



## ORIGINAL ARTICLE

# The quality of life in type I diabetic patients with end-stage kidney disease before and after simultaneous pancreas-kidney transplantation: a single-center prospective study

Karin Romano Posegger<sup>1</sup> , Marcelo Moura Linhares<sup>1</sup>, Samantha Mucci<sup>2</sup>, Thais Malta Romano<sup>1</sup>, Adriano M. Gonzalez<sup>1</sup>, Alcides A. Salzedas Netto<sup>1</sup>, Érika Bevilaqua Rangel<sup>3</sup> , Gaspar de Jesus Lopes Filho<sup>1</sup>, Helio Tedesco Silva-Junior<sup>3</sup> & Jose Medina-Pestana<sup>3</sup>

1 Gastroenterology Division, Hospital São Paulo, Universidade Federal de São Paulo, Sao Paulo, Brazil

2 Medical Psychology Division, Universidade Federal de São Paulo, Sao Paulo, Brazil

3 Nephrology Division, Hospital do Rim, Universidade Federal de São Paulo, Sao Paulo, Brazil

## Correspondence

Marcelo Moura Linhares, Rua Napoleão de Barros, 715 – 2nd floor, São Paulo CEP: 04024-002, Brazil. Tel.: +55 11 5576-4000; e-mail: linhares.sp@gmail.com

## SUMMARY

Simultaneous pancreas-kidney transplantation (SPKT) aimed at increasing the life expectancy for diabetic patients with end-stage kidney disease (ESKD). However, the risks of surgery complications and immunosuppression therapy make it unclear if the SPKT positively impacts patient's quality of life (QoL). Using the Kidney Disease Quality of Life—Short-Form Health Survey (KDQOL-SF36) and Problems Areas in Diabetes (PAID) measurement tools, we compared the QoL of 57 patients on the pretransplant waiting list with that of 103 patients who had undergone SPKT. Posttransplantation patients were assessed within different time intervals (<1, 1–3, and >3 years). Mean KDQOL-SF36 scores were better among posttransplantation patients in the SF36 and KDQOL domains. It was also observed patients' stress reduction in PAID mean score ( $P = 0.011$ ) after SPKT. We concluded that patients receiving SPKT had a better perception of QoL than did patients on the waiting list, and this positive perception remained almost entirely comparable over the three different intervals of the posttransplantation time. These positive results showed better outcomes when excluding patients that lost pancreas graft function. Further research is needed to compare diabetic patients with kidney transplant alone using specific measurement tools to evaluate patient's QoL.

*Transplant International* 2020; 33: 330–339

## Key words

end-stage kidney disease, pancreas-kidney transplantation, quality of life, type 1 diabetes

Received: 25 July 2019; Revision requested: 14 September 2019; Accepted: 28 November 2019; Published online: 23 December 2019

## Introduction

Diabetes mellitus represents a serious public health problem as a chronic disease and consumes a significant portion of healthcare resources. This condition has a negative impact on the health and well-being of the individual, causing clinical, psychological, and social

harm [1]. Half of all patients with diabetes can develop specific microvascular complications relating to their limbs, kidneys, nerves, and eyes. Diabetes mellitus is the leading cause of blindness in adults [2]. About one-third of all insulin-dependent diabetic patients will become uremic and require some type of renal replacement therapy [3].

Simultaneous pancreas-kidney transplantation (SPKT) is considered the gold standard treatment for diabetics with end-stage kidney disease (ESKD). This is a therapeutic intervention that enables patients with insulin-dependent diabetes mellitus and renal failure to maintain a healthier lifestyle without the burden of dialysis and insulin therapy, and increases the life expectancy of these patients [4–6]. Despite kidney graft has shown superior survival after living donor transplant, simultaneous pancreas-kidney recipients show better patient log-term survival when the pancreas graft has no signs of failure [7].

Improvement in quality of life (QoL) is one of the main benefits of SPKT, opposed to the negative effects of endless hemodialysis sessions, social and physical restrictions, and the long wait time for transplantation. However, SPKT infectious complications and rejection episodes may have a considerable impact on a patient's QoL. In the literature, it is also addressed the importance of new multiinstitutional studies on a more efficient immunosuppression strategy and its impact on pancreas transplantation in terms of QoL [8–10]. Deciding to offer the pancreas transplantation for diabetic patients with ESKD has been a challenge; however, this therapy may provide survival advantages and patients' QoL improvement [11].

By comparing different groups of patients, this study aimed to measure the improvement in perceived QoL with SPKT, using the Kidney Disease Quality of Life—Short-Form Health Survey (KDQOL-SF36) and Problems Areas in Diabetes (PAID) as specific measurement instruments. We evaluated this improvement from the perspective of long-term survival in three different time intervals following transplantation.

