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Somatotype Characteristics of Patients with Non-Dialysis Chronic Kidney Disease and its Relationships with Physical Activity and Depression

Características del Somatotipo de Pacientes con Enfermedad Renal Crónica sin Diálisis y su Relación con la Actividad Física y la Depresión

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SUMMARY: Somatotype characters have been defined for many diseases. However, there is insufficient information on the somatotype characters of chronic kidney patients. The first aim of our study was to define the specific somatotype in patients diagnosed with CKD. The second aim was to investigate the relationship between somatotype characters and physical activity and depression in CKD patients. A total of 88 (52.7 %) patients diagnosed with CKD between January and December 2021 at the Department of Nephrology, Inonu University Hospital (Malatya, Turkey) and 79 (47.3 %) healthy volunteers were included in the study. Somatotype analysis was performed using the Heath-Carter method. Physical activity was assessed with the International Physical Activity Questionnaire (IPAQ) and depressive symptoms with the Beck Depression Inventory (BDI). Analysis revealed that patients had greater medial calf girth (p = 0.036), higher triceps (p = 0.007) and suprailiac (p = 0.042) skinfold thicknesses and higher body mass index (p = 0.007) compared to controls. Patients also had significantly higher endomorphy (patients: 6.57±1.35 vs. controls: 6.04±1.3; effect size (ES): 0.40, p=0.010) and significantly higher mesomorphy (patients: 7.44±2 vs. controls: 6.85±2.3; ES: 0.27, p=0.039) as well as significantly lower ectomorphy (patients: 0.71±0.69 vs. controls: 1.10±0.93; ES: 0.47, p=0.006). Significant positive correlations were also observed between mesomorphy and IPAQ (rho = 0.219, p = 0.04), endomorphy and BDI (rho = 0.423, p < 0.001) and mesomorphy and BDI (rho = 0.392, p > 0.001). Significant negative correlations were observed between ectomorph and BDI (rho = -0.325, p = 0.002). We observed that the dominant somatotype was endomorphic mesomorph in patients with CKD. In addition, the fact that CKD patients with ectomorphic body structure have lower depressive symptoms could have an impact on their well-being.

KEY WORDS: Chronic kidney disease; Depression; Obesity; Phsyical activity; Somatotype.

INTRODUCTION

Chronic kidney disease (CKD) has become a leading public health problem worldwide, as it is associated with high mortality and morbidity in the adult population (Kalantar-Zadeh *et al*., 2021). In the 2022 update on the epidemiology of chronic kidney disease, Kovesdy defines CKD as one of the few non-communicable diseases that have seen an increase in associated deaths has increased over the last 2 decades (Kovesdy, 2022). In addition to known risk factors such as age, sex, genetic component, race/ethnicity, family history, nephrotoxins, hepatitis C virus, human immunodeficiency virus infection, diabetes, hypertension, obesity, smoking, cardiovascular disease, hyperlipidaemia and metabolic syndrome, some researchers have defined an abnormal increase in oxidative stress and chronic inflammation as an important pathogenetic role in the development of CKD (Kazancioglu, 2013; Tinti *et al*., 2021).

Physical activity (PA) has been shown to improve vascular endothelial function in patients with CKD by increasing nitric oxide (NO) and reducing reactive oxygen species (ROS). In addition, PA reduces angiotensin levels II

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through its suppressive effect on the overactive renin-angiotensin system, helping to maintain renal health. Studies have also shown that low PA levels are associated with obesity and increased body fat in CKD (Memarian *et al*., 2021). In addition, depression has been described as the most common and debilitating symptom in CKD patients. The prevalence of depressive symptoms assessed by self- or physician-generated rating scales was 39.3 % in CKD stage 5D, 26.5 % in stages 1-5 and 26.6 % in transplant recipients (Palmer *et al*., 2013). In the studies conducted, the mechanism of the association between CKD and depression was also explained by abdominal obesity, body fat percentage and inflammatory markers (Kopple & Feroze, 2011).

