into the previously mentioned logistic model. Serum hsCRP was heavily skewed, and therefore, hsCRP was log transformed and then divided by the logarithm of 2; the results are expressed as the increase in the odds ratios for every 2-fold increase in hsCRP.

Furthermore, unadjusted and adjusted associations of the previously mentioned factors with sedentary behavior were examined in logistic regression models.

Summation of the Baecke household score, sport score, and leisure time activity score resulted in a continuous overall unitless activity score. We classified those in the top 25th percentile of the overall score as physically active and examined the associations of MHD versus CKD status with Baecke overall activity score ≥7.375 (75th percentile) in logistic regression models similar to those described previously for sedentary behavior. All statistical analyses were conducted by using Stata (version 12).

Results

Demographic and clinical characteristics of the entire cohort and the CKD and MHD subgroups are described in Table 1. Compared with the MHD participants, those with CKD were older and had higher BMI. However, the MHD participants still had higher prevalence of cardiovascular conditions, higher CRP levels, and lower albumin levels.

As shown in Figure 1, the frequency of sedentary behavior was greater in the MHD population. Compared with the CKD subgroup, MHD subgroup had 4.33 fold higher odds (95% CI, 2.13-8.83) of being classified as sedentary unadjusted for other factors (Fig. 2). Even after further adjustment for demographics (model 2 in Fig. 2) or comorbidity and BMI (model 3 in Fig. 2) or serum albumin and CRP (model 4 in Fig. 2), MHD patients had greater than 3.8-fold higher odds of being sedentary (odds ratio 3.84, 95% CI, 1.18-12.51 in model 4 in Fig. 2).

The associations of other factors with sedentary behavior in the entire cohort are summarized in Table 2. Reflecting the younger age and lower education level of the MHD subgroup, unadjusted, these 2 factors were associated with sedentary behavior. However, they were no longer significant in the adjusted models.