## Patients and methods

This single-center, prospective, nonrandomized study was approved by local ethic committee and was conducted in accordance with the Declaration of Helsinki and the Declaration of Istanbul 2008. All patients signed a written informed consent.

Two groups of patients, divided into pre- and post-SPKT, older than 18 years with ESKD and type 1 diabetes from the same transplant list at a single-center were interviewed. All patients on the waiting list were eligible for the transplantation after an accurate selection based on patient's clinical condition and indication. When on the waiting list, all the patients were transplanted taking into account the chronological order and grafts match and all of them were considered equally eligible for the transplantation. To date, all the posttransplantation patients have passed through the same waiting list.

A total of 160 type 1 diabetic patients with end-stage renal disease were evaluated between December 2015 and October 2017. Two groups of patients were compared: The pretransplantation group ( $n = 57$ ) and the posttransplantation group ( $n = 103$ ); the latter was transversally divided into three time intervals posttransplantation (<1 year, between 1 and 3 years, and >3 years), as shown in Fig. 1.

The pretransplantation group consisted of insulin-dependent diabetic patients with end-stage renal disease who were placed on the waiting list for SPKT. Patients in the posttransplantation group had undergone pancreas and kidney transplantations simultaneously and had regular follow-up appointments at the posttransplantation outpatient clinic of Hospital do Rim at the Universidade Federal de São Paulo.

Time with ESKD was defined by any time since the diagnosis of kidney function impairment characterized by a reduction in glomerular filtration ratio and presence of proteinuria, yet not requiring dialysis.

All patients received their transplants free of charge under the Brazilian public health system. There were no socio-economic advantages to patients. A trained and prepared team of doctors and psychologists interviewed the patients individually in a private room to preserve the patient's privacy and guarantee the reliability of the responses.

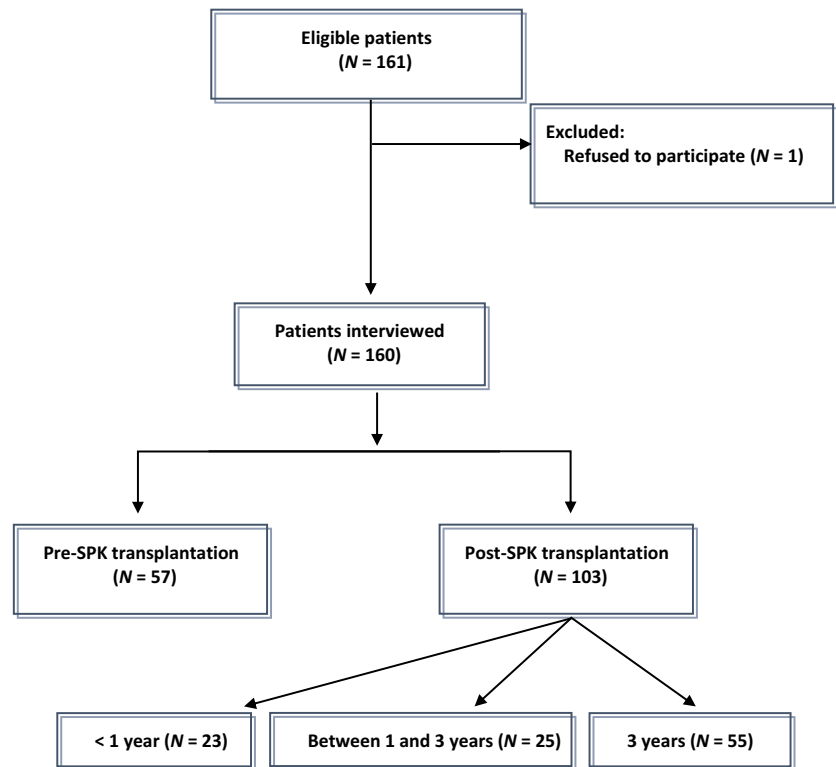
## Instruments

*The Kidney Disease Quality of Life Short Form (KDQOL-SF36)* was developed to evaluate QoL among individuals with ESKD. It consists of 80 items including the *Short-Form Health Survey (SF-36)*. To consider the results qualitatively, scores were classified as follows: those between 0 and 50 represented a “low QoL,” and those above 50 represented a “good QoL” [12,13].

*The Problem Areas in Diabetes (PAID)* is a 20-item questionnaire focusing on negative emotions such as anger, fear, guilt, depression, and concerns experienced by patients living with diabetes. Responses to the PAID are given on a five-point Likert scale ranging from 0 (“not a problem”) to 4 (“a serious problem”), producing a total score ranging from 0 to 100, with scores equal to or under 40 indicating a low level of emotional distress [14].

