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ORIGINAL ARTICLE

The relationship between marijuana use and psychosocial variables in living kidney donor candidates

Marci M. Loiselle[1] | Shaina Gulin[2] | Terra Rose[3] | Eileen Burker[3] | Lauren Bolger[2] | Patrick Smith[1]

[1]Department of Psychiatry and Behavioral Sciences, Division of Behavioral Medicine, Duke University Medical Center, Durham, NC, USA

[2]Department of Surgery, University of North Carolina, Chapel Hill, NC, USA

[3]Department of Allied Health Sciences and Department of Psychiatry, University of North Carolina, Chapel Hill, NC, USA

Correspondence
Marci M. Loiselle, Medical Psychology, Department of Psychiatry, Division of Behavioral Medicine, Duke University Medical Center, Durham, NC 27710, USA.
Email: marci.loiselle@duke.edu

Abstract

Background: We investigate whether marijuana use in living kidney donor candidates is associated with psychosocial risk factors that place donors at higher risk for adverse outcomes and the unique associations between marijuana use and donor candidacy.

Methods: Medical records of 757 living kidney donor candidates were reviewed. Patients were grouped into marijuana users/abstainers; demographic, psychiatric, and substance use variables were compared. Multivariate logistic regression assessed the independent association of marijuana use on committee approval for donation.

Results: Marijuana use was associated with lack of health insurance, legal history, lower education level, active and history of substance use disorder, active psychiatric disorder, history of multiple psychiatric diagnoses, and history of suicidality. Marijuana users were also more likely to be young, male, unmarried, and less likely to be approved for donation by the multidisciplinary selection committee. This latter association persisted in multivariate models.

Conclusions: This is the first study to show that marijuana use is associated with psychosocial factors that could impact behavioral adherence following kidney donation, while reducing chances of committee approval for kidney donation. Special attention to potential overlay between psychosocial risk factors and marijuana use should be considered when evaluating kidney donors, particularly in context of increasingly legal use.

KEYWORDS
kidney transplantation, living kidney donation, marijuana use

1 | INTRODUCTION

The shortage of kidneys available for transplantation is well documented and the prevalence of end-stage renal disease (ESRD) is increasing. Based on Organ Procurement and Transplantation Network (OPTN) data as of November 11, 2020, there are currently 91 851 people on the national kidney transplant waitlist (https://optn.transplant.hrsa.gov/data/; "Waiting List Candidates as of Today"). In 2018, one fifth of kidney transplant recipient on the waiting list accumulated more than 5 years dialysis time.[1] Living kidney donation increases the donor pool, decreases the wait time from listing to transplantation, and is associated with more favorable clinical outcomes.

Because living donation necessitates major surgery for the donor in the absence of medical necessity, it is of utmost importance that the field of transplantation ensures the well-being of

the donor and mitigates adverse outcomes. Adverse outcomes include potential surgical, medical, social, financial, and psychological complications.

Consensus statements, guidelines, and federal regulations emphasize the importance of psychosocial evaluations among living donor candidates,[2–11] with the aim of reducing risk of adverse mental health outcomes.[12] Psychosocial evaluations help to identify high-risk social and psychological characteristics that are associated with increased likelihood of untoward outcomes. In the absence of data to the contrary, most centers currently rely on conventional risk markers associated with increased risk of poor psychosocial outcomes, such as lack of health insurance, significant past or ongoing psychiatric concerns, unrelated donors without a pre-existing donor-recipient relationship, and active substance use disorders,[2,13] including marijuana use.

