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Research Article

The Stanford Integrated Psychosocial Assessment for Transplant and Early Hospital Readmission after Kidney Transplantation

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Abstract

Background: Early hospital readmission (EHR) after kidney transplant (KTX) is associated with increased morbidity, costs and transition-of-care errors. While evidence indicates that EHR may be influenced by psychosocial factors, the relationship is poorly understood. We examined the association of the Stanford Integrated Psychosocial Assessment for Transplant score (SIPAT) and its subscales with EHR and other KTX outcomes.

Methods: We analyzed adult KTX recipients at our program between 2014-2019 with a documented pre-transplant SIPAT score (n=568). Multivariate models examined relationships between SIPAT tertiles (<5, 5-11, >11) and subscales on outcomes.

Results: The pre-transplant SIPAT score was low (<5), medium (5-11), and high (>11) in 162, 250, and 156 recipients and EHR frequencies were 20%, 30%, and 30%, respectively (p=0.045). High SIPAT scorers (*vs*. lower scorers) were more likely to be black, <college educated, repeat transplant, have longer dialysis vintage, and receive a deceased-donor kidney. On multivariate analyses adjusted for clinical factors, elevated SIPAT (higher score indicates higher psychosocial risk) was not associated with EHR, length of stay, delayed graft function, 1-year creatinine, or time to graft failure. Psychopathology score >2 directly correlated with EHR (aOR, 1.8; 95% CI: 1.2-2.7), and substance use score >0 inversely correlated with EHR (aOR, 0.7; 95% CI: 0.5-0.9). Readiness score >0 was borderline significant (aOR, 1.4; 95% CI: 1.0-2.1) and social support score >0 did not correlate with EHR (aOR, 1.0; 95% CI: 0.6-1.4).

Conclusions: Psychopathology was independently associated with kidney transplant EHR. SIPAT tool subscales may be useful to identify KTX candidates at risk for poor outcomes independent of clinical factors.

Keywords: Stanford Integrated Psychosocial Assessment for Transplantation; Kidney transplantation; 30-day readmission; Psychosocial evaluation

Abbreviations

SIPAT: Stanford Integrated Psychosocial Assessment for Transplantation; KTX: Kidney Transplant; HER: Early Hospital Readmission; LOS: Length of Stay; DGF: Delayed Graft Function; KDPI: Kidney Donor Profile Index; SD: Standard Deviation; OR: Odds Ratio; aOR: Adjusted Odds Ratio; CI: Confidence Interval

Introduction

Early Hospital Readmission (EHR) following Kidney Transplantation (KTX) is common (30% nationally) and is associated with post-transplant morbidity and mortality. Despite being considered preventable in half of the cases [1], EHR after KTX has not improved over the last decade [2]. Multiple risk factors for EHR have been identified, however, the majority are clinical factors [2]. Psychosocial factors may also influence EHR but are understudied for this outcome. Further work is necessary to explore risk factors for readmission, beyond clinical characteristics, to better inform coordination of care and reduce EHR.

The Stanford Integrated Psychosocial Assessment for Transplantation (SIPAT) is a standardized psychosocial assessment tool that was developed in 2012 [3] and has been used by transplant programs [4-9] to identify psychosocial characteristics that may adversely impact transplant success. Although some studies have shown the pre-transplant SIPAT score may predict post-transplant clinical outcomes, it has not been investigated for EHR.

We analyzed a retrospective cohort of KTX recipients at our center to determine whether patients' pre-transplant SIPAT score or SIPAT subscale scores were associated with post-transplant EHR. We also examined the association of total SIPAT score with length of stay (LOS) and measures of graft function, including delayed graft function, elevated serum creatinine level, and overall graft survival.

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Methods

Study population

We conducted a retrospective cohort study of consecutive adult kidney-only transplant recipients at Erie County Medical Center (ECMC) between January 2014 and September 2019 (n=568). We excluded recipients who did not have a pre-transplant SIPAT score (n=73). These individuals were typically incarcerated or had a neurocognitive impairment. We excluded recipients who expired within 30 days of discharge (n=5) to ensure that readmission rates were not biased by early deaths. We also excluded graft failure during index hospitalization (n=3) since these patients receive different follow-up care after discharge. Clinical data was assessed from electronic medical records. There was no loss to follow-up. The study was approved by the University at Buffalo Institutional Review Board.

