A Contemporary Analysis of Mental Well-being Among Living Donor Kidney Applicants

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Background. Living donation is paramount for expanding the donor pool. The aim of this study was to assess changes over time in self-reported mental health of living donor kidney applicants in efforts to inform patient-centered discussions with potential donors. **Methods.** Kidney donor applications from 2017 through 2021 were compiled. Data included age, gender, race, ethnicity, applicant–recipient relationship, medical history, and medications. Trends over time were analyzed and post hoc analyses were performed. **Results.** During the study period, 2479 applicants to the living donor kidney program were evaluated; 73% of applicants were female individuals. More than half of applicants were not related to their intended recipient; this fraction increased from 46% in 2017 to 58% in 2021 ($P < 0.01$). A similar decline in family relations was not present among Black and Latino applicants. Of all applicants, 18% reported depression and 18% reported anxiety; 20% reported taking antidepressants or anxiolytics. Depression and anxiety increased 170% ($P < 0.001$) and 136% ($P < 0.001$) from 2018 to 2019, respectively; antidepressant and anxiolytic use rose 138% ($P < 0.001$) between 2018 and 2020. **Conclusions.** The profile of living donor applicants has changed in recent years, with approximately 1 in 5 requiring antidepressants or anxiolytics. Predonation counseling and postdonation monitoring are imperative to decrease adverse psychological outcomes for living donors.

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Kidney transplantation has evolved into a highly successful treatment for end-stage kidney disease, with increased 10-y overall graft and patient survival rates.[1] More than 5000 living donor kidney transplants are performed annually in the United States.[2,3] Living donor kidney transplant is the best treatment option for end-stage kidney disease, offering better outcomes than deceased-donor transplantation, including superior patient[4,5] and graft[6,7] survival, lower rates of early transplant failure and delayed graft function,[8] shorter lengths of postoperative hospital stay,[9] and lower healthcare costs.[10] As the waitlist continues to steadily grow,[11] there remains a substantial gap between those in need for transplant and the availability of donor organs. As such, living donation continues to play a critical role in expanding the donor pool through timely transplantation and excellent outcomes.

In living donation, it remains critical to minimize any adverse medical or psychological impact on the donor. Most reports have shown that donors do not regret their donation, and negative experiences are often associated with poor recipient outcomes.[12,13] Few studies have assessed donor characteristics that are associated with worse mental health outcomes postdonation,[14] and there has been a noted decrease in mental health-related quality of life 3 mo after donation with a trend toward baseline by approximately 12 mo after donation.[15,16] Furthermore, there are limited data that characterize the mental health of living donors predonation,[14,16,17] and no data describing the mental health of prospective living donor applicants. It is important to consider the self-reported mental

health conditions that applicants report on their intake screening forms, such as anxiety and depression, as well as the medications they report taking. These self-reported conditions may be a more accurate representation of the actual mental health state of applicants, especially for those who may be experiencing distress but have not sought a formal psychiatric diagnosis.

In the general population, there are limited data on the self-appraisal of mental well-being. In 2020, during the early COVID-19 pandemic, a Centers for Disease Control report described that the prevalence of self-reported anxiety disorders among American adults was 25.5% and that of depressive disorders was 24.3%, with >40% of respondents reporting some form of adverse mental health.[18] The proportion of American adults aged 18–44 y who had received treatment for mental health conditions increased 25.4% from 2019 to 2021,[19] whereas globally, the proportion with anxiety and depression increased 26% and 28%.[20] There was considerable variation in these rates across race and ethnic groups in the United States.[18,19]

However, it remains unknown how the mental health of individuals who voluntarily step forward to be evaluated for living donation compares with that of the general population. Therefore, our study aims to assess changes in the characteristics of living donor kidney applicants over time, focusing on psychosocial elements among different ethnic and racial groups. This will help us better understand their mental health landscapes and engage in meaningful patient-centered discussions with potential donors.

