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Impact of Perioperative Complications on Living Kidney Donor Health-Related Quality of Life and Mental Health: Results From a Prospective Cohort Study

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Abstract

Background: Although living kidney donation is safe, some donors experience perioperative complications.
Objective: This study explored how perioperative complications affected donor-reported health-related quality of life, depression, and anxiety.
Design: This research was a conducted as a prospective cohort study.
Setting: Twelve transplant centers across Canada.
Patients: A total of 912 living kidney donors were included in this study.
Measurements: Short Form 36 health survey, Beck Depression Inventory and Beck Anxiety Inventory.
Methods: Living kidney donors were prospectively enrolled predonation between 2009 to 2014. Donor perioperative complications were graded using the Clavien-Dindo classification system. Mental and physical health-related quality of life was assessed with the 3 measurements; measurements were taken predonation and at 3- and 12-months postdonation.
Results: Seventy-four donors (8%) experienced a perioperative complication; most were minor (n = 67 [91%]), and all minor complications resolved before hospital discharge. The presence (versus absence) of a perioperative complication was associated with lower mental health-related quality of life and higher depression symptoms 3-month postdonation; neither of these differences persisted at 12-month. Perioperative complications were not associated with any changes in physical health-related quality of life or anxiety 3-month postdonation.
Limitations: Minor complications may have been missed and information on complications postdischarge were not collected. No minimal clinically significant change has been defined for kidney donors across the 3 measurements.
Conclusions: These findings highlight a potential opportunity to better support the psychosocial needs of donors who experience perioperative complications in the months following donation.
Trial registration: NCT00319579 and NCT00936078.

Abrégé

Contexte: Bien que le don vivant d'un rein soit une procédure sécuritaire, certains donneurs souffrent tout de même de complications périopératoires.
Objectifs: Cette étude a examiné l'incidence des complications périopératoires sur la qualité de vie liée à la santé et les symptômes de dépression et d'anxiété rapportés par les donneurs.
Type d'étude: Étude de cohorte prospective
Cadre: Douze centers de transplantation à travers le Canada
Sujets: 912 donneurs vivants d'un rein
Mesures: Un questionnaire abrégé de 36 questions sur l'état de santé, l'inventaire de dépression Beck et l'inventaire d'anxiété Beck
Méthodologie: Les donneurs ont été inscrits avant le don de façon prospective entre 2009 et 2014. Les complications périopératoires des donneurs ont été classées à l'aide du système de classification Clavien-Dindo. La qualité de vie liée à la

santé physique et mentale a été évaluée à l'aide des trois outils de mesure; ces mesures ont été faites avant le don, puis 3 et 12 mois après le don.

Résultats: Au total, 74 donneurs (8 %) ont souffert d'une complication périopératoire; la plupart étaient mineures (n = 67 [91 %]) et ont été résolues avant le congé de l'hôpital. La présence (par rapport à l'absence) d'une complication périopératoire a été associée à une plus faible qualité de vie liée à la santé mentale et à des symptômes de dépression plus graves 3 mois après le don; aucune de ces différences n'a persisté après 12 mois. Les complications périopératoires n'ont pas été associées à des changements dans la qualité de vie liée à la santé physique ou à l'anxiété 3 mois après le don.

Limites: Certaines complications mineures ont pu être manquées. L'information sur les complications survenues après le congé n'a pas été recueillie. Dans les trois outils de mesure, aucune variation minimale cliniquement significative n'a été définie pour les donneurs d'un rein.

Conclusion: Ces résultats soulignent une occasion de mieux répondre aux besoins psychosociaux des donneurs d'un rein qui présentent des complications périopératoires dans les mois suivant le don.

Keywords
depression, health-related quality of life, living kidney donation

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Introduction

Research to date has shown that nephrectomy in the short- and long-term is relatively safe for carefully selected living kidney donors.[1-5] As with all surgeries, however, there are risks: while less than 1% of donors will experience a major complication such as pulmonary embolism, approximately 10% to 20% of donors will experience a minor perioperative complication such as ileus or infection.[2,6,7]

Major surgery results in a short-term decline in mental and physical quality of life.[8] Perioperative complications have been linked with further declines in mental and physical quality of life and a delayed recovery of functional status.[9-11] In comparison with patients undergoing other perioperative interventions, living kidney donors have fewer comorbidities and are generally at or above population norms for quality of life prior to surgery.[7,12] Nonetheless, similar to other major surgical procedures, prior studies suggest a reduction in self-reported health-related quality of life 3 months following donation, with a return to predonation values by 12 months.[13-19]

Known potential risks of donating a kidney should be quantified and communicated to living kidney donor candidates, and when possible, used to guide supportive care to mitigate harm. The objective of this study was to compare donors with and without perioperative complications on self-reported scales of mental and physical health-related quality of life and mental health 3 and 12 months after donation.