Research has shown that marijuana use more than doubled in a decade from 2002–2003 to 2012–2013[14] is increasingly socially accepted,[15] and perceptions of marijuana use in the United States are more positive while perceptions of the harmfulness of such use has decreased.[15] Twelve states have legalized marijuana for recreational use, thirty-four states have legalized marijuana use for medical purposes, and nine states are considering legislation to legalize either medical or recreational use.[16] Medical benefit from smoked marijuana includes stimulating appetite, nausea relief, pain management, and improved spasticity in conditions like multiple sclerosis.[17] Given the evolving legal status of medicinal and recreational marijuana use in the United States, few programs consider active marijuana use to be an absolute contraindication to kidney donation.[18]

A recent literature review noted that survival rates for kidney transplant patients who use marijuana are equivalent to non-users.[19] However, there is a paucity of research on marijuana use in potential kidney donors. A recent study by Ruckle et al[20] reported that marijuana-using donors did not differ from non-marijuana-using donors in eGFR, serum creatinine, or pulmonary, infectious, or other medical complications. However, data were not gathered on psychosocial characteristics of these donors, their sample size was small (N = 58), and they did not investigate whether marijuana use influenced team decision regarding donation candidacy. We were particularly interested in the potential relationship between psychosocial variables of potential donors who did and did not use marijuana to determine whether there are any differences in behavioral risk factors, such as psychiatric history, substance use history, and social/occupational functioning, as there are no known studies that investigate the psychosocial environment of marijuana use in kidney donor candidates. There are also no known studies that evaluate the effect of marijuana use on multidisciplinary committee decision-making.

We hypothesized that marijuana use in kidney donor candidates is associated with psychosocial variables that place donors at higher risk for adverse outcomes compared with donor candidates without marijuana use. We also were interested in examining the unique relationship of marijuana use with team decisions regarding donor candidacy.

2 | METHODS

2.1 | Participants

Institutional Review Board approval was obtained. Retrospective chart review was performed on 1640 renal donor candidates who made contact with the donor team at a single academic medical institution from August 1998 through January 2019. This medical institution is situated in a state where marijuana use is illegal, not allowed for medical use, but decriminalized (in quantities < 1.5 oz). Of the 1640 donor candidates, 877 were ruled out due to positive crossmatch or lack of interest in proceeding. Of those remaining, 763 were seen by a psychologist and/or social worker for a full psychosocial evaluation, and 757 included data on marijuana use/non-use (six were excluded since they did not have a structured psychological interview). The final sample of 757 donor candidates was used in the present analyses. The large majority of these (n = 756) were evaluated by both a psychologist and social worker.

2.2 | Measures

Donor candidates were delineated by those who used marijuana (marijuana-using donors/MU) and those who did not (non-marijuana-using donors/NMU). MU was defined as those who either self-reported current marijuana use or had a positive toxicology screen for cannabinoids. Current marijuana use was defined as potential donors who endorsed being active marijuana users and who had used marijuana within the past month. Duration and patterns of use were not collected on all subjects, so this variable was not reported. Broad urine toxicology screens for illicit substances were implemented on all donor candidates beginning in March, 2017 as part of our center's programmatic response to the growing social acceptance of marijuana use and in attempts to gather data to corroborate self-report (positive marijuana screen cutoff was >20 ng/ml) and these screens were conducted after donors proceeded through donor testing. Self-report data were used for candidates prior to this date. Demographic data were collected from the electronic medical record on all donor candidates, including age at time of evaluation, gender, ethnicity, race, marital status, education level, and employment status. Data were collected on whether candidates had health insurance, a legal history, their relationship to their potential recipient, whether the candidate was approved to donate by the multidisciplinary selection committee (consisting of physicians, surgeons, nurse coordinators, social workers, and psychologists), and whether a donor nephrectomy took place.

In accordance with the transplant center's policy, all potential living donor candidates completed a structured psychosocial evaluation as part of their comprehensive living kidney donor evaluation. Structured psychological evaluations were performed by licensed psychologists experienced in living donor evaluation or advanced psychology trainees (PhD/PsyD-level interns or post-doctoral fellows) under the direct supervision of these licensed psychologists. Structured clinical

TABLE 1 Sample characteristics, described as *n* (%) for categorical variables and mean (SD) for continuous variables