MATERIALS AND METHODS

Data Source

As part of the initial donor evaluation at our center, applicants seeking to donate a kidney completed electronic forms via the MedSleuth BREEZE platform (MedSleuth Inc, San Francisco, CA), which is a web-based clinical decision support solution designed to elicit a comprehensive transplant-specific medical history from patients. The BREEZE platform has been used in the field of transplantation for several years and is a "software as a service" to which transplant centers subscribe.[21] Each center manages its own data. The BREEZE platform uses branch chain logic that causes fields to expand and collapse based on the complexity of the patient. All fields used for this study were complete; there were no missing data, as the BREEZE platform enforces the completion of fields. Patient-reported data were de-identified.

This study underwent review by our institutional review board and was deemed exempt (Institutional Review Board No. STU-2022-0055). Based on our institutional review board guidelines, because all data were retrospectively collected and de-identified, the study underwent expedited review and did not require patient consent for data collection.

Study Population

All applicants for living kidney donation who applied via BREEZE with submissions between January 1, 2017, and December 31, 2021, were analyzed. In cases of multiple forms in the database corresponding to a single donor, only the most recent submission was included.

Applicant Characteristics

Applicant characteristics obtained for analysis included age, gender, race, ethnicity, body mass index (BMI), relationship with the intended recipient, medical history, current medications, exercise frequency, alcohol use, tobacco use, illicit drug use, and donation status (ie, whether the applicant ultimately donated a kidney).

Applicant's relationship with the intended recipient was categorized as immediate family, extended family, friend, or unrelated. Immediate family and extended family were defined by Texas Department of State Health Services Vital Statistics guidelines. Close friends, acquaintances, and coworkers were categorized as friends. Members of the same community, met through social media, were not related, and all others were classified as unrelated. Alcohol use was reported as no use, rare use, occasional use, or daily use; this was encoded as 0, 1, 2, and 3, respectively. Tobacco use and illicit drug use were reported as never used, remote (ie, former) use, or current use, which were encoded as 0, 1, and 2, respectively.

Variables for the history of depression, anxiety, sleep disorders, and other psychiatric conditions were constructed to indicate applicants with mention of pertinent medical history (**Table S1, SDC,** http://links.lww.com/TXD/A649). Similarly, a variable for the use of antidepressants or anxiolytics was constructed to indicate applicants who were prescribed a drug commonly used to treat depression or anxiety (**Table S2, SDC,** http://links.lww.com/TXD/A649). The medications in Table S2 (**SDC,** http://links.lww.com/TXD/A649) comprise every medication reported by a patient that is indicated for the treatment of depression or anxiety. Generic names were substituted when patients reported brand names.

Statistical Analyses

Statistical analyses were performed using R, version 4.1.3. Applicant characteristics were described using mean (SD) for numeric variables and count (percentage) for categorical variables. Observations were grouped by year to analyze temporal changes. Changes in numeric variables were first analyzed across the entire study period using ANOVA. When a significant change was present, a post hoc analysis was performed year to year using the Tukey honest significant difference test for multiple comparisons of means. Changes in categorical variables were analyzed using Pearson chi-squared tests. Significance was determined by 2-tailed P values of <0.05 after adjusting for multiple comparisons where appropriate.

RESULTS

Overall Applicant Characteristics

During the 5-y study period, 2479 applicants to the living kidney donation program met the inclusion criteria. Of these, 102 (4.1%) ultimately donated a kidney. Applicant characteristics are summarized in Table 1. Applicants had a mean age of 41.9 y (SD 13.5) and were predominantly women (n = 1804; 72.8%). Of the applicants, 449 (18.1%) reported a history of depression; 444 (17.9%) reported a history of anxiety; 241 (9.7%) reported a history of a sleep disorder; 238 (9.6%) reported a history of some other psychiatric condition; and 76 (3.1%) reported a history of depression, anxiety, and sleep disorder. A total of 504 applicants (20.3%) took either antidepressants or anxiolytics. The mean exercise frequency of applicants was 1.77 times per week (SD 1.47).

When considering only those applicants who ultimately went on to donate a kidney, 10 (9.8%) reported a history of depression, 9 (8.8%) reported a history of anxiety, 10 (9.8%)

TABLE 1.

