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Research Article

Pulmonary Physiotherapy in Kidney Recipients: Evaluation of Effects on Functional Capacity and Quality of Life

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Abstract **Introduction:** Renal replacement therapy (RRT), including dialysis and kidney transplantation (KT), is employed for treating patients with end-stage renal disease (ESRD). Among RRT options, KT offers the highest quality of life (QoL) and overall survival. However, pulmonary complications following KT remain significant contributors to morbidity, mortality, and potential graft failure. The primary objective of this study is to assess the impact of respiratory and strengthening exercises on respiration, body composition, physical performance, and QoL of the patients following KT. **Materials and Methods:** Preoperative assessments included forced expiratory volume in one second (FEV1), 6-minute walking test (6MWT) scores, body composition measurements, hand grip strength, and QoL scores using the Short Form 36 Scale (SF-36) for the patients undergoing their first KT at Antalya Medical Park Hospital. Participants were randomly assigned to two groups. The experimental group (EG) received respiratory exercises until discharge, followed by combined respiratory, upper, and lower extremity strengthening exercises three days a week for two weeks post-discharge, while the control group (CG) received standard care. Measurements were repeated at the end of the third postoperative week, and the changes from the initial measurements were statistically compared between the groups. **Results:** Demographic characteristics were comparable between the groups. The SF-36 physical function sub-parameter demonstrated a significant increase in the experimental group, while it decreased in the control group. Pain sub-parameter scores and grip strengths of the SF-36 QoL scale did not exhibit statistically significant changes in either group. **Conclusion:** Implementing early respiratory physiotherapy and strengthening program over three weeks following KT improved QoL and physical function significantly.

Keywords pulmonary physiotherapy; postoperative exercise; kidney transplantation

Introduction

Chronic kidney disease (CKD) is a persistent clinical condition characterized by the progressive deterioration of renal function (1). It was suggested that CKD would rank as the fifth leading global cause of mortality in 2040 (2).

As per another definition, when the glomerular filtration rate (GFR) falls below 15 ml/min, it signifies end-stage disease (ESRD). In this critical phase, patients undergo renal replacement therapies, encompassing peritoneal dialysis, hemodialysis, and kidney transplantation (KT) (3). Among these options, KT provides the highest success rate and survival outcome. While successful KT leads to improved quality of life (QoL) and reduced mortality risk, specific functional indicators such as QoL, muscle strength, and physical activity tend to be notably lower in KT recipients compared to their healthy counterparts (1,4).

It is known that pulmonary complications constitute a significant source of morbidity and mortality after KT (5). Ucan et al. reported that in solid organ transplantations, hospital-acquired infections are most prevalent within the first month, and the post-KT 6-month period was associated with the highest intensity of immunosuppression, resulting in a higher incidence of opportunistic infections such as cytomegalovirus (CMV), aspergillus, and others (6).

Beyond the sixth month, due to ongoing maintenance immunosuppression, community-acquired infectious agents and opportunistic pathogens such as S. pneumonia, H. influenza, Nocardia, and M. tuberculosis may cause infections in these patients. In line with this suggestion, Zeyneloğlu noted that early-stage respiratory failure was most commonly due to cardiogenic pulmonary edema, while bacterial pneumonia was the underlying cause more commonly in the subsequent months or years after KT (7).

Pencheva et al. followed 267 KT recipients for seven years post-transplant to monitor the development of pulmonary complications and their outcomes (5). These authors reported that 97 recipients experienced pulmonary complications, leading to 31 mortalities. Consequently, they highlighted the risk for mortality and graft failure due to post-KT pulmonary complications.

Fishman stated that immunosuppressive therapy significantly reduced the incidence of graft rejections but increased the susceptibility to opportunistic infections and cancer (8).

Pulmonary rehabilitation (PR) constitutes a tailored, multidisciplinary care program to address the specific therapeutic needs arising from chronic respiratory conditions (9,10). The primary objective of PR is to sustain the patient's daily activities and quality of life at an optimal level. It was shown that inpatient or outpatient PR programs substantially improved the clinical status and functional capacity. Since there is typically a reduction in functional residual and vital capacity following thoracic and abdominal surgeries, postoperative emphasis on respiratory exercises and cough training becomes crucial. Additionally, in conditions affecting the respiratory system, increased exercise capacity can be achieved through enhanced functionality of skeletal muscles involved in physical activities, allowing patients to perform daily tasks with reduced respiratory effort (11). Notably, it was reported that heightened physical activity positively correlated with graft function within the first year after KT (12).