Donor and recipient characteristics

Recipient characteristics collected were age, sex, race, history of diabetes mellitus, body mass index >35kg/m^2 at evaluation, prior kidney transplant, preemptive transplant, time on dialysis (cut-offs at 25th and 75th percentile), and calculated panel-reactive antibody level >0%. Donor characteristics collected were age, sex, race (black vs. other), donation after circulatory death, and living donor.

Study environment

During the study period, most patients (>95%) received induction with anti-thymocyte globulin (1.5mg/kg/day for 2-3 days) and a minority with basiliximab (20mg at surgery and post-transplant day 1). Both groups received maintenance tacrolimus, mycophenolate mofetil, and corticosteroid taper. Following KTX, all recipients were evaluated daily by the transplant multidisciplinary team, which consisted of nephrologists, surgeons, nurse practitioners, social workers, dieticians, and financial specialists. Following discharge, patients were typically seen by transplant clinicians within 1-3 days and then twice weekly, with laboratory assessments, during the first post-transplant month. Each recipient was given the telephone number of the transplant center, and physicians were available after hours and on weekends to respond to calls. Home healthcare agencies were often utilized. An outpatient observation unit was not available.

Exposure classification

Kidney transplant recipients were categorized into three groups based on their most recent pre-transplant SIPAT score scaled at 25th and 75th percentile thresholds: low SIPAT (<5), medium SIPAT (5-11), and high SIPAT (>11) (n=162, 250, 156), respectively. The SIPAT score ranges between 0-115 and higher scores indicate higher psychosocial risk. The patients' SIPAT was determined pre-operatively by one of three trained transplant social workers (SW), who conducted a semi-structured interview to populate the SIPAT tool embedded in our electronic medical records. Only the most recent SIPAT level was used for this study.

Clinical outcomes investigated

The primary outcome was Early Hospital Readmission (EHR), defined as at least one hospital readmission within 30 days of discharge from the index hospitalization. Secondary outcomes were (i) Hospital length of stay greater than five days (25th percentile), (ii) Delayed graft function (DGF, defined as dialysis within seven days of transplantation), (iii) Time to all-cause graft failure (defined as allograft nephrectomy, re-transplantation, return to chronic dialysis, or death) and (iv) Serum creatinine level greater than 2mg/dL at one-year post-transplant.

Statistical analysis

Patient and donor characteristics were compared across SIPAT sub-groups using the Chi-square test for categorical variables and Analysis of Variance for continuous variables. Graft survival curves were computed using Kaplan-Meier methods and compared using log-rank tests. Multivariable logistic regression models were used to examine associations between EHR and total SIPAT score as well as its four subscales, adjusting for variables significantly associated with EHR. All statistical analyses were conducted using the SAS system version 9.4 (SAS Institute, Inc.). All p-values were 2-sided, and <0.05 was considered statistically significant.

Sensitivity analyses

First, we examined a binary SIPAT cutoff at >20 since this threshold was deemed "minimally acceptable risk" by the SIPAT tool developers [3]. Second, we examined four psychosocial subscales that contribute to the final score: (1) Patient's readiness level and illness management ('readiness level', score range 0-24), (2) Social support system level of readiness ('social support', score range 0-20), (3) Psychological stability and/or psychopathology ('psychopathology', score range 0-37) and (4) Lifestyle and effect of substance use ('substance use', score range 0-39) [3]. The subscales are further described in Table 1. The subscale score was dichotomized into low and high categories by the median value.

Results

Of 568 kidney transplant recipients, 27% had EHR within 30 days of discharge. Total SIPAT score pre-transplantation was low (<5), medium (5-11) and high (>11) in 250, 156, and 162, respectively. Recipients with high SIPAT (versus medium and low) scores were significantly more likely to be black race (40%, 32%, 19%, p<0.001), have less than a college education (62%, 47%, 39%, p<0.001), have been re-transplanted (8%, 19%, 14%, p=0.030), require chronic dialysis >3 years (34%, 26%, 18%, p=0.005), and receive a deceased-donor kidney (93%, 90%, 84%, p=0.030), respectively (Table 2).

