

Psychological characteristics and associations between kidney transplant recipients and biologically related or unrelated living donors: a retrospective observational study

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Abstract

Background : Although recipients and donors in living kidney transplantation are exposed to psychological distress, including depression and anxiety during the pre-operative period, only a few studies have evaluated their psychological relationship. This study aimed at determining the psychological characteristics and correlation between transplant recipients and donors as well as at investigating it in relation to biologically related and unrelated donors.

Methods : This retrospective study on living kidney transplantation at the Korea University Anam Hospital was conducted from April 2008 to June 2019. While participants' personality patterns were assessed using the Minnesota Multiphasic Personality Inventory-2(MMPI-2), their mood states before transplantation were evaluated via both the State-Trait Anxiety Inventory (STAI) and The Center for Epidemiologic Studies Depression Scale (CES-D). Statistical analysis was performed using a paired t-test and Spearman's correlation analyses.

Results : The recipient group showed a significantly higher sub-score in hypochondriasis ($t = -4.49, P = .0001$), depression ($t = -3.36, P = .0015$), hysteria ($t = -3.30, P = .0018$), STAI-T ($t = -2.14, P = 0.0372$), and CES-D ($t = -3.93, P = .0003$) than donor group. A comparison of the psychological association between the recipient and donor groups revealed a significant positive correlation in the STAI-S ($r = .357, P = .009$) and CES-D ($r = .362, P = .008$). When assessing the difference in correlation based on the biological relationship between the recipients and donors, there is a positive correlation in CES-D ($r = .415, P = .0202$) in biologically related donors and recipients. In biologically unrelated but emotionally related group, recipients' STAI-S score and donors' STAI-S ($r = 0.413, P = .163$), STAI-T ($r = .559, P = .009$) score is positively correlated, and recipients' STAI-T score and donors' STAI-S ($r = .466, P = .033$), STAI-T ($r = .520, P = .016$) score is also positively correlated. Besides, recipients' CES-D and donors' STAI-S ($r = .529, P = .014$) and STAI-T ($r = .560, P = .008$) score show a positive correlation.

Conclusions : The study indicated that transplantation recipients suffered from a higher level of depression and anxiety compared to the donors before transplantation. The findings suggest that recipients are more depressive and anxious than donors, and psychological problems like depression and anxiety can be shared in living kidney transplantation donors and recipients, especially in biologically unrelated but emotionally related groups.

Background

Kidney transplantation is the treatment of choice for end-stage renal disease (ESRD). Kidney transplantation has been shown to improve survival and quality of life when compared with maintenance dialysis for patients with ESRD [1]. Kidney transplantation is divided into living and cadaver donors. More than 27,000 living-donor kidney transplantations are performed each year across developed and developing countries [2]. According to the International Registry in Organ Donation and Transplantation (IRODaT) in 2017, the number of cadaveric organ donors is 9.95 per million people, whereas the number of living donors is 44.28.28 per million people in South Korea. 15,541(61.9%) of the 2,5101 total kidney transplantation from February 2002 to June 2019 were living kidney transplantations [3]. This means that living kidney transplantation is more common than that of cadaver kidney transplantation in South Korea.

Especially, in South Korea, 95.7% of living kidney transplantation occurs in familial relationships [3]. Candidates for living donors have been classified into six types: 1) biologically related to the recipient, 2) emotionally related to the recipient, 3) an altruistic direct relationship, 4) altruistic relationship but unrelated to the recipient 5) organ sellers and 6) organ exchangers [4]. According to this, donors within family members can be classified into biologically related donors and emotionally related donors. Reflecting the characteristics of South Korea, we divided donors and recipients into biologically related and biologically unrelated but emotionally related, respectively.

The studies on the psychological aspects of kidney transplantations published so far have mainly focused on only one part of donors and recipients pairs. First, in the recipients' aspect, it is known that mortality in patients with depression after kidney transplantation is higher than in patients without depression [5]. Depression is association with a twofold increase in risk of graft failure and death [6]. Although kidney transplantation is known to cause lower psychological stress than hemodialysis [7, 8], recipients have higher levels of depression and anxiety. This may be due to both their ESRD and the guilt with respect to donors [9, 10]. Studies on donors' psychological difficulties report that while the majority of donors experience an absence of depression (77-95 %) or anxiety (86-94%), 39% of the patients described the overall experience at least somewhat stressful [11]. Another study, however, suggests that poor recipient outcomes may result in depression in donor, feelings of waste and guilt, and even causing conflicts in donor-recipient relationships [12]. However, as far as we know, studies on the psychological relationship between donors and recipients are insufficient. Because the patients enrolled in this study had the characteristics of organ transplantation in the family, we assumed that the psychological characteristics of the donor and the recipient would be related. As we know, temperament is affected by genetic factors [13]. Moreover, recipients and donors can also be exposed to similar environments including parenting, socioeconomic status and family norms, which may lead to similar personalities and coping styles. Therefore, it is essential to consider that psychological characteristics can influence the relationship between donors and recipients.