Materials and Methods

Design and Setting

The data for this study were obtained from an ongoing international, multicenter, prospective cohort study examining the medical, psychological, and financial consequences of living kidney donation (clinicaltrials.gov NCT00319579 and NCT00936078). Participants were enrolled from 12 centers

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in Canada and 5 centers in Australia between 2004 and 2009 for phase I (pilot, n = 73), and from 2009 to 2014 for phase II (n = 969). To maximize homogeneity among health-related quality-of-life normalized data, we excluded 57 (6%) donors whose nephrectomy was performed outside Canada; the results presented here are for the subset of 912 Canadian donors enrolled between 2009 and 2014. All participants were approved by their local program for living kidney donation and provided written informed consent. Inclusion criteria for the larger prospective study included enrollment prior to donation, 18 years of age or older, and the ability to communicate in English or French. Ethics approval was obtained from Western University's Research Ethics Board and from all participating centers. The conduct and reporting of this study follows recommended guidelines (Supplemental Material Table S1).[20]

Data Collection and Measures

Donors completed standardized health questionnaires, and the material deprivation index quintile was obtained from the Canadian Marginalization Index using postal codes.[21]

We collected intraoperative and perioperative data (until hospital discharge). The presence and severity of complications were assessed and graded independently by 2 authors (C.G.O. and L.F.) using the Clavien-Dindo classification system; authors had complete agreement on data abstraction (kappa 1.0).[7,22-25] Perioperative complications were graded as either minor (grade I or II) or major (grade III or IV). In this study perioperative complications were those the donor would be aware of, anything apparent in hospital after surgery or any intended laparoscopic surgeries that were converted to open surgeries due to an intraoperative complication. There were no deaths related to perioperative complications, so there were no Clavien-Dindo grade-V events. Examples of minor complications included ileus, infection, or atelectasis. Examples of major complications included sepsis, pulmonary embolism, and wound dehiscence with reintervention.

Psychosocial Instruments

Psychosocial instruments were collected at 3 time points (predonation, and at 3 and 12 months postdonation) using standardized, validated scales: the Short Form 36 (SF-36) health survey, the Beck Depression Inventory (BDI) and the Beck Anxiety Inventory (BAI).[26-28] All patient-reported measurement surveys used in this study have undergone extensive validation.[29-31]

Mental and physical health-related quality of life. Health-related quality of life was measured using the SF-36, which contains 36 questions on physical and mental well-being and can be summarized via 8 scales and standardized as a mental component summary (MCS) score and physical component summary (PCS) score; the MCS and PCS scores were calculated for this study using Canadian normative data.[32] Higher scores indicate better well-being. We also examined the proportion of donors who demonstrated a minimal clinically significant change in MCS and PCS scores; we defined a decline of 3 or more as a minimal clinically significant change in these scales.[33]

Depression and anxiety. The BDI and the BAI each contain 21 questions on symptoms of depression and anxiety, respectively. Scores range from 0 (no depression or anxiety) to 63 (severe depression or anxiety). Lower scores indicate better well-being. In addition to analyses performed treating the BDI and BAI as continuous variables, we defined an increase of 3 or more as a minimal clinically significant change in these scales.

Statistical Analysis

If ≥50% of a donor's responses for a given scale for each of the 8 scales in the SF-36 were observed, personal mean imputation was used to fill in missing data where applicable. If <50% of the responses for a given scale were observed, fully conditional specification multiple imputation was used to impute missing data at the scale level.[34-36] Multiple imputation was used at the item-level for missing items on the BDI and BAI. We assumed data were missing at random and 50 complete data sets were imputed. Both predonation and postdonation variables were used to impute data. Details on completeness of data and multiple imputation methods are presented in Supplemental Material Table S2. All predonation and surgical data were complete, with the exception of education level (missing in <1% of donors) and material deprivation index (missing in 17% of donors); predonation quality-of-life questionnaires were completed by over 97% of donors, and by over 86% and 78% of donors 3 and 12 months after donation, respectively. There were no appreciable differences in response rates between donors with and without perioperative complications.