Although the underlying pathophysiological mechanisms are not well explained, the interaction between obesity and CKD is well documented and scientific data are available (Martin-Taboada *et al*., 2021; Memarian *et al*., 2021). Obesity-related increase in adipose tissue, lipotoxicity and oxidative stress lead to irreversible damage to renal functions over time with damage to vascular endothelial structure and fibrosis in the kidneys (Martin-Taboada *et al*., 2021). Examination of the literature shows that anthropometric measurements and body composition parameters are highlighted as obesity indicators when assessing the role of obesity in the development of CKD (Memarian *et al*., 2021), but somatotype is not mentioned. However, somatotype could also be an important measurement parameter for the risk of CKD. To the best of our knowledge, although only one study has analysed the sonographic model parameters of patients with endo-mesoporic kidneys for anthropometric index characteristics, no studies were found that directly assessed the somatotype characteristics of patients with CKD (Ustymenko, 2018).

The first aim of our study was to define the specific somatotype in patients diagnosed with CKD. The second aim was to investigate the relationship between somatotype characteristics and physical activity and depression in CKD patients.

MATERIAL AND METHOD

Research Groups and Study Design. A total of 88 patients (48 women and 40 men) diagnosed with chronic kidney disease (mean age ± standard deviation: 44.9 ± 9.49 years). Seventy-nine healthy controls (46 women and 33 men) were included in the study (mean age ± standard deviation: 42.34 ± 11.84 years). The patients with chronic kidney disease were measured at the nephrology outpatient clinic of Inonu University, while the healthy control subjects were recruited among the medical staff and students of the Faculty of Medicine. This study was approved by the Malatya Clinical Research Ethics Committee (Protocol No: 2021/202) and the clinical research was conducted from January 2021 to December 2021. The study was conducted in accordance with the principles of the Declaration of Helsinki. After the subjects were informed about the study, informed consent forms were signed. The socio-demographic data of each participant were recorded in the patient information form.

Inclusion and Exclusion Criteria. Inclusion criteria were stage 2-5 CKD patients nondialysis (CKD-ND) or proteinuria based on standard definitions and ability to participate in informed consent. CKD-ND was defined as either estimated glomerular filtration rate (eGFR) < 60 ml/min/1.73 m2 or eGFR 60-89 with another marker of renal disease such as albuminuria, proteinuria, haematuria or abnormal pathology on imaging or biopsy of the kidneys present at least 3 months prior to inclusion in the study. Stage 2 CKD-ND was defined as eGFR 60-89 with another marker of kidney disease; stage 3, eGFR 30-59; stage 4, eGFR 15-29; and stage 5, eGFR < 15 (Levey *et al*., 2005). Patients on chronic peritoneal dialysis or haemodialysis and renal transplant recipients were excluded. In addition, patients with congenital anomalies, patients with large cortical cysts or masses, patients with partial or total nephrectomy and patients with atrophic kidney were excluded.

Anthropometric Measurements. Participants were instructed to rest for 24 hours before the measurements and not to engage in heavy physical activity. Measurements were taken at rest in all participants in the morning after 8 hours of fasting. All anthropometric measurements of the subjects were performed in accordance with the measurement techniques and standards recommended by the International Society for the Advancement of Kinanthropometry.

Somatotype Determination. Somatotypes were determined according to the Heath-Carter method (Carter & Heath, 1990). The anthropometric profiles of the subjects were measured according to the protocols of the International Society for the Development of Kinanthropometry with a technical measurement error of no more than 1 % (Stewart *et al*., 2011). All measurement procedures were performed with minimal clothing and no shoes. Height was measured using a stadiometer with a sensitivity of 0.1 cm and weight was measured using a segmental body composition analyser (Tanita Corporation, Tokyo, Japan, model: BC 418) with a sensitivity of 0.1 kg. BMI was calculated using the formula weight (kg) / height (m^2). Then, body circumferences (flexed and tensed upper arm circumference and calf circumference) were measured to the nearest 0.1 cm using a flexible but non-stretchable tape (Holtain Ltd, Croswell, UK). Bi-epicondylar humerus and femur width was measured to the nearest 0.1 cm using a bicondylar calliper (Holtain Ltd, Croswell, UK). Participants' skinfold thickness was determined at 4 sites (triceps, suprailiacus, subscapula, calf) using a skinfold caliper (Holtain Ltd, Croswell, UK). The somatotype calculations were performed using the software "Somatotype for Windows 1.2.5 Trial Version".