Living donor applicant characteristics before and after the COVID-19 pandemic

	Overall (N = 2479)
Age	
Mean (SD)	41.9 (13.5)
Gender	
Female	1804 (72.8%)
Male	675 (27.2%)
Race	
Asian/Pacific Islander	73 (2.9%)
Black	255 (10.3%)
Indigenous	19 (0.8%)
Mixed	41 (1.7%)
White	1906 (76.9%)
Middle Eastern/North African	2 (0.1%)
Missing	183 (7.4%)
Ethnicity	
Latino	421 (17.0%)
Non-Latino	2058 (83.0%)
BMI	
Mean (SD)	28.0 (5.50)
History of depression	
Yes	449 (18.1%)
No	2030 (81.9%)
History of anxiety	
Yes	444 (17.9%)
No	2035 (82.1%)
History of sleep disorder	
Yes	241 (9.7%)
No	2238 (90.3%)
History of other psychiatric condition	
Yes	238 (9.6%)
No	2241 (90.4%)
Taking antidepressant or anxiolytic	
Yes	504 (20.3%)
No	1975 (79.7%)
Alcohol use	
Mean (SD)	1.26 (0.823)
Missing	326 (13.2%)
Illicit drug use	
Mean (SD)	0.183 (0.511)
Missing	326 (13.2%)
Tobacco use	
Mean (SD)	0.432 (0.712)
Missing	326 (13.2%)
Exercise frequency	
Mean (SD)	1.77 (1.47)
Missing	561 (22.6%)
Relationship to recipient	
Extended family	328 (13.2%)
Friend	655 (26.4%)
Immediate family	761 (30.7%)
Unrelated	603 (24.3%)
Missing	132 (5.3%)

reported a history of a sleep disorder, and 6 (5.9%) reported a history of some other psychiatric condition; only 1 (0.98%) reported a history of depression, anxiety, and sleep disorder. With regards to medications, 20 (19.6%) took either antidepressants or anxiolytics.

A minority of applicants were biologically related to their intended recipient: 761 applicants (30.7%) were immediate family and 328 applicants (13.2%) were extended family. Most applicants had no family relation, as 655 (26.4%) were friends and 603 (24.3%) were entirely unrelated.

Temporal Trends

Number of Applicants

The mean number of applicants yearly was 495 (SD 116). The number of applicants dipped from 505 in 2019 to 337 in 2020 (33%) but rebounded to 485 (44%) in 2021 (Figure 1A). For comparison, the annual numbers of applicants who ultimately donated a kidney in each study year, from 2017 to 2021, were 27, 19, 27, 18, and 11, respectively.

Demographic Changes

The proportion of female applicants increased over the study period. Women comprised 67.1% of the applicant pool in 2017 and >73% in 2021, peaking at 78.4% in 2019, as shown in Figure 1B. The mean age increased by 4.1 y (10.1%) from 2017 to 2019 ($P < 0.01$), as shown in Figure 1C. Mean BMI significantly decreased over time ($P < 0.001$), falling from 29.2 in 2018 to 26.8 in 2019 (8.4%), as depicted in Figure 1D.

In this sample, there were 421 (17%) Latino and 255 (10%) Black applicants. No other ethnoracial minority comprised ≥5% of the sample. The number of Latino applicants fell from 110 in 2018 to 43 in 2020 (–61%), and the number of Black applicants fell from 106 to 24 (–77%) in the same period. This paralleled a trend in the number of White applicants, with a decrease from 469 to 271 (–42%). The number of applications rebounded in 2021, with 71 Latino applicants (+65%), 38 Black applicants (+58%), and 392 White applicants (+45%).

Applicant–Recipient Relationship

The relationship with the intended donor significantly changed during the course of the study. The proportion of applicants not related by family to their recipient increased from 45.9% in 2017 to 58.1% in 2021 ($P < 0.01$). This increase was mostly among friend relationships, as the proportion of entirely unrelated (ie, not family or friend) donors remained relatively stable (Figure 2A).

Compared with 38% of White applicants who were related by family to their intended recipient, 55% of Latino applicants and 68% of Black applicants were family related to their recipients. The proportion of family-related applicants declined among White applicants between 2017 and 2021 ($P < 0.05$) but did not significantly change for Latino ($P = 0.4$) or Black ($P = 0.9$) applicants (Figure 2B).