Demographic characteristics	Total (*n* = 757)	MUD (*n* = 56)	NMUD (*n* = 701)	*p*-value (Fisher's Exact test for categorical data)	Effect size
Age at evaluation, years	44.1 (12.7)	36.1 (11.5)	44.7 (12.6)	<.001	d = .69
Sex					
Female	481 (64%)	24 (43%)	457 (65%)	.001	Φ = −.12
Male	276 (36%)	32 (57%)	244 (35%)		
Race					
Caucasian	516 (68%)	33 (59%)	483 (69%)	.137	Φ = .06
African American	148 (20%)	16 (29%)	132 (19%)		
Other	93 (12%)	7 (13%)	86 (12%)		
Ethnicity					
Not Hispanic/Latino	612 (81%)	43 (77%)	569 (81%)	.521	Φ = .04
Hispanic/Latino	46 (6%)	3 (5%)	43 (6%)		
Unknown	99 (13%)	10 (18%)	89 (13%)		
Currently married/cohabitating					
Yes	458 (61%)	14 (25%)	444 (63%)	<.001	Φ = −.23
No	299 (39%)	42 (75%)	257 (37%)		
Education level					
Less than high school/technical school/high school graduate	424 (56%)	41 (73%)	383 (55%)	.001	Φ = −.12
Undergraduate/post- graduate	326 (43%)	12 (21%)	314 (45%)		
Unknown	7 (1%)	3 (5%)	4 (<1%)		
Employment					
Employed (full- or part-time)	587 (78%)	35 (63%)	552 (79%)	.042	Φ = .16
Unemployed	86 (11%)	11 (20%)	75 (11%)		
Student/disabled/retired	81 (11%)	8 (14%)	73 (10%)		
Unknown	3 (<1%)	2 (4%)	1 (<1%)		
Health insurance					
Yes	650 (86%)	34 (60%)	616 (88%)	<.001	Φ = −.19
No	82 (11%)	17 (30%)	65 (9%)		
Unknown	25 (3%)	5 (9%)	20 (3%)		
Health insurance type					

(Continues)

TABLE 1 (Continued)

Demographic characteristics	Total (n = 757)	MUD (n = 56)	NMUD (n = 701)	p-value (Fisher's Exact test for categorical data)	Effect size
Private	386 (51%)	17 (30%)	369 (53%)	.258	Φ = −.06
Public	45 (6%)	4 (7%)	41 (6%)		
Unknown	326 (43%)	35 (63%)	291 (42%)		
Legal history					
No	658 (87%)	33 (59%)	625 (89%)	<.001	Φ = .23
Yes	91 (12%)	21 (38%)	70 (10%)		
Unknown	8 (<1%)	2 (4%)	6 (1%)		
Relationship to recipient					
Immediate family(sibling, child, spouse/partner, parent)	407 (54%)	31 (55%)	376 (54%)	.890	Φ = −.01
Extended family and other (extended family, friend, acquaintance, stranger/non-directed)	350 (46%)	25 (45%)	325 (46%)		
Committee approval for donation					
No	499 (66%)	50 (89%)	449 (64%)	<.001	Φ = −.14
Yes	258 (34%)	6 (11%)	252 (36%)		
Underwent nephrectomy					
No	580 (77%)	52 (93%)	528 (75%)	.002	Φ = −.11
Yes	177 (23%)	4 (7%)	173 (25%)		
Era of evaluation					
<March, 2017	545 (72%)	45 (80%)	500 (71%)	.166	Φ = .05
≥March, 2017	212 (28%)	11 (20%)	201 (29%)		

d = 0.69, p < .001.

interviews were used to assign DSM diagnoses and to conduct the full psychological assessment. Problematic substance use was distinguished from social/experimental use based on DSM-IV/DSM-IV TR (Substance Use/Dependence Disorders) and DSM-5 (Substance Use Disorders) criteria. Recent/social marijuana use per se was not a rule out for donation at our center, but potential donors who used marijuana had to produce at least one negative toxicology screen prior to consideration for donation candidacy. If patients met criteria for Marijuana Use Disorder, they were ruled out as a donor.