Physical Activity Level. The International Physical Activity Questionnaire (IPAQ) was used to determine the level of physical activity of the study participants. This questionnaire provides information on how much time individuals spend in light, moderate and vigorous activities, as well as their sedentary behaviour. In assessing these activities, the criterion for inclusion is that each activity is performed for at least 10 minutes at a time. For each activity level, the metabolic equivalent value (MET) was determined by multiplying the minutes by the number of days to obtain a min/week value. The value was classified as either no physical activity (MET≤600) or an insufficient activity level (MET≥3,000) (Ainsworth *et al*., 2000). To determine how much energy was expended during each physical activity, the weekly duration (min) of each activity and the MET values from the IPAQ were multiplied together. In this way, the values for light, moderate and intense activity and the total energy expenditure for each activity level were calculated.

Depression Level. The Beck Depression Inventory (BDI) is a self-report scale developed by Beck in 1961 to measure emotional, cognitive, somatic and motivational components. The BDI is one of the most commonly used self-report instruments in research and clinical settings. Although its main purpose is to comprehensively assess symptoms of depression, it also allows for the assessment of cognitive content. The scale consists of 21 items. Two items relate to emotions, eleven items to cognitions, two items to behaviours, five items to somatic symptoms and one item to interpersonal symptoms. This questionnaire, consisting of 21 questions, was used in the evaluation of the BDI. Patients were asked to select the most appropriate questions for their situation. Scores from 0 to 63 were obtained by assigning 0, 1, 2, 3 points for each question. The scores were classified as follows: 0-9 no/mild depression, 10-18 mild depression, 19-29 moderate depression and 30-63 severe depression (Miller, 1987).

Statistical Analysis. Descriptive data were represented by mean, standard deviation, median, interquartile range, maximum and minimum values. We determined normality using the Kolmogorov-Smirnov test. The significance of demographic and anthropometric differences between patients and controls was tested using the independent samples t-test and the Mann-Whitney U-test. In addition, somatotype comparisons between patients and controls were performed using the non-parametric Mann-Whitney test. The effect size was calculated as Hedge's g, which is similar to Cohen's d but corrected for small sample bias. As with Cohen's d, an effect size ≥0.2 was considered small, an effect size ≥0.5 was considered medium and an effect size ≥0.8 was considered large (Gennaro & de Bruin, 2020). Correlations between somatotype characteristics and BDI and IPAQ skores were assessed in CKD patients using Spearman's rank correlation coefficient. The significance level was set at a ≤ .05.

RESULTS

A total of 167 subjects (88 patients with CKD and 79 healthy subjects) participated in this study. There was no statistically significant difference between the two groups in demographic parameters except BMI (p =0.007) (Table I).

The results of the comparison between the patients and the control subjects regarding the anthropometric parameters of the body dimensions are shown in the Table II. The medial calf girth was significantly greater in the patients with CKD (40.1±4.32 vs. 38.76±4.03 cm, p=0.036), the triceps (22.69±7.91 vs. 19.38±7.27 mm, p=0.007) and the suprailiac skinfold (23.85±7.1 vs. 21.27±6.33 mm, p= 0.042) were significantly higher than in the controls.

Table III shows the values of the components of somatotype in the patients and the control group. Patients with CKD had significantly higher endomorphy (patients: 6.57±1.35 vs. controls: 6.04±1.3; effect size (ES): 0.40, p=0.010) and significantly higher mesomorphy (patients: 7.44±2 vs. controls: 6.85±2.3; ES: 0.27, p=0.039) as well as significantly lower ectomorphy (patients: 0.71±0.69 vs. controls: 1.10±0.93; ES: 0.47, p=0.006) (Fig. 1). The somato-map of all subjects is shown in Fig. 2 (A: patients with CKD; B: healthy subjects).

Significant positive correlations were found between mesomorphy and IPAQ (rho = 0.219, p = 0.04), endomorphy and BDI (rho = 0.423, p < 0.001) and between mesomorphy and BDI (rho = 0.392, p > 0.001). Negative correlations were observed between ectomorphy and BDI (rho = -0.325, p = 0.002). There were no other significant correlations (p > 0.05) between somatotype scores and the measured parameters in patients with CKD (Fig. 3).