Mental Health Conditions and Medication Use

The self-reported incidence of mental health conditions and medication use increased during the study period, with the most pronounced changes occurring from 2018 to 2019 (Figure 3). The proportion of applicants who reported having a history of depression increased by 170% in 2019 ($P < 0.001$; Figure 3A), and those reporting a history of anxiety increased by 136% ($P < 0.001$; Figure 3B). Sleep disorders increased by 85% ($P < 0.005$; Figure 3C). The proportion of applicants who reported having a history of depression, anxiety, and sleep disorder increased by 140% in 2019 ($P = 0.001$;
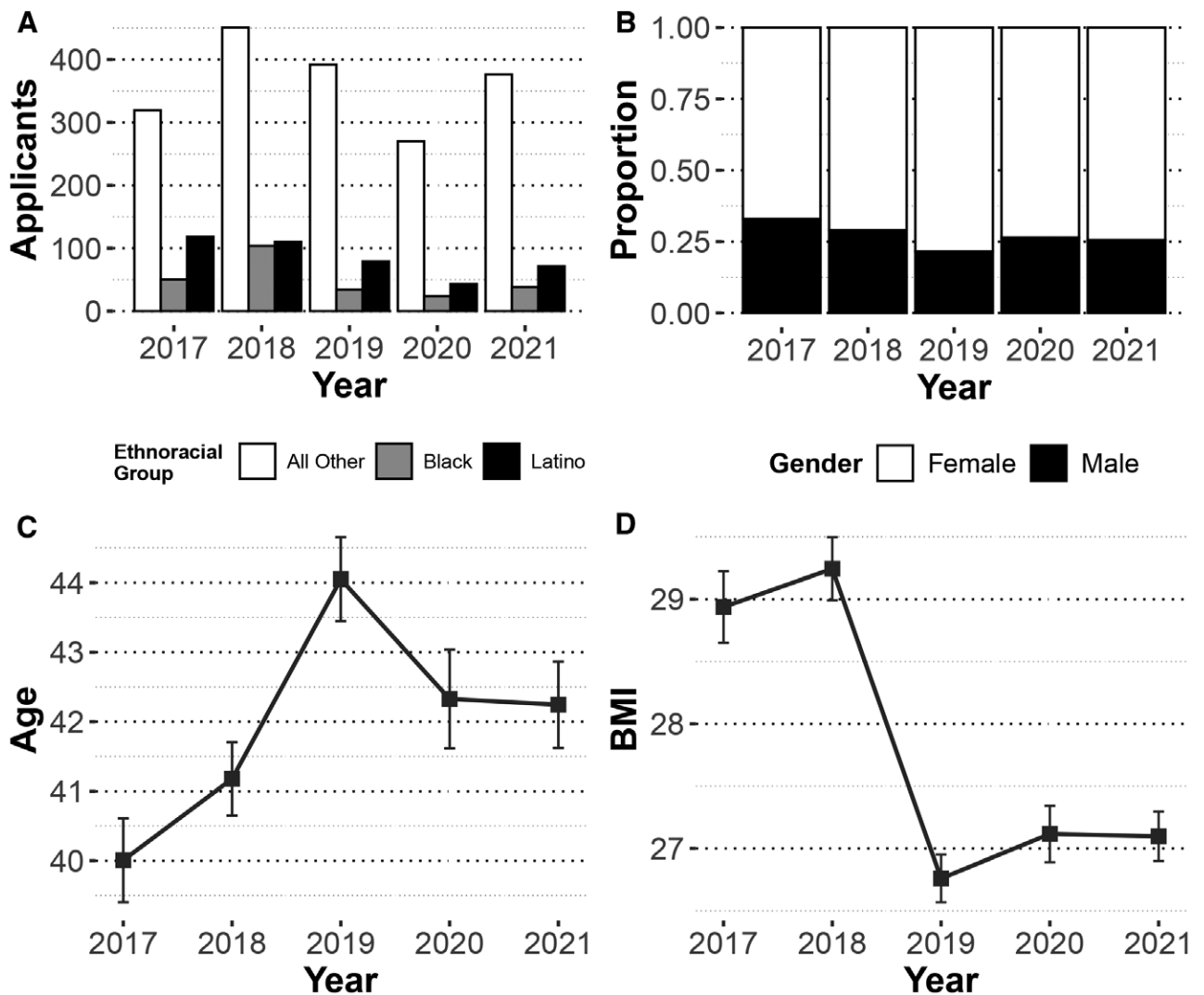
FIGURE 1. Temporal trends in (A) number, (B) gender, (C) age, and (D) BMI of living donor kidney applicants. BMI, body mass index.