This study aimed to investigate the psychological characteristics of living kidney donors and recipients. We hypothesized that living kidney donors and recipients have a psychological association, and we aimed to determine whether a difference in their psychological characteristics was present based on whether the donor was biologically related or unrelated to the recipient.

Methods

Study Population

During the evaluation of patients with ESRD to establish their eligibility for the present study, 132 recipients and the potential waiting lists for kidney donors were examined. Clinical data from 26 foreigners who were unable to understand and complete the psychological questionnaire were excluded. Therefore, we retrospectively reviewed the medical records of 106 adult donors and recipients who underwent living donor kidney transplantation at the Korea University Anam Hospital between April 2008 and June 2019.

Of them, 53 pairs of living donors and recipients were included. While 31 pairs were biologically related (e.g., mother to child, father to child, between brothers), the remaining 22 were biologically unrelated but only emotionally related (e.g., wives to husbands or husbands to wives). Finally, following a retrospective analysis, eligible patients who were > 18 years of age at the time of transplantation were included in our study.

All the subjects provided written informed consent, and the study was approved by the Institutional Review Board of the Korea University Anam Hospital (IRB No. 2019AN0380). The principles described in the "Declaration of Helsinki" were followed during both clinical and research activities. No organs/tissues were obtained from the subjects.

Assesment

Several standardized questionnaires with known validity and reliability were employed to assess the severity of anxiety and depression symptoms, as well as the health information in transplant donors and recipients. All data were collected in face-to-face interviews by well-trained psychologists and then validated by expert psychiatrists.

Assessment Of Socio-demographic Information

Participants' socio-demographic and general health information was confirmed. Specifically, the questionnaire was used for the sociodemographic and clinical identification of patients, with the following data being recorded: name, age, gender, alcohol consumption, and smoking history (Table 1).

Table 1. Demographic variables (Mean± SD or N (%))

	Recipients (n = 53)	Donors (n = 53)
Age (years)	46.98 ± 11.27	49.36 ± 11.31
Gender		
Male	34 (64.15 %)	22 (41.51 %)
Female	19 (35.85 %)	31 (58.49 %)
Alcohol history		
None	36 (67.92 %)	
≥ 1 year	15 (28.3 %)	
Currently in progress	2 (3.77 %)	
Smoking history		
None	39 (73.58 %)	
≥ 1 year	9 (16.98 %)	
Currently in progress	5 (9.43 %)	
Height	165.58 ± 8.84	
Weight	65.44 ± 13.91	
BMI (kg/m^2)	23.65 ± 3.42	
BMI; body mass index		

Assessment Of Personality Dimensions

The Minnesota Multiphasic Personality Inventory-2 (MMPI-2) is a well-standardized self-report measure designed to assess personality traits and psychopathology in an individual's personality. Briefly, it consists of 567 statements that can be rated as "correct" or "incorrect." Successively, statements are grouped into ten clinical scales and nine validity scales. This present study is based on the results obtained from the following ten clinical scales: Hypochondriasis (Hs), Depression (D), Hysteria (Hy), Psychopathic Deviate (Pd), Masculinity-Femininity (Mf), Paranoia (Pa), Psychasthenia (Pt), Schizophrenia (Sc), Hypomania (Ma), and Social Introversion (Si). Additionally, data from the following three validity scales are discussed: Lie (L), Infrequency

(F), and Defensiveness (K). Rather than personality dimensions, the three validity scales assess either the individual's pattern of responses or the response bias. In contrast, the clinical scales assess a variety of clinical conditions (e.g., depression, anxiety, and psychopathic deviate) and are used to identify individuals with psychiatric symptoms.

In the present investigation, MMPI-2 raw scores were converted to T-scores to enable comparison with the normative group (standardized test) [14]. Given the T-scores of the normative group (mean = 50, SD = 10), a T-score between 50 and 65 is considered to be within the normal range. In contrast, a T-score ≥ 65 is interpreted as clinically significant. All the clinical scales of reliability and validity have been well-established [15]. Here, we used the Korean version of the MMPI-2, which was highly validated, and they are results reliable in Korea [16].

Assessment Of Anxiety And Depression

The State-Trait Anxiety Inventory (STAI) is a 40-item self-report instrument assessing anxiety. Specifically, it consists of two subscales, one related to the anxiety state (STAI-S-20) and the other associated with the anxiety trait (STAI-T-20). Answers for each item are scored according to a 4-point Likert scale, and the overall score ranges from 20 to 80, with higher values indicating greater anxiety levels. Total scores with cut-offs ≥ 54 are defined as 'mild anxiety,' whereas cut-offs ≥ 64 are described as 'severe anxiety' [17]. We used the well-validated Korean version of both the STAI-S and STAI-T [18].

The Center for Epidemiologic Studies Depression Scale (CES-D) was applied to evaluate the symptoms of depression [19]. The 20-item CES-D assesses the frequency of depressive symptoms experienced in a week-long period on a 4-point scale (0 = rarely, 1 = sometimes, 2 = moderately, and 3 = always). The total score could range from 0 (no depressive symptoms) to 60 (severe depressive symptoms). The total scores with standard cut-offs ≥ 16 are defined as 'possible depression,' whereas cut-offs ≥ 23 are described as 'probable depression'. Here, we used the Korean version of the questionnaire [20].