Table I. Comparison of the demographic parameters of patients with CKD and controls.

Parameters	Patients (n=88)				Controls (n=79)				P value
	Mean±SD	Median	Min-max	IQR	Mean±SD	Median	Min-max	IQR	
Age (years)	44.9±9.49	45	21-71	10.5	42.34±11.84	45	20-67	17	0.123
Weight (kg)	77.84±13.36	76.5	53-120	17	74.75±11.44	74	51-101	18.5	0.113
Height (cm)	165.04±8.27	165	150-182	11	167.48±7.79	168	150-185	15	0.053
BMI (kg/m^2)	28.67±4.76	27.61	21.3-45.72	6.89	26.66±3.87	26.35	19.49-37.78	4.96	**0.007**

Data shown as mean ± SD, median, min-max: minimum-maximum; IQR: interquartile range; BMI: body mass index. Significance shown in bold, p<0.05.

Table II. Comparison of anthropometric characteristics of patients with CKD and controls.

Parameters	Patients (n=88)				Controls (n=79)				P value
	Mean (SD)	Median	Min-max	IQR	Mean ±SD	Median	Min-max	IQR	
Triceps skinfold (mm)	22.69 (7.91)	23	8 38	13	19.38 7.27	19	7 39	13	**0.007**
Subscapular skinfold (mm)	22.53 (6.96)	22	8 39	11	22.10 6.36	22	8 40	9	0.774
Suprailiac skinfold (mm)	23.85 (7.1)	24	7 38	11	21.27 6.33	21	6 36	8	**0.042**
Medial calf skinfold (mm)	19.85 (7.87)	19	7 39	11.75	20.37 7.18	20	8 41	11	0.558
Flexed upper arm girth (cm)	31.38 (3.09)	31	25 39	4	31.13 3.35	31	24 38	5	0.544
Medial calf girth (cm)	40.1 (4.32)	40	32 53	5	38.76 4.03	38	28 52	5	**0.036**
Bi-Humeral breadth (cm)	8.08 (.67)	8.1	7 9.7	.97	8.06 1.03	8	6 10.5	1.6	0.905
Bi-Femoral breadth (cm)	10.01 .95	9.9	8.1 14.4	1.17	9.91 1.03	9.9	7.5 13.5	1.1	0.438

Data shown as mean ± SD, median, min-max: minimum-maximum; IQR: interquartile range. Significance shown in bold, p<0.05.

Table III. Somatotype characteristics of patients with CKD and controls.

Parameters	Patients (n=88)				Controls (n=79)			
	Mean ±SD	Median	Min-max	IQR	Mean ±SD	Median	Min-max	IQR
Endomorphy	6.57 ±1.35	6.7	3.2-9.3	2.05	6.04 ±1.30	6	2.7-8.7	1.80
Mesomorphy	7.44 ±2	7.35	3.3-13.2	2.68	6.85 ±2.30	6.7	3.3-12.3	3.40
Ectomorphy	.71 ±.69	.50	.10-2.7	1.00	1.10 ±.93	.90	.10-3.8	1.50

Data shown as mean ± SD, median, min-max: minimum-maximum; IQR: interquartile range.

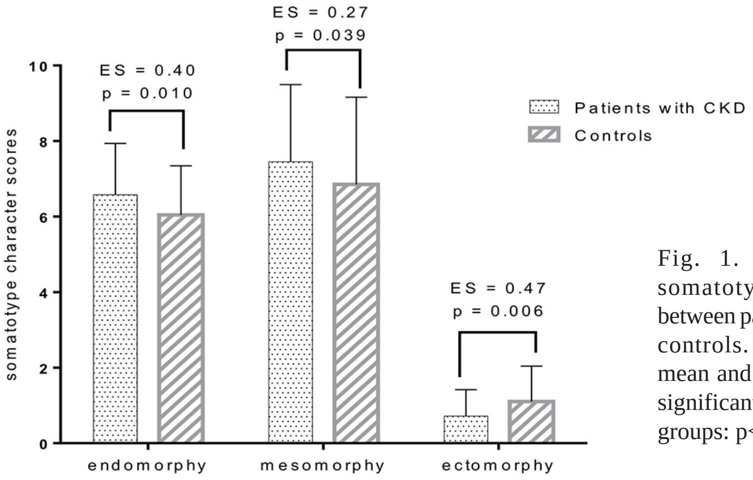

Fig. 1. Comparations of somatotype characteristics between patients with CKD and controls. Data presented as mean and SD. ES: effect size; significant difference between groups: p<0.05.