The objective of this study was to assess the impact of respiratory exercises initiated from the first postoperative day, coupled with post-discharge upper and lower extremity strengthening exercises, on FEV1 values, 6-minute walking test (6MWT) results, body composition, QoL, and grip strength in KT recipients.

Materials and Methods

Study Design

This study was designed as a prospective randomized controlled clinical trial. Patients admitted to Antalya Medical Park Hospital Kidney Transplantation Unit between December 2020 and August 2021 constituted its target population. The study received approval from the Akdeniz University Clinical Research Ethics Committee (KAEK-279/ 08.04.2020). All patients and study participants gave written and verbal consent before enrollment.

Assessments

Personal Data Form

A personal data form including demographic characteristics, education level, body mass index (BMI), Coronavirus disease-2019 (COVID-19) history, alcohol use, smoking habits, history of dialysis, and the primary reason for ESRD was filled out for each study participant.

6-Minute Walk Test

During the 6MWT, participants were instructed to walk the maximum distance they could in six minutes along a 30-meter corridor marked every three meters. They were informed they could rest if needed, but the timer would continue. Oxygen saturation, blood pressure, and heart rate were monitored before and after the test, and the distance walked was recorded in meters.

Respiratory function test

A spirometry device (ZAN300 CO Diffusion®, Spire Health, USA) with ZAN GPI 3.xx software was used. Data including height, weight, age, and gender were recorded in the spirometry program. Patients were instructed to breathe normally three times while wearing a nose clip. Subsequently, they were instructed to take the deepest breath possible and exhale forcefully at maximum speed. The highest FEV1 value among the three acceptable tests was recorded.

Assessment of body composition

This assessment was performed using an MC-980 Body Composition Analyzer (Tanita Corp. Tokyo- Japan) measuring device. Before measurement, patients were asked to remove their socks, weight-bearing clothes, and any metal accessories. Height, gender, age, and date of birth were recorded on the device. The measurements included fat tissue percentage, BMI, lean tissue percentage, body weight, body fat weight, body water content, and lean tissue weight. The calculations were recorded as percentages or kilograms.

Upper extremity muscle strength measurements

Grip strength was assessed in kilograms using a Smedley hand dynamometer. Participants were instructed to squeeze and relax the dynamometer with their right and left hands with maximum force, respectively. These maneuvers were performed while the patient was sitting upright on a back-supported chair with the shoulder in adduction adjacent to the trunk, the elbow in 90 degrees flexion, and the wrist in 0-30 degrees extension. The test was repeated three times, and the researcher recorded the mean value in kilograms/force.

Measurement of the serum urea and creatinine levels

Serum urea and creatinine values measured in the last week before KT and three weeks after KT were recorded as initial and final values.

QoL assessment

The Short Form 36 Scale, which encompasses 36 questions, assesses various facets of general health and physical well-being over the preceding four weeks. These include physical functioning, role limitations due to physical issues, physical pain, overall physical health, vitality, social functioning, role limitations due to emotional issues, and general mental health. Each category is scored on a scale from 0 to 100 points. Lower scores indicate a lower QoL, while higher scores are associated with a higher QoL. While the total score can be used, each category can be evaluated separately.

In our study, one of the researchers asked the participants all SF-36 questions in a room at the KT outpatient clinic. The responses were recorded, and scores for each subcategory were noted.

Exercise protocol

After recording their preoperative assessment results, all patients were instructed on using the spirometer and the significance of postoperative breathing and coughing. They were advised to perform spirometry exercises 10 times every 1-2 hours during the daytime during the first-week post-KT and 10 times at least 3 times daily in the second and third weeks.

Study protocol for the experimental group

In addition to the spirometry, patients in the experimental group practiced apical, basal, and diaphragmatic breathing exercises with puckered lip breathing twice daily (i.e., 10x2) for three weeks post-KT. They performed 9 upper and lower extremity strengthening exercises 3 times a week (10 exercises each time) starting from post-KT day 5-7 until the end of the third post-KT week. These exercises were conducted under the supervision of a researcher in an exercise room at the KT outpatient clinic. The intensity of the exercises was gradually increased based on the patient's clinical condition, and by the end of the third week, strengthening exercises were performed with three sets of 15 repetitions.