Statistical analysis

To compare the psychological characteristics of renal transplant recipients and donors, we analyzed the psychological tests using paired t-tests. Also, an independent two-sample test was performed to evaluate the psychological differences between the biologically related and unrelated recipients and donors. Furthermore, Spearman's correlation analyses were performed to explore the relationship between the donor and recipient's psychological state concerning the MMPI-2, STAI, and CES-D. Specifically, we calculated the correlation coefficient by dividing the biologically related group and the unrelated group. All the associations were considered to be statistically significant when P was less than .05. All the data were analyzed using the SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

The sociodemographic characteristics of recipients and donors are presented in Table 1. The mean age of the recipient and donor groups at the time of the survey was 46.98 ± 11.27 and 49.36 ± 11.31 years, respectively. With regard to the gender proportion, 64.15% of the total recipient sample identified themselves as male and 35.85% as female. In contrast, 41.51% of the entire donor sample identified themselves as male and 58.49% as female.

Comparison of the psychological assessments between recipients and living donors

The psychological differences between recipients and donors in the sub-scales of the MMPI-2, STAI-T, and STAI-S are given in Table 2. When comparing the recipient and donor groups, the former showed significantly higher scores in Hs ($t = -4.49$, $P = .0001$), D ($t = -3.36$, $P = .0015$), Hy ($t = -3.30$, $P = .0018$), STAI-T ($t = -2.14$, $P = .0372$), and CES-D ($t = -3.93$, $P = .0003$) than the latter.

Table 2. Comparison of the psychological assessments between kidney transplant recipients and donors (Mean (SD))

Variables	Total sample(n=53)				Biological related sample(n=31)				Biological unrelated sample(n=22)		
	Recipient	Donors	<i>t</i>	<i>P</i>	Recipient	Donors	<i>t</i>	<i>P</i>	Recipient	Donors	<i>t</i>
MMPL_L	49.89(8.09)	50.25(9.26)	0.02	0.9815	47.74(6.93)	50.55(10.89)	1.23	0.230	52.91(8.78)	49.81(6.35)	-1.96
MMPL_F	43.32(6.47)	44.29(7.65)	0.70	0.4864	43.94(7.16)	45.26(8.34)	0.75	0.461	42.45(5.40)	42.86(6.42)	0.14
MMPL_K	52.55(9.59)	52.92(11.22)	0.14	0.8856	51.13(10.26)	52.71(12.76)	0.67	0.509	54.55(8.39)	53.24(8.74)	-0.69
MMPL_Hs	51.57(8.66)	44.79(6.13)	-4.49	0.0001**	50.97(8.20)	45.03(5.85)	-3.00	0.0054**	52.41(9.41)	44.43(6.67)	-3.37
MMPL_D	53.30(11.15)	46.87(8.79)	-3.36	0.0015**	52.97(11.34)	46.90(9.78)	-2.16	0.0390**	53.77(11.12)	46.81(7.33)	-2.86
MMPL_Hy	51.74(8.80)	46.29(7.20)	-3.30	0.0018**	50.52(7.84)	46.13(7.26)	-2.11	0.0435**	53.45(9.92)	46.52(7.27)	-2.57
MMPL_Pd	47.43(10.63)	44.69(8.23)	-1.43	0.1581	47.65(11.76)	44.77(9.29)	-0.98	0.337	47.14(9.06)	44.57(6.56)	-1.20
MMPL_Mf	50.06(9.65)	46.65(7.83)	-1.77	0.0822*	49.61(10.62)	47.55(7.21)	-0.88	0.386	50.68(8.31)	45.33(8.69)	-1.78
MMPL_Pa	46.81(8.16)	45.75(8.83)	-0.68	0.4970	47.87(9.88)	46.45(9.91)	-0.54	0.591	45.32(4.64)	44.71(7.05)	-0.44
MMPL_Pt	46.06(7.65)	45.12(9.30)	-0.56	0.5793	45.90(8.61)	45.68(8.19)	-0.10	0.919	46.27(6.23)	44.29(10.90)	-0.77
MMPL_Sc	43.77(8.08)	44.44(8.79)	0.40	0.6891	43.77(9.45)	45.35(7.90)	0.75	0.456	43.77(5.84)	43.10(10.02)	-0.32
MMPL_Ma	45.79(8.84)	46.27(8.32)	0.39	0.6977	43.61(5.65)	46.26(9.04)	1.66	0.107	48.86(11.44)	46.29(7.34)	-0.91
MMPL_Si	46.43(9.98)	47.63(10.41)	0.50	0.6255	47.45(10.31)	48.16(10.57)	0.28	0.779	45.00(9.55)	46.86(10.37)	0.44
STAI_S	39.91(10.45)	37.29(10.42)	-1.50	0.1402	39.16(10.88)	35.71(10.66)	-1.45	0.156	40.95(9.98)	39.62(9.84)	-0.48
STAI_T	39.81(10.32)	35.96(9.08)	-2.14	0.0372**	40.13(11.00)	35.32(9.25)	-1.93	0.0627*	39.36(9.51)	36.90(8.97)	-0.92
CES_D	13.49(8.24)	8.56(6.77)	-3.93	0.0003**	13.61(9.45)	7.94(6.44)	-3.53	0.0014**	13.32(6.35)	9.48(7.30)	-1.88