Post-transplant EHR occurred in 20% of patients with low SIPAT, 30% of those with medium SIPAT, and 30% of those with high SIPAT scores (p=0.045) (Table 3). After adjusting for patient and donor characteristics, these differences were not significant (Table 4). Among the high SIPAT scorers, 42 recipients had a SIPAT score >20, and the frequency of EHR was 24%, similar to the lowest SIPAT group (EHR 20%).

There were no differences among the three SIPAT groups (low, medium and high) in terms of length of stay >5 days (58%, 54%, 49%, p=0.277), delayed graft function (46%, 46%, 39%, p=0.365), elevated serum creatinine level greater than 2mg/dL at one-year post-transplant (13%, 17%, 16%, p=0.680) (Table 3), or overall kidney graft survival (p=0.285), as shown in Figure 1.

We analyzed individual SIPAT domain scores by the median value, where high depicts a worse score and low depicts a better score (Figure 2). Recipients with SIPAT readiness level score >2 were

Table 1: Psychosocial Subscales and Factors Measured by the SIPAT.

SIPAT subscale	Factors
Patient's Readiness Level and Illness Management (0-24)	• Knowledge and understanding of medical illness process (that caused specific organ failure) (0-4)
	• Knowledge and understanding of the process of transplantation (0-4)
	• Willingness and/or desire for treatment (transplant) (0-4)
	• History of treatment adherence and/or compliance (pertinent to medical issues) (0-8)
	• Lifestyle factors (diet, exercise, fluid restrictions and habits according to organ system) (0-4)
Social Support System Level of Readiness (0-20)	• Availability of social support system (0-8)
	• Functionality of social support system (0-8)
	• Appropriateness of physical living space and environment (0-4)
Psychological Stability and Psychopathology (0-37)	• Presence of psychopathology (other than personality disorders and organic psychopathology) (0-8)
	• History of organic psychopathology or neurocognitive impairment (i.e., illness or medication-induced psychopathology) (0-5)
	• Influence of personality traits versus disorder (0-4)
	• Effect of truthfulness versus deceptive behavior (0-8)
	• Overall risk for psychopathology (0-4)
Lifestyle and Effect of Substance Use (0-29)	• Alcohol use, abuse, and dependence (0-8)
	• Alcohol abuse - risk for recidivism (0-4)
	• Illicit substance use, abuse and dependence (0-8)
	• Illicit substance abuse - risk for recidivism (0-4)
	• Nicotine use, abuse and dependence (0-5)

Table 2: Kidney Transplant Recipient and Donor Characteristics by SIPAT Category.

Characteristics Mean ± Standard Deviation or n (%)	Total n=568	SIPAT <5 n=162	SIPAT 5-11 n=250	SIPAT >11 n=156	P-value
Recipient age (years)					
≤45	25%	25%	23%	28%	0.63
46-64	52%	48%	54%	51%	
≥65	24%	27%	23%	22%	
Recipient female (male)	39%	44%	40%	31%	0.05
Recipient black race (non-black)	31%	19%	32%	40%	<0.001
Recipient history of diabetes	42%	35%	46%	42%	0.11
Recipient previous kidney transplant	14%	19%	14%	8%	0.03
Recipient pre-transplant dialysis duration					
None	21%	30%	17%	19%	0.005
< 1 year	16%	16%	18%	14%	
1-3 years	37%	36%	39%	34%	
>3 years	26%	18%	26%	34%	
Recipient body mass index (kg/m^2)	31 ± 6	31 ± 6	31 ± 6	30 ± 6	0.05
Recipient calculated panel reactive antibody level > 0%	32%	30%	34%	31%	0.61
Induction thymoglobulin	97%	96%	97%	97%	0.67
Total HLA mismatch ≥4	77%	74%	78%	78%	0.6
Cold ischemic time (<30)					
30-34 hours	11%	7%	12%	14%	0.46
35-39 hours	10%	12%	9%	9%	
40-44 hours	4%	6%	3%	5%	
>44 hours	4%	6%	4%	3%	
Recipient education level > college	51%	61%	53%	38%	<0.001