Figure 3D) and remained high in subsequent years. The proportion of applicants with other psychiatric conditions increased by 67%, with a further 60% increase in 2020 ($P < 0.001$; Figure 3E). These changes were accompanied by a concordant 138% increase in applicants reporting usage of antidepressants or anxiolytics between 2017 and 2020 ($P < 0.001$; Figure 3F).

The rates of self-reported depression among White, Black, and Latino applicants were 21%, 6.3%, and 12%, respectively; rates of anxiety were 20%, 9.0%, and 12%. Similarly, usage of antidepressants or anxiolytics among these groups was 24%, 5.1%, and 11%, respectively.

Rates of self-reported depression and anxiety, as well as self-reported antidepressant or anxiolytic use, also differed significantly between those applicants related as a family to their intended recipient (ie, immediate family, extended family) and those with no family relation (ie, friend, unrelated). The rate of depression in family-related applicants was 12% compared with 23% in non-family-related applicants ($P < 0.001$). The rate of anxiety in family-related applicants was 13% compared with 22% in non-family-related applicants ($P < 0.001$). Furthermore, the rate of use of antidepressants or anxiolytics

in family-related applicants was 15% compared with 24% in non-family-related applicants ($P < 0.001$).

Substance Use

Alcohol use and illicit drug use did not change during the study period. Tobacco use decreased by 20% from 2017 to 2021 ($P < 0.05$).

Exercise Frequency

Mean exercise frequency dropped 30% between 2018 and 2020 ($P < 0.001$). On average, applicants exercised 1.9× weekly in 2018, 1.5× weekly in 2019, and only 1.3× weekly in 2020. However, mean exercise frequency in 2021 was back up to 1.9× weekly ($P < 0.001$).

DISCUSSION

Currently, there are only a few studies on the psychosocial outcomes of living kidney donors, and there has been no prior study assessing the prevalence of mental health disorders in living donor applicants; this study reports new findings in these areas. In this study, we identified that mental health
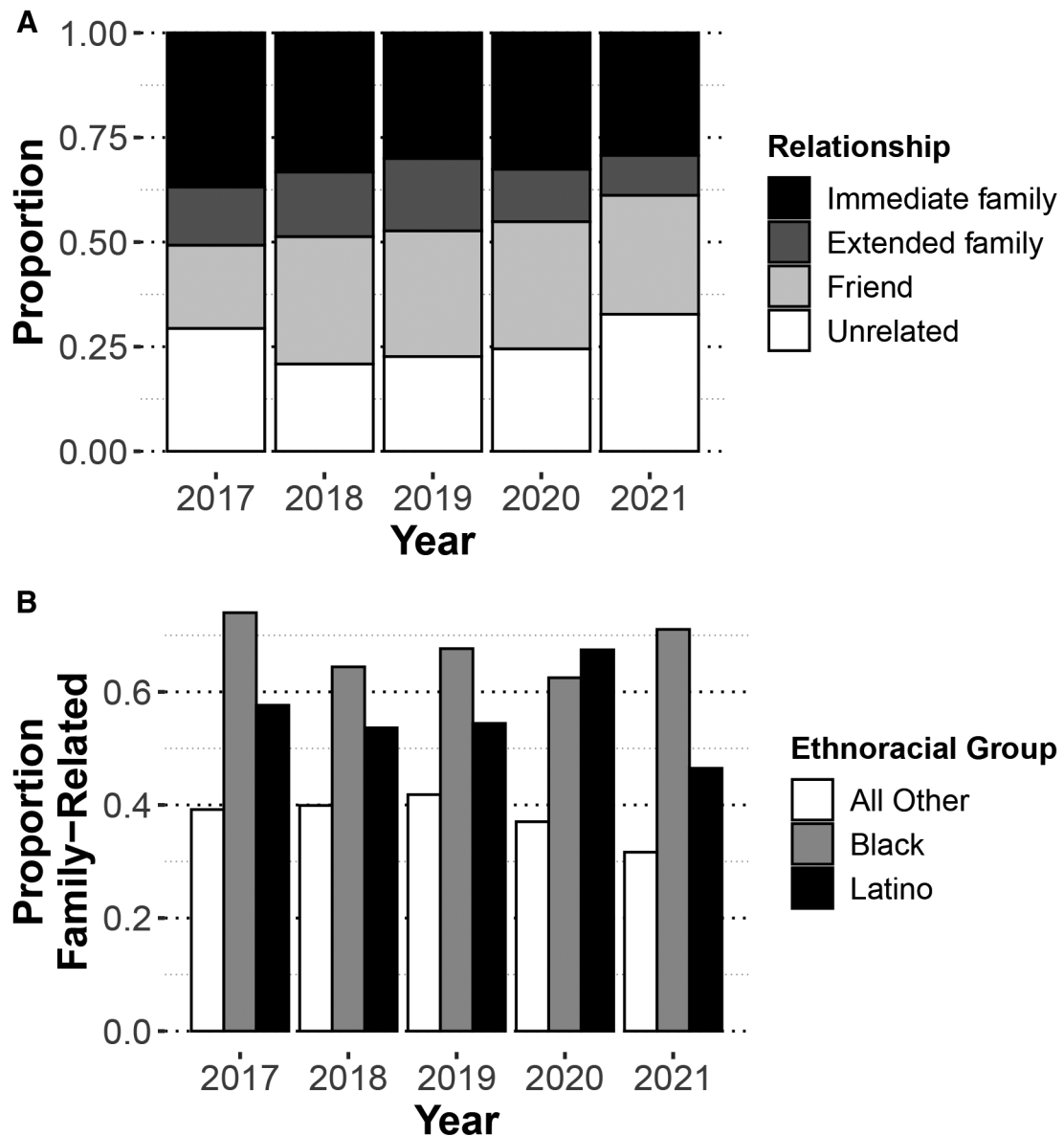
FIGURE 2. Temporal trend in (A) applicant–recipient relationship and (B) proportion family related (immediate or extended) by ethnoracial group.