2.3 | Analyses

Statistical analyses were performed with SPSS Statistics version 26 and SAS 9.4. Descriptive analyses, including means, standard deviations, and frequencies, were conducted on all variables, including demographics and donation-related characteristics and presence/absence of: substance use disorder of any severity, use of controlled substances, psychiatric diagnosis, chronic pain, history of suicidal ideation and/or attempts, and history of psychiatric hospitalizations. Specific diagnoses were collapsed across broad diagnostic categories in order to ensure sufficient cell sizes for categorical analysis. To assess for differences between marijuana-using donors and non-marijuana-using donors, independent samples t-tests were performed on continuous variables and Fisher's exact test for categorical variables. For categorical variables containing more than two levels, we used Bonferroni-corrected significance levels for post hoc testing of subgroups.

Logistic regression analyses were used to assess the associations between marijuana use and related behavioral and psychiatric factors on committee approval for donation. We first conducted univariate analyses between factors that could plausibly have confounded the association between marijuana use and committee approval, as well as presenting a multivariate logistic regression analysis in which these additional behavioral and psychiatric factors are modeled concurrently with marijuana use. Within these analyses, committee approval was modeled as a binary outcome. In order to account for the small number of participants missing data on administratively collected data, such as the presence of health insurance data (3% missing), multiple imputation with Markov Chain Modeling and 100 imputations was used. As reported, parameter estimates from imputed analyses did not differ substantively from analyses among individuals with complete data. In order to characterize the magnitude of the observed associations, effect sizes noted are either Cohen's *d* (for continuous variables) or Phi (for categorical variables).

3 | RESULTS

3.1 | Living donor demographic characteristics

Demographic and donation-related characteristics for the overall sample (n = 757), marijuana-using donors (MU; n = 56), and non-marijuana-using donors (NMU; n = 701) are presented in Table 1. Fourteen donors had a positive marijuana urine toxicology screen, and only one donor had discrepant results from self-report (they denied any marijuana use but had a positive toxicology screen). Thus, they were included in the MU group. No other substances were detected other than marijuana. In the overall sample, donors were primarily female (64%), Caucasian (68%), and married/cohabitating (61%). Regarding relationship to the recipient, donors that were immediate family (including sibling, child, spouse/partner, or parent) accounted for 54% of the sample, while donors that were extended family or other relation (including friends, acquaintances, or strangers/non-directed) accounted for 46%. In the overall sample, the majority of donors evaluated did not receive committee approval for donation (66%) and did not undergo donor nephrectomy (77%). Of the donors who received committee approval for donation (n = 258), 69% underwent nephrectomy.

Significant differences between the two groups are noted here and in Table 1. MU were nearly a decade younger (M = 36.1 years, SD = 11.5) than NMU (M = 44.7 years, SD = 12.6, d = 0.69, p < .001), were more likely to be male (p = .001), and unmarried (p < .001). Compared with NMU, MU were less likely to have health insurance (p < .001), more likely to have a legal history (p < .001), and less likely to have a college degree (p = .001). Finally, MU had a lower likelihood than NMU of being approved by the committee (p = .001).

In order to test for possible cohort differences between individuals who did not (n = 545) and did undergo toxicology screens (n = 212), we conducted sensitivity analyses comparing cohort groups on demographic, clinical, and behavioral health characteristics. We found no evidence of systematic group differences in any factor, including age (M = 43.4 vs M = 45.7), gender (65% female vs 61% female), race (69% vs 67% White), ethnicity (95% vs 92% non-Hispanic/other), marital status (58% vs 62% married), education level (43% vs 45% college-educated), employment status (77% vs 80% employed), health insurance (90% vs 88% with health insurance), and legal history (13% vs 10% with a legal history).