Recipient public insurance	57%	51%	60%	60%	0.17
Recipient functional status requiring assistance*	14%	11%	14%	19%	0.12
Recipient another adult in home	76%	85%	76%	67%	<0.001
Donor age, years	40 ± 15	43 ± 13	39 ± 16	39 ± 16	0.05
Donor female (male)	42%	44%	40%	31%	0.24
Living donor (deceased donor)	9%	16%	10%	7%	0.03
Donor donation after circulatory death	37%	40%	40%	32%	0.25
Donor black race (non-black)	11%	12%	12%	11%	0.968
Kidney donor profile index					
≤20%	10%	3%	10%	17%	0.003
21-85%	82%	89%	82%	77%	
>85%	8%	8%	8%	6%	

*Assistance is defined by using medical equipment to ambulate, such as a cane, walker, and wheelchair, and living with an adult to complete activities of daily living.
SIPAT: Stanford Integrated Psychosocial Assessment for Transplantation.

Table 3: Kidney Transplant Recipient Outcomes by Pre-transplant Total SIPAT Score.

Outcomes Numerator/Denominator (%)	Total n=568	SIPAT <5 n=162	SIPAT 5-11 n=250	SIPAT >11 n=156	P-value
30-day readmission	154/568 (27%)	32/162 (20%)	75/250 (30%)	47/156 (30%)	**0.04**
Length of stay >5 days	306/568 (54%)	80/162 (49%)	135/250 (54%)	91/156 (58%)	0.28
Delayed graft function	251/568 (44%)	64/162 (40%)	115/250 (46%)	72/156 (46%)	0.37
1-year creatinine ≥2mg/dL	72/463 (16%)	22/137 (16%)	34/204 (17%)	16/122 (13%)	0.68

SIPAT: Stanford Integrated Psychosocial Assessment for Transplantation.

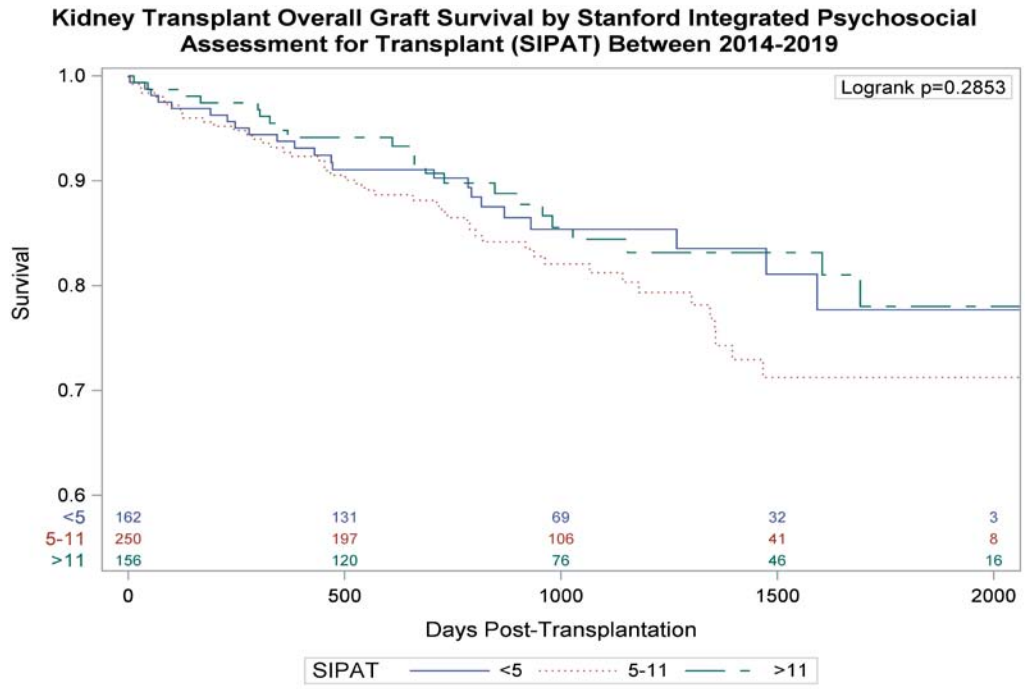

Figure 1: Kaplan-Meier Analysis of All-cause Graft Survival by SIPAT Group.