Within each imputed data set, linear regression analysis was used to estimate the difference in change in health-related quality-of-life scores between those with and without complications. The following variables which have been shown in prior studies to impact quality of life were included in the adjustment: age (years), gender, ethnicity (Caucasian versus non-Caucasian), body mass index (per kg/m^2), smoking (yes versus no), marital status (married or common-law versus not married), employed full- or part-time (vs. all other employment types), university education (yes vs. no), relationship to recipient (genetically related, emotionally related or anonymous), and material deprivation quintile (1,2 or 3 vs. 4 or 5).[13,37-40] We also adjusted for year of surgery, province of surgery and intended surgical technique (open vs. laparoscopic). Model assumptions were assessed, and standard methods to combine estimates and obtain variance

estimates were used.[41] Separate models were fitted for each patient-reported outcome and for each time point (change from predonation to 3 months postdonation and change from predonation to 12 months postdonation). Complete-case adjusted analyses were performed in sensitivity analyses.

Separate logistic regression models were fitted for each patient-reported outcome to estimate the adjusted odds ratio of a clinically significant change in quality of life, comparing donors with perioperative complications to donors without, adjusting for the covariates listed above. In all analyses, a 2-sided P value $<.05$ was considered statistically significant. SAS software version 9.4 was used for all analyses.

Results

Baseline characteristics of the 912 donors are shown in Table 1. Donors had a median age of 48 years, and the majority (67%) were women. Most donors were Caucasian (87%) and were genetically (49%) or emotionally (35%) related to their recipients. The majority (82%) of donors had a predonation body mass index of <30 kg/m^2 and nearly all (95%) had normal blood pressure.

A total of 74 (8%) patients experienced at least one perioperative complication (Supplemental Material Table S3). The predonation characteristics of donors who did and did not experience a complication are presented in Table 1. Except for pre-donation serum creatinine (71 vs. 68 μmol/L, P value $= .044$), there were no statistically significant baseline differences between donors with and without complications, respectively.

Of the patients who experienced a complication, the majority were minor (n = 67 [91%]) and all minor complications resolved before hospital discharge. Four donors experienced major complications which included wound dehiscence requiring reoperation, pulmonary embolism, myocardial infarction, and sepsis. Three additional donors experienced intraoperative complications resulting in conversion from laparoscopic to open procedure. No donors died during the first 90 days after surgery, or as a result of a perioperative complication.

Health-Related Quality of Life

Mean (95% confidence interval) predonation, and 3- and 12-month postdonation PCS and MCS scores in donors with and without complications are shown in Figure 1. Predonation scores were similar between donors with and without complications.

Change from predonation and between-group differences for the PCS are shown in Table 2. At 3 months postdonation, donors with and without complications had a decline from predonation with a mean decline of −4.1 (95% CI: [−6.4, −1.8]) and −5.8 (95% CI: [−6.5, −5.1]), respectively. At 12 months postdonation, donors with and without complications were trending toward recovering their predonation scores. Between-group differences for donors with and without complications were not significant at either 3 or 12 months postdonation for the PCS. No significant between-group differences were noted for individual physical health-related quality-of-life scales (Table 2). No clinically significant changes were identified at 3 or 12 months postdonation (Supplemental Material Tables S4 and S5).

For the MCS, both donors with and without complications had a decline from predonation to 3 months postdonation with an average change of −4.6 (95% CI: [−7.3, −2.0]) and −1.6 (95% CI: [−2.3, −1.0]), respectively. Between-group differences for donors with and without complications were significant at 3 months postdonation for the MCS: donors with complications had a significantly larger decline in scores compared to donors without complications (−3.0 [95% CI: −5.5, −0.6], $P = .015$). At 12 months postdonation, donors with complications showed an improvement in MCS scores but remained below their predonation values (−2.8 [95% CI: −5.4, −0.2]), while the change in scores from predonation to 12 months postdonation in donors without complications was similar the change in their 3 month scores. Between-group differences for MCS scores did not persist at 12 months postdonation. Donors with complications also had a significantly larger decline at 3 months postdonation compared to donors without complications for both the "role emotional," and "mental health" individual mental health-related quality-of-life scales; these significant differences did not persist at 12 months postdonation (Table 2). The adjusted odds ratios of clinically significant changes in quality-of-life scores at 3 and 12 months postdonation (comparing donors with and without complications) are shown in Supplemental Material Tables S4 and S5, respectively; no differences were statistically significant. Results of the complete case analyses were similar to the main analysis (Supplemental Material Table S6).

