Journal of Babol University of Medical Sciences
JBUMS
e-ISSN: 2251-7170 p-ISSN: 1561-4107

Physical Activity and Renal Function: Results of the Entry Phase of the Fasa Cohort Study

M. Rostami Chijan (MD)[1], A. Dehghan (PhD)[2], M. Kazemi (MD)[2], M. M. Naghizadeh (PhD)[2], M. Emkani (MD)[3], M. Bijani (PhD)[2], M. Farjam (MD, PhD)[2], R. Homayounfar (PhD, MPH)[4*], N. Samimi (MD)[3], M. Sedigh Rahimabadi (MD)[1], A. Ghaemi (PhD)[5]

1.Department of Persian Medicine, Faculty of Medicine, Fasa University of Medical Sciences, Fasa, I.R.Iran.
2.Noncommunicable Diseases Research Center, Fasa University of Medical Sciences, Fasa, I.R.Iran.
3.Student Research Committee, Fasa University of Medical Sciences, Fasa, I.R.Iran.
4.National Nutrition and Food Technology Research Institute, Shahid Beheshti University of Medical Sciences, Tehran, I.R.Iran.
5.Department of Basic Sciences and Nutrition, Faculty of Public Health, Mazandaran University of Medical Sciences, Sari, I.R.Iran.

[*]Corresponding Author: R. Homayounfar (PhD, MPH)
Address: Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, I.R.Iran.
Tel: +98 (21) 22357483. **E-mail:** r_homayounfar@yahoo.com

Article Type
Research Paper

ABSTRACT

Background and Objective: Chronic kidney disease is a major health problem that is associated with low quality of life and premature death. According to the contradictory results of some studies regarding the effect of exercise and physical activity on renal indicators, this study was conducted to determine the relationship between physical activity and glomerular filtration rate (GFR) in the population of Fasa County, Fars province, Iran.

Methods: The current cross-sectional study is derived from the data of the Fasa Persian cohort study. In order to measure the level of physical activity, a standard questionnaire was used in three levels of low, moderate and intense physical activity. Also, renal function was evaluated in three levels: normal, mild insufficiency, and severe insufficiency based on milliliters per minute. In addition to this, the demographic characteristics of people including age, gender, etc. were also evaluated.

Findings: The number of studied people was 5963. The mean physical activity and GFR level in the studied subjects were 2540.1±703.9 (MET-min/Week) and 77.7±11.2 ml/min, respectively. Analytical evaluation showed that there was a statistically significant relationship between GFR levels and physical activity in all three levels ($p<0.001$). Also, a statistically significant relationship was observed between GFR levels with the variables of age, gender, body mass index, waist circumference, blood sugar, blood pressure, sleep duration, smoking, diabetes and hypothyroidism ($p<0.001$).

Conclusion: The results of this study showed that there is a direct relationship between the levels of glomerular filtration rate (GFR) and physical activity.

Keywords: *Glomerular Filtration, Chronic Kidney Disease, Physical Activity.*

Received:
Apr 24th 2023
Revised:
Jun 18th 2023
Accepted:
Aug 22nd 2023

Cite this article: Rostami Chijan M, Dehghan A, Kazemi M, Naghizadeh MM, Emkani M, Bijani M, et al. Physical Activity and Renal Function: Results of the Entry Phase of the Fasa Cohort Study. *Journal of Babol University of Medical Sciences*. 2024; 26: e59.

Introduction

Chronic kidney disease (CKD) is a major public health problem that is associated with low quality of life, increased health costs, and premature death (1). The prevalence of this disease in Iran has been reported to be 27.5% (2). The clinical manifestation of this disease is uremic syndrome, which is usually associated with a severe decrease in glomerular filtration rate (GFR). Among the various known factors, genetics (family history of end-stage kidney disease), environmental factors (exposure to toxins), social and economic weakness, aging, increased blood lipids, lack of diabetes control, high blood pressure, and lifestyle play an important role in the occurrence of kidney dysfunction (3).