## Statistical methods

Analysis was performed using the Statistical Package for the Social Sciences (SPSS, v. 18.0). To compare KDQOL-SF36 and PAID scores up to two groups, it was used the



**Figure 1** Flowchart illustrating patient recruitment for the study and the number of participants in each group (pretransplant and each posttransplant interval period).

Student *t*-test (parametric) or Mann–Whitney test (non-parametric). For more than two groups, it was used a one-way (parametric) analysis of variance (ANOVA) followed by post hoc Bonferroni tests, or the Kruskal–Wallis (nonparametric) test followed by Mann–Whitney *U* tests (with proper Bonferroni corrections). *P* values <0.05 were considered to be statistically significant.

## Results

Data were collected from a total of 160 patients, of whom 57 were pretransplantation patients and 103 were posttransplantation patients. According to Table 1, the groups were comparable in terms of race, number of amputations, vision grade, and cardiac obstructive lesions. The two groups were different in gender, and as it was expected, in age (group posttransplantation is older than pretransplantation, with mean scores of 40 vs. 36.7 years, standard deviation (SD) 8.2 vs. 6.1; *P* = 0.037), and use of insulin, with striking prevalence in pretransplantation group.

In the posttransplantation group, 19 patients continued to be insulin-treated. A total of 12 patients lost the graft with a mean of 12 days after transplantation, as shown in Tables 1 and 2.

Tables 3 and 4 show the results and respective statistical analysis for each scale of the KDQOL-SF36 and

PAID, with their respective dimensions, comparing pretransplantation and posttransplantation patients, with the latter group divided into three time intervals. Two patients lost their kidney graft function three years after transplantation (Tables 3 and 4) and were included in the dialysis treatment patient satisfaction dimension. Analysis of the ESKD-related scores, as shown in Table 3, verified that the Burden of Kidney Disease dimension captured the most relevant general impact on the QoL gain of the patients evaluated (mean scores: 45.7 pretransplant vs. 83.3 posttransplant, *P* < 0.001).

After the SPKT (*n* = 19) patients lost their pancreas graft function. This loss impact was compared on Table 5 excluding insulin-dependent patients. When comparing to Table 3, PAID scores after transplantation are better when pancreas graft had no failure (mean scores: 29.7 when including patients with graft failure vs. 25.0 excluding insulin-dependent patients, *P* < 0.001).

## Discussion

In our study, we identified significant variation in mean scores between the groups at different posttransplant time intervals. After the first year following SPKT, there was a significant improvement in patients' QoL, as can

**Table 1.** Demographic and clinical characteristics of pre- and posttransplantation groups with the respective statistical analysis.

		Groups		Total	$\chi^2$	P	pFisher
		Pretransplantation	Posttransplantation				
Gender							
Male	N	41	53	94	6.347	0.012*	0.013*
	%	43.6%	56.4%	100.0%			
Female	N	16	50	66			
	%	24.2%	75.8%	100.0%			
Total	N	57	103	160			
	%	35.6%	64.4%	100.0%			
Race							
White	N	41	67	108	4.232	0.238	0.219
	%	38.0%	62.0%	100.0%			
Asian	N	1	3	4			
	%	25.0%	75.0%	100.0%			
Mulatto	N	9	28	37			
	%	24.3%	75.7%	100.0%			
Black	N	6	5	11			
	%	54.5%	45.5%	100.0%			
Total	N	57	103	160			
	%	35.6%	64.4%	100.0%			
Insuline- treated							
Yes	N	57	19	76	97.864	<0.001*	<0.001*
	%	75.0%	25.0%	100.0%			
No	N	0	84	84			
	%	0.0%	100.0%	100.0%			
Total	N	57	103	160			
	%	35.6%	64.4%	100.0%			
Amputation							
Yes	N	2	9	11	1.567	0.211	0.33
	%	18.2%	81.8%	100.0%			
No	N	55	94	149			
	%	36.9%	63.1%	100.0%			
Total	N	57	103	160			
	%	35.6%	64.4%	100.0%			
Vision							
Good	N	9	25	34	1.746	0.145	0.225
	%	26.5%	73.5%	100.0%			
Satisfactory	N	17	27	44			
	%	38.6%	61.4%	100.0%			
Bad	N	12	22	34			
	%	35.3%	64.7%	100.0%			
Blindness	N	19	29	48			
	%	39.6%	60.4%	100.0%			
Total	N	57	103	160			
	%	35.6%	64.4%	100.0%			
Cardiac obstructive lesion							
Yes	N	3	14	17	2.681	0.102	0.116
	%	17.6%	82.4%	100.0%			
No	N	54	89	143			
	%	37.8%	62.2%	100.0%			
Total	N	57	103	160			
	%	35.6%	64.4%	100.0%			

N, total number of patients.

\*P < 0.05.