conditions such as anxiety and depression are both prevalent and rising among living donor kidney applicants at our center in recent years, which might reflect broader trends in the general population and the effect of stressors, such as the COVID-19 pandemic. We further found that the rates of anxiety and depression were higher in White applicants than in Black or Latino applicants. Further investigation is needed to validate and understand our findings of the changing mental health landscape of living donor kidney applicants.

The existing literature has focused on the postdonation incidence of depression, anxiety, and other adverse psychological outcomes in living kidney donors. These studies differ in the type of screening used and the results reported. The prevalence of postdonation depression in living kidney donors was up to 46.9%, with most studies reporting either no difference or lower rates compared with the general population.[22-25] The prevalence of postdonation anxiety in living donors was up to 66.7%.[26,27] Risk factors for the development of psychological

distress that were identified in the existing literature included younger age,[22] female gender,[22,23,28] single relationship status,[23,27] and lack of social support.[27]

Our data, which describe the predonation prevalence of adverse psychological conditions in living kidney donor applicants, note that approximately 1 in 5 living donor candidates reports anxiety and depression and uses medication to treat these conditions. Furthermore, there has been a significant increase in self-reported mental health conditions among living donor candidates at our institution. This trend began after 2018, with increases first noted in 2019, a peak in 2020, and a subsequent slight decrease by 2021. However, this trend should not be extrapolated outside the study period, because no data were available beyond this interval.

