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Investigation of factors affecting weight gain and physical activity in kidney transplant recipients

Investigación de los factores determinantes del aumento de peso y la actividad física en los receptores de trasplante renal

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ABSTRACT

Objective: This study aimed to determine the affecting factors related to weight gain and physical activity in kidney transplant recipients. **Design:** The study has a descriptive and cross-sectional design. The study population consisted of all the patients having kidney transplantation (n=107) at one private hospital and one university hospital between November 2017 and August 2018. **Methods:** Data were collected by using a sociodemographic and clinical characteristic form, Nutrition Assessment Questionnaire, and the International Physical Activity Scale. Linear regression analysis was used to evaluate the data. **Results:** The difference between the body mass index in the first follow-up and the body mass index in last follow-up was 2.44 ± 4.78. There were statistically significant differences between weight and BMI in the first follow-up and weight and the body mass index in the last follow-up after transplantation. As age increased, weight gain decreased by 0.22 times, but as time from transplantation increased, weight gain increased by 0.37 times. Transplants from live donors increased weight gain by 0.21 times. None of the variables included in the regression model was predictive of physical activity levels. No significant relation was found between weight gain and physical activity levels. **Conclusion:** While the recipients gained less weight as age progressed, they gained more weight as the time elapsed after kidney transplantation increased. It seems that live transplant recipients gain more weight and need support in this respect. Sociodemographic and clinical characteristics of the recipients did not affect their physical exercise levels. Weight gain and physical activity status of kidney transplant recipients should be examined periodically.

KEYWORDS: kidney transplant recipients; weight gain; physical activity

RESUMEN

Objetivo: La finalidad de este estudio es determinar los factores relacionados con la ganancia de peso y la actividad física en los receptores de trasplante renal. **Diseño:** Estudio de diseño descriptivo transversal. La población de estudio engloba la totalidad de los pacientes trasplantados de riñón (n=107) en un hospital privado y un hospital universitario entre noviembre de 2017 y agosto de 2018. **Materiales y métodos:** La recogida de datos se realizó mediante un formulario clínico sociodemográfico, el Nutrition Assessment Questionnaire y The International PhysicalActivity Scale. La evaluación de los datos se realizó mediante un análisis de regresión lineal. **Resultados:** La diferencia entre el índice de masa corporal (IMC) en el primer control y el IMC en el control de seguimiento posterior fue de 2.44±4.78. Estadísticamente hubo diferencias significativas entre el peso e IMC en el primer control y tras el seguimiento del mismo postrasplante. A mayor edad, el peso ganado disminuye en 0.22 puntos, pero a mayor tiempo postrasplante, el

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peso ganado aumenta 0.37 veces. Los trasplantes de donantes vivos, aumentan la ganancia 0.21 veces más. Ninguna de las variables incluidas en el modelo de regresión fue predictiva de los niveles de actividad física. No se halló relación significativa entre la ganancia ponderal y los niveles de actividad física. **Conclusiones:** Mientras que los receptores de edad más avanzada ganaron menos peso, hubo un incremento ponderal en el lapso de tiempo postrasplante. Parece significativo que los trasplantados de donantes vivos ganan más peso y precisan un soporte específico al respecto. Las características clínicas y sociodemográficas de los receptores no afectaron sus niveles de actividad física. La ganancia de peso así como la actividad deportiva en los pacientes trasplantados debería ser reevaluada de forma periódica.

PALABRAS CLAVE: receptores de trasplantes renales; aumento de peso; actividad física

1. INTRODUCTION

While the survival rate in the first year after kidney transplantation (KT) is 98%, this rate decreases to 94% in the fifth year, 86% in the tenth year and 76% in the 20th year.[1] According to a single-center study from Turkey was stated that one-year graft survival rates were 99.3% and 95.8% for pre-emptive vs non-pre-emptive cohorts, respectively.[2] This shows that the success in the short term does not continue in the long term. Therefore, it should be emphasized that long term follow-up and care of patients are important.

The most common complications in the short term after KT are acute allograft rejection, proteinuria, and vascular necrosis.[1] In the long term after KT, hyperlipidaemia, hypertension, metabolic syndrome, malignancy, diabetes mellitus and obesity are the most common complications. The most important complications affecting survival after KT are cardiovascular diseases.[3] Obesity and physical exercise are modifiable risk factors for prevention of cardiovascular diseases. It is important that nurses assess kidney transplant recipients' (KTR) weight gain and physical activity levels.