3.2 | Substance use

A total of 147 donors (19%) met criteria for a current substance use disorder of any severity (SUD), with the most common being tobacco (13%), followed by alcohol (2%). Cannabis Use Disorder comprised 0.5%, while other current SUD or combination of SUDs (eg, stimulants, opiates, sedatives) comprised 2%. Of potential donors who endorsed a current SUD, 117 had one SUD, 22 had two SUDs, three had three SUDs, and five had four SUDs. In the overall sample, 263 (35%) reported a history of SUD, with tobacco comprising the majority (16%), followed by other SUD or combination of SUDs (7%), alcohol (4%), and then marijuana (1%). Current use of licit controlled substances was reported by 11% (n = 83) of the overall sample, with similar frequency distribution among type (opiate, benzodiazepine, stimulant, sedative/hypnotic/anxiolytic, and other).

As noted in Table 2, MU were more likely than NMU to have a current SUD (p < .001). In addition, NMU and MU groups differed

on the type of current SUD ($p < .001$), such that MU patients were more likely than NMU patients to have multiple/other SUDs (38% vs 1%, Bonferroni-adjusted $p < .001$). MU were also more likely than NMU to have a prior SUD ($p < .001$). We found no group differences regarding the presence ($p = .67$) or type ($p = .22$) of illicit controlled substance use. Of note, patients reporting ongoing/current use of substances were also included in calculations for those with a history of substance use.

3.3 | Psychiatric characteristics

Excluding SUDs, 34% of the overall sample reported a current or past psychiatric diagnosis. Depression was the most common (7%), followed by anxiety (7%), with 17% of donors reporting other diagnoses or a combination of diagnoses (eg, PTSD, personality disorders). One hundred fifty-nine potential donors met criteria for one prior psychiatric diagnosis, 63 met criteria for two diagnoses, 25 met

TABLE 2 The prevalence of substance use disorders (SUD) and prior substance use across the cohort

	Total ($n = 757$)	MUD ($n = 56$)	NMUD ($n = 701$)	Fisher's exact test p-value	Effect size
Current substance use disorder					
No	610 (81%)	16 (29%)	594 (85%)	<.001	Φ = .37
Yes	147 (19%)	40 (71%)	107 (15%)		
Current SUD, type					
Alcohol only	12 (2%)	2 (4%)	10 (1%)	<.001	Φ = .57
Tobacco only	101 (13%)	13 (23%)	88 (13%)		
Marijuana only[a]	4 (0.5%)	4 (7%)	0 (0%)		
Alcohol and tobacco	12 (2%)	5 (9%)	7 (1%)		
Marijuana and tobacco	5 (0.7%)	5 (9%)	0 (0%)		
Other/multiple SUDs[a]	13 (2%)	11 (20%)	2 (4%)		
History of SUD					
No	494 (65%)	10 (18%)	484 (69%)	<.001	Φ = .28
Yes	263 (35%)	46 (82%)	217 (31%)		
Past SUD, type					
Alcohol only	32 (4%)	3 (5%)	29 (4%)	<.001	Φ = .37
Tobacco only	118 (16%)	8 (14%)	110 (16%)		
Marijuana only[a]	9 (1%)	3 (5%)	6 (1%)		
Alcohol and tobacco	41 (5%)	10 (18%)	31 (4%)		
Marijuana and tobacco	12 (2%)	4 (7%)	8 (1%)		
Other/multiple SUDs[a]	51 (7%)	18 (32%)	33 (5%)		
Current use of controlled substance					
No	674 (89.0%)	49 (885%)	625 (89%)	.498	Φ = .02
Yes	83 (11.0%)	7 (13%)	76 (11%)		
Current use of controlled substance, type					
Opiate	19 (3%)	2 (4%)	17 (2%)	.085	Φ = .09
Benzodiazepine	20 (3%)	4 (7%)	16 (2%)		
Stimulant	17 (2%)	2 (4%)	15 (2%)		
Sedative/hypnotic/other and multiple substances	35 (5%)	2 (4%)	33 (5%)		

Note: Data are presented as *n* (%).

[a]Denotes subgroups demonstrating $p < .01$ after adjustment for multiplicity.

criteria for three diagnoses, five met criteria for four diagnoses, and two met criteria for five diagnoses. Refer to Table 3 for frequency of lifetime DSM psychiatric diagnoses in the overall sample.