significantly more likely to have EHR (31%) compared to recipients with lower readiness score (23%, p=0.04), but the difference was borderline significant after adjusting for clinical factors (aOR, 1.4; 95% CI, 1.0-2.1) (Table 5). Recipients with SIPAT psychopathology score >2 were significantly more likely to have EHR (34%) compared to lower scoring recipients (22%, p=0.002), including on multivariate analyses (aOR, 1.8; 95% CI, 1.2-2.6). Recipients with SIPAT social support score >0 had similar EHR (29%) compared to lower scorers (25%), including after multivariate analyses (aOR, 1.0; 95% CI, 0.6-1.4). SIPAT substance use score >0 translated to significantly lower EHR (23%) compared to lower scorers (32%), and the protective association remained significant on multivariate analyses (aOR, 0.7;

Table 4: Kidney Transplant Recipient and Donor Characteristics with Univariate and Multivariate.

Characteristics (reference)	Univariate	Multivariate
SIPAT		
5-11(<5)	1.7(1.1-2.8)	1.6 (1.0-2.6)
>11(<5)	1.8 (1.0-2.9)	1.6 (0.9-2.7)
Recipient age (years)		
46-64 (≤45)	0.9 (0.5-1.4)	
≥65 (≤45)	1.4 (0.8-2.3)	
Recipient female (male)	1.0 (0.7-1.5)	
Recipient black race (non-black)	1.3 (0.9-1.9)	
Recipient history of diabetes	1.4 (1.0-2.0)	
Recipient previous kidney transplant	0.7 (0.4-1.2)	
Recipient pre-transplant dialysis duration		
<1 year (none)	1.0 (0.5-2.0)	0.8 (0.4-1.7)
1-3 years (none)	1.5 (0.9-2.5)	1.1 (0.6-2.0)
>3 years (none)	2.4 (1.4-4.3)	1.7 (0.9-3.1)
Recipient body mass index (kg/m²)		
Recipient calculated panel reactive antibody >0%	1.0 (0.7-1.5)	
Induction thymoglobulin	1.4 (0.5-4.3)	
HLA mismatch ≥4	1.3 (0.8-2.1)	
Cold ischemic time >30 hours (<30)	1.3 (0.8-1.9)	
Recipient education level >college	0.9 (0.6-1.3)	
Recipient public insurance	1.7 (1.2-2.5)	1.4 (0.9-2.2)
Recipient functional status requiring assistance	2.0 (1.2-3.2)	1.8 (1.1-3.0)
Recipient another adult in home	1.5 (1.0-2.4)	
Donor female (male)	1.1 (0.8-1.6)	
Living donor (deceased donor)	0.7 (0.4-1.3)	
Donor donation after circulatory death	1.0 (0.7-1.6)	
Donor black race (non-black)	1.6 (0.9-2.7)	
Kidney donor profile index (%)		
21-85 (≤20)	1.3 (0.7-2.7)	1.2 (0.6-2.6)
>85 (≤20)	3.3 (1.3-8.2)	3.3 (1.2-8.6)

Analysis in Relation to the Outcome of 30-day Readmission.

95% CI, 0.5-0.9).