**Table 2.** Description of variables related to the time factor for chronic kidney disease KDQOL, SF36\* with the respective statistical analysis.

Variables	Pretransplantation Group			Posttransplantation Group			U	P
	n	Mean	SD <sup>†</sup>	n	Mean	SD <sup>†</sup>		
Time with known CKD (months) <sup>‡</sup>	57	59.0	33.7	103	82.6	58.0	2208.5	0.009 <sup>§</sup>
Time on dialysis (months) <sup>‡</sup>	57	34.8	17.9	103	42.1	2876.5	2876.5	0.833
Time since diabetes diagnosis (years) <sup>‡</sup>	57	22.6	5.7	103	24.4	2523.5	2523.5	0.141
Insulin-treated (years) <sup>‡</sup>	57	21.8	6.3	19	21.3	534.5	534.5	0.933
Months after transplant <sup>‡</sup>	-	-	-	103	56.5	-	-	-
Graft lost after transplant (days) <sup>‡</sup>	-	-	-	12	12.9	-	-	-

N, total number of patients; n, number of subset of patients.

\*SF-36, Short-Form Health Survey.

<sup>†</sup>SD, Standard Deviation.

<sup>‡</sup>Data obtained at start of study.

<sup>§</sup>P < 0.05.

be observed in the specific variables relating to ESKD and general health.

In our daily practice, we have observed that patients who have undergone SPKT, even when they have experienced major postoperative complications [15], and, in some cases, lost one or both grafts, still wish to be put on the waiting list for re-transplantation. We have questioned, for example, what factors would lead to a patient's desire to be put on the waiting list again, despite the great psychological and physical suffering involved, including the risk of serious complications and even possible death given the initial unsuccessful transplant. Our main hypothesis was that, in terms of perceived QoL, patients on the waiting list would consider SPKT more favorably than suffering due to chronic complications of hyperglycemia, hypoglycemia, dialysis, and diabetes.

Although there were irreversible complications due to prolonged hemodialysis or following immunosuppressive therapy in the posttransplant period, we observed improvements in patients' perceptions of their general health, social interaction, vitality, and energy [16,17].

As observed in Table 3 the Burden of Kidney Disease dimension addresses the extent to which ESKD interferes in the patient's life, the time the patient spends on care for the disease, whether the patient is unhappy with the presence of kidney disease in his life, and whether he considers himself a "burden" on his family [10].

We believe that a patient's QoL and well-being will only stabilize after the third year following transplantation, which can be explained by the improved

performance of the pancreas in turn contributing to the stabilization or even regression of diabetic neuropathy and improvement of uremic symptoms may have contributed to a better QoL after transplant.

Surprisingly, comparisons of mean scores on the Cognitive Function variable in Table 3, revealed higher mean scores in the pretransplantation group than the posttransplantation group (12.7 vs. 8.8; P = 0.023), indicating a drop in QoL following SPKT. This variable relates to a patient's difficulty concentrating, as well as episodes of confusion and memory loss. As scores are very low in both groups, social-economic factors may also be considered. More than 50% of patients from the national public health system in Brazil have not completed elementary school, thus, this might be understood as one possible cause [18]. Yet, Gonçalves [19] cited polymedication, metabolic alterations, oxidative stress, chronic inflammation, anemia, endothelial dysfunction, dialysis (since this may induce cerebral ischemia), and other factors still poorly recognized by healthcare staff as possible explanations for cognitive decline among ESKD patients, mainly diabetics. Despite Cognitive Function dimension low scores in Table 3, when compared to patients General Health scores before and after SPKT, a significant improvement was observed (45.0 vs. 71.8; P < 0.001), indicating a general positive outcome.

Regarding the impact of diabetes mellitus on the QoL of the chronic renal patient, we compared their pre-transplant scores on the PAID with posttransplant scores at three posttransplant time intervals (<1 year, between 1 and 3 years, >3 years), and observed

**Table 3.** Comparison of mean scores on each dimension of the KDQOL, SF-36\*, and PAID scale for pre- and posttransplantation groups (N = 160).