As displayed in Table 4, MU were more likely than NMU to have a current psychiatric diagnosis ($p < .001$). Specifically, per results of a Bonferroni-corrected post hoc test, MU were more likely than NMU to report diagnoses other than anxiety and depression and/or to report multiple diagnoses (36% vs 15%, respectively, $P < .001$). MU were more likely than NMU to have a history of suicidal ideation and/or attempts ($p < .001$). There were no differences between the groups for history of psychiatric hospitalization ($p = .276$) or chronic pain ($p = .235$).

3.4 | Impact on donation candidacy

In an effort to more comprehensively address this important issue, we conducted several additional analyses to further delineate the independent association between marijuana use and subsequent committee decisions regarding approval to donate. We first examined the associations between background and clinical factors that could plausibly confound the observed association between marijuana use and committee approval for donation, including (a) the presence of psychiatric diagnoses (excluding substance use disorder), (b) history of legal problems, (c) health insurance status, and (d) chronic pain. Results demonstrated that several of these factors were associated with both a greater likelihood of marijuana use and committee adjudication regarding donation. For example, marijuana use was more common among patients with a psychiatric diagnosis compared with those without a diagnosis (13% vs 5%, $p < .001$), more common among patients lacking health insurance compared with those with insurance (21% vs 5%, $p < .001$), and more common among individuals with a legal history compared with those without (23% vs 5%, $p < .001$). In contrast, marijuana use did not differ between those with and without chronic pain (10% vs 7%, $p = .235$).

In addition to being associated with marijuana use, several of these clinical characteristics were also associated with a higher likelihood of being declined for donation. Specifically, the presence of a psychiatric diagnosis (OR = 1.56 [1.13, 2.17], $p = .008$), having a legal history (OR = 2.71 [1.54, 4.74], $p < .001$), and lacking health insurance (OR = 1.78 [1.05, 3.02], $p = .027$) were all associated with a greater likelihood of being declined for donation when examined in univariate analyses. Similarly, marijuana use was also associated with a higher likelihood of being declined for donation (OR = 4.68 [1.98, 11.06], $p < .001$). Results of multivariate logistic regression analyses including multiple behavioral and psychiatric predictors are presented in Table 5. Results demonstrated that marijuana use continued to associate with committee approval after accounting for plausible confounders (OR = 3.42 [1.42, 8.26], $p = .006$), such that active marijuana users had more than three times the odds of failing to be approved for donation relative to their counterparts not using marijuana. Moreover, the association between marijuana use and donation approval was stronger compared with other behavioral predictors, including current psychiatric diagnosis or legal history. In addition to the multivariate results from analyses using multiple imputation (Table 5), results were not substantively changed in multivariate analyses limited to individuals with complete data only (Table S1).

TABLE 3 Donors with lifetime psychiatric diagnoses, diagnosed using Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria ($n = 254$)

Psychiatric diagnosis	*n* (%)
Depressive	125 (17)
Anxiety	109 (14)
Trauma- and stressor-related	67 (9)
Neurodevelopmental	36 (5)
Personality	13 (2)
Disruptive, impulse-control, and conduct	9 (1)
Bipolar and related	6 (0.8)
Feeding and Eating	7 (0.9)
Neurocognitive	4 (0.5)
Schizophrenia spectrum and other psychotic	4 (0.5)
Sleep-wake	4 (0.5)
Obsessive-compulsive and related	2 (0.3)
Other	2 (0.3)
Dissociative	1 (0.1)
Sexual dysfunctions	1 (0.1)

Note: Data are presented as *n* (%).