Note: MMPI-2; Minnesota Multiphasic Personality Inventory-2; L = Lie; F = Infrequency; K = Defensiveness; Hs = Hypochondriasis; D = Depression; Hy = Hyster Psychopathic Deviate; Mf = Masculinity-Femininity; Pa = Paranoia; Pt = Psychasthenia; Sc = Schizophrenia; Ma = Hypomania; Si = Social Introversion; STAI-S State-Trait Anxiety Inventory-State; STAI-T; Spielberger State-Trait Anxiety Inventory-Trait; CES-D; The Center for Epidemiologic Studies Depression Scale.

P*<0.1; *P*<0.05.

To further validate the study results, Table 2 summarizes the differences between donors and recipients based on their biological relationship. Significant differences in the neurotic triad (i.e., Hs, D, Hy scales) were seen, regardless of whether the donor-recipient matched subjects were related [21]. Additionally, in contrast to the biologically related donor group, the biologically related recipient group showed higher scores of Hs ($t = -3.00$, $P = .0054$), D ($t = -2.16$, $P = .0390$), and Hy ($t = -2.11$, $P = .0435$). Similarly, the biologically unrelated recipient group reported higher scores of Hs ($t = -3.37$, $P = .003$), D ($t = -2.86$, $P = .0098$), and Hy ($t = -2.57$, $P = .00185$) compared to the biologically unrelated donor group. In contrast, while significant differences between the biologically related donors and recipients were observed in the CES-D, no significant differences were seen in the biologically unrelated group. Finally a higher score of CES-D was found in the biologically related recipient group compared to the biologically related donor group ($t = -3.53$, $P = .0014$).

Comparison of the psychological assessments between recipients and donors based on their biological relationship

The psychological differences between the recipients and donors based on their biological relationships are given in Table 3. Comparing the psychological characteristics between biologically related and unrelated recipients, no significant difference in the sub-scores was observed, except for the L-scale sub-score ($P = 0.0204$), which was significantly higher for biologically unrelated recipients. With regards to the donors, significant differences between biologically related and unrelated recipients were not found in any of the psychological assessments.

Table 3

Comparison of psychological assessments between the transplant recipient and donor groups based on biological relationship (Mean (SD))

Variables	Recipients (n = 53) [*]				P	Donors (n = 53)				P
	Biologically related recipients(n = 31)		Biologically unrelated recipients(n = 22)			Biologically related donors(n = 31)		Biologically unrelated donors(n = 22)		
MMPL_L	47.74	(6.93)	52.91	(8.78)	0.0204**	50.55	(10.89)	49.81	(6.35)	0.7592
MMPL_F	43.94	(7.16)	42.45	(5.40)	0.4170	45.26	(8.34)	42.86	(6.42)	0.2708
MMPL_K	51.13	(10.26)	54.55	(8.39)	0.2043	52.71	(12.76)	53.24	(8.74)	0.8696
MMPL_Hs	50.97	(8.20)	52.41	(9.41)	0.5558	45.03	(5.85)	44.43	(6.67)	0.7314
MMPL_D	52.97	(11.34)	53.77	(11.12)	0.7985	46.90	(9.78)	46.81	(7.33)	0.9704
MMPL_Hy	50.52	(7.84)	53.45	(9.92)	0.2344	46.13	(7.26)	46.52	(7.27)	0.8483
MMPL_Pd	47.65	(11.76)	47.14	(9.06)	0.8656	44.77	(9.29)	44.57	(6.56)	0.9315
MMPL_Mf	49.61	(10.62)	50.68	(8.31)	0.6953	47.55	(7.21)	45.33	(8.69)	0.3219
MMPL_Pa	47.87	(9.88)	45.32	(4.64)	0.2155	46.45	(9.91)	44.71	(7.05)	0.4917
MMPL_Pt	45.90	(8.61)	46.27	(6.23)	0.8643	45.68	(8.19)	44.29	(10.90)	0.6014
MMPL_Sc	43.77	(9.45)	43.77	(5.84)	0.9994	45.35	(7.90)	43.10	(10.02)	0.3684
MMPL_Ma	43.61	(5.65)	48.86	(11.44)	0.0567	46.26	(9.04)	46.29	(7.34)	0.9908
MMPL_Si	47.45	(10.31)	45.00	(9.55)	0.3836	48.16	(10.57)	46.86	(10.37)	0.6621
STAI_S	39.16	(10.88)	40.95	(9.98)	0.5434	35.71	(10.66)	39.62	(9.84)	0.1869
STAI_T	40.13	(11.00)	39.36	(9.51)	0.7930	35.32	(9.25)	36.90	(8.97)	0.5429
CES_D	13.61	(9.45)	13.32	(6.35)	0.8993	7.94	(6.44)	9.48	(7.30)	0.4262