Depression and Anxiety

Mean (95% CI) predonation and 3 and 12 month postdonation BDI and BAI scores are shown in Figure 2.

BDI scores from predonation to 3 months postdonation increased for both donors with and without complications (representing more depression) (Table 3). Donors with complications, however, had a significantly higher increase in depression scores compared to donors without complications (mean difference: 1.7 [95% CI: 0.6, 2.8], $P = .002$). At 12 months postdonation, donors with complications recovered toward their baseline scores. There were no statistically significant differences between donors with and without complications 12 months postdonation. For donors with and without complications, BAI scores increased (representing more anxiety) from predonation to 3 months postdonation. At 12 months postdonation, donors with complications had nearly recovered their baseline values. There were no statistically significant differences between donors with and

Table 1. Baseline Characteristics of 912 Living Kidney Donors.

	All donors	Perioperative complications		
		Yes	No	
	N = 912	N = 74	N = 838	*P* value[a]
Predonation characteristics				
Age, years	48 (39, 55)	49 (40, 55)	48 (39, 55)	.75
Women, n (%)	609 (66.8)	43 (58.1)	566 (67.5)	.10
Caucasian, n (%)	789 (86.5)	69 (93.2)	720 (85.9)	.077
Relationship to recipient, n (%)				.22
Genetically related	443 (48.6)	32 (43.2)	411 (49.1)	
Emotionally related, spouse	139 (15.2)	15 (20.3)	124 (14.8)	
Emotionally related, nonspouse	177 (19.4)	18 (24.3)	159 (19.0)	
Kidney paired donation	118 (12.9)	5 (6.8)	113 (13.5)	
Altruistic/anonymous	35 (3.8)	4 (5.4)	31 (3.7)	
University education, n (%)[b]	308/908 (33.9)	24/74 (32.4)	284/834 (34.1)	.78
Employed, n (%)	700 (76.8)	53 (71.6)	647 (77.2)	.28
Married or common-law, n (%)	707 (77.5)	60 (81.1)	647 (77.2)	.44
Socioeconomic marginalization quintile[c], n (%)				.22
1 (least deprived)	207/759 (27.3)	21/62 (33.9)	186/697 (26.7)	
2	168/759 (22.1)	9/62 (14.5)	159/697 (22.8)	
3	174/759 (22.9)	18/62 (29.0)	156/697 (22.4)	
4	119/759 (15.7)	10/62 (16.1)	109/697 (15.6)	
5 (most deprived)	91/759 (12.0)	4/62 (6.5)	87/697 (12.5)	
Marginalized[d]	210/759 (27.7)	14/62 (22.6)	196/697 (28.1)	.35
Physical component summary	55.8 (52.4, 58.0)	55.3 (52.3, 56.9)	56.0 (52.4, 58.0)	.37
Mental component summary	55.7 (51.6, 58.1)	55.0 (50.5, 58.9)	55.7 (51.7, 58.0)	.93
Beck Depression Inventory	2.0 (0.0, 4.0)	1.0 (0.0, 4.0)	2.0 (0.0, 4.0)	.31
BAI	3.0 (1.0, 6.0)	2.5 (1.0, 5.0)	3.0 (1.0, 6.0)	.89
Predonation health				
Body mass index, kg/m^2[e]	26.0 (23.5, 29.0)	26.3 (23.0, 28.6)	26.0 (23.5, 29.0)	.98
Obese, n (%)[c]	162 (17.8)	12 (16.2)	150 (17.9)	.72
Current smoker, n (%)	127 (13.9)	5 (6.8)	122 (14.6)	.063
Hypertension, n (%)	45 (4.9)	5 (6.8)	40 (4.8)	.45
Serum creatinine, μmol/L	69 (62, 79)	71 (64, 81)	68 (62, 79)	.044
estimated glomerular filtration rate, mL/min per 1.73m^2[e]	96 (86, 107)	93 (82, 104)	96 (86, 107)	.14
Depression diagnosis, n (%)[f]	132 (14.5)	11 (14.9)	121 (14.4)	.92
Anxiety diagnosis, n (%)[g]	69 (7.6)	2 (2.7)	67 (8.0)	.10

