Physical Activity in Daily Life Assessed by an Accelerometer in Kidney Transplant Recipients and Hemodialysis Patients

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ABSTRACT

Background. Sedentary lifestyle is a problem among hemodialysis (HD) patients, potentially attenuated after kidney transplantation. However, the effect of kidney transplantation on physical activity has not been thoroughly investigated.

Objective. This study sought to evaluate the physical activity in daily life in kidney transplant recipients (KTRs) compared with HD patients and to explore its relationship with clinical variables.

Methods. A cross-sectional study enrolled KTRs who received transplants at least 6 months before the study (N = 23; 48.3 ± 10.3 years) and patients undergoing HD for at least 6 months (N = 20; 47.3 ± 12.6 years). Time spent in different activities (walking, standing, sitting, and lying down) and number of steps taken, measured by a multiaxial accelerometer used for 12 h/d on 2 consecutive days for KTRs and on 4 consecutive days for HD patients, were evaluated.

Results. KTRs engaged in more active time per day (sum of walking and standing time) than HD patients (311 ± 87 vs 196 ± 54 min/d; $P = .001$), with longer walking (106 ± 53 vs 70 ± 27 min/d; $P = .008$) and standing time (205 ± 55 vs 126 ± 42 min/d; $P < .001$). Sixty-five percent of KTRs were classified as active (>7500 steps/d) compared with only 20% of the HD group ($P < .05$). The multivariate analysis showed that time posttransplantation was significantly associated with walking time and active time.

Conclusions. By using an accelerometer, a precise method, this study showed that KTRs are significantly more active in daily life than HD patients, and that daily physical activity increases with time since transplantation.

SEDENTARY lifestyle is associated with 2 million deaths per year worldwide and contributes to the development and progression of several chronic diseases, notably those of the cardiovascular system [1]. This type of behavior is even worse among patients with end-stage renal disease, who have an elevated risk of cardiovascular events or mortality and are more sedentary than the general population [2–4]. There are several factors promoting a sedentary lifestyle in patients on regular hemodialysis (HD): anemia, functional and structural muscle abnormalities, uremia, inflammation, hyperparathyroidism, reduced secretion of testosterone, and malnutrition [5]. Moreover, the time spent in dialysis sessions makes these subjects less active in their daily lives than healthy individuals [6].

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Many factors associated with a sedentary lifestyle in HD patients, such as anemia, uremia, and the 12 hours per week spent on dialysis, may be corrected by a kidney transplant. However, adverse effects of immunosuppressive drugs, recurrent infections, and bone and muscle changes acquired during the dialysis treatment could contribute to inactivity in kidney transplant recipients (KTRs) [7,8]. The net result of all these factors on physical activity in KTRs is not well established.

There is an increasing interest in measuring the physical activity in daily life in different populations. However, among end-stage renal disease patients, most studies have used questionnaires, which are instruments with low accuracy, especially among subjects with light activities such as HD patients [9]. The accelerometer-based activity monitor used in this study measures time spent on different activities (walking, standing, sitting, and lying), number of steps taken, and movement intensity, and it has been validated in patients with different chronic diseases [10,11]. Therefore, the aim of the present study was to evaluate the physical activities in daily life in KTRs compared with HD patients using a triaxial accelerometer. Furthermore, we investigated the relationship between physical activities in daily life and the potentially related variables.

SUBJECTS AND METHODS

Study Design

We conducted a cross-sectional study of KTRs and HD patients at the Nephrology Unit of the University Hospital of the Federal University of Juiz de Fora, Brazil. Patients included in the study were recruited and evaluated between January 2012 and March 2013.