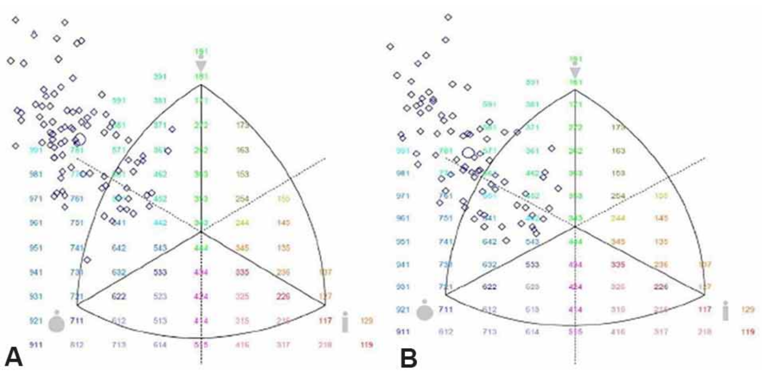

Fig. 2. Individual somatoplots of subjects and the mean somatoplot for participants (circle); A: Patients with CKD; B: Control Subjects

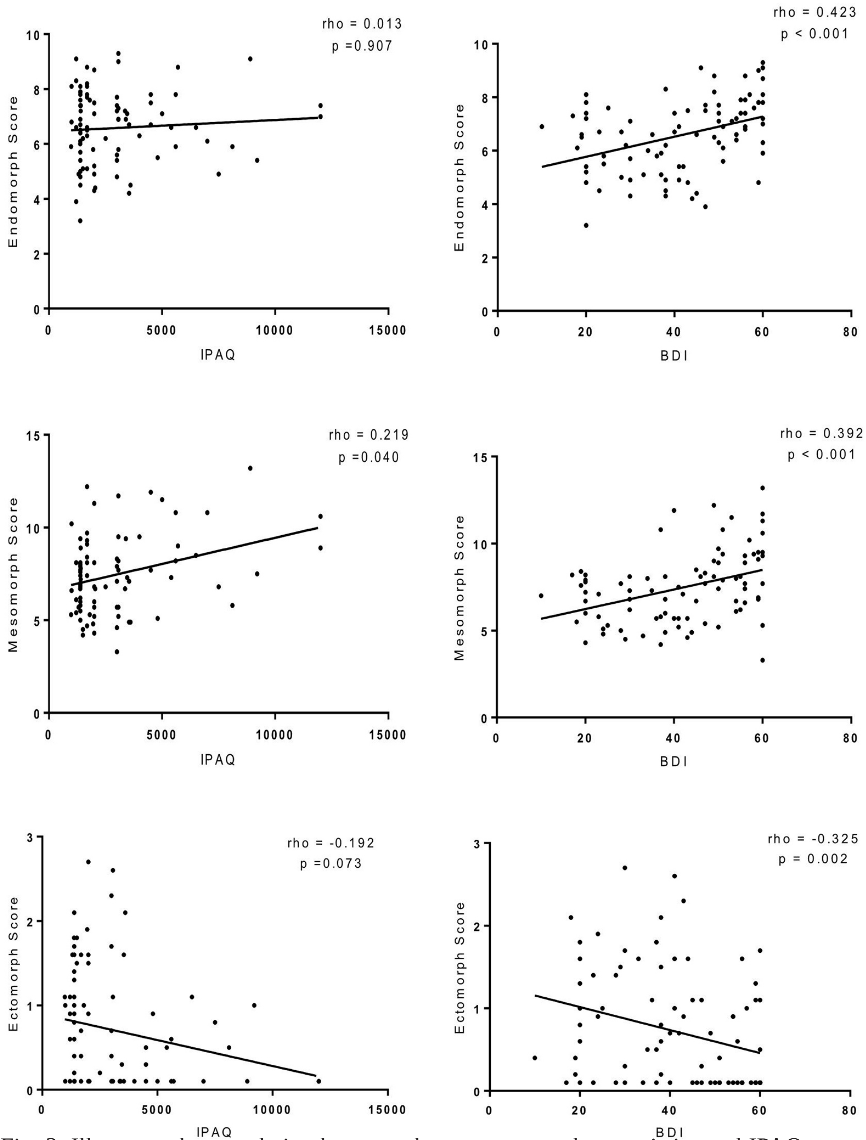

Fig. 3. Illustrates the correlation between the somatotype characteristics and IPAQ scores (left column) and BDI scores (right column).

DISCUSSION

This study was conducted to determine the anthropometric and somatotype characteristics of patients with CKD. The second aim was to determine the relationship between somatotype characteristics, physical activity and depression in CKD patients. The results of this study show that somatotype in CKD patients has endomorphy (6.57) - mesomorphy (7.44) - ectomorphy (0.71). BMI, triceps and suprailiac skinfolds and medial calf girth were significantly greater in patients than in controls. In addition, a positive correlation was found between depression and mesomorphic and endomorphic scores. On the other hand, ectomorphy was negatively correlated with depression. Furthermore, mesomorphy was associated with increased physical activity in CKD patients.

Visceral abdominal fat and subcutaneous adipose tissue are considered prognostic factors for decline in renal function (Kim *et al*., 2011). The association between obesity and CKD could be explained by the negative effects of lipotoxicity and adipose tissue inflammation on renal function in obesity (Martin-Taboada *et al*., 2021; Memarian *et al*., 2021). In line with the above findings, the study by Dong *et al*. (2018) identified visceral fat index, BMI and percentage body fat as predictors of CKD development. Our results showed that the thickness of the suprailiac skinfold, which is an indicator of truncal obesity, was significantly higher in patients compared to the healthy group. The fact that the endomorphy and BMI values of the patient group were higher than those of the control group and the ectomorphy values were lower suggests that fattyness may be an important risk factor for CKD.