Possible factors contributing to the observed change were examined, revealing no difference in the incidence of alcohol or illicit drug use. However, there was a decrease in self-reported weekly exercise, which partially coincided with the
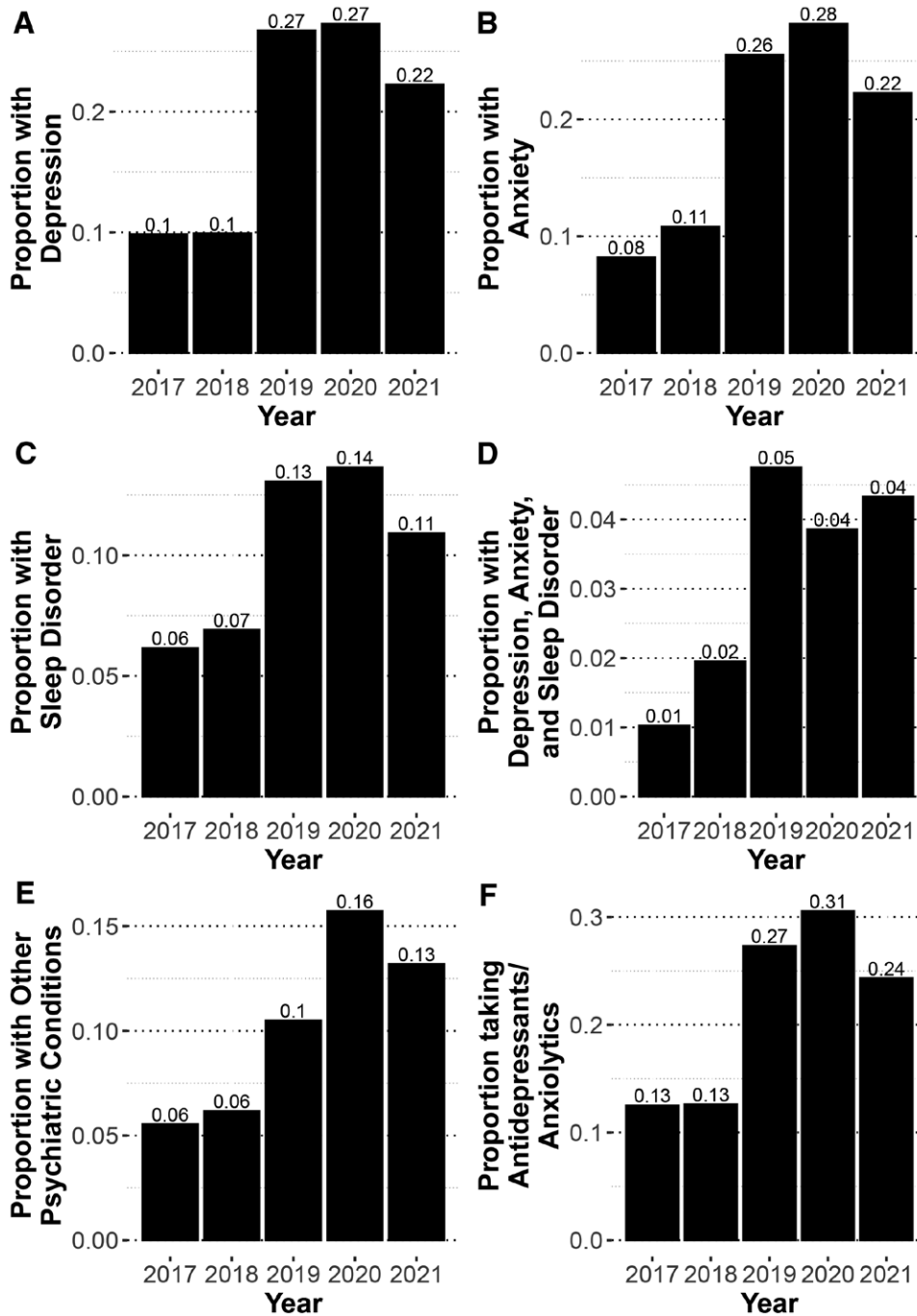
FIGURE 3. Temporal trends in donor applicant self-reported (A) depression, (B) anxiety, (C) sleep disorders, (D) depression, anxiety, and sleep disorders, (E) other psychiatric conditions, and (F) donor applicant self-reported antidepressant/anxiolytic use.

increase in mental health conditions. Although exercise has been found to have a positive effect on mental health, it is uncertain whether the decrease in exercise directly contributed to the increase in mental health disorders. There may have been an increase in mental health conditions overall, which could be because of various societal stressors, including the COVID-19 pandemic.[18,20] Such changes have been observed in the general population,[19] and may partly explain the rise in mental health conditions observed in our sample. However, further study is needed to establish whether these temporal trends also apply to living donor applicants for other organs,

such as bone marrow and liver, to identify more accurately which changes are unique to this population. It is essential to address potential psychosocial issues that uniquely impact living donors to provide appropriate counseling predonation and adequate support in the postdonation follow-up period.