*P < 0.1; **P < 0.05.
Note: MMPI-2; Minnesota Multiphasic Personality Inventory-2; L = Lie; F = Infrequency; K = Defensiveness; Hs = Hypochondriasis; D = Depression; Hy = Hysteria ; Pd; Psychopathic Deviate; Mf = Masculinity-Femininity; Pa = Paranoia; Pt = Psychasthenia; Sc = Schizophrenia; Ma = Hypomania; Si = Social Introversion; STAI-S; Spielberger State-Trait Anxiety Inventory-State; STAI-T; Spielberger State-Trait Anxiety Inventory-Trait; CES-D; The Center for Epidemiologic Studies Depression Scale.

Correlation of the psychological assessments between recipients and donors

Table 4 summarizes the relationship between the MMPI-2, STAI-S, STAI-T, and CES-D sub-scores of recipients and donors using the Spearman correlation analysis. Briefly, a positive correlation between recipients and donors in the K-($r = 0.282$, $P = .043$) and Ma-($r = 0.282$, $P = .003$) scores were found. Similarly, a significant positive correlation was seen in the STAI-S ($r = 0.357$, $P = .009$) and CES-D ($r = 0.362$, $P = .008$)

Table 4
Correlations of the psychological assessments between recipients and donors (n = 106)

Donor's psychological dimensions		L	F	K	Hs	D	Hy	Pd	Mf	Pa	Pt	Sc	Ma	Si
Recipient's psychological dimensions	L	0.029	-0.295**	0.093	0.052	0.009	0.151	-0.147	-0.201	-0.136	-0.248*	-0.328**	-0.067	-0.207
	F	-0.091	0.218	-0.037	0.167	0.037	0.160	0.128	-0.088	0.156	0.239*	0.133	0.039	0.115
	K	0.306**	-0.203	0.282**	0.024	-0.052	0.232*	0.005	0.043	0.075	-0.122	-0.214	-0.195	-0.319
	Hs	0.100	0.010	0.173	-0.062	-0.203	-0.066	-0.065	0.006	-0.121	0.014	0.031	0.053	-0.111
	D	-0.144	0.021	-0.230	-0.100	0.023	-0.189	-0.102	-0.078	0.050	-0.120	-0.095	-0.091	0.113
	Hy	0.098	-0.009	0.099	-0.116	-0.101	-0.097	0.014	-0.017	0.013	0.004	-0.061	0.005	-0.151
	Pd	-0.053	-0.022	-0.011	-0.075	-0.100	-0.021	-0.058	-0.116	-0.091	-0.039	-0.100	-0.105	-0.066
	Mf	-0.315**	0.176	-0.310**	-0.159	-0.086	-0.247*	-0.067	-0.066	-0.105	0.031	0.132	0.059	0.266*
	Pa	-0.005	-0.037	0.017	-0.090	-0.141	-0.102	-0.154	-0.160	-0.012	-0.112	-0.053	0.117	-0.060
	Pt	-0.194	0.149	-0.206	-0.063	-0.017	-0.075	-0.016	0.016	0.078	0.063	0.016	0.011	0.188
	Sc	-0.070	0.103	-0.001	-0.016	-0.072	0.020	0.076	-0.040	0.147	0.116	0.084	0.018	-0.032
	Ma	-0.172	0.104	-0.098	0.007	-0.080	-0.088	-0.107	-0.028	-0.042	0.070	0.165	0.402**	0.119
	Si	-0.260*	0.078	-0.262*	-0.129	0.004	-0.233*	-0.017	-0.124	-0.046	0.000	0.052	-0.112	0.192
	STAI-S	-0.053	0.073	-0.148	-0.015	0.087	-0.146	-0.018	-0.060	0.073	0.017	0.006	0.019	0.123
STAI-T	-0.171	0.071	-0.192	-0.068	-0.017	-0.211	-0.084	0.008	-0.048	-0.013	0.017	0.137	0.154	
CES-D	-0.179	0.208	-0.288**	-0.102	-0.051	-0.264*	-0.154	0.035	-0.070	0.033	0.116	0.108	0.208	

*P < 0.1; **P < 0.05.
Note: MMPI-2; Minnesota Multiphasic Personality Inventory-2; L = Lie; F = Infrequency; K = Defensiveness; Hs = Hypochondriasis; D = Depressive Psychopathic Deviate; Mf = Masculinity-Femininity; Pa = Paranoia; Pt = Psychasthenia; Sc = Schizophrenia; Ma = Hypomania; Si = Social Introversion; STAI-S; State-Trait Anxiety Inventory-State; STAI-T; Spielberger State-Trait Anxiety Inventory-Trait; CES-D; The Center for Epidemiologic Studies Depression Scale

Finally, the correlation between the sub-scales of biologically related and unrelated recipients-donors pairs are given in Tables 5 and 6, respectively. As opposed to the biologically unrelated group, a positive correlation between the K ($r = 0.372$, $P = .039$), Ma ($r = 0.468$, $P = .008$), and CES-D ($r = 0.415$, $P = .0202$) sub-scores was observed in the biologically related pairs. However, a significant correlation was observed between biologically unrelated recipients and donors in the STAI-T score ($r = 0.520$, $P = .016$). Furthermore, association tendency was also found in the STAI-S score ($r = 0.413$, $P = 0.063$), which is not significant.