Statistical analysis

Statistical analyses were conducted using Statistical Package for Social Sciences (SPSS Statistics for Windows, v24, IBM Corp., Armonk, NY, USA). The normal distribution of variables was assessed using visual (histograms and probability plots) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk). Descriptive analyses were presented using mean and standard deviation for normally distributed variables, while nominal variables were expressed as counts and percentages. The Student's t test was employed to ascertain the significance of differences between the means of the experimental and control groups. The Chi-square test (Pearson chi-square) was utilized to analyze the relationship between categorical variables. Mixed design repeated measures two-way analysis of variance (i.e., mixed design repeated measures ANOVA) was employed to assess changes in the variables of the experimental and control groups over time, as well as group-time interactions. The total type-1 error level for statistical significance was set at 5%.

Results

Overall, 53 patients were included. The experimental group included 27 patients, while there were 26 patients in the control group (Table 1). The control and the experimental groups had a mean age of 41.2±14.1 and 35.3±11.1 years, respectively. The ratios of female patients were 34.6% (n=9) and 40.7% (n=11) in the control and experimental groups.

Table 1. Comparative analysis of sociodemographic characteristics between the groups

		Control Group (n=26)		**Experimental Group (n=27)**		**t**	**p**
		X	**SD**	**X**	**SD**		
Age (years)		41,2	14,1	35,3	11,1	1,68	0,098
Height (cm)		167,3	8,0	164,4	10,2	1,15	0,254
Daily smoked cigarette (pack/day)		1,9	4,9	3,7	9,3	-0,86	0,389
Smoking period (Months)		108,0	78,7	208,8	145,1	-1,08	0,319
		n	**(%)**	**n**	**(%)**	**χ^2**	**p**
Gender	Female	9	34,6	11	40,7	0,21	0,646
	Male	17	65,4	16	59,3		
Education Level	Primary Education	9	34,6	12	44,4	0,53	0,765
	High School	8	30,8	7	25,9		
	Bachelor and above	9	34,6	8	29,6		
Alcohol Use	Yes	0	0,0	0	0,0		
	No	26	100	27	100		

Smoking	Yes	4	15,4	5	18,5	0,09	0,761
	No	22	84,6	22	81,5		

t: Student's T test, X²: Chi-square test, M: mean, SD: Standard deviation

There were no statistically significant differences between the groups regarding gender distribution, educational level, smoking, and alcohol use (p>0.05). Similarly, the two groups did not significantly differ concerning the primary reason for ESRD (Table 2). In the control group, 30.8% had hypertension (HT), 7.7% had diabetes mellitus (DM), 19.2% had nephrological or urological diseases, 3.8% had genetic causes leading to ESRD, while 38.5% of these patients had other reasons. In the experimental group, 33.3% had HT, 3.7% had DM, 22.2% had nephrological-urological diseases, 18.5% had genetic causes, and 18.5% had other factors causing ESRD.

Table 2. Classification of Experimental and Control Groups according to ESRD etiology

		Control Group (n=26)		**Experimental Group (n=27)**		χ^2	**p**
		n	**(%)**	**n**	**(%)**		
ESRD etiology	Hypertension	8	30,8	9	33,3	4,13	0,388
	Diabetes mellitus	2	7,7	1	3,7		
	Nephrological-Urological Diseases	5	19,2	6	22,2		
	Genetic Causes	1	3,8	5	18,5		
	Other Causes	10	38,5	6	22,2		

χ^2: Chi-square tets, X: mean, SD: Standard deviation, ESRD: End Stage Renal Disease

In both groups, the comparison between initial and final measurements of weight and BMI showed statistically significant differences (p<0.05) (Table 3).