Scale	Dimension	Pretransplantation Group			Posttransplantation Group			U/t	P
		n	Mean	SD <sup>†</sup>	n	Mean	SD <sup>†</sup>		
SF-36*	Symptom/problem list	57	81.2	12.7	103	87.0	12.24	2067	0.002 <sup>§</sup>
	Effects of kidney disease	57	61.4	25.2	103	94.4	8.36	-9.57	<0.001 <sup>§</sup>
	Burden of kidney disease	57	45.7	26.1	103	83.3	22.76	-9.481	<0.001 <sup>§</sup>
	Work status	57	49.1	20.0	103	52.4	21.44	2757.5	0.337
	Cognitive function	57	12.7	14.8	103	8.8	16.10	2365.5	0.023 <sup>§</sup>
	Quality of social interaction	57	42.1	19.7	103	37.7	17.40	2486.5	0.098
	Sexual function	22	84.0	24.1	69	94.2	17.49	535.5	0.005 <sup>§</sup>
	Sleep	57	45.5	12.7	103	44.8	9.93	2704	0.407
	Social support	57	78.3	24.9	103	85.4	28.07	2159	0.002 <sup>§</sup>
	Dialysis staff encouragement	57	89.2	20.3	87	99.5	2.98	1745.5	<0.001 <sup>§</sup>
	Patient satisfaction (dialysis)	57	69.3	15.3	2	75.0	11.79	47.5	0.669
	Physical functioning	57	62.8	26.7	103	81.1	21.94	-4.422	<0.001 <sup>§</sup>
	Role limitations: physical	57	51.3	42.1	103	80.1	33.46	1805.5	<0.001 <sup>§</sup>
	Pain	57	55.3	11.9	103	58.6	13.15	2617.5	0.239
	General health	57	45.0	26.1	103	71.8	20.95	-6.628	<0.001 <sup>§</sup>
	Emotional well-being	57	56.4	10.5	103	57.8	9.87	-0.864	0.389
Role limitations: emotional	57	61.9	38.0	103	83.1	32.63	2020.5	<0.001 <sup>§</sup>	
Social function	57	64.4	32.4	103	85.9	22.67	1773.5	<0.001 <sup>§</sup>	
Energy/fatigue	57	55.0	14.9	103	51.1	14.23	1.66	0.099	
Health changes	57	52.1	28.8	103	84.7	22.20	1160	<0.001 <sup>§</sup>	
Health related to the chronic kidney disease	57	56.4	18.2	103	83.5	13.71	670.5	<0.001 <sup>§</sup>	
PAID <sup>‡</sup>		57	42.3	23.6	103	29.7	24.20	2015.5	0.001 <sup>§</sup>

N, total number of patients; n, number of subset of patient.

\*SF-36, Short-Form Health Survey.

<sup>†</sup>SD, Standard Deviation.

<sup>‡</sup>PAID, Problem Areas in Diabetes.

<sup>§</sup>P < 0.05.

**Table 4.** Comparisons of mean scores on each dimension of the KDQOL, SF-36, and PAID scale of pretransplantation patients and three groups of posttransplantation patients allocated by the time interval since transplantation.

Scale	Dimension	Pretransplantation Group						<1 year PT <sup>§</sup>			Between 1 and 3 years PT			>3 years PT			F	p
		n	Mean	SD*	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD		
Chronic kidney disease	Symptom/problem list	57	81.2	12.8	23	92.2	9.0	25	87.2	10.8	55	84.8	13.5	4.69	0.004 <sup>§</sup>			
	Effects of kidney disease	57	61.5	25.3	23	96.7	5.2	25	94.3	7.7	55	93.6	9.6	48.79	<0.001 <sup>§</sup>			
	Burden of kidney disease	57	45.7	26.1	23	87.8	20.4	25	89.3	17.3	55	78.8	25.1	31.87	<0.001 <sup>§</sup>			
	Work status	57	49.1	20.0	23	50.0	21.3	25	52.0	26.9	55	53.6	18.9	0.47	0.706			
	Cognitive function	57	12.7	14.8	23	5.2	15.3	25	9.1	13.9	55	10.3	17.3	1.32	0.269			
	Quality of social interaction	57	42.1	19.7	23	32.2	16.5	25	37.3	9.0	55	40.2	20.1	1.78	0.154			
	Sexual function	22	84.1	24.1	11	87.5	30.1	19	96.1	12.5	39	95.2	14.8	2.06	0.112			
	Sleep	57	45.6	12.8	23	46.7	8.1	25	45.5	11.9	55	43.7	9.7	0.50	0.686			
	Social support	57	78.4	25.0	23	81.9	29.3	25	83.3	28.1	55	87.9	27.9	1.16	0.325			
	Dialysis staff encouragement	57	89.3	20.4	18	100.0	0.0	19	100.0	0.0	50	99.3	3.9	7.14	<0.001 <sup>§</sup>			
SF-36 <sup>†</sup>	Patient satisfaction (dialysis)	57	69.3	15.4	-	-	-	-	-	-	2	75.0	11.8	0.27	0.607			
	Physical functioning	57	62.8	26.8	23	73.3	30.6	25	85.2	18.7	55	82.6	18.3	8.54	<0.001 <sup>§</sup>			
	Role limitations: physical	57	51.3	42.1	23	84.8	26.9	25	71.0	40.0	55	82.3	32.5	8.20	<0.001 <sup>§</sup>			
	Pain	57	55.4	12.0	23	57.4	14.3	25	57.0	9.0	55	60.0	14.3	3.17	0.366			
	General health	57	45.1	26.2	23	86.1	15.0	25	72.4	20.2	55	65.6	20.7	22.51	<0.001 <sup>§</sup>			
	Emotional well-being	57	56.4	10.5	23	55.8	11.8	25	60.0	8.3	55	57.7	9.6	0.93	0.426			
	Role limitations: emotional	57	62.0	38.0	23	91.3	20.6	25	72.0	40.5	55	84.8	32.0	5.98	0.001 <sup>§</sup>			
	Social function	57	64.5	32.5	23	91.8	16.3	25	84.0	25.1	55	84.3	23.7	8.45	<0.001 <sup>§</sup>			
	Energy/fatigue	57	55.1	15.0	23	48.5	12.4	25	52.2	11.1	55	51.7	16.2	1.24	0.296			
	Health changes	57	52.2	28.8	23	100.0	0.0	25	87.0	24.1	55	77.3	22.7	27.87	<0.001 <sup>§</sup>			
PAID <sup>‡</sup>	Health related to the chronic kidney disease	57	56.5	18.3	23	91.7	10.3	25	83.2	12.5	55	80.4	14.3	42.24	<0.001 <sup>§</sup>			
		57	42.3	23.6	23	34.8	27.1	25	29.5	21.9	55	27.8	24.1	3.83	0.011 <sup>§</sup>			