Weight gain and obesity after kidney transplantation are a common problem. Weight gain is reported in 50-90% of patients after kidney transplantation.[1, 4] It is stated weight gain after KT is 5-10 kg in the first year and 6.6 kg in the third year.[5-7] The presence of obesity before transplantation, eating habits (high calorie intake), sedentary lifestyle, corticosteroid use, bone disease, lack of physical activity causes weight gain after kidney transplantation.[4- 7] Age, donor type, gender, pre-transplant BMI are risk factors for the development of obesity and weight gain after KT.[7-9] It is stated in the literature that there is a relation between the body mass index (BMI) and physical activity levels of KTRs[10-12]. However, the studies reported in the literature used only weight gain or BMI at the time of the study. They did not utilize the difference in weight or BMI in the first presentation to the outpatient clinic and weight or BMI in the last presentation to the outpatient clinic, indicator of real weight gain after transplantation. The difference in BMI was not determined in the studies reported. Weight gain after KT should be evaluated according to the patients' weight and BMI changes.[13] Also, eating habits of KTRs are evaluated by using daily and weekly nutrition diaries.[14]

There is no specific physical exercise recommended for KTRs in the literature. However, no restrictions are mentioned, either. American College of Sports Medicine has stated that organ transplant recipients can exercise physically like healthy adults as long as their abilities and conditions allow.[15] Among the reasons why KTRs do not exercise are fear of damaging new kidneys, development of health problems after transplantation, and absence of free time due to return to work.[16] Several studies have shown that older age, female gender, low financial status and presence of a comorbid disease negatively affect physical activity.[10, 12, 17]

It is important to identify and manage risk factors that affect the survival of KTRs. Factors such as weight gain and physical activity are modifiable risk factors in the development of various comorbidities and mortality in the long term after KT.[3] There have been studies examining weight gain and physical exercise separately.[1, 14, 18] Weight gain and physical activity, which complement each other, should be assessed together. Therefore, the results from the studies which assess weight gain and physical activity concurrently will provide a very important benefit for prevention of comorbid diseases, early diagnosis, and management of the disease. This study aimed to determine the factors related to weight gain and physical activity in KTRs.

2. METHODS

2.1. Aim

The present study was conducted to investigate the factors affecting weight gain and physical activity in KTRs.

2.2. Design

The study is descriptive and cross-sectional.

2.3. Participants

The study sample was carried out on 107 KTRs followed up in the kidney transplant outpatient clinics of a private hospital and a university hospital between November 2017 and August 2018. The inclusion criteria were as follows: over 18 years of age and willing to participate in the study. The exclusion criteria were as follows: multiorgan transplantation, stay-in hospital, and re-transplantation. The sample size was determined by using the data from the study by Zelle *et al.*[19] It was calculated by using the statistical tool G Power 3.0.10 and was found to be 80. It was based on the effect size of 0.56, type I error (alpha) of 0.05 and type II error (beta) of 0.80. The mean BMI of the females and the males was found to be 28.8 ± 4.5 and 26.2 ± 4.7 respectively.

2.4. Data Collection

2.4.1. Sociodemographic and clinical characteristic form

The form was developed by the researcher in light of the literature.[13, 20-23] It included questions about age, gender, marital status, education, history of smoking and consuming alcohol, occupation, and clinical features (e.g., aetiology of kidney transplantation, donor type, live-donor relationship, transplant time, immunosuppressive therapy, and chronic diseases).

2.4.2. Weight Gain and Nutrition Assessment Questionnaire

The questionnaire was developed by the researcher in light of the literature.[24-25] Weight gain was evaluated by using weight measurements and BMIs of patients. Weight and BMI statuses in the first and last outpatient clinic visits of the patients were taken into consideration. Weight and BMI statuses in the first outpatient clinic visit of the patients were obtained from medical records. Also, weight and BMI statuses in the last outpatient clinic visit of the patients were assessed by researcher. Differences in weight and BMI between the two outpatient measurements were also calculated. In addition, patient satisfaction about the diet, three-day (one day at weekends) food selection and frequency of their consumption were assessed with Weight Gain and Nutrition Assessment Questionnaire.