In this regard, many studies have investigated the effect of exercise and physical activity on kidney function indicators. The results of the research conducted regarding the relationship between physical activity and chronic kidney failure are inconsistent and contradictory. In some findings, it has been shown that lack of physical activity is associated with a decrease in GFR and an increase in the incidence of end-stage kidney disease (4, 5). In this regard, Rafati Fard et al. reported that aerobic activity can be effective in preventing chronic kidney disease in the early stages and in preventing or delaying the progression of chronic kidney failure (6). On the other hand, Ramezanpour et al. reported that periodic, continuous and parallel aerobic exercises had no effect on the level of urea, uric acid, urinary creatine and protein catabolism (7).

Studies conducted on the relationship between physical activity and chronic kidney disease have reported conflicting results. Therefore, the aim of this research is to investigate the relationship between physical activity and GFR level, the most important indicator in evaluating kidney function, in the population of Fasa.

Methods

After being approved by the Ethics Committee of Fasa University of Medical Sciences with the code IR.FUMS.REC.1397.083, this cross-sectional study was conducted using the data of the first phase of the Fasa Persian cohort study (Prospective Epidemiological Research in Iran) (8, 9). The statistical population included 10141 people. In order to evaluate physical activity, the International Physical Activity Questionnaire (10) was used, in which each activity is weighted based on their relative intensity in terms of metabolic equivalent (MET) (11). Also, in order to estimate the GFR, the Modification of Diet in Renal Disease (MDRD) was used. Based on the GFR score, people are classified into three categories of normal function (GFR equal to or greater than 90 ml/min), mild insufficiency (GFR between 60 and 90 ml/min) and moderate to severe insufficiency (GFR less than 60 ml/min) (12). In addition, in the present study, the demographic characteristics of people including age, sex, blood pressure level, sleep duration, blood sugar level, body mass index, waist circumference and underlying diseases were also evaluated. After collecting data, continuous variables were expressed as mean and standard deviation. Independent t-tests were used to examine the relationship between GFR and quantitative variables using Pearson correlation and using IBM SPSS 26 and $p<0.05$ was considered significant.

Results

The population studied in the present study included 5963 people, of which 2911 people (48.8%) were men and 3052 people (51.2%) were women (Table 1). The mean physical activity of the participants was

2540.1±703.9 MET minutes/week; 4725 people (79.2%) had moderate physical activity and 1238 (20.8%) had intense physical activity. Also, the results showed that the mean level of GFR was 77.7±11.2. The evaluation of GFR levels indicated that 707 people (11.9%) were in the first level and had normal kidney function, 5024 people (84.2%) were in the second level and had mild kidney failure and 232 people (3.9%) were in the third level and had moderate to severe renal failure.

The results of the statistical analysis showed that there was a statistically significant difference between the mean GFR levels and the variables of age (p<0.001, r=-0.260), body mass index (p<0.001, r=-0.200), waist circumference (p<0.001, r=-0.207), blood sugar (p<0.001, r=-0.191), diastolic blood pressure (p<0.001, r=-0.064), systolic blood pressure (p<0.001, r=-0.094), sleep duration at night (p<0.001, r=±0.046) and day (p=0.037, r=-0.027) on the one hand and variables of gender (d=0.967, p<0.001), smoking (p<0.001, d=0.677), diabetes (p<0.001, d=0.398) and hypothyroidism (p<0.001, d=0.346) on the other hand (Figure 1).

Table 1. Demographic characteristics of study participants

Variable	Minimum	Maximum	Number(%) or Mean±SD
Quality indicators			
Gender (male)			2911(48.8)
Smoking	–	–	1741(22.9)
Diabetes			481(8.1)
Hypertension			450(7.5)
Qualitative indices			
Age (years)	35	70	47±8.7
Diastolic blood pressure (mmHg)	55	110	72.1±10.5
Systolic blood pressure (mmHg)	78	170	106.4±14.5
Duration of night sleep (minutes)	30	900	419.8±95
Daily sleep duration (minutes)	0.0	720	50.6±54.8
Fasting blood sugar (mg/dL)	54.2	385.7	90.4±26.2
Body mass index (kg/m2)	15.3	55.4	25±4.7
Waist circumference (cm)	48	146	91.4±11.5
Physical activity (MET minutes/week)	1464	6078	2540.1±703.9
Glomerular filtration rate (ml/min)	32.6	147.1	77.7±11.2