n, number of subset of patients.

\*SD, Standard Deviation.

<sup>†</sup>SF-36, Short-Form Health Survey.

<sup>‡</sup>PAID, Problem Areas in Diabetes.

<sup>§</sup>PT, posttransplant.

<sup>§</sup>P < 0.05.



**Table 5.** Comparison of mean scores on each dimension of the KDQOL, SF-36\*, and PAID scale for pre- and posttransplantation groups excluding insulin-dependent patients.

Scale	Dimension	Pretransplantation Group			Posttransplantation Group			U/t	P
		n	Mean	SD <sup>†</sup>	n	Mean	SD <sup>†</sup>		
SF-36*	Chronic kidney disease	57	81.2	12.7	84	87.7	11.91	1595.5	0.001 <sup>§</sup>
	Effects of kidney disease	57	61.4	25.2	84	94.5	8.68	-9.518	<0.001 <sup>§</sup>
	Burden of kidney disease	57	45.7	26.1	84	83.5	22.18	-9.222	<0.001 <sup>§</sup>
	Work status	57	49.1	20.0	84	51.8	21.18	2277	0.452
	Cognitive function	57	12.7	14.8	84	8.2	15.54	1875	0.015 <sup>§</sup>
	Quality of social interaction	57	42.1	19.7	84	38.2	16.63	2022	0.105
	Sexual function	22	84.0	24.1	59	94.1	18.62	448.5	0.003 <sup>§</sup>
	Sleep	57	45.5	12.7	84	44.9	9.98	2208.5	0.434
	Social support	57	78.3	24.9	84	90.5	22.45	1501	<0.001 <sup>§</sup>
	Dialysis staff encouragement	57	89.2	20.3	70	99.5	3.32	1414	<0.001 <sup>§</sup>
	Patient satisfaction (dialysis)	57	69.3	15.3	1	66.7	-	-	-
	Physical functioning	57	62.8	26.7	84	80.5	23.23	-4.167	<0.001 <sup>§</sup>
	Role limitations: physical	57	51.3	42.1	84	79.5	34.09	1485.5	<0.001 <sup>§</sup>
	Pain	57	55.3	11.9	84	58.4	12.66	2120	0.233
	General health	57	45.0	26.1	84	72.3	20.96	-6.539	<0.001 <sup>§</sup>
	Emotional well-being	57	56.4	10.5	84	58.2	9.38	-1.073	0.285
	Role limitations: emotional	57	61.9	38.0	84	82.5	34.51	1663	<0.001 <sup>§</sup>
Social function	57	64.4	32.4	84	86.8	21.90	1403.5	<0.001 <sup>§</sup>	
Energy/fatigue	57	55.0	14.9	84	51.5	13.94	1.461	0.146	
Health changes	57	52.1	28.8	84	83.6	23.12	995	<0.001 <sup>§</sup>	
Health related to the chronic kidney disease	57	56.4	18.2	84	84.4	13.65	512	<0.001 <sup>§</sup>	
PAID <sup>‡</sup>		57	42.3	23.6	84	25.0	21.08	1366.5	<0.001 <sup>§</sup>

N, total number of patients; n, number of subset of patients.

\*SF-36, Short-Form Health Survey.

<sup>†</sup>SD, Standard Deviation.

<sup>‡</sup>PAID, Problem Areas in Diabetes.