Note. All continuous variables are summarized as median (25th, 75th percentile).
[a]Comparison between donors with and without complications. A chi-square test was used for discrete data and a 2-sample *t*-test was used for continuous data.
[b]Education status was missing in 4 (0.4%) donors.
[c]Obesity defined as body mass index ≥30 kg/m^2.
[d]Socioeconomic marginalization quintile was missing in 153 (17%) donors. A higher quintile indicates higher material deprivation. A quintile ≥4 is considered marginalized.
[e]eGFR calculated using the CKD-EPI equation.
[f]Participant-reported diagnosis by a physician of depression before the study recruitment visit.
[g]Participant-reported diagnosis by a physician of anxiety before the study recruitment visit.

without complications at either 3 or 12 months postdonation. The adjusted odds ratios of clinically significant changes in BDI and BAI scores at 3 and 12 months postdonation (comparing donors with and without complications) are shown in Supplemental Material Tables S4 and S5, respectively; no differences were statistically significant. Results of the complete-case analyses were similar to the main analysis (Supplemental Material Table S6).

Supplemental Material Table S7 contains results of complete-case analyses which are similar to the results reported in Table 3.

Discussion

Living kidney donation remains an elective surgery; understanding the impact of perioperative complications on

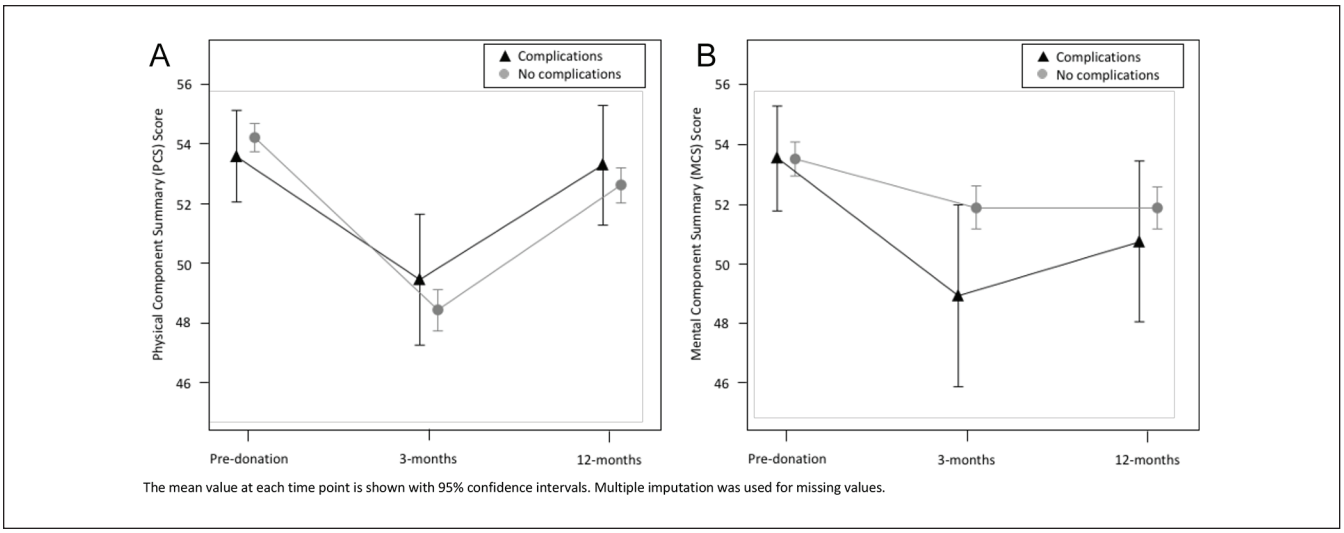

Figure 1. Physical Component Summary (A) and Mental Component Summary (B) measured predonation and at 3- and 12-months postdonation, in those with perioperative complications (n = 74) and those without perioperative complications (n = 838).

Table 2. Health-Related Quality of Life Among Living Kidney Donors With Perioperative Complications (n = 74) and Without Perioperative Complications (n = 838).