Participants

All KTRs who had received transplants at least 6 months before the study and all patients undergoing HD 3 times per week for at least 6 months from our unit were assessed for eligibility. In both groups, exclusion criteria were age <18 or >65 years, uncontrolled arrhythmia, hypertension, uncontrolled diabetes mellitus, unstable angina, severe respiratory disease, acute infection, severe renal osteodystrophy, neurologic or musculoskeletal disturbance, and involvement in any kind of exercise training in the preceding 6 months. Patients who lived in other cities also were excluded because of the difficulty in coming to the unit on the nondialysis days. The study protocol was approved by the Research Ethics Committee of the Federal University of Juiz de Fora, and it is in accordance with the Declaration of Istanbul. All patients signed an informed consent form before participation.

Measurements and Outcomes

General and Laboratory Data. Demographic and clinical data, including sex, age, time on HD, time posttransplantation, type of donor, comorbidities, body mass index (BMI), education level, and family income were collected through medical records and self-report. Hemoglobin, creatinine, urea, phosphorus, calcium, albumin, and iron were measured. For the HD patients, measurements were done before the first HD session of the week. The adequacy of dialysis was calculated by Kt/V [12].

Physical Activities in Daily Life by Accelerometer. A triaxial accelerometer (DynaPort Activity Monitor; McRoberts BV, The Hague, Netherlands) was used to assess physical activity in daily life. The device measures the time spent walking, standing, sitting, and lying down, and the number of steps taken. Active time was calculated as the sum of walking and standing time. The accelerometer was used for 12 h/d in both groups, beginning when the patient woke up. The HD patients used it for 4 consecutive weekdays that corresponded to 2 dialysis days and 2 non-dialysis days, and KTRs were monitored for 2 consecutive weekdays; they were instructed to maintain normal activities of daily life. According to the numbers of steps taken, the patients were classified as sedentary (<5000 steps/d), somewhat active (5000 to 7499 steps/d), and active (≥7500 steps/d) [13].

Six-Minute Walk Test and Peripheral Muscle Strength. The analysis of physical functioning was performed by a 6-minute walk test (6MWT) following the recommendations of the American Thoracic Society [14]. The HD patients performed the 6MWT on a nondialysis day. Isometric handgrip strength was measured with a hydraulic hand dynamometer (Jamar Hydraulic Hand Dynamometer, Sammons Preston, Rolyan, Illinois, USA). At least 3 trials were conducted, with a rest period of at least 1 minute between trials; the highest value was used in the analyses [15]. In KTRs without arterial venous (AV) fistula, the measurements were made on the dominant side, whereas in patients with AV fistula, the measurements were performed on the nonfistula side. The sit-to-stand test was used to assess lower extremity muscle strength. Patients were instructed to stand up and sit back down from a seated position, with arms folded across the chest, on a standard 44-cm straight-back chair with no armrests. The number of repetitions achieved at the end of 60 seconds was recorded [16]. All of the force measurements were performed on nondialysis days for the HD patients.

Statistical Analysis

Data were shown as mean and standard deviation (SD), median and interquartile range (IQR) or number and percentage. Normal distribution was checked with the Kolmogorov-Smirnov test. Comparisons between groups were performed by independent-sample t test for normally distributed variables, by the Mann-Whitney U test for variables that were not normally distributed, and by the χ^2 test for categorical variables. Pearson coefficient was used for the study of the correlations, except for those involving family income, time on HD, time posttransplantation, hemoglobin, phosphorus, SF-36 domains, and sit-to-stand test, all of which were evaluated by Spearman coefficient. Multivariate linear regression analysis was performed when significant correlations were found between the accelerometer outcomes and clinical data. Those were used as adjusting variables regarding the group differences in activity time estimation. The level of significance was set at $P < .05$. All statistical analyses were performed using SPSS 17.0 for Windows (SPSS Inc., Chicago, Illinois, USA).

RESULTS

One hundred and thirty-two KTRs and 40 HD patients were assessed for inclusion eligibility; 104 KTRs not satisfying the inclusion criteria were excluded (74 lived in another city, 4 were under 18 years old, 12 were older than 65, 8 had less than 6 months of transplantation, 6 had musculoskeletal disease) and 5 patients declined to participate in the study.