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(Citation)

Clinical and Experimental Nephrology, 24(12):1189-1190

(Issue Date)

2020-12

(Resource Type)

journal article

(Version)

Accepted Manuscript

(Rights)

The final publication is available at Springer via <http://dx.doi.org/10.1007/s10157-020-01939-z>

(URL)

<https://hdl.handle.net/20.500.14094/0100495530>



Physical activity in patients with pre-dialysis chronic kidney disease is related to physical function

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Keywords: physical activity, chronic kidney disease, physical function

Physical activity (PA) is associated with renal function and mortality in patients with pre-dialysis chronic kidney disease (CKD) [1-3]. A previous study suggested that higher levels of PA are associated with a lower prevalence of CKD [4]. Although some studies have objectively characterized PA in pre-dialysis CKD, few have assessed objective parameters of PA such as number of steps or exercise energy expenditure. Further, factors relevant to PA remain unclear in patients with pre-dialysis CKD. Thus, we aimed to measure PA objectively and investigate factors related to PA in patients with pre-dialysis CKD.

The participants included 168 outpatients with pre-dialysis CKD stage G2-5 who could ambulate to our nephrology clinic. There were 125 men and 43 women (average age, 73.1±9.2 years) with a mean estimated glomerular filtration rate (eGFR) of 35.3±15.9 mL/min/1.73 m².

We investigated patient characteristics including age, sex, body mass index (BMI), primary kidney disease, presence of diabetes, employment status, and biochemical parameters including eGFR, hemoglobin (Hb), albumin, C-reactive protein, and urinary protein (UP) from the medical records. Knee extensor muscle strength, handgrip strength, and one-leg standing time were measured and evaluated according to our previous study [5]. We also assessed PA, defined as average daily energy expenditure on exercise and average daily number of steps taken, using an accelerometer-pedometer. The patients were divided into three groups based on eGFR: stage 2·3a group (n=46), stage 3b group (n=55), and stage 4·5 group (n=67). One-way analysis of covariance was used to test for differences in PA between the three groups. The relation between PA and the variables was analyzed by Spearman's partial correlation coefficients. Stepwise multiple regression analysis was conducted using factors showing a single correlation as independent variables and PA as the dependent variable.

In the stage 2·3a, stage 3b, and stage 4·5 groups, exercise energy expenditures were 197.8 ± 97.6 , 129.6 ± 85.2 , and 110.7 ± 61.8 kcal/day, and numbers of steps were 6815.8 ± 2659.9 , 5134.2 ± 2779.3 , and 4755.6 ± 2365.5 steps/day, respectively (Figure 1). Exercise energy expenditure and number of steps were significantly lower in the stage 3b and stage 4·5 groups compared with that in the stage 2·3a group ($p < 0.05$). Exercise energy expenditure correlated significantly with age ($r = -0.55$), sex ($r = 0.22$), BMI ($r = 0.20$), eGFR ($r = 0.33$), Hb ($r = 0.37$), UP ($r = 0.17$), employment ($r = 0.23$), handgrip strength ($r = 0.51$), knee extensor muscle strength ($r = 0.58$), and one-leg standing time ($r = 0.49$). On multiple regression analysis, exercise energy expenditure significantly correlated with knee extensor muscle strength, one-leg standing time, and eGFR in patients with pre-dialysis CKD ($R = 0.66$, $R^2 = 0.42$, $p < 0.001$).

We previously reported that the physical function of pre-dialysis CKD patients declines as the disease progresses [5]. The present study showed that the PA of patients with pre-dialysis CKD also declines with the advancement of CKD stage, especially after the patients reach CKD stage 3b. It is important to evaluate PA in early CKD stages. This study showed that PA was related to physical function in patients with pre-dialysis CKD. To increase physical function in these patients, it will likely be necessary to increase their PA. However, the effect of PA on physical function remains unclear. It will be necessary to increase the number of subjects because of the high numbers of males and elderly subjects compared with the

numbers of women and middle-aged subjects in this study.

Conflict of interest: All authors declare no conflicts of interest in relation to the work reported in this manuscript.