		Observed data Mean (*SE*)	Change from predonation Mean (95% CI)		Between-group differences Mean (95% CI)[a] *P* value	
	Complications	Predonation	3 months	12 months	Predonation to 3 months	Predonation to 12 months
Physical component summary	Yes	53.6 (0.8)	−4.1 [−6.4, −1.8]	−0.3 [−2.3, 1.7]	1.3 [−1.1, 3.8]	1.1 [−0.9, 3.1]
	No	54.1 (0.2)	−5.8 [−6.5, −5.1]	−1.6 [−2.2, −1.0]	.28	.29
Physical functioning	Yes	93.0 (1.8)	−4.9 [−9.0, −0.8]	−0.7 [−4.8, 3.3]	0.0 [−4.6, 4.6]	−0.1 [−4.2, 4.0]
	No	93.1 (0.5)	−5.3 [−6.6, −4.0]	−1.1 [−2.3, 0.1]	.99	.96
Role physical	Yes	93.8 (2.4)	−29.5 [−40.6, −18.4]	−3.4 [−11.1, 4.3]	−0.9 [−11.5, 9.6]	2.6 [−5.1, 10.3]
	No	94.7 (0.7)	−29.3 [−32.3, −26.3]	−6.3 [−8.5, −4.1]	.86	.51
Bodily pain	Yes	86.0 (2.4)	−6.6 [−12.4, −0.8]	−2.5 [−8.2, 3.2]	1.4 [−3.8, 6.6]	0.3 [−4.5, 5.1]
	No	88.2 (0.6)	−9.1 [−10.6, −7.6]	−3.2 [−4.6, −1.8]	.60	.90
General health	Yes	84.0 (1.5)	−2.0 [−5.4, 1.4]	−2.6 [−6.2, 1.1]	0.7 [−2.4, 3.9]	1.5 [−2.2, 5.2]
	No	85.3 (0.4)	−3.2 [−4.2, −2.3]	−4.5 [−5.6, −3.4]	.64	.43
Mental component summary	Yes	53.5 (0.9)	−4.6 [−7.3, −2.0]	−2.8 [−5.4, −0.2]	**−3.0 [−5.5, −0.6]**	−1.2 [−3.7, 1.2]
	No	53.5 (0.3)	−1.6 [−2.3, −1.0]	−1.6 [−2.3, −1.0]	**.015**	.32
Energy/vitality	Yes	72.2 (2.0)	−12.1 [−16.8, −7.3]	−6.5 [−10.9, −2.1]	−3.6 [−8.2, 0.9]	−1.2 [−5.3, 3.0]
	No	71.8 (0.6)	−8.7 [−10.0, −7.4]	−5.7 [−7.0, −4.5]	.12	.59
Social functioning	Yes	92.1 (1.9)	−8.5 [−14.0, −3.0]	−1.0 [−5.7, 3.7]	0.4 [−4.7, 5.5]	2.5 [−1.9, 6.9]
	No	93.4 (0.5)	−9.5 [−11.0, −8.1]	−3.6 [−4.9, −2.3]	.89	.26
Role emotional	Yes	93.6 (2.2)	−15.7 [−24.2, −7.3]	−6.8 [−14.4, 0.7]	**−9.0 [−16.8, −1.3]**	−4.3 [−11.5, 2.9]
	No	93.3 (0.7)	−7.0 [−9.2, −4.8]	−3.3 [−5.3, −1.2]	**.023**	.25
Mental health	Yes	84.6 (1.2)	−5.4 [−8.9, −1.9]	−3.3 [−6.8, 0.2]	**−4.1 [−7.3, −0.9]**	−2.2 [−5.4, 1.1]
	No	84.1 (0.4)	−1.4 [−2.3, −0.5]	−1.3 (−2.2, −0.3]	**.012**	.20

Note. A separate linear regression model was used for each outcome. Statistically significant between-group differences in change in score are bolded. CI = confidence interval.

[a]The mean difference with confidence intervals is adjusted for the following predonation covariates: age, gender, ethnicity, body mass index, smoking status, marital status, employment status, university-level education, relationship to recipient, material deprivation quintile, year of surgery, province of surgery, and intended surgical technique.