Table 5
Correlations of the psychological assessments between biologically related recipients and donors (n = 62)

Donor's psychological dimensions		L	F	K	Hs	D	Hy	Pd	Mf	Pa	Pt	Sc	Ma	Si
Recipient's psychological dimensions	L	-0.025	-0.259	0.110	0.005	-0.094	0.035	-0.118	-0.233	-0.139	-0.083	-0.152	-0.063	-0.155
	F	-0.134	0.204	-0.097	0.122	-0.147	0.064	0.006	-0.132	0.098	0.052	0.067	-0.001	0.172
	K	0.385**	-0.152	0.372**	-0.044	-0.060	0.092	0.082	-0.044	0.135	0.050	-0.106	-0.260	-0.246
	Hs	0.069	-0.188	0.172	-0.094	-0.282	-0.063	-0.072	0.010	-0.307	-0.207	-0.300	-0.011	-0.085
	D	-0.143	-0.024	-0.144	0.031	-0.087	-0.118	-0.099	0.035	0.063	-0.071	-0.046	-0.040	0.115
	Hy	0.123	-0.137	0.196	-0.142	-0.123	-0.116	0.013	0.040	-0.119	-0.038	-0.182	-0.063	-0.136
	Pd	-0.082	-0.162	0.108	-0.122	-0.281	-0.089	-0.107	-0.162	-0.144	-0.085	-0.184	-0.043	-0.094
	Mf	-0.420**	0.189	-0.403**	-0.316*	-0.316*	-0.439**	-0.273	-0.090	-0.073	-0.109	0.072	0.071	0.223
	Pa	-0.012	-0.030	0.028	-0.030	-0.203	-0.051	-0.046	-0.043	-0.004	-0.177	-0.087	0.100	-0.015
	Pt	-0.165	0.015	-0.151	-0.116	-0.129	-0.171	-0.173	0.016	0.035	-0.037	-0.059	0.018	0.186
	Sc	0.024	0.108	0.029	-0.080	-0.177	-0.075	0.031	-0.011	0.084	0.066	0.063	-0.013	0.026
	Ma	-0.235	0.056	-0.241	-0.230	-0.154	-0.165	-0.175	-0.186	-0.032	-0.104	0.060	0.468**	0.035
	Si	-0.221	0.113	-0.234	0.031	-0.092	-0.139	0.011	0.158	-0.049	0.067	0.147	0.037	0.189
	STAI-S	-0.127	0.014	-0.126	-0.028	0.051	-0.139	-0.054	-0.018	0.210	-0.097	0.050	0.065	0.065
	STAI-T	-0.266	-0.018	-0.204	-0.012	-0.047	-0.092	-0.146	0.017	-0.061	-0.165	-0.058	0.161	0.133
CES-D	-0.289	0.159	-0.356**	-0.084	-0.011	-0.208	-0.269	0.050	-0.103	-0.047	0.106	0.132	0.245	

*P < 0.1; **P < 0.05.
Note: MMPI-2; Minnesota Multiphasic Personality Inventory-2; L = Lie; F = Infrequency; K = Defensiveness; Hs = Hypochondriasis; D = Depressive Psychopathic Deviate; Mf = Masculinity-Femininity; Pa = Paranoia; Pt = Psychasthenia; Sc = Schizophrenia; Ma = Hypomania; Si = Social Introversion; STAI-S; State-Trait Anxiety Inventory-State; STAI-T; Spielberger State-Trait Anxiety Inventory-Trait; CES-D; The Center for Epidemiologic Studies Depression Scale

Table 6
Correlations of the psychological assessments between biologically unrelated recipients and donors (n = 44)