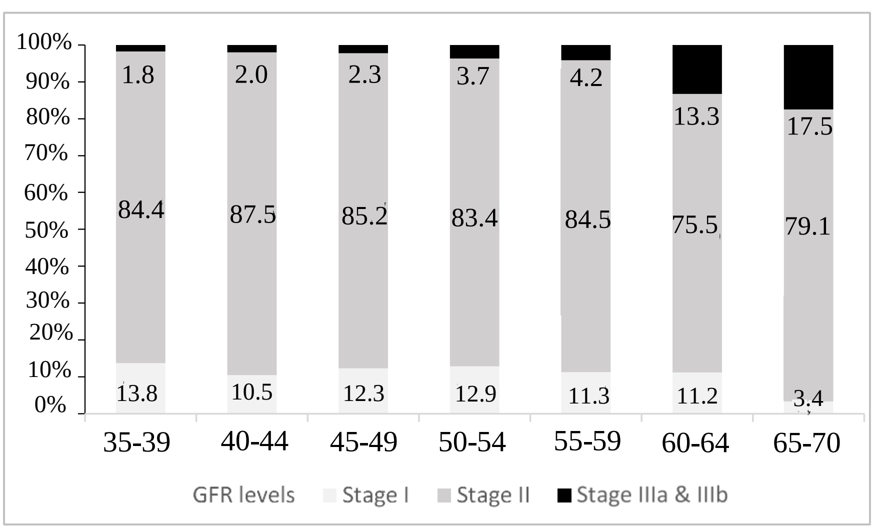

Figure 1. Distribution of GFR level in different age groups

Also, the results indicated that there was a statistically significant relationship between GFR levels and physical activity (p<0.001). 4.4% of people with low and moderate physical activity were involved with stage 3 GFR, while only 1.9% of people with high physical activity experienced this problem (Figure 2). While controlling confounding variables, the relationship between GFR and physical activity was still significant (p<0.001), while systolic blood pressure (p=0.363), diastolic blood pressure (p=0.405) and hypothyroidism (p=0.274) had no significant relationship with GFR (Table 2).

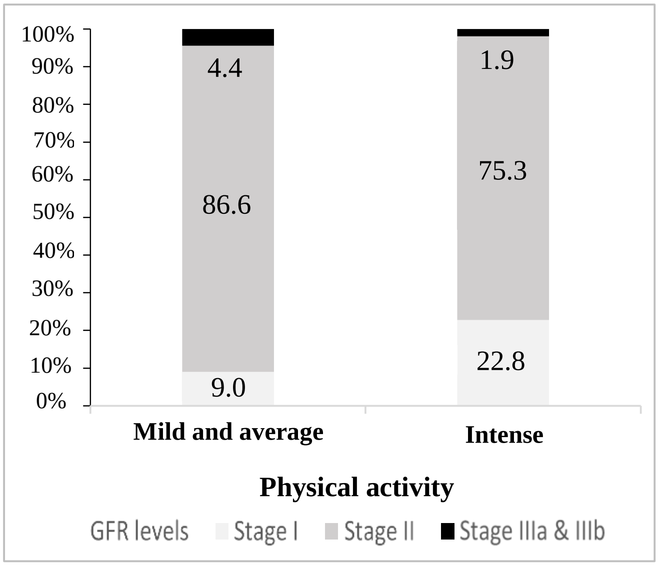

Figure 2. Distribution of GFR levels in moderately and intensely physically active participants

Table 2. Linear regression analysis to show the correlation between GFR and physical activity

Variable	Non-standard coefficients B	Non-standard coefficients S. E	Standard coefficients (Beta)	p-value
Gender	-8.601	0.359	-0.391	<0.001
Age	-0.377	0.017	-0.306	<0.001
physical activity (MET-min/week)	0.001	0.001	0.083	<0.001
body mass index (kg/m2)	-0.114	0.032	-0.062	<0.001
Smoking	1.418	0.359	0.055	<0.001
Diabetes	-1.585	0.460	-0.044	0.001
Daily sleep duration (minutes)	-0.009	0.003	-0.044	0.001
Duration of night sleep (minutes)	0.004	0.001	0.032	0.014
Systolic blood pressure (mmHg)	0.014	0.016	0.019	0.363
diastolic blood pressure (mmHg)	-0.018	0.021	-0.017	0.405
Hypothyroidism	-0.524	0.479	-0.014	0.274