2.4.3. International Physical Activity Questionnaire

The International Physical Activity Questionnaire (IPAQ) was developed by Craig *et al.*[26] The questionnaire is available in 21 languages. It has long and short versions. In the present study, physical activity was assessed by using the self-administered short form (7 items) of the IPAQ. The questionnaire lists activities and requests the duration and frequency of each activity engaged in over the past week. Durations are multiplied by known metabolic equivalents (METs) per activity and the results for all items are summed for the overall physical activity score. Scores for walking and for moderate and vigorous activities are the sums of corresponding item scores. Although sitting has been considered as physical activity recently, it is not included in the physical activity score, as the IPAQ recommends. According to the IPAQ scores, patients were categorized into three groups; namely light, moderate, and vigorous.[26-27] The IPAQ scoring protocol assigns the following MET values to walking: 3.3 for light activity, 4.0 for moderate activity, and 8.0 for vigorous activity. This is expressed in the MET-min per week: MET level x min of activity x events per week. The questionnaire was adapted into Turkish by Saglam *et al.*[27] Criterion validity of the short version of the IPAQ was found to be 0.30. The test-retest reliability coefficient was 0.69.[27]

2.4.4. Ethical consideration

Written consent was obtained from all the participants prior to data collection. The non-invasive research ethical committee at the authors' institution approved the study protocol.

2.4.5. Data analysis

IBM SPSS 24.0 (IBM Inc., Armonk, NY, USA) was used for statistical analysis. Descriptive statistics were used. Kolmogrov-Simirnov and Shapiro-Wilk tests were used to verify the normal distribution of variables. Weight gain analyses

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were performed according to the mean difference in BMI of the patients. Linear regression analysis was made to determine what extent age, gender, type of recipients and presence of chronic diseases were predictive of weight gain and physical exercise levels. The t-test was employed to compare physical activity in terms of gender and donor type. Mann-Whitney U test was adopted to compare physical activity in terms of chronic diseases. The Pearson correlation analysis was used to show whether physical activity changed in terms of age and monthly income. Kruskal-Wallis test was used to reveal whether physical activity changed in terms of time after transplantation. A p-value of less than 0.05 was significant.

3. FINDINGS

3.1. Demographics features

The mean age of the patients was 47.01 ± 13.78 years (min-max: 20-80), and time after transplantation was 47.01 ± 13.78 months (min-max: 20-80 months). Also, time after transplantation in 36 patients (33.64%) was 11 years or longer. Of all the patients, 66.36% were men, 72.35% married, 36.45% primary school graduates, and 71.02% unemployed. Also, most of the patients did not smoke (n=102, 95.33%) and did not drink alcohol (n=95, 88.79%). Sociodemographic and clinical characteristics are shown in **Table 1**. (Pág. 138)

3.2. Weight gain

The first and last mean weights were 67.97 ± 16.93kg (min-max: 30-107 kg) and 74.62 ± 15.79 kg (min-max: 45-128kg) respectively. The mean difference in weight was 11.18 ± 10.33 kg (min-max: 0-70). The first and last mean BMIs were 23.83 ± 5.12 (min-max: 13-37) and 26.26 ± 4.83 (min-max: 18-44) respectively. The mean difference in BMI was 2.44 ± 4.78 (min=-7, max=23) **(Figure 1)**. There was a significant difference between the first and last weight status (p=<0.001) and between the first and last BMIs (p=<0.001).

The linear regression model including the factors affecting weight (the difference in BMI) was found to be significant (p=>0.001). All the variables included in the model explained 24% of weight gain. Examination of the variables showed that as age increased, weight gain dropped by 0.22 times (β= -0.229, p=0.019), but that as time from transplantation increased, weight gain rose by 0.37 times (β= 0.374, p=<0.001). Weight gain increased by 0.21 times more in the patients receiving kidney transplants from live donors compared to those receiving transplants from deceased donors (β= -0.213 p=0.031). However, monthly income and presence of chronic diseases were not found to affect weight gain (p=>0.05). **(Table 2)**

Of all the patients, 94.39% were satisfied with their diet. The mean number of the daily meals was found to be one in 0.94%, two in 14.02%, three in 80.37%, four in 2.80%, and six in 1.87%. Concerning the frequency of eating habits, 74.77% of the patients consumed milk and yogurt every day, 84.11% consumed cheese every day, 56.07% consumed red meat 1-2 times a week, 58.88% consumed white meat 1-2 times a week, 43.00% consumed eggs every day, 63.55% consumed dry pulses 1-2 times a week, 73.84% consumed fresh vegetables every day, 75.70% consumed fresh fruit every day, 82.24% consumed bread every day, 69.15% consumed grains 1-2 times a week, 92.53% consumed vegetable oil every day and 40.19% never consumed fat.