Donor's psychological dimensions		L	F	K	Hs	D	Hy	Pd	Mf	Pa	Pt	Sc	Ma	Si
Recipient's psychological dimensions	L	0.110	-0.279	0.120	0.132	0.113	0.236	-0.217	-0.123	-0.031	-0.336	-0.398	-0.186	-0.240
	F	-0.079	0.279	-0.027	0.166	0.331	0.151	0.288	-0.105	0.251	0.379*	0.112	0.171	0.060
	K	0.162	-0.158	0.105	0.195	-0.030	0.486**	-0.024	0.289	0.042	-0.228	-0.219	-0.193	-0.413*
	Hs	0.139	0.330	0.104	-0.009	-0.082	-0.093	0.005	0.040	0.117	0.247	0.460**	0.256	-0.133
	D	-0.213	0.142	-0.515**	-0.357	0.167	-0.411*	-0.114	-0.277	0.024	-0.189	-0.165	-0.189	0.123
	Hy	0.066	0.212	-0.034	-0.025	-0.033	-0.080	0.089	-0.031	0.230	0.105	0.117	0.054	-0.112
	Pd	0.085	0.337	-0.176	0.087	0.224	0.038	0.092	-0.073	0.013	0.040	0.024	-0.345	-0.010
	Mf	-0.072	0.244	-0.138	0.134	0.392*	0.106	0.254	-0.014	-0.121	0.337	0.241	0.006	0.355
	Pa	-0.031	-0.020	-0.090	-0.274	0.013	-0.217	-0.332	-0.331	-0.042	-0.105	-0.005	0.176	-0.132
	Pt	-0.253	0.473**	-0.513**	0.034	0.235	0.036	0.289	-0.042	0.171	0.236	0.139	-0.015	0.251
	Sc	-0.185	0.185	0.003	0.122	0.099	0.167	0.132	-0.068	0.288	0.201	0.219	0.107	-0.148
	Ma	-0.060	0.249	0.255	0.298	0.005	0.049	-0.029	0.217	-0.018	0.350	0.491**	0.298	0.250
	Si	-0.287	0.016	-0.311	-0.336	0.222	-0.400*	-0.018	-0.588**	-0.027	-0.132	-0.223	-0.321	0.203
	STAI-S	0.126	0.235	-0.186	-0.016	0.103	-0.180	0.026	-0.129	-0.167	0.196	-0.009	0.064	0.214
STAI-T	0.046	0.265	-0.159	-0.101	0.103	-0.347	-0.009	-0.012	-0.045	0.166	0.132	0.104	0.211	
CES-D	0.046	0.385*	-0.139	-0.109	-0.070	-0.343	0.052	0.011	-0.041	0.199	0.201	0.044	0.162	

*P < 0.1; **P < 0.05.
Note: MMPI-2; Minnesota Multiphasic Personality Inventory-2; L = Lie; F = Infrequency; K = Defensiveness; Hs = Hypochondriasis; D = Depress Psychopathic Deviate; Mf = Masculinity-Femininity; Pa = Paranoia; Pt = Psychasthenia; Sc = Schizophrenia; Ma = Hypomania; Si = Social Introversion; STAI-S; State-Trait Anxiety Inventory-State; STAI-T; Spielberger State-Trait Anxiety Inventory-Trait; CES-D; The Center for Epidemiologic Studies Depression Scale

To compare the psychological characteristics of renal transplant recipients and donors, we analyzed the psychological tests using paired t-tests. Also, an independent two-sample test was performed to evaluate the psychological differences between the biologically related and unrelated recipients and donors. Furthermore, Spearman's correlation analyses were performed to explore the relationship between the donor and recipient's psychological state concerning the MMPI-2, STAI, and CES-D. Specifically, we calculated the correlation coefficient by dividing the biologically related group and the unrelated group. All the associations were considered to be statistically significant when P was less than .05. All the data were analyzed using the SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA).

Discussion

To our knowledge, this is the first study to investigate the psychological characteristics and associations between recipients and donors in living kidney transplantation. Comparing the psychological characteristics of recipients and donors, the scores from the Hs, D, Hy scales in the MMPI-2 were significantly higher in the former group. The depression, hypochondria, and hysteria scales constitute the 'neurotic triad' [21], i.e., high scores in all the three scales are associated with an excessive concentration on somatic health status as well as frequent complaints of physical illnesses [22]. Similar to various chronic diseases, many physical and psychological stressors exist during the course of ESRD [23]. One prospective cohort study reported that kidney transplantation recipients' anxiety and depression symptoms increase progressively waiting for transplantation. Considering that the average waiting time for kidney transplantation in South Korea is 1,592 days [24], it is obvious that patients suffer from depression, anxiety, and deterioration of quality of life with various stresses (e.g., uncertainty about life and death, social isolation, and economic problems) [25]. Despite dialysis therapy, transplantation recipients with ESRD present a high morbidity rate of cardiovascular diseases due to atherosclerosis and vascular calcification. The incidence of malignant tumors is also higher in recipients compared to the general population [26]. Even after transplantation, recipients are faced with persistent medical sequelae associated with strict medical surveillance and the maintenance of immunosuppression. Reflecting the depression and anxiety of these patients, the total CES-D and STAI-T scores were also significantly higher in the recipient group. It is known that donors are also associated with a higher risk of all-cause mortality, ESRD, and cardiovascular death in the long-term when compared to the non-donor control group [27]. However, the depressive and anxiety scores were significantly higher in the recipient group in this study. This seems to be a result of the recipients' cumulative hopelessness, uncertainty, and depression caused by the long waiting periods, as well as the lifestyle disruption due to the chronic physical illness and hemodialysis [28, 29]. This means that clinician has to keep in mind the fact that the psychological difficulties in recipients are generally more severe than in donors. Although not examined in this study, further studies will be

needed to determine whether more severe depression, anxiety and elevated 'neurotic triads' in recipients may affect long-term transplantation outcomes prospectively.