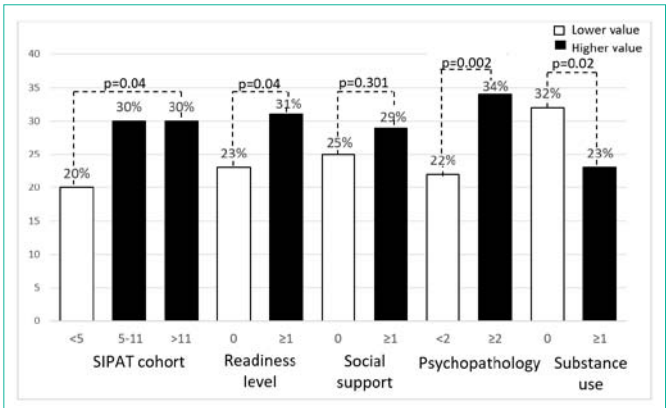

Figure 2: Frequency of Early Hospital Readmission by Total Stanford Integrated Psychosocial Assessment Tool Score and Subscale Score.

Discussion

Our single-center study of 568 adult KTX recipients over a 5-year period did not identify any effect of the total baseline SIPAT score on EHR, length of stay, delayed graft function, 1-year serum creatinine level, or overall kidney graft survival. However, we found that the SIPAT subscale of psychopathology was associated with EHR. Patients with higher readiness level demonstrated a trend toward higher EHR, and substance use inversely correlated with EHR.

This is the first transplant study to examine the relationship between the SIPAT score and EHR (Table 3). We found that KTX recipients with higher total SIPAT scores were significantly more likely to experience EHR on univariate but not on multivariate analyses adjusting for clinical factors. Other studies assessing SIPAT in solid organ recipients evaluated the outcome of readmission within six or twelve months but not at thirty days, and none adjusted for clinical factors. A study of 134 kidney and pancreas transplant recipients reported no significant difference in six-month readmission between recipients with SIPAT<20 and SIPAT>20 [4] (Table 6). However, only twelve patients had a SIPAT>20, suggesting a small sample size and low power to detect discernible differences, despite a 60% readmission rate in the total cohort [4] (Table 6). Similarly, in a liver transplant study, SIPAT >40 was not predictive of one-year readmission or number of days hospitalized relative to lower SIPAT scorers (27% vs 33%, respectively) [6] (Table 6). In contrast, a study of 217 abdominal and thoracic transplant recipients found a 28% one-year readmission rate, and the probability of six-month readmission increased by 3.8% for each point increase in the SIPAT score across all three groups (<6, 7-20, >20) [8] (Table 6), suggesting an association of psychosocial risk as determined using the SIPAT tool with one-year readmission. However, the study comprised a heterogeneous cohort of transplant recipients limited to only 25% KTXs, who all tended to have lower average SIPAT scores than recipients of other solid organs [8] (Table 6). Taken together, the total SIPAT score may be useful to predict EHR in populations that have high SIPAT scores, such as lung and heart transplant recipients.

In our study, the total SIPAT score was not associated with clinical outcomes such as graft survival or graft functional outcomes. Our findings are similar to other studies, wherein total SIPAT did not predict graft survival or mortality after heart transplant [5,7], liver transplant [6,9], and combined abdominal and thoracic transplants [8] (Table 6). This may be due to low event rates since follow up was assessed at only 1 year in all but one of the studies. Many of these studies found associations between total SIPAT score and behaviors that are thought to be detrimental to outcomes, such as non-adherence [5-7], substance use [4-6], and social support instability [4,8], and with clinical outcomes such as graft rejection [8]. However, these proximal outcomes are not always strong predictors of graft survival and death as examined previously in a liver transplant study [9]. As such, the potential ability of SIPAT to predict graft survival and mortality should be evaluated for a longer period. Also, other psychosocial factors outside of the tool which may influence clinical outcomes should also be considered. For example, education level, insurance status, socioeconomic status, and access to health care have

Table 5: Multivariate Analysis of SIPAT Subscales in Relation to Early Hospital Readmission.