4 | DISCUSSION

This is the first study to show that active marijuana use in potential kidney donors is associated with psychosocial risk factors and behavioral markers that could impact safety and outcomes post-donation. Marijuana use was associated with lack of health insurance, presence of a legal history, lower level of education, presence of a current substance use disorder of any severity (including cannabis use disorder), history of polysubstance use disorder of any severity, current psychiatric disorder, history of multiple psychiatric diagnoses, and a history of suicidal ideation and/or attempts. Marijuana users were more likely to be young, male, unmarried, and less likely to be approved for donation by the multidisciplinary selection committee. Further, active marijuana users had more than three times the odds of failing to be approved for donation relative to their counterparts not using marijuana. Moreover, the association between marijuana use and approval for donation was stronger than other codified behavioral risk markers, including current psychiatric diagnosis or legal history. This study suggests that marijuana use can be considered a marker for other high-risk variables that impact safety after kidney donation and, when taken into context with other high-risk variables, compounds potential risks to donors and reduces their likelihood of being approved for donation.

TABLE 4 Psychiatric characteristics among individuals with (MUD) and without (NMUD) a marijuana use disorder

	Total (n = 757)	MUD (n = 56)	NMUD (n = 701)	Fisher's Exact test p-value	Effect size
Psychiatric diagnosis					
No	500 (66%)	23 (42%)	477 (68%)	<.001	Φ = .15
Yes	254 (34%)	32 (58%)	222 (32%)		
Psychiatric diagnosis, type[a]					
Depression only	55 (7%)	6 (11%)	49 (7%)	<.001	Φ = .21
Anxiety only	51 (7%)	2 (4%)	49 (7%)		
Depression and anxiety	20 (3%)	4 (7%)	16 (2%)		
Other/multiple diagnoses[a]	128 (17%)	20 (36%)	108 (15%)		
Suicidal ideation or attempts					
No	679 (90%)	41 (75%)	638 (91%)	<.001	Φ = .15
Yes	74 (10%)	14 (26%)	60 (9%)		
Psychiatric hospitalization					
No	717 (95%)	49 (91%)	668 (96%)	.276	Φ = .06
Yes	35 (5%)	5 (9%)	30 (4%)		
Chronic pain					
No	648 (86%)	45 (80%)	603 (86%)	.235	Φ = .04
Yes	108 (14%)	11 (20%)	97 (14%)		

Note: Data are presented as *n* (%).

[a]Denotes subgroups demonstrating $p < .01$ after adjustment for multiplicity.

TABLE 5 Multivariate logistic regression model examining the associations between clinical and psychological variables and the odds of being accepted for kidney donation following multiple imputation (Hosmer and Lemeshow Goodness-of-fit test, $X^2 = 3.32$; $p = .539$)

Variable	OR (95% CI)	p-value
Psychiatric diagnosis	1.43 (1.02, 2.00)	.037
Legal history	2.14 (1.19, 3.82)	.010
Health insurance	0.73 (0.42, 1.27)	.272
Marijuana use	3.42 (1.42, 8.26)	.006

Note: As shown, current marijuana use demonstrated the strongest association with being declined for donation.

Odds ratios (OR) denote likelihood of NOT being approved for donation.

Young, male, and unmarried potential donors were found to use marijuana significantly more than their counterparts. In a study of risky behaviors, marijuana use was associated with increased social and health risk taking.[21] Although risk taking was not evaluated in the current study, it is possible that donor candidates who smoke marijuana may be more prone to risk taking and thus, careful assessment is vital to ensure these donors recognize the impact donation may have on their future functioning. The pre-donation psychological evaluation can help the donor candidate understand future health, financial, and psychosocial risks.