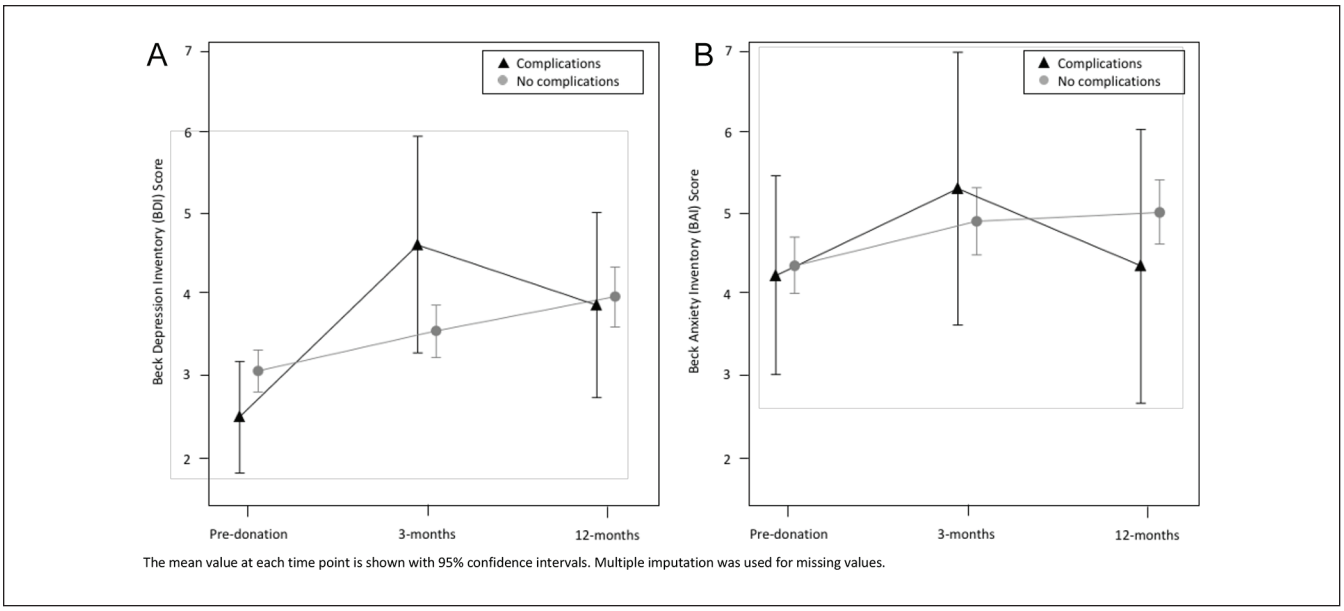

Figure 2. Beck Depression Inventory (A) and Beck Anxiety Inventory (B) measured predonation and at 3 and 12 months postdonation, in those with perioperative complications (n = 74) and those without perioperative complications (n = 838).

Table 3. Depression and Anxiety Among Living Kidney Donors With and Without Perioperative Complications (n = 912).

		Observed data Mean (*SE*)	Change from baseline Mean (95% CI)[a]		Between-group differences Mean (95% CI)[a] *P* value	
	Complications	Predonation	3 months	12 months	3 months	12 months
Beck Depression Inventory	Yes	2.5 (0.4)	2.1 [0.9, 3.3]	1.4 [0.4, 2.4]	**1.7 [0.6, 2.8]**	0.5 [−0.7, 1.7]
	No	3.1 (0.1)	0.5 [0.2, 0.8]	0.9 [0.6, 1.2]	**.002**	.45
Beck Anxiety Inventory	Yes	4.2 (0.6)	1.1 [−0.6, 2.7]	0.1 [−1.8, 2.0]	0.7 [−0.7, 2.1]	−0.4 [−1.8, 1.0]
	No	4.4 (0.2)	0.5 [0.2, 0.9]	0.7 [0.3, 1.0]	.34	.57

Note. A separate linear regression model was used for each outcome. Statistically significant between-group differences in change in score are bolded. Multiple imputation was used to impute missing values. CI = confidence interval.
[a]The mean difference with confidence intervals is adjusted for the following covariates measured predonation: age, gender, ethnicity, body mass index, smoking status, marital status, employment status, university-level education, relationship to recipient, material deprivation quintile, year of surgery, province of surgery, and intended surgical technique.

health-related quality of life, along with depression and anxiety, can help inform practices supporting living donors. Our study found donor-reported mental health-related quality of life 3 months after donation was significantly worse in donors who experienced perioperative complications compared to donors who did not experience complications; this difference did not persist a year after donation. A similar pattern was observed in donor-reported depression.

Other studies have also reported lower mental health quality of life among donors with and without surgical complications. Klop et al reported results from 3 prospective studies measuring quality of life up to 1 year after donation in 501 living kidney donors and found that postoperative complications induced a small significant reduction in MCS scores ($d = -0.34$, $P = .023$).[42] In a prospective study of 237 donors, Hosseini et al reported health state utility (HSU) scores measured at 3 months postdonation. In addition to seeing a decrease in HSU scores 3 months postdonation for all donors, donors with complications were more likely to report a clinically relevant decrease than donors without complications (odds ratio 2.2 [95% CI: 1.0, 4.9]).[43] Another study that assessed psychological symptoms and well-being found that the presence of more or severe complications among donors was related to an increase in psychological symptoms over time among donors following living kidney donation.[44]

Our findings on increased depression and anxiety scores, as reflected by the BDI and BAI, among donors with perioperative complications are consistent with other findings in the literature. Among a subsample of 460 donors, compared to donors without complications, reoperation was strongly associated with postdonation depression, and other surgical

complications showed a nearly significant association ($P = .05$).[45] A retrospective, cross-sectional study (n = 208) found that living kidney donors with postoperative complications had increased anxiety ($P = .018$).[46] In our sample, the increase in depression and anxiety at 3 months in donors with complications is temporary, and scores return toward baseline at 12 months.