Characteristics (reference)	Readiness level		Social support		Psychopathology		Substance use	
	aOR (95% CI)	p-value	aOR (95% CI)	p-value	aOR (95% CI)	p-value	aOR (95% CI)	p-value
SIPAT subscale > median	1.4 (1.0-2.1)	0.09	1.0 (0.6-1.4)	0.8	1.8 (1.2-2.6)	0.004	0.7 (0.5-0.9)	0.04
Kidney donor profile index								
21-85% (<20)	1.3 (0.6-2.7)	0.03	1.2 (0.6-2.5)	0.04	1.4 (0.7-2.9)	0.03	1.2 (0.6-2.4)	0.05
>85% (<20)	3.6 (1.4-9.3)		3.2 (1.2-8.1)		3.7 (1.4-9.7)		3.1 (1.2-7.9)	
Dialysis Duration								
< 1 year (none)	0.9 (0.4-1.8)	0.08	0.9 (0.5-1.8)	0.05	1.0 (0.5-2.0)	0.1	0.9 (0.5-1.8)	0.05
1-3 years (none)	1.2 (0.7-2.2)		1.3 (0.7-2.2)		1.3 (0.7-2.3)		1.3 (0.7-2.3)	
>3 years (none)	1.9 (1.0-3.4)		2.0 (1.1-3.7)		1.9 (1.0-3.6)		2.0 (1.1-3.6)	
Public insurance (private)	1.4 (0.9-2.2)	0.1	1.4 (0.9-2.2)	0.09	1.5 (1.0-2.2)	0.08	1.4 (0.9-2.2)	0.1
Recipient functional status requiring assistance	1.8 (1.1-3.1)	0.02	1.9 (1.1-3.1)	0.01	1.9 (1.1-3.1)	0.02	1.8 (1.1-3.0)	0.02

aOR: adjusted Odds Ratio after multivariate analysis; 95% CI: 95% Confidence Interval.

Table 6: Studies of Solid Organ Outcomes by Pre-transplant Stanford Integrated Psychosocial Assessment Tool score.

Outcome	Chen [4]	Moayedi [5]	Sheiner [6]	Vandenbogaart [7]	Maldonado [8]	Deutsch-Link [9]
	KTX, SPK n=134	HTX n=393	OLTX n=168	HTX n=51	KTX, HTX, OLTX, LTX n=217	OLTX n=1357
Mean ± SD SIPAT	13 ± 6	14* (10-19)	43 ± 16	NA	13 ± 9	NA
SIPAT Groups (Sample size)	0-6 (18)	<21 (325)	0-40 (43)	0-20 (34)	0-6 (54)	<21 (936)
	7-20 (106)	≥21 (68)	>40 (11)	≥21 (17)	7-20 (127)	≥21 (421)
	21-39 (12)				≥21 (36)	
1-year readmission	n		n	n	s	
1-year cumulative hospital days			n	n		
Graft loss[1]	n	n	n		n	n
Graft Rejection[1]	n	n	n	n	s	n
Mortality[1]	n	n	n	n	n	n
Infection[1]	n		n	n	s	
Psychopathology	n	n	n	n	s	
Non-adherence	n	s	s	s		
Substance use	s	s	s	n		
Support system instability	s	n	n	n	s	
Financial barriers	n	n	n	n		

n: Factor explored but did not show a significant association; s: Factor explored and showed a significant association with the outcome; kidney transplant.
*Median (Interquartile range) Stanford Integrated Psychosocial Assessment for Transplantation score.
[1]1-year follow-up times for all studies with the exception of Moayedi (5-year).

been shown to correlate with kidney transplant outcomes.

We found that the SIPAT psychopathology score >2 was strongly associated with post-kidney transplant EHR, even after adjustment for donor and recipient factors (Table 5). Contrary to our results, a prior study found that pre-transplant psychopathology measured by SIPAT was not significantly associated with six-month readmission after kidney and/or pancreas transplantation, and psychopathology measured by other definitions have not predicted readmission rates or readmission days [10]. Although few studies have assessed the outcome of EHR, pre-transplant psychopathology has been significantly associated with post-transplant morbidity, which are often downstream events after EHR [8]. Depression has been associated with increased mortality after heart, liver, kidney, lung, or pancreas transplantation [10] and death-censored graft loss after kidney transplantation. However, a psychosis or mania history prior to kidney transplantation has had similar risk of death, graft loss, and rejection compared to recipients without a psychosis or mania history. Our findings add to the literature and suggest that the SIPAT subscale of psychological stability and/or psychopathology may serve to highlight the psychological needs of the patient to provide targeted support before and after transplantation to reduce EHR.