It has been mentioned that there is an association between obesity and increased fat and low PA in CKD patients (Memarian *et al*., 2021). In our study, only a positive linear relationship was observed between the mesomorphy component and PA. It is suggested that the results obtained are due to the fact that people with higher mesomorphy scores have higher strength output. The moderate and high correlation between PA and the strength scores may directly explain the relationship between the mesomorphy component and PA. However, although a relationship between the endomorphy component and low PA values was expected in our study, no significant correlation was observed. A study has found that somatotype scores interact with vitality rather than PA and that somatotype scores may not be sufficient to explain PA scores. (Marta *et al*., 2011). Linking low physical activity only to somatotype components may therefore be of limited use.

However, it can be noted that the increase in obesity indicators (BMI, fattyness or endomorphy) is negative at PA level.

Indicators of body composition and obesity are associated with the development of depression. The negative effects of depression on kidney functions are mainly explained by vascular endothelial damage, oxidative stress and the accumulation of inflammatory substances. In addition, depression is involved in modulating vascular tone by altering serotonin levels, altering norepinephrine and cortisol production, and increasing platelet aggregation, all of which can lead to kidney damage (Kopple & Feroze, 2011; Shirazian *et al*., 2017). In a clinical study assessing depression scores with the BDI:II, it was found that 165 female adults (BMI: 27.5 kg/m^2) attending an obesity clinic had higher levels of depression and anxiety compared to the healthy control group (Lim *et al*., 2017). In another study, 31 female patients diagnosed with manic-depressive disorder were found to have mesomorph-endomorph (Tóth *et al*., 2003). In our study, endomorphy (rho = 0.423) and mesomorphy scores (rho = 0.392) of CKD patients were found to be positively correlated with the level of depression (p = 0.001), while the ectomorphy score was negatively correlated with the level of depression (rho = -0.325; p = 0.002). The increase in mesomorphic and endomorphic scores could be a risk factor for the degree of depression in CKD patients.