In subanalyses, we found higher rates of self-reported depression and anxiety in White living donor applicants compared with Black and Latino applicants. As noted, these rates were approximately 20% in White applicants, 12% in Latino applicants, and up to 9% in Black applicants. The self-reported use of antidepressants or anxiolytics correlated with

the rates of depression and anxiety reported in each group. Comparatively, another study assessing a broad sample of US workers found that depression and anxiety symptoms were comparable between Black and White workers but were significantly higher for Latino workers.[29] The study used a questionnaire that directly screened the respondents using the patient health questionnaire-9 and general anxiety disorder-7 validated questionnaires for depression and anxiety, respectively, and found an overall prevalence of depression to be 38% and anxiety to be 42%.[29] Given that our study rates were substantially lower, these conditions may be underdiagnosed, underreported, or less prevalent in the living donor applicant population. However, this discrepancy between ethnoracial groups warrants further investigation.

It is important to consider whether applicants with mental health conditions or those who use medication for these conditions should be excluded from the donation process. The self-reported rates of depression and anxiety were roughly half among accepted donors compared with all applicants, whereas the rates of medication use for these were the same. Notably, the prevalence of mental health conditions among donor applicants may reflect the general population, and further study is needed to determine the extent to which predonation psychiatric history predicts postdonation psychosocial adverse events.

In addition to our main findings regarding the mental health of living donor applicants, we found that the average age of applicants increased slightly. In contrast, the average BMI decreased slightly during the study period. The rise in age could be because of changes in the general population's demographics. In contrast, the drop in average BMI may indicate a difference between the donor applicant population and the general population, which could extend to health-related behaviors and lifestyle factors. However, more research is required to verify these hypotheses or determine alternative reasons for these observed trends. It is worth noting that the magnitude of these changes was relatively small, and a longer time frame is necessary to assess these trends more completely.

Another conclusion we drew from our results was that the proportion of family-related applicants decreased among White applicants but not among Black or Latino applicants. This may indicate that Black and Latino applicants rely more heavily on family for donation. However, it is also possible that the decrease in family-related White applicants is because of improved non-family community-based outreach efforts by these recipients when searching for an organ. Future research is needed to validate and further explain the noted differences in rates of self-reported depression and anxiety as well as antidepressant and anxiolytic use in family-related versus non-family-related applicant groups.

Our study has several limitations, which include selection bias because of the single-center study design. Our donor population may be distinctly different from other geographic and cultural regions and, therefore, lacks some generalizability. More importantly, the data provided were self-reported by potential donors, which can lead to discrepancies between the medical record and patient report because of various factors such as low health literacy, poor provider–patient communication, or self-diagnosis. We felt that using self-reported mental health conditions for analysis could have potential strengths because they reflect the perceived mental health distress experienced by each individual. In other words, people might not have pursued formal psychiatric evaluation and may, therefore, not have a formal diagnosis; self-reports may be valuable for capturing these individuals. However, in future studies, it would be useful to use validated tools such as the patient health questionnaire-9 or general anxiety disorder-7 to complement our findings, because this would enable more robust comparison with other literature. Additionally, a multi-institutional or multinational comparison of the donor pool would provide more insight into the mental well-being of potential living donors. Our study examined mental health trends among those who are interested in donating a kidney rather than just those who have already gone through with donation. We used data from the entire pool of donor applicants to identify any potential trends in mental health conditions. As mental health issues are becoming more prevalent in the general population, we believe it is important to investigate whether a similar trend exists among those who wish to donate and undergo the evaluation process. In the future, we plan to conduct a larger study comparing actual donors with potential donors to determine similar trends and identify potential risk factors.

CONCLUSION

The profile of living donor kidney transplant applicants significantly changed from 2017 to 2021. Reporting of mental health conditions increased significantly in frequency, as did the use of medications for these conditions. These data indicate a need for robust psychosocial counseling and long-term postdonation follow-up support for living donors. Special attention should be paid to specific populations, particularly women, who account for most of the donor pool, and Black and Latino donors who may be uniquely impacted. It is important for the transplant community to reduce the burden associated with living kidney donation and understand the mental health of potential donors to provide optimal long-term care for these patients.

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