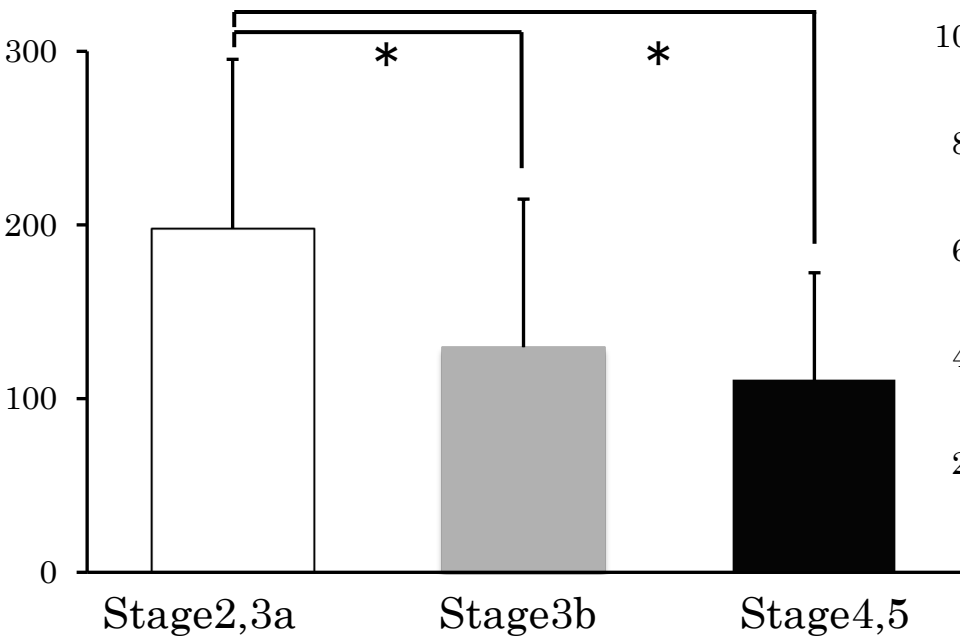
Human and Animal Rights: This article does not contain any studies with animals performed by any of the authors. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee at which the studies were conducted and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The present study was approved by the St. Marianna University School of Medicine Institutional Committee on Human Research (approval number 1965)

Informed Consent: Informed consent was obtained from each patient

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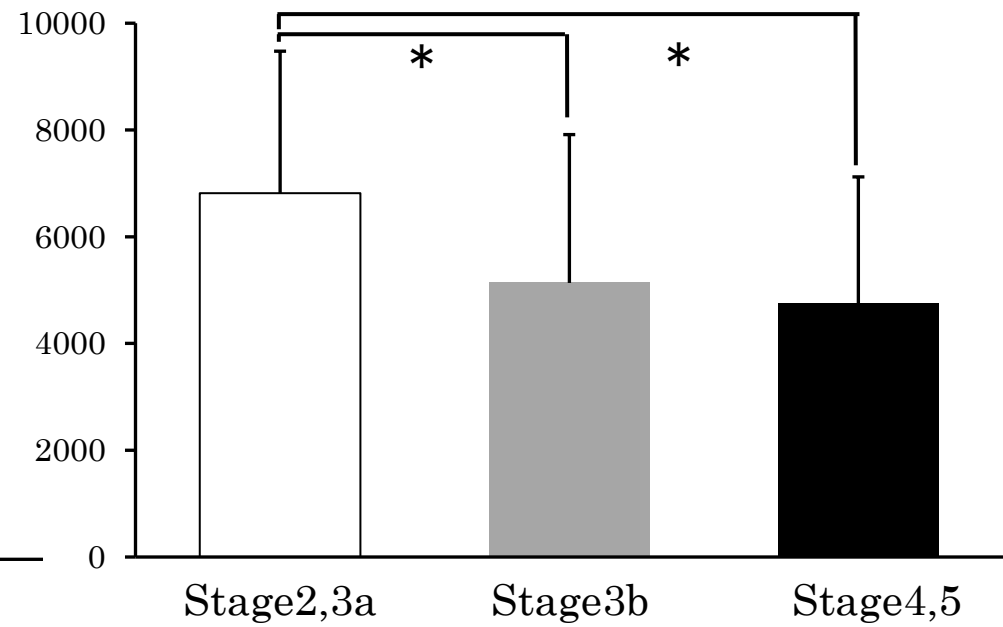
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Exercise energy expenditure (kcal/day)



(F=16.7, $p<0.01$)

Number of steps (steps/day)



(F=9.2, $p<0.01$)