We found that SIPAT subscale score of lifestyle and effect of substance use was inversely correlated with EHR. This subscale measures alcohol and illicit substance use and abuse, risk of recidivism, and nicotine use. The reason for the inverse effect found in our study is unclear but may be due to efforts of the social worker in our program to link patients with counseling as recommended by national guidelines (KDIGO). Additionally, some literature

suggests an absence or minimal effect of past alcohol use, substance use, and smoking on kidney transplant outcomes. Although active alcohol abuse has been associated with an increased risk of post-KTX mortality, a history of tobacco or alcohol or drug consumption has been found to have only a small significant increased risk of graft loss after 3 years (HR=1.19, p<0.001) compared to non-consumers in KTX recipients [11]. Furthermore, a meta-analysis found that a history of illicit substance use did not affect the overall survival following heart, kidney, lung, pancreas, or liver transplantation.

Regarding SIPAT subscales, we found that low readiness level and illness management had a borderline significant association with EHR. Our findings of the importance of patient transplant readiness is also suggested in other studies. A recent liver transplant study found that SIPAT readiness score >5 was strongly associated with allograft rejection and immunosuppressant nonadherence, including each of the individual questions that comprised the domain (knowledge and understanding of their illness and transplantation, and lifestyle factors) [9]. Another study of heart, liver and lung transplant recipients found that lower "conscientiousness" was independently associated with non-adherence [12]. The observed relationship between SIPAT readiness score and EHR, adherence, and allograft rejection in our and other studies highlights the potential impact of knowledge and medical literacy on transplant outcomes [13].

We did not find a relationship between SIPAT social support system level of readiness and EHR. This subscale measures availability and functionality of the social support system and appropriateness of physical living space and environment [14-17]. The lack of difference may be due to a low risk profile of the transplant recipients in both groups due to exclusion of high risk patients from transplant access at our center, a practice that may require reconsideration given the recent national guidelines describing "little evidence suggesting that the absence of social support is an absolute contraindication to transplantation" (KDIGO) [18,19]. In terms of evidence, results of other studies are inconsistent. A prior meta-analysis of solid-organ transplants found social support to be associated with substance use relapse after transplantation [13]; however, other studies did not find an association of social support with kidney transplant medication adherence, graft rejection or patient survival or graft clinical outcomes in heart, lung or liver transplant [12,20,21].

Limitations

The retrospective design inherently limits the causative conclusions that can be drawn from the associations found. As a single-center study, generalizability to other transplant programs is limited. The SIPAT tool, although standardized, is ultimately a subjective assessment and subject to bias, and we do not have data on interrater reliability among the 3 SIPAT raters in our study. A minority of recipients received a SIPAT score considered to be increased risk (i.e., ≥21) despite a maximum score of 110. Therefore, this study predominantly provides results of recipients with low to moderate psychosocial risk profiles. Patients with high-risk profiles may have not been offered kidney transplantation or may have had difficulty navigating the healthcare system. SIPAT evaluations were performed to optimize the candidate for transplantation. Therefore, candidates were not deemed ineligible for transplantation solely based on their SIPAT score, and, where possible, some candidates received interventions before listing to address psychosocial difficulties to mitigate risk. This may introduce bias in our assessment of the association between the SIPAT scores and post-transplant outcomes.

Our study highlights some relationships between SIPAT score and clinical outcomes after kidney transplantation. The SIPAT psychopathology score and, to a lesser extent, the illness readiness score were associated with early hospital readmission, beyond clinical characteristics. These results suggest the potential utility of psychosocial characteristics to better inform targeted interventions to improve coordination of care and reduce EHR. The conservative range of total SIPAT score seen in our study and in other studies of kidney transplantation suggests the need for efforts to ensure that psychosocial assessment does not unnecessarily limit access to kidney transplantation.

Declaration

Contributions: LK, JN, AL, KN and TC participated in research design, data collection, and analysis. AL, KN and LK contributed to data collection and manuscript preparation and editing.

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