CONCLUSION

In our study, it was observed that kidney patients had higher endomorphy and mesomorphy scores and lower ectomorphy scores compared to the control subjects. In addition, it can be noted that kidney patients with an increase in the mesomorphy component can be expected to have an increase in PA, while with an increase in the ectomorphy component, a decrease in depression can be observed. To better understand the interaction between kidney disease and somatotype characters in future research, it may be advisable to study the somatotype characters of kidney patients who are on dialysis or have received an organ transplant.

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RESUMEN: Se han definido caracteres de somatotipo para muchas enfermedades. Sin embargo, no hay suficiente información sobre los caracteres somatotípicos de los pacientes renales crónicos. El primer objetivo de nuestro estudio fue definir el somatotipo específico en pacientes diagnosticados de ERC. El segundo objetivo fue investigar la relación entre los caracteres del somatotipo y la actividad física y la depresión en pacientes con ERC. Se incluyeron en el estudio un total de 88 (52,7 %) pacientes diagnosticados con ERC entre enero y diciembre de 2021 en el Departamento de Nefrología del Hospital Universitario de Inonu (Malatya, Turquía) y 79 (47,3 %) voluntarios sanos. El análisis del somatotipo se realizó mediante el método de Heath-Carter. La actividad física se evaluó con el Cuestionario Internacional de Actividad Física (IPAQ) y los síntomas depresivos con el Inventario de Depresión de Beck (BDI). El análisis reveló que los pacientes tenían una mayor circunferencia media de la pierna (pantorrilla) (p = 0,036), tríceps (p = 0,007) y pliegues cutáneos suprailíacos (p = 0,042) más altos y un IMC más alto (p = 0,007) en comparación con los controles. Los pacientes también tenían una endomorfia significativamente mayor (pacientes: 6,57±1,35 frente a controles: 6,04±1,3; tamaño del efecto (ES): 0,40, p=0,010) y una mesomorfia significativamente mayor (pacientes: 7,44±2 frente a controles: 6,85±2,3; ES: 0,27, p=0,039) así como una ectomorfia significativamente menor (pacientes: 0,71±0,69 vs. controles: 1,10±0,93; ES: 0,47, p=0,006). También se observaron correlaciones positivas significativas entre mesomorfia e IPAQ (rho = 0,219, p = 0,04), endomorfia y BDI (rho = 0,423, p < 0,001) y mesomorfia y BDI (rho = 0,392, p > 0,001). Se observaron correlaciones negativas significativas entre ectomorfo y BDI (rho = -0,325, p = 0,002). Observamos que el somatotipo dominante fue el mesomorfo endomórfico en pacientes con ERC. Además, el hecho de que los pacientes con ERC con estructura corporal ectomórfica tengan menos síntomas depresivos podría tener un impacto en su bienestar.

PALABRAS CLAVE: Enfermedad renal crónica; Depresión; Obesidad; actividad física; Somatotipo.

REFERENCES

Ainsworth, B. E.; Haskell, W. L.; Whitt, M. C.; Irwin, M. L.; Swartz, A. M.; Strath, S. J.; O'Brien, W. L.; Bassett Jr., D. R.; Schmitz, K. H.; Emplaincourt, P. O.; *et al*. Compendium of physical activities: an update of activity codes and MET intensities. *Med. Sci. Sports Exerc., 32(9 Suppl.)*:S498-504, 2000.

Carter, J. E. L. & Heath, B. I. *Somatotyping. Development and Applications*. Cambridge, Cambridge University Press, 1990.

Dong, Y.; Wang, Z.; Chen, Z.; Wang, X.; Zhang, L.; Nie, J.; Zheng, C.; Wang, J.; Shao, L.; Tian, Y.; *et al*. Comparison of visceral, body fat indices and anthropometric measures in relation to chronic kidney disease among Chinese adults from a large scale cross-sectional study. *BMC Nephrol., 19(1)*:40, 2018.

Gennaro, F. & de Bruin, E. D. A pilot study assessing reliability and age-related differences in corticomuscular and intramuscular coherence in ankle dorsiflexors during walking. *Physiol. Rep., 8(4)*:e14378, 2020.