Table 3. Comparison of the first and last measurements of weight and BMI between the groups

	Control Group (n=26)		**Experimental Group (n=27)**		**Time**	**Group * Time**	n^2
	X	**SD**	**X**	**SD**	**F/p**	**F/p**	

Body weight (kg)	First Measurement	70,7	15,2	67,7	17,5	20,32 / **0,000**	4,02 / **0,048**	0,073
	Final Measurement	67,6	13,8	66,5	16,7			
BMI	First Measurement	25,2	4,6	25,2	7,3	19,28 / **0,000**	3,44 / 0,069	0,063
	Final Measurement	24,1	4,3	24,7	7,0			

*Two-way Analysis of Variance in Repeated Measurements, n2: Effect size, **p<0.01, *p<0.05, BMI: Body-mass index, X: mean, SD: Standard deviation*

Although the mean patient weight significantly decreased in both groups, the difference was significantly higher in the control group (p<0.05).

In addition, both groups experienced a statistically significant reduction in muscle mass (p<0.05) (Table 4). However, the comparison of the muscle mass reduction between the two groups did not reveal a statistically significant difference (p>0.05). There was no statistically significant difference in the initial and final measurement values of fat mass in both groups, and the change in fat mass over time was also similar (p>0.05).

Table 4. Comparison of the muscle mass and fat mass values of the experimental and control groups

		Control Group (n=26)		**Experimental Group (n=27)**		**Time**	**Group *Time**	**n^2**
		X	**SD**	**X**	**SD**	**F/p**	**F/p**	
Muscle mass (kg)	First measurement	52,9	9,2	50,5	10,1	21,99 / **0,000**	3,58 / 0,064	0,066
	Final measurement	49,8	7,8	49,2	9,6			
Fat mass (kg)	First measurement	15,0	9,6	16,0	13,7	0,43 / 0,513	0,77 / 0,382	0,015
	Final measurement	15,2	9,1	14,4	10,7			

*Two-way Analysis of Variance in Repeated Measurements, n2: Effect size, **p<0.01, *p<0.05, X: mean, SD: Standard deviation*

Our analysis also revealed that fat-free mass decreased and fat percentage increased in both groups (Table 5).

Table 5. Comparison of the first and last measurements of the fat-free mass and fat percentage between the experimental and control groups

		Control Group (n=26)		Experimental Group (n=27)		Time	Group *Time	n^2
		X	**SD**	**X**	**SD**	**F/p**	**F/p**	
Lean mass (kg)	First measurement	55,7	9,7	53,2	10,6	22,18 / **0,000**	3,63 / 0,062	0,067
	Final measurement	52,4	8,2	51,8	10,1			
Fat percentage (%)	First measurement	19,9	10,3	19,6	11,0	6,96 / **0,011**	0,30 / 0,581	0,006
	Final measurement	21,2	9,9	20,5	10,2			

*Two-way Analysis of Variance in Repeated Measurements, n2; Effect size, **p<0.01, *p<0.05, X: mean, SD: Standard deviation*

The comparison between initial and final measurements for fat-free mass and fat percentage in both groups showed statistically significant differences (p<0.05). However, no statistical difference was found in the comparison of these variables between the groups (p>0.05).

The FEV1 values increased significantly in both groups (p<0.05) (Table 6).

Table 6. Comparison of the FEV1 measurements between the experimental and control groups

		Control Group (n=26)		Experimental Group (n=27)		Time	Group *Time	n^2
		X	**SD**	**X**	**SD**	**F/p**	**F/p**	
FEV1	First measurement	69,5	8,5	73,5	12,1	47,77/ **0,000**		

	Final measurement	78,3	12,6	83,6	13,2		0,21/0,64 4	0,004

*Two-way Analysis of Variance in Repeated Measurements, n2; Effect size, **p<0.01, *p<0.05, FEV1: Forced expiratory volume 1; X: mean, SD: Standard deviation*

However, there was no statistically significant difference between the groups regarding the change in FEV1 (p>0.05).

The 6MWT scores showed a statistically significant increase in both groups (p<0.05). However, the comparison of the changes between the two groups revealed no significant difference (p>0.05). Notably, the 6WWT scores were lower than the typical values in healthy individuals in both groups (Table 7).

