

Depression, anxiety, and associated psychological outcomes in living organ transplant donors: A systematic review

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ABSTRACT

With increasing demands for living organ donations, understanding the prevalence of depression and anxiety, which are the commonest psychiatric disorders in donors following organ transplantation, will serve to improve psychiatric care to safeguard donors' mental wellbeing. This descriptive systematic review examines all observational studies in English investigating prevalence of depression and anxiety in adult transplant donors using bibliographic databases. Sixty-two papers were included (kidney, $n = 25$; liver, $n = 25$; bone marrow, $n = 7$; uterus, $n = 2$; lung, $n = 1$; kidney and lung concurrently, $n = 2$). Post-transplantation depression and anxiety prevalence rates (Depression: 0–46.9%, Anxiety: 0–66.7%) did not differ significantly from pre-transplantation and were largely comparable to the general population. Other psychiatric disorders observed included bipolar disorder, conversion disorder, adjustment disorder and sleep disorder. Other psychological outcomes observed included lower quality of life, lower satisfaction of life and regret after donation. Pre-donation risk factors such as poor physical/psychological health status, and post-donation risk factors such as complicated post-surgical recovery and poor physical/psychological health in recipients were identified, predisposing donors to poor psychological outcomes. Individuals with risk factors should be monitored and provided with social support, psychoeducation, psychotherapy and long-term follow up. Future studies should adopt consistent methodological