<sup>§</sup>P < 0.05.



significant and progressive emotional distress reduction, improving diabetes-related QoL in SPKT patients. Some authors attributed the improvement in the QoL of type I diabetic patients who had undergone SPKT to the stabilization of the metabolism of blood glucose, contributing to prevention of the appearance of other chronic complications [20].

When comparing the group of patients who lost the pancreas graft function ( $n = 19$ ) with those whose pancreas function did not fail ( $n = 84$ ) after SPKT in Table 5, results were significant (50.8 vs. 24.9;  $P < 0.001$ ). Complications as pancreatitis, infections, and hemorrhage may be some of the causes for pancreatic failure [21]. The burden of clinical comorbidities, restrict diet and insulin-dependency can be considered elements to impact patient's QoL [5].

We did not expect patients with recent transplants to have a QoL equal to or greater than that of patients who had undergone transplantation ( $\geq 1$  year). We believe that patients are better adapted to the grafts after a year; but QoL improves progressively over the years after SPKT, when patients better understand their limitations. This outcome may be the result of the stabilization of the levels of glycosylated hemoglobin provided by pancreas transplantation. It is also due to the symbiosis between the two transplanted organs, with the grafts providing mutual protection for each other [22,23].

Most hemodialysis patients expect to experience an extreme change in their lives after transplantation, and consequently, they can overestimate the benefits of this procedure [24]. This fact may cause frustration in some patients since they face limitations and complications after the surgery. Even so, this study suggests that these factors may be irrelevant when compared to the suffering caused by ESKD during the pretransplant period.

The greatest fear reported by patients was in reference to treatment by hemodialysis. This result was also observed by Adang *et al.* [25], who reported that patients who lost the pancreas still showed improvement in their QoL.

To our knowledge, there are no comparative studies that have specifically evaluated the impact of SPKT on QoL and well-being among diabetic patients with ESKD, with groups representing different posttransplantation time intervals, using the specific instruments employed in this study.

As we did not follow the same patients between the pre- and posttransplant periods, across the relevant time intervals, this can be considered a limitation of this

study. Other limitations are as follows: improved scores in KDQOL-SF36 are most likely attributed to kidney graft, and could have been observed in kidney transplant alone, and improved scores in PAID could be attributed to pancreas graft (freedom from diabetes) but there is no comparison with the group of diabetic patients with kidney transplant alone. Further longitudinal and prospective studies are needed, as well as cognitive function studies among patients with long-term ESKD, and comparison with diabetic patients with kidney transplant alone using specific measurement tools to evaluate patients' QoL in different time intervals. Analysis of death was not included in this study, therefore, patient's QoL analysis was considered while alive for the pre- and posttransplanted patients in the three time intervals.

In conclusion, patients receiving SPKT have an improved perceived QoL, based on specific questionnaires used as measures for kidney disease and diabetes, compared with patients on the waiting list for SPKT. This positive perception remains almost entirely comparable over the long-term follow-up period.

### Authorship

KR: designed the study, performed the study, collected data, analyzed data, wrote and revised the paper. MML: designed the study, performed the study, collected data, analyzed data, wrote and revised the paper. SM: designed the study, analyzed data, revised the paper. TMR: collected data, analyzed data. AMG: analyzed data, revised the paper. AASN: analyzed data, revised the paper. ÉBR: analyzed data, revised the paper. GJLF: analyzed data, revised the paper. HTS-J: designed the study, analyzed data, revised the paper. JM-P: designed the study, analyzed data, revised the paper.

### Funding

The authors have declared no funding.

### Conflict of interest

The authors have declared no conflicts of interest.

### Acknowledgements

To all patients and their families. To the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