Although active substance use disorders are considered contraindications to kidney donation,[13,18,22,23] few programs immediately exclude a potential donor for having a history of alcohol or drug use. Instead, programs tend to require a sustained period of abstinence prior to consideration for donation. Thus, a potential donor's pattern of marijuana use deserves special attention. The context of use (eg, recreational, medical, self-medication, abusive) should be carefully assessed during the kidney donor evaluation, as those who report engaging in drug use pre-donation endorse emotional, psychological, or substance abuse concerns after donation.[11] Also, it is important to determine whether the lack of availability of marijuana in the inpatient setting and during recovery will impact the donor's psychological functioning (if used a coping tool or self-medication) and interfere with rehabilitation, as there is evidence for a marijuana withdrawal syndrome.[24]

A potential donor's use of marijuana needs to be evaluated in the context of their psychiatric history. Studies show that marijuana use causes disruption of certain brain functions and networks that can mirror the brain changes that occur in schizophrenia and Alzheimer's disease.[25] Further, research has confirmed an association between marijuana use and the development of psychoses and other schizophrenia-spectrum disorders, bipolar disorders, hypomania, depression, and suicide.[26] Active psychiatric disorders are relative contraindications to kidney donation,[12,22] especially when combined with a history of suicidal ideation or attempts. As some potential donors might be using marijuana to self-medicate psychiatric symptoms, assessing psychiatric functioning may be challenging, but is critically important.

The prevalence of marijuana use in our society continues to expand, and transplant centers must evolve their policies and procedures to reflect a changing society where marijuana use is more accepted. Thorough evaluation of substance use history is recommended during psychosocial evaluations. Further, it may be warranted to standardize toxicology screenings as part of living donor evaluations to minimize the dilemma of self-report. Clinical innovations are needed in guarding against stigma and bias that accompanies marijuana use and can impact equity in transplant.[27] This study showed an increase in legal issues for marijuana users, and there are disconcerting data showing how marijuana, and other substance use, is perceived and treated among different socioeconomic groups. Marijuana-specific education for staff and patients is warranted to protect against this bias.

Study limitations include the limited number of candidates who self-reported current marijuana use. It should be noted that the center where these data were collected is located in a state where marijuana use is illegal for both recreational purposes and medicinal purposes. Potential donors could have been motivated to present favorably to either be approved to donate or to avoid admitting to using an illegal substance. As routine toxicology screens were not performed at our center until March, 2017, corroborating data were not obtained until then, and lack of systematically collected toxicology screens is a limitation to our study. However, an analysis of groups before and after toxicology screens were routinely collected did not suggest any concerns about a cohort effect. We also did not collect data on those who endorsed remote (eg, 10+ years ago) occasional social marijuana use. Additional limitations include the lack of structured substance use disorder assessment, not being able to identify the specific reason a potential donor was declined by the multidisciplinary committee, failing to control medical factors that would predict candidacy decisions, and missing data from items being left blank on administrative forms in the medical record.

As an increasing number of states continue to legalize recreational and medical marijuana, future studies can be conducted in these states to determine whether these results are generalizable to regions where use might be considered more socially acceptable. Future directions include investigating whether recreational use of marijuana is associated with adverse psychosocial outcomes for the renal donor after nephrectomy. Finally, standardized guidelines based on empirical evidence would be useful in establishing policies involving the use of marijuana in donors.

With ESRD on the rise and a severe shortage of cadaver kidneys, living kidney donation is becoming increasingly prevalent. With increased prevalence comes an urgent need for the ability to choose donors who will have the best outcomes. Since marijuana's social acceptance, legalization and use is steadily increasing, special attention must be paid to its impact on kidney donor outcomes.

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CONFLICT OF INTEREST

None.

AUTHORS' CONTRIBUTIONS

Marci Loiselle: concept/design, database development, drafting article, critical revision of article, data collection, approval of article. Shaina Gulin: data analysis/interpretation, statistics, data collection, critical revision of article, drafting article, drafting tables. Terra Rose: data collection, drafting article, critical revision of article. Eileen Burker: drafting article, critical revision of article. Lauren Bolger: database development, data extraction. Patrick Smith: data analysis/interpretation, statistics, critical revision of article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ORCID

Marci M. Loiselle https://orcid.org/0000-0002-7284-6342
Terra Rose https://orcid.org/0000-0001-7687-7173
Eileen Burker https://orcid.org/0000-0002-8045-7507
Lauren Bolger https://orcid.org/0000-0002-8638-3852
Patrick Smith https://orcid.org/0000-0002-6374-0298

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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