Discussion

The results of the present study showed that there is a statistically significant relationship between the levels of kidney function and physical activity. Also, the results indicated that there is a statistically significant relationship between kidney function and age, sex, body mass index, waist circumference, blood sugar, blood pressure, sleep duration, smoking, diabetes and hypothyroidism.

Studies that have investigated the association between physical activity and kidney function have reported contradictory findings. Some population-based studies have shown that a sedentary lifestyle is associated with a higher risk of decreased glomerular filtration rate (GFR). In line with the results of the present study, a study conducted on 6281 people in Australia reported that the risk of chronic kidney failure in men with high mobility is reduced by 37% compared to people with low mobility, but no significant relationship was observed in women (4). Also, in the American Cardiovascular Health Study, it was shown that a higher level of physical activity reduces the risk of chronic kidney disease by 28% (13). In another cohort study with 15 years of follow-up on 3935 adults, it was stated that there is no significant relationship between regular physical activity and the incidence of chronic kidney disease (14).

Furthermore, in examining the role of demographic variables, the results of our study showed that the GFR level was higher in men compared to women, and age was another related factor. These findings are consistent with population-based studies showing that CKD differs in men and women. Kidney function decreases faster in men compared to women (15). Also, there is a statistically significant relationship between large kidneys and increased GFR in diabetes (16). As a result, there was a significant relationship between diabetes and GFR in our population.

Finally, it is worth noting that the mean GFR rate of the evaluated population was very low compared to other studies such as USA and Pakistan. Nevertheless, GFR has a wide normal range and many factors are contributing; in adults, a normal GFR is 90 mL/min or higher, and a GFR between 60-89 mL/min may be normal for some people, including those over 60 years of age. However, GFR decreases with age even in people without kidney disease (17, 18).

The large and well-selected sample size is the most important strength of our study. On the other hand, this is a population-based study that allows generalization of the findings to other similar adults.

Moreover, the limitation of this study was the assessment of GFR based on the MDRD equation. But its seems that using the creatinine/cystatin CKD-EPI equation method is a more accurate way (19, 20).

In the end, it can be concluded that the findings of this study show that more physical activity is related to a lower risk of chronic kidney disease. It seems that physical activity, as one of the important determinants of lifestyle, plays an important role in preventing the occurrence of chronic kidney disease.

Acknowledgment

We hereby acknowledge the support of the Research and Technology Vice-Chancellor of Fasa University of Medical Sciences for supporting the research, as well as all the participants in this study and the research staff Soroush Dadvari, Sediqeh Aghaei Kian and Sara Azarnia for their compassionate assistance.

References

1.The EMPA-KIDNEY Collaborative Group; Herrington WG, Staplin N, Wanner C, Green JB, Hauske SJ, Emberson JR, et al. Empagliflozin in Patients with Chronic Kidney Disease. N Engl J Med. 2023;388(2):117-27.

2.Dehghani A, Alishavandi S, Nourimajalan N, Fallahzadeh H, Rahmanian V. Prevalence of chronic kidney diseases and its determinants among Iranian adults: results of the first phase of Shahedieh cohort study. BMC Nephrol. 2022;23(1):203.

3.Köttgen A, Cornec-Le Gall E, Halbritter J, Kiryluk K, Mallett AJ, Parekh RS, et al. Genetics in chronic kidney disease: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference. Kidney Int. 2022;101(6):1126-41.

4.Bharakhada N, Yates T, Davies MJ, Wilmot EG, Edwardson C, Henson J, et al. Association of sitting time and physical activity with CKD: a cross-sectional study in family practices. Am J Kidney Dis. 2012;60(4):583-90.