Kalantar-Zadeh, K.; Jafar, T. H.; Nitsch, D.; Neuen, B. L. & Perkovic, V. Chronic kidney disease. *Lancet, 398(10302)*:786-2, 2021.

Kazancioglu, R. Risk factors for chronic kidney disease: an update. Kidney *Int. Suppl. (2011), 3(4)*:368-71, 2013.

Kim, S. R.; Yoo, J. H.; Song, H. C.; Lee, S. S.; Yoo, S. J.; Kim, Y. D.; Lim, Y. S.; Kim, H. W.; Yang, C. W.; Kim, Y. S.; *et al*. Relationship of visceral and subcutaneous adiposity with renal function in people with type 2 diabetes mellitus. *Nephrol. Dial. Transplant., 26(11)*:3550-5, 2011.

Kopple, J. D. & Feroze, U. The effect of obesity on chronic kidney disease. *J. Ren. Nutr., 21(1)*:66-71, 2011.

Kovesdy, C. P. Epidemiology of chronic kidney disease: an update 2022. *Kidney Int. Suppl. (2011), 12(1)*:7-11, 2022.

Levey, A. S.; Eckardt, K. U. & Tsukamoto, Y. Definition and classification of chronic kidney disease: a position statement from Kidney Disease: Improving Global Outcomes (KDIGO). *Kidney Int., 67(6)*:2089-100, 2005.

Lim, H. R.; Park, E. J.; Oh, H. J.; Seo, C. N. & Han, S. H. A Comparative study on the depression, anxiety, quality of life, psychological well-being ındex and sleep quality in obesity clinic-visited patients. *Korean J. Fam. Pract. 7(1)*:30-5, 2017.

Marta, C.; Marinho, D. A.; Costa, A. M.; Barbosa, T. M. & Marques, M. C. Somatotype is more interactive with strength than fat mass and physical activity in peripubertal children. *J. Hum. Kinet. 29A*:83-91, 2011.

Martin-Taboada, M.; Vila-Bedmar, R. & Medina-Gómez, G. From obesity to chronic kidney disease: how can adipose tissue affect renal function? *Nephron, 145(6)*:609-13, 2021.

Memarian, E.; Nilsson, P. M.; Zia, I.; Christensson, A. & Engström, G. The risk of chronic kidney disease in relation to anthropometric measures of obesity: A Swedish cohort study. *BMC Nephrol., 22(1)*:330, 2021.

Miller, B. D. Depression and asthma: A potentially lethal mixture. *J. Allergy Clin. Immunol., 80(3 Pt. 2)*:481-6, 1987.

Palmer, S.; Vecchio, M.; Craig, J. C.; Tonelli, M.; Johnson, D. W.; Nicolucci, A.; Pellegrini, F.; Saglimbene, V.; Logroscino, G.; Fishbane, S.; *et al*. Prevalence of depression in chronic kidney disease: systematic review and meta-analysis of observational studies. *Kidney Int., 84(1)*:179-91, 2013.

Shirazian, S.; Grant, C. D.; Aina, O.; Mattana, J.; Khorassani, F. & Ricardo, A. C. Depression in chronic kidney disease and end-stage renal disease: similarities and differences in diagnosis, epidemiology, and management. *Kidney Int. Rep., 2(1)*:94-107, 2017.

Stewart, A.; Marfell-Jones, M.; Olds, T. & de Ridder, H. *International Standards for Anthropometric Assessment.* Sidnay, International Society for the Advancement of Kinanthropometry, 2011.

Tinti, F.; Lai, S.; Noce, A.; Rotondi, S.; Marrone, G.; Mazzaferro, S.; Di Daniele, N. & Mitterhofer, A. P. Chronic kidney disease as a systemic inflammatory syndrome: update on mechanisms involved and potential treatment. *Life (Basel), 11(5)*:419, 2021.

Tóth, G. A.; Buda, B. L. & Eiben, O. G. Contribution to the physique of women with manic-depressive disorder in Hungary. *Coll. Antropol., 27(2)*:581-6, 2003.

Ustymenko, O. S. Sonographic model parameters of kidney in men and women endo-mesomorphic somatotype depending on the anthropometric indices characteristics. *Biomed. Biosoc. Anthropol., 30*:43-9, 2018.

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