## REFERENCES

1. Augustine T. Simultaneous pancreas and kidney transplantation in diabetes with renal failure: the gold standard? *J Ren Care* 2012; **38**: 115.
2. Gruessner A, Sutherland DE. Pancreas transplant results in the United Network for Organ Sharing (UNOS) United States of America (USA) Registry compared with non-USA data in the International Registry. *Clin Transpl* 1994; **47**: 68.
3. Rosen CB, Frohnert PP, Velosa JA, Engen DE, Sterioff S. Morbidity of pancreas transplantation during cadaveric renal transplantation. *Transplantation* 1991; **51**: 123.
4. Piehlmeier W, Bullinger M, Nusser J, et al. Quality of life in type 1 (insulin-dependent) diabetic patients prior to and after pancreas and kidney transplantation in relation to organ function. *Diabetologia* 1991; **34**: S150.
5. Gross CR, Limwattananon C, Matthees BJ. Quality of life after pancreas transplantation: a review. *Clin Transplant* 1998; **12**: 351.
6. Ziaja J, Bozek-Pajak D, Kowalik A, Krol R, Cierpka L. Impact of pancreas transplantation on the quality of life of diabetic renal transplant recipients. *Transplant Proc* 2009; **41**: 3156.
7. Barlow AD, Saeb-Parsy K, Watson CJE. An analysis of the survival outcomes of simultaneous pancreas and kidney transplantation compared to live donor kidney transplantation in patients with type 1 diabetes: a UK Transplant Registry study. *Transpl Int* 2017; **30**: 884.
8. Loseke CA. Quality of life after pancreas transplantation. *Diabetes Care* 1990; **13**: 541.
9. Sureshkumar KK, Patel BM, Markatos A, Nghiem DD, Marcus RJ. Quality of life after organ transplantation in type 1 diabetics with end-stage renal disease. *Clin Transplant* 2006; **20**: 19.
10. Martins LS, Outerelo C, Malheiro J, et al. Health-related quality of life may improve after transplantation in pancreas-kidney recipients. *Clin Transplant* 2015; **29**: 242.
11. Wai PY, Sollinger HW. Long-term outcomes after simultaneous pancreas-kidney transplant. *Curr Opin Organ Transplant* 2011; **16**: 128.
12. Hays RD, Kallich JD, Mapes DL, et al. *Kidney Disease Quality of Life Short Form (KDQOL-SF™), Version 1.3: A Manual for Use and Scoring* [Internet]. Santa Monica, CA: RAND Corporation, 1997. [Cited 2017 September 9]. Available from: <https://www.rand.org/content/dam/rand/pubs/papers/2006/P7994.pdf>.
13. Duarte PS, Miyazaki MC, Ciconelli RM, Sesso R. Translation and cultural adaptation of the quality of life assessment instrument for chronic renal patients (KDQOL-SFTM). *Rev Assoc Med Bras* 2003; **49**: 375.
14. Gross CC, Scain SF, Scheffel R, Gross JL, Hutz CS. Brazilian version of the problemareas in diabetes scale (B-PAID): validation and identification of individuals at high risk for emotional distress. *Diabetes Res Clin Pract* 2007; **76**: 455.
15. Khubutia MS, Pinchuk AV, Dmitriev IV, Balkarov AG, Storozhev RV, Anisimov YA. Surgical complications after simultaneous pancreas-kidney transplantation: a single-center experience. *Asian J Surg* 2016; **39**: 232.
16. Redfield RR, Scalea JR, Odorico JS. Simultaneous pancreas and kidney transplantation: current trends and future directions. *Curr Opin Organ Transplant* 2015; **20**: 94.
17. Burra P, De Bona M. Quality of life following organ transplantation. *Transplant Int* 2007; **20**: 397.
18. de Faria Stamm AMN, Osellame R, Duarte F, Cecato F, Medeiros LA, Marasciulo AC. Perfil socioeconômico dos pacientes atendidos no Ambulatório de Medicina Interna do Hospital Universitário da UFSC. *Arq Catarinenses Med* 2002; **31**: 17.
19. Gonçalves V. *Insuficiência renal e declínio cognitivo* [Internet]. Portugal: Portal da Diálise; 2014. **20**: 25 [Cited 2017 September 9]. Available from: <https://www.portaldadialise.com/article/s/insuficiencia-renal-e-declinio-cognitivo>.
20. Piehlmeier W, Bullinger M, Kirchberger I, Land W, Landgraf R. Evaluation of the quality of life of patients with insulin-dependent diabetes mellitus before and after organ transplantation with the SF 36 health survey. *Eur J Surg* 1996; **162**: 933.
21. Meirelles Júnior RF, Salvalaggio P, Pacheco-Silva A. Pancreas transplantation: review. *Einstein (Sao Paulo)* 2015; **13**: 305.
22. Nyumura I, Babazono T, Tauchi E, et al. Quality of life in Japanese patients with type 1 diabetes and end-stage renal disease undergoing simultaneous pancreas and kidney transplantation. *Diabetol Int* 2017; **8**: 268.
23. Von Der Lippe N, Waldum B, Brekke F, et al. A longitudinal study of health related quality of life from dialysis to transplantation [abstract]. In: Abstracts of the 51st ERA-EDTA Congress; 2014 May 31–June 3, 2014; Amsterdam, Netherlands. *Nephrol Dial Transplant* 2014; **29**(Suppl\_3): iii309.
24. Smith D, Loewenstein G, Jepson C, Jankovich A, et al. Mispredicting and misremembering: patients with renal failure overestimate improvements in quality of life after a kidney transplant. *Health Psychol* 2008; **27**: 653.
25. Adang EM, Engel GL, van Hooff JP, Kootstra G. Comparison before and after transplantation of pancreas-kidney and pancreas-kidney with loss of pancreas: a prospective controlled quality of life study. *Transplantation* 1996; **62**: 754.