5.Finkelstein J, Joshi A, Hise MK. Association of physical activity and renal function in subjects with and without metabolic syndrome: a review of the Third National Health and Nutrition Examination Survey (NHANES III). Am J Kidney Dis. 2006;48(3):372-82.

6.Rafati Fard M, Taghian F, Pakfetrat M, Daryanoosh F, Mohammadi H. The Effect of aerobic training on the Amount of GFR and excreted of Creatinine in Patients with Chronic kidney. J Army Univ Med Sci. 2011;9(4):264-70. [In Persian]

7.Ramezanpour MR, Hejazi SM, Mottaghy Shahri S, Kianmehr M, Mottaghy Shahri MR. Comparison the Effect of Interval, Continuous and Parallel Aerobic Exercise on Urea, Uric Acid and Creatinine of Urine Level. Intern Med Today (Quart Horizon Med Sci). 2013;19(3):137-41. [In Persian]

8.Farjam M, Bahrami H, Bahramali E, Jamshidi J, Askari A, Zakeri H, et al. A cohort study protocol to analyze the predisposing factors to common chronic non-communicable diseases in rural areas: Fasa Cohort Study. BMC Public Health. 2016;16(1):1090.

9.Homayounfar R, Farjam M, Bahramali E, Sharafi M, Poustchi H, Malekzadeh R, et al. Cohort Profile: The Fasa Adults Cohort Study (FACS): a prospective study of non-communicable diseases risks. Int J Epidemiol. 2023;52(3):e172-8.

10.Kriska AM, Edelstein SL, Hamman RF, Otto A, Bray GA, Mayer-Davis EJ, et al. Physical activity in individuals at risk for diabetes: Diabetes Prevention Program. Med Sci Sports Exerc. 2006;38(5):826-32.

11.Sesso HD, Paffenbarger RS Jr, Lee IM. Physical activity and coronary heart disease in men: The Harvard Alumni Health Study. Circulation. 2000;102(9):975-80.

12.Levey AS, Coresh J, Bolton K, Culleton B, Harvey KS, Ikizler TA, et al. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Am J Kidney Dis. 2002;39(2 Suppl 1):S1-266.

13.Robinson-Cohen C, Katz R, Mozaffarian D, Dalrymple LS, de Boer I, Sarnak M, et al. Physical activity and rapid decline in kidney function among older adults. Arch Intern Med. 2009;169(22):2116-23.

14.Herber-Gast GC, Hulsegge G, Hartman L, Verschuren WM, Stehouwer CD, Gansevoort RT, et al. Physical Activity Is not Associated with Estimated Glomerular Filtration Rate among Young and Middle-Aged Adults: Results from the Population-Based Longitudinal Doetinchem Study. PLoS One. 2015;10(10):e0133864.

15.Carrero JJ, Hecking M, Chesnaye NC, Jager KJ. Sex and gender disparities in the epidemiology and outcomes of chronic kidney disease. Nat Rev Nephrol. 2018;14(3):151-64.

16.Mutter S, Valo E, Aittomäki V, Nybo K, Raivonen L, Thorn LM, et al. Urinary metabolite profiling and risk of progression of diabetic nephropathy in 2670 individuals with type 1 diabetes. Diabetologia. 2022;65(1):140-9.
17.Coresh J, Astor BC, Greene T, Eknoyan G, Levey AS. Prevalence of chronic kidney disease and decreased kidney function in the adult US population: Third National Health and Nutrition Examination Survey. Am J Kidney Dis. 2003;41(1):1-12.
18.Jessani S, Levey AS, Bux R, Inker LA, Islam M, Chaturvedi N, et al. Estimation of GFR in South Asians: a study from the general population in Pakistan. Am J Kidney Dis. 2014;63(1):49-58.
19.Levey AS, Inker LA, Coresh J. GFR estimation: from physiology to public health. Am J Kidney Dis. 2014;63(5):820-34.
20.Schwandt A, Denkinger M, Fasching P, Pfeifer M, Wagner C, Weiland J, et al. Comparison of MDRD, CKD-EPI, and Cockcroft-Gault equation in relation to measured glomerular filtration rate among a large cohort with diabetes. J Diabetes Complications. 2017;31(9):1376-83.