Our study has several strengths and extends the findings from prior studies in important ways. Our contemporary cohort had twice the number of donors compared to prior prospective cohorts which reported the effects of postoperative perioperative complications on donor-reported psychosocial outcomes. This was a multicenter study, enrolling donors in 12 transplant centers across Canada, representing almost half of all donors in these centers during the period of accrual. Furthermore, we avoided the limitations of abstracting perioperative complications through administrative data by performing a manual review of surgical reports and discharge notes, allowing for more thorough data abstraction.[45] Finally, we had a minimal loss to follow-up.

Our study has limitations. Although the operative reports and discharge summaries of all donors were reviewed, reporting is not standardized, and it is possible that some minor complications were missed. Furthermore, though we followed donors postdischarge, we did not collect information on complications occurring after hospital discharge and minor complications may present later (e.g., wound infection, pain, etc.).[47] We assumed that any observed impact on quality of life is due to events captured through operative reports and discharge summaries. No minimal clinically significant change has been defined for the scales we used in kidney donors; we therefore defined a decline as a change of 3 or more points (increase or decrease, depending on the scale). While a comparison to the mean and/or standard deviation of scores in the general population in Canada may provide information on the changes observed, donors are often noted to have higher predonation health-related quality of life as compared to the general population.[12] We have found that to be the case in our study as well; for example, Hopman et al showed that the mean (95% CI) MCS score in the general population in Canada is 51.7 (51.5, 51.9), and in our study, the mean (95% CI) predonation MCS score is 53.5 (52.9, 54.0).[32] At 3 months postdonation, less than 14% of donors had missing data at the item-level in the SF-36, BDI and BAI questionnaires; at 12 months postdonation, item-level responses were missing in at most 23% of donors. We used multiple imputation to impute missing values, which included responses collected at the 2-year postdonation follow-up visit. We also conducted complete case analyses with results similar to those of the multiple imputation analyses. It should also be noted that the impact on quality of life with minor complications such as nausea/vomiting or ileus, might not be reflected 3 months postdonation because this would have a greater impact during the first weeks postdonation. Conversely, we could also not meaningfully look at psychosocial outcomes restricted to the most serious perioperative complications, as serious complications were rare. However, in a sensitivity analysis where those with major perioperative complications were excluded (Supplemental Material Table S8), the results were consistent with the main analysis.

Donors who experience minor perioperative complications do not suffer long-term mental health consequences. However, donors with in-hospital complications may require more intense follow-up of their psychological health beyond what is currently being provided and may benefit from increased psychosocial support in the 3 months following donation. Such additional support could be provided by the living donor team, including social workers or psychologists, or the primary care provider. Determining the optimal level and type of support for donors with complications warrants future study.

List of Abbreviations

BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory; CI, confidence interval; MCS, mental component summary; PCS, physical component summary; SF-36, Short Form 36

Ethics Approval and Consent to Participate

Ethics approval was obtained from Western University's Research Ethics Board and from all participating centers.

Consent for Publication

All authors have consented to publication.

Availability of Data and Materials

Data and materials cannot be made publicly available due to restrictions on its disclosure and use.

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Author Contributions

Participated in research design: L.S.F., C.N., M.M.-C., N.B., C.D., J.S.G., M.K., S.K., G.K., C.E.K., M.M., G.V.R.P., J.M.S., L.S., and A.X.G. Participated in the writing of the paper: C.G.-O, L.B., M.S.C., and A.X.G. Participated in the performance of the research: C.G-.O., L.S.F., C.N., M.M-.C., J.B.A., L.B., N.B., C.D., J.S.G., M.K., S.K., G.K., C.E.K., M.M., G.V.R.P., J.M.S., L.S., and A.X.G. Participated in data analysis: C.G-.O., L.S.F., and M.S.C.

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Supplemental Material

Supplemental material for this article is available online.

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