3.3. Physical activity

The mean MET min/week was 2172.51 ± 1555.09 (min-max=526-2172). The patients were classified into three groups according to their mean MET min/week. The distribution of the recipients according to physical activity categories was as follows: category 1 (light, n=6, 5.61%), category 2 (moderate, n=93, 86.61%) and category 3 (vigorous, n=8, 7.48%) **(Figure 1)**. The highest IPAQ score was 7200 MET min/week (n=1, 0.93%) and the lowest IPAQ score was 526 MET min/week (n=1, 0.93%) **(Figure 2)**. The linear regression model including the factors affecting physical activity was not found to be significant (R=0.234, R^2=0.055, F=0.930, p=0.477, DW=1.754). Therefore, these factors were analysed with one-way analyses. Age, time after transplantation, gender, marital status, donor type, monthly income, and chronic disease were not found to be factors affecting physical activity levels (p=> 0.05). **(Table 3)**

The model used to examine the relation between weight gain and physical activity levels was found to be insignificant (R=0.008, R^2=0.000, F=0.007, p=0.935). The relation between weight gain and physical activity levels was not significant (β=0.008, p=0.935).

Table 1. Sociodemographic and clinical characte-ristics of the kidney transplant recipients (n=107)

Characteristics	**$\bar{X}$ ± SD (min-max)**
Age	47.01 ± 13.78 (20-80)
Time after transplantation (months)	98.82 ± 70.79 (3-242)
Monthly income (□)	2115.17 ± 803.79(500-5500)
	Number (%)
Time after transplantation (year classification)	
0-1 year	21 (19.63%)
2-5 year	26 (24.30%)
6-10 year	24 (22.43%)
11-above	36 (33.64%)
Gender	
Female	36 (33.64%)
Male	71 (66.36%)
Marital status	
Single	29 (27.11%)
Married	78 (72.89%)
Education	
Primary school	44 (41.12%)
Secondary school	37 (34.58%)
University	26 (24.30%)
Employment status	
Employed	31 (28.97%)
Unemployed	76 (71.03%)
Smoking	
Yes	5 (4.67%)
No	102 (95.33%)
Alcohol consumption	
Yes	12 (11.21%)
No	95 (88.79%)
Aetiology	
Polycystic kidney disease	6 (5.60%)
Hypertension	25 (23.36%)
Diabetes mellitus	5 (4.67%)
Glomerulonephritis	11 (10.28%)
Unknown cause	49 (45.79%)
Focal Segmental Glomerulosclerosis	2 (1.87%)
Vesicoureteral reflux	2 (1.87%)
Hyperoxaluria	1 (0.94%)
Haemolytic uremic syndrome	1 (0.94%)
Stone disease	2 (1.87%)
Amyloidosis	2 (1.87%)
Acute kidney disease	1 (0.94%)
Donor type	
Live	60 (56.07%)
Deceased	47 (43.93%)
Live donor relationship, n= 60	
Yes	41 (68.33%)
No	19 (31.67%)
Live donor non-relationship, n= 19	
Spouse	18 (94.74%)
Friend	1 (5.26%)
Chronic disease	
Yes	72 (67.29%)
No	35 (32.71%)
Immunosuppressive medication therapy	
Corticosteroid +Tacrolimus + Mycophenolate mofetil	52 (48.59%)
Corticosteroid +Cyclosporine + Mycophenolate mofetil	20 (18.69%)
Corticosteroid +Tacrolimus +Mycophenolic acid	8 (7.48%)
Corticosteroid + Cyclosporine + Mycophenolic acid	4 (3.74%)
Corticosteroid +Tacrolimus +Azathioprine	6 (5.61%)
Corticosteroid + Cyclosporine +Azathioprine	2 (1.87%)
Corticosteroid +Everolimus + Mycophenolate mofetil	4 (3.74%)
Corticosteroid +Tacrolimus	11 (10.28%)