Table 7. Comparison of the first and last 6-Minute Walk Test (6 MWT) results between the experimental and control groups

		Control Group (n=26)		**Experimental Group (n=27)**		**Time**	**Group *Time**	**n^2**
		X	**SD**	**X**	**SD**	**F/p**	**F/p**	
6MWT (meters)	First measurement	413,2	92,0	456,0	75,8	13,75 / **0,001**	0,58 / 0,450	0,011
	Final measurement	444,0	93,3	502,9	64,8			

*Two-way Analysis of Variance in Repeated Measurements, n2: Effect size, **p<0.01, *p<0.05, 6MWT: 6-minute walk test; X: mea;, SD: Standard deviation.*

There was no statistically significant difference in the changes in grip strength in the right and left hands over time for both groups (p>0.05) (Table 8).

Table 8. Comparison of the first and last measurements of the right and left hand grip strengths between the groups

	Control Group (n=26)	**Experimental Group (n=27)**	**Time**	**Group *Time**	**n^2**

		X	SD	X	SD	F/p	F/p	
Handgrip strength (kg) **Right hand**	First Measurement	29,9	9,4	32,0	10,1	0,86 / 0,358	1,23 / 0,272	0,024
	Final Measurement	29,8	9,7	33,3	10,1			
Handgrip strength (kg) **Left hand**	First Measurement	26,3	9,2	28,6	10,1	0,73 / 0,395	0,51 / 0,477	0,010
	Final Measurement	26,4	9,1	29,1	9,6			

*Two-way Analysis of Variance in Repeated Measurements, n2: Effect size, **p<0.01, *p<0.05, X: mean; SD: Standard deviation*

Additionally, there was no statistically significant difference when comparing these changes over time between the groups ($p>0.05$).

The serum urea and creatinine values decreased statistically significantly over time in both groups ($p<0.05$) (Table 9). The serum urea and creatinine reduction was statistically similar between the groups ($p>0.05$).

Table 9. Comparison of the renal funtion tests between the experimental and control groups

		Control Group (n=26)		**Experimental Group (n=27)**		**Time**	**Group *Time**	**n^2**
		X	**SD**	**X**	**SD**	**F/p**	**F/p**	
Urea	First Measurement	57,9	22,5	62,4	17,8	165,47/ **0,000**	1,96 / 0,167	0,037
	Final Measurement	24,1	10,1	20,3	7,7			
Creatine	First Measurement	6,6	2,9	7,8	2,8	245,14 / **0,000**	2,78 / 0,102	0,052
	Final Measurement	1,1	0,4	1,1	0,3			

*Two-way Analysis of Variance in Repeated Measurements, n2: Effect size, **p<0.01, *p<0.05, X: mean; SD: Standard deviation*

Our analysis also showed that the physical functioning scale of SF-36 showed a statistically significant increase in the experimental group, while it decreased in the control group (Table 10).

Table 10. Comparison of the SF-36 quality of life scale scores between the experimental and control groups

		Control Group (n=26)		Experimental Group (n=27)		Time	Group *Time	n^2
		X	SD	X	SD	F/p	F/p	
Physical function	First Measurement	73,7	17,1	60,0	20,6	4,53/ **0,038**	7,90/**0,007**	0,134
	Final Measurement	72,0	12,4	71,9	9,9			
Physical role difficulty	First Measurement	12,5	27,6	9,3	15,7	44,56/ **0,000**	0,01/0,90	0,000
	Final Measurement	40,4	20,1	36,2	21,3			
Emotional role difficulty	First Measurement	34,6	40,5	22,2	39,2	63,31/ **0,000**	0,31/0,57	0,006
	Final Measurement	80,8	32,9	75,3	32,8			
Energy/Vitality	First Measurement	38,1	19,5	37,0	22,2	148,58/ **0,000**	0,21/0,644	0,004
	Final Measurement	71,5	17,7	73,1	13,2			
Mental health	First Measurement	59,1	19,2	60,4	19,1	65,98/ **0,000**	0,03/0,854	0,001
	Final Measurement	80,3	16,4	82,7	10,5			
Social functioning	First Measurement	51,4	21,0	44,0	31,8	52,62/ **0,000**	0,01/0,892	0,000
	Final Measurement	20,7	22,9	12,0	17,8			
Pain	First Measurement	56,3	26,7	65,5	24,5	0,59/ 0,443	0,86/0,358	0,017
	Final Measurement	63,5	19,7	64,8	19,6			
General health	First Measurement	30,6	13,3	29,4	16,2	340,09/ **0,000**	1,15/0,28	0,022
	Final Measurement	66,3	14,2	69,6	14,3			

*Two-way Analysis of Variance in Repeated Measurements, n2: Effect size, **p<0.01, *p<0.05, X: mean; SD: Standard deviation.*

In the post-KT period, the social functioning scale of SF-36 decreased significantly in both groups. However, the scores regarding the physical role difficulty, emotional role difficulty, mental health, energy/vitality, and general health domains of SF-36 increased significantly and similarly in both groups. The pain scale of SF-36 did not show a significant change between the groups.