When we examined the correlation of psychological assessments between recipients and donors, the STAI-S, STAI-T, and CES-D scores showed a significant positive correlation between donors and recipients. Interestingly, when we compared recipients and donors by biologically related or not, there are some different results. First, only the CES-D score is positively correlated in biologically related recipients and donors. However, in the biologically unrelated but emotionally related recipients and donors, the higher the recipients' STAI-S scores, the higher the donors' STAI-S, STAI-T scores, and the higher the recipients' STAI-T scores, the higher the donor's STAI-S, STAI-T scores. Besides, the higher the recipients' CES-D scores, the higher the donors' STAI-S and STAI-T scores.

This suggests that biologically unrelated, but emotionally related donors and recipients have more tendency to share their emotional difficulties like anxiety and depression. Indeed, of 1,260 people who received living kidney transplantation in South Korea in 2017, 431 (34.20%) donations were provided by spouses, 230 (18.25%) by lineal descendants, 212 (16.83%) by linear ascendants, and 279 (22.14%) by siblings [3]. Though we couldn't distinguish specific relationships in donor and recipient in this study, these results showed that most of the biologically unrelated but biologically related donors are in marital relationships. This means that anxiety can be easily shared, assuming that most relationships are married and likely to live together. Psychological difficulties like depression have a characteristic known as 'emotional contagion'. This has been conceptualized under the term "depression contagion" and interpreted by the interactional theory of depression. Emotional transmission can occur in close relationships, such as between a couple. According to this theory, recipients who have suffered from chronic illness could share their negative emotions such as depression and anxiety during the long disease course with emotionally related donors. The previous researches have shown that emotional contagion is more clear in depression than in anxiety. It is somewhat different results from this study. The reason is that the study targets in this study are transplantation patients and families who have uncertainty about kidney transplantation outcomes. Although several strategies have been used to control graft rejection in recent years, there is an anxiety about HLA (human leukocyte antigen) incompatibility in biologically unrelated pairs. It also has clinical meanings, as clinicians have to assess the anxiety status of recipients and donors carefully especially in an emotionally related relationship, and explore the reason for anxiety to improve the prognosis of transplantation. Moreover, K ($r = .372, P = .039$) and Ma ($r = .468, P = .008$) subscales in MMPI-2 is shown positive correlation between the biologically related donor and recipient groups. Because personality is composed of genetic properties and environmental interactions [30], a significant correlation was only found in the biologically related donor and recipient group, though it is difficult to determine personality only through the MMPI-2.

This study has several limitations. Firstly, the sample size is not enough, as we only collect our sample at a single hospital. We should be careful to generalize the characteristics of living kidney transplantation donors and recipients. In addition, given the cross-sectional nature of this study, it was impossible to identify the psychological and medical prognosis of donors and recipients. Further studies focusing on the effects of psychological prognoses (e.g., depression, anxiety, donor-recipient relationship, and emotional contagion) and medical prognoses (e.g., infection, rejection, and mortality) can be helpful to understand detailed in recipients and donors' psychological characteristics and their association. Lack of information about stress factors affecting the psychological scale of patients, including family dynamics and socioeconomic status, also limits this study. Finally, although kidney transplantation is divided into biologically related and unrelated, additional details on the types of relationships between donors and recipients are not assessed. So, we assumed the types of relationships reference to the national statistics for transplantation. Since the psychological status of kidney transplant recipients and donors is not easy to obtain, despite some limitations, this study is very valuable and important.

Conclusions

This study found that transplantation recipients suffered from a higher level of depression and anxiety compared to donors before transplantation. Specifically, higher levels of depressive mood were shared in the biologically related group, whereas a higher anxiety state was found in the biologically unrelated group. These results confirm that clinicians have to be more concerned about affective symptoms, including anxiety and depression, not only in recipients but also in donors because of emotional contagion, especially in emotionally related donors and recipients.

List Of Abbreviations

CES-D; Center for Epidemiologic Studies Depression, ESRD; End-Stage Renal Disease, IRODaT; International Registry in Organ Donation and Transplantation, MMPI-2; Minnesota Multiphasic Personality Inventory-2, STAI; State-Trait Anxiety Inventory

Declarations

Ethics approval and consent to participate

All the subjects provided written informed consent, and the study was approved by the Institutional Review Board of the Korea University Anam Hospital (IRB No. 2019AN0380). The principles described in the "Declaration of Helsinki" were followed during both clinical and research activities. No organs/tissues were obtained from the subjects.

Consent to publish

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' Contributions

HP, YL, HJJ, HJL, JGG, HM, CWJ, MGK, and CHC conceived and designed the study. HP, YL, HJJ, HM, MGK, and CHC performed statistical analyses. HP, YL, HJJ, and CHC wrote the first draft of the manuscript. HP, YL, JGG, HM, CWJ, MGK, and CHC participated in data collection. All the authors edited the manuscript drafts, were involved in the interpretation of the results and read, commented, and approved the final version of the manuscript

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