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Figure 1. The distribution of the kidney transplant recipients at the first follow-up and last follow-up according to weight and BMI

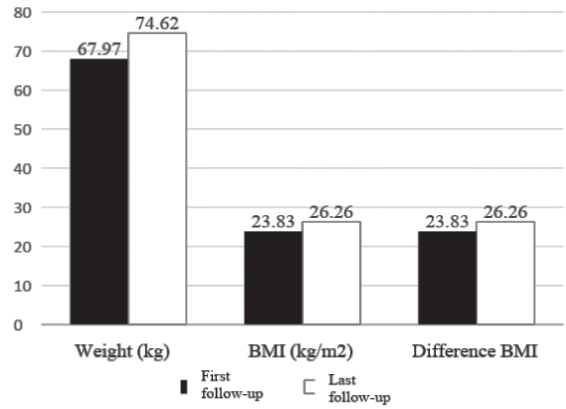
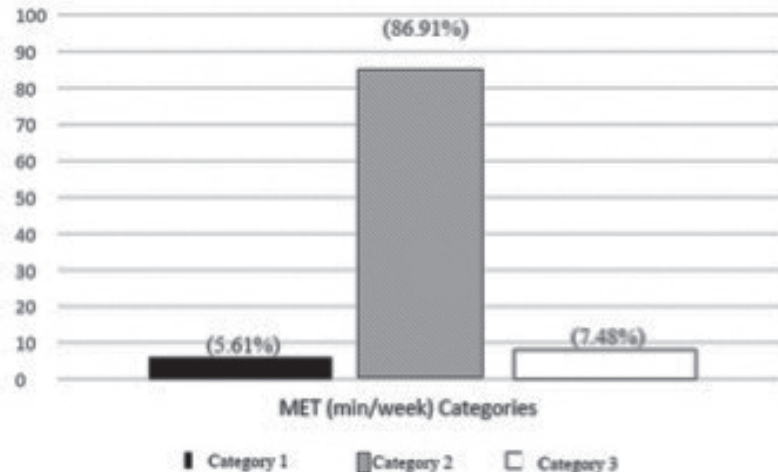


Table 2. Factors affecting weight gain in the kidney transplant recipients (n= 107)

	Weight gain
	B
Age	-0.229 (**p= 0.019***)
Gender	-0.061 (p= 0.538)
Time after transplantation[&]	0.374 (**p< 0.001***)
Donor type	-0.213 (**p= 0.031***)
Monthly income[#]	-0.170 (p= 0.074)
Chronic disease	-0.099 (p= 0.285)
R	0.490
R^2	0.240
F	5.063
P	< 0.001
DW	1.766

&: Time after transplantation analyses were performed according to years, **#**: monthly income in Turkish Liras, *p=< 0.05

Figure 2. The distribution of the kidney transplant recipients according to MET categories



4. DISCUSSION

Several prior studies have shown that KTRs gain weight after transplantation, which is consistent with the results of the present study.[28-31] Many studies stated that as the time elapsed after the transplant increases, the weight and BMI of the patients increase.[4, 6-7]. A study by Pantik et al. revealed that 36.5% of the KTRs gained weight at 12 months after KT.[22] In addition, in another study by Oste *et al.*, the BMI and weight of KTRs were reported to increase 3 kg/m2 and 5.7 ± 5.0 kg, respectively at 12 months after KT.[29]

Beckmann *et al.*[13] noted that 18.1% of the KTRs became obese three years after transplantation. Nicoletto *et al.*[24] reported that the uremic state of the patients improved and that nutritional restrictions were eliminated after KT. Also, dietary satisfaction of patients increased.[24] For these reasons, it is thought that there is an increase in weight after KT. In the present study, time from transplantation was more than five years in 56.07% of the patients. Therefore, the study shows weight gain in the long term.

In the present study, as the mean age of the KTRs increased, the mean BMI decreased. Conflicting with the present study, Kugler *et al.*[20] stated that as age increases, so does the mean BMI. Several studies have shown that being over 50 years old affects weight gain.[13, 31-32] However, some studies have revealed that weight gain decreases with age, consistent with the present study.[5, 8-9, 18, 29] It is attributed to the fact that patients can adopt more healthy dietary habits when their age is increased. Oste *et al.*[32] drew the conclusion that as age increases, BMI may decrease in transplant recipients. In the current study, the mean age of the patients was 47.01 years. In other words, they were middle-aged. They might have paid attention to their diets to protect themselves against comorbid diseases likely to appear in their old age. For this reason, they might maintain their current weight.

Receiving transplants from live donors was found to be an affecting factor in weight gain in the present study. In two studies was stated that the transplantation from live-donor was not related to the increase in BMI.[6, 33] Turkey had the highest number of live donors in the world, with 53.03 live donors per million people in the year 2019.[34] Therefore, the finding that receiving transplants from live donors affected weight gain is important for our country. Higher weight gain in patients receiving transplants from live donors might be due to shorter duration of waiting for an organ or having pre-emptive transplantation. Although preemptive transplantation is the preferred strategy to prevent patients from undergoing dialysis, its psychological impact is unknown.[35] This psychological effect might have affected weight gain in the patients. These variables need to be examined in further studies with larger samples.

Gender, financial status, and chronic diseases were not found to be affecting factors in weight gain in the present study. There is no consensus regarding the effect of gender on weight gain. Gender has not been found to affect weight gain in some studies,[20, 28] while the female gender has been reported to affect weight gain in other studies.[6, 8, 22]

In the current study, most of the patients (n=93, 86.91%) were classified into category 2 according to their physical activity. Kumar *et al.*[10] evaluated physical activity by using MET scores. They showed that KTRs had physical activity lasting 932 ± 720 min/week. They noted that the majority of KTRs had low physical activity (MET <600 min/week).[10] Dew *et al.* reported that while the number of the recipients performing moderate or heavy physical activity was 26 in the early post-transplantation period, only 11 recipients maintained their physical activity in the 12th month after transplantation.[22] Raymond *et al.*[23] reported that 59% of the KTRs had moderate physical activity for 150 minutes per week and that the total sedentary time during the week was 11.6 hours daily. Vallance *et al.*[12] stated that KTRs had low physical activity for 4 hours, moderate physical activity for 20.7 minutes and sedentary time for 9.4 hours daily. It seems that KTRs have a low level of physical activity, congruent with the present study.

Age, gender, time after transplantation, donor type, financial status and presence of chronic diseases were not found to be affecting factors in physical activity in the current study. However, Vallance *et al.*[12] reported that the number of steps decreased by 59 steps, the duration of moderate physical activity decreased by 30 seconds with each age and sedentary time increased by 1 minute in KTRs. They added that as income increased so did physical activity.[12] Kumar *et al.*[10] stated that as age increased, physical activity decreased in KTRs and that female gender negatively affected physical activity. Van Andrichem *et al.*[17] reported that the presence of comorbid diseases decreased as physical activity levels increased.[17] In the present study, the lack of an effect of these factors on physical activity can be explained by the fact that the majority of the KTRs were in the category 2 in terms of their physical activity.

In the current study, no significant correlation was found between BMI and physical activity. However, prior studies revealed a correlation

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between them.[10-12] It is expected that as the level of physical activity increases, weight gain decreases or vice versa. However, the majority of the KTRs were found to have physical activity in the category 2 in the present study. Therefore, there may not be a relation between the level of physical activity and BMI.

4.1. Limitations of the study

There are several limitations of the present study. First, weight and BMI of KTRs were measured once in their last outpatient clinic visits and obtained values were compared with those from the first outpatient clinic visits retrospectively. Weight and BMI values of KTRs should be followed prospectively and periodically after transplantation. In addition, there was not a valid and reliable instrument to assess nutritional habits of the KTRs. Therefore, a questionnaire developed by the researcher was utilized for their assessment.

5. CONCLUSION

While the recipients gained less weight as age progressed, they gained more weight as the time elapsed after kidney transplantation increased. Therefore, younger recipients should be assessed carefully in terms of weight gain. Patients' weight gain should be followed more closely as the time after transplantation increases. Since patients receiving transplants from live donors have a higher weight gain, they also should be offered more carefully planned follow-up care. Sociodemographic and clinical characteristics of the recipients did not affect their physical exercise levels. In addition, no correlation was found between the weight gain and physical exercise levels of the recipients. Healthcare professionals should periodically give education to recipients about nutrition, weight monitoring, and physical activity starting before transplantation and continuing long-term after transplantation. It can be recommended that KTRs should be encouraged to increase their physical activity and that interventional programs should be offered to increase their physical activity adherence.

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