Discussion

This study showed that early respiratory physiotherapy and strengthening performed for three weeks following KT improved QoL and physical functions significantly. On the other hand, the pain scale scores of the SF-36 QoL scale and grip strength did not change significantly in either group.

Many clinical studies investigated the role of exercise training in slowing the progression of ESRD in its early stages, preparing them for RRT, enhancing graft compliance, and improving patients' QoL after KT (13). However, the number of studies analyzing the impact of exercise programs initiated early after KT is limited. In these studies, failure to achieve expected results from exercise training was generally attributed to incision site pain and the ongoing healing process.

Pulmonary rehabilitation is performed to improve the systemic effects of the disease, optimize patients' functional capacity, and reduce pulmonary symptoms and healthcare costs. In the early postoperative period, the goal is to enhance gas exchange and ventilation, preserve functional lung capacity, and facilitate the drainage of secretions.

Our study aimed to assess the impact of respiratory exercises starting from the first postoperative day and the lower and upper extremity strengthening exercises after discharge on FEV1 values, 6MWT scores, QoL, and grip strength in KT recipients.

The similarity of the groups regarding physical, sociodemographic, and clinical characteristics significantly contributed to the homogeneity of the study sample.

Waked et al. conducted a study on 40 KT patients aged between 40 and 60 (14). These researchers divided the cohort into pilates and control groups. The pilates group received training comprising respiratory, strengthening, balance, and coordination exercises for three weeks, starting from the third postoperative day. The authors assessed the participants' quality of life and pulmonary function 1 day before, 3 days, and 3 weeks after KT. While there was no significant difference in the FEV1 value on the third postoperative day in both groups, the FEV1 value increased significantly in both groups in the third postoperative week, with the exercise group showing statistical superiority over the control group.

As is common in any abdominal surgery, there is a decline in pulmonary functions due to diaphragmatic inhibition resulting from general anesthesia in KT recipients (15). The lack of a significant change in the FEV1 value detected by Waked et al. on the third day after KT can be explained by the findings of this study (14). In our study, similar to the results of Waked et al., a significant increase was found in the FEV1 value of both groups at the end of the third week after KT.

In a meta-analysis assessing the effects of respiratory exercises on respiratory function, it was demonstrated that respiratory exercises can lead to a significant improvement in maximal respiratory pressure after upper abdominal surgery. Grams et al. suggested that most patients undergoing upper or lower abdominal surgery developed a restrictive lung pattern. Thus, these authors stated that respiratory exercises enhanced the mobility of the diaphragm and improved respiratory muscle synergy (16).

In another study, Wang et al. worked on 9 KT recipients six months after KT (17). They performed an aerobic exercise program utilizing video games for 30 minutes 3 days per week for 8 weeks. As a result, they reported a mean increase of 14 meters in the 6MWT walking distance, which is consistent with our study. Onofre et al. analyzed the 6MWT results of 63 recipients before transplantation and on the day of discharge (15). In this study, all patients performed breathing exercises until the day of discharge. In the experimental group, patients practiced upper extremity and walking exercises, gradually intensifying from postoperative day 1 until discharge.

Consequently, the authors noted that an exercise program initiated immediately after KT and continued until discharge did not increase the distance walking distance in the 6MWT. They attributed this finding to decreased muscle strength and the adverse effects of the surgery. Our study showed an increase in 6MWT results in both groups within two weeks, probably because surgery-related pain decreased and exercise capacity improved during this period. In line with our findings, Lima et al. reported that a combined exercise training regimen encompassing both aerobic and strengthening exercises enhanced graft function and aerobic capacity (18).

Painter et al. initiated exercise training one month after KT and reported that exercise alone had a limited impact on body composition by the end of the first year (19). Habedank et al. analyzed the dual-energy X-ray absorptiometry (DEXA) and cardiopulmonary exercise test results of 25 patients after KT (20). These researchers noted a shift in participants' body composition towards adipose tissue. They also found that preoperative lean body weight correlated with fat gain after KT. Sánchez et al. conducted a study involving supervised lower and upper extremity strengthening exercises over 10 weeks with participants who underwent KT within one year (21). They reported no significant change in the diameter and mass of the rectus femoris and vastus lateralis muscles. They referred to the small sample size and the lack of nutritional variables that could impact muscle mass in their analysis while noting the limitations of their study.

Our study aligns with the existing literature in terms of the findings regarding the changes in the body composition of the patients. In our cohort, the reduction in body fat-free mass in both patient groups may suggest a potential decrease in muscular strength following the procedure.

In their meta-analysis, Baker et al. claimed that intensive exercise training in the early post-KT period could not prevent declines in physical function (13). However, they recommended encouraging mobility during this period.

One of the postoperative studies included in this meta-analysis is the work of Onofre et al. (15). This report concluded that an exercise program initiated immediately after KT and continued until discharge did not increase peripheral muscle strength. Oguchi et al. reported that corticosteroid use after KT was a risk factor for muscle wasting (22). Sánchez et al. noted in their study with 16 patients who had previously undergone KT within 1 year that grip strength exhibited a statistically significant increase in the exercise group compared to the control group (21). However, the achieved strength was still lower than expected in a healthy population. In their study, including patients who had previously undergone KT, Lima et al. reported that a combined exercise program comprising both aerobic and strengthening exercises for 12 weeks positively impacted grip strength (18). Notably, these two studies were conducted with participants who had previously undergone KT, and the exercise programs were more prolonged than ours. This finding may account for the significant increase in grip strength observed in kidney transplant recipients in these studies.

Sánchez et al. reported that following 10 weeks of supervised resistance exercise training with 16 patients who had undergone KT within one year, the exercise group had significantly higher physical role and vitality scores than the control group (21). However, it should be noted that the results were lower than anticipated for a healthy population.

Mazzoni et al. compared the data of 118 KT recipients engaged in low and moderate-intensity regular sports and 79 sedentary recipients (23). In this study, the former group demonstrated significantly higher scores in various domains of the SF-36 scale, including physical function, role limitations due to physical problems, vitality, general health, social functioning, role limitations due to emotional problems, mental health, and social functioning compared to the latter group.

In their study, including 40 KT recipients and comparing the patients in the Pilates group with those in the control group, regarding QoL 1 day before, 3 days, and 3 weeks after KT, Waked et al. reported that the Pilates group had significantly higher scores than the control group 3 weeks after KT (14).

Painter et al. initiated exercise training 1 month after KT and reported that these patients significantly improved concerning the physical function domain of the SF-36 scale one year after KT (19). However, they also noted that exercising only slightly impacted the body composition of their patients. Notably, these authors found a significant association between maximum oxygen consumption level and the physical function of KT recipients.

It is known that the social functioning domain of the SF-36 can be affected by the social and physical isolation process experienced after KT. Due to the risk of COVID-19 and the necessity for immunosuppressive use, participants tended to avoid crowded environments post-KT.

In their study conducted with patients who had previously undergone KT, Lima et al. stated that a combined exercise program consisting of aerobic and strengthening exercises for 12 weeks was associated with lower serum urea and creatinine levels, along with increases in GFR and oxygen consumption in the exercise group while the control group had higher serum urea and creatinine levels and a lower GFR (18). This finding indicated that combined exercise training positively affected graft function in KT recipients.

Conclusion

The early post-KT period is of utmost importance for the recipients, and incorporating respiratory physiotherapy into the standard patient management protocols can enhance recipients' physical activity levels while reducing mortality and morbidity. We suggest that respiratory physiotherapy be given to all KT recipients, starting from the preoperative period.

Conflicts of interest

The authors have no conflicts of interest to declare.

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This study was unfunded.

Ethical approval

The study received approval from the Akdeniz University Clinical Research Ethics Committee (KAEK-279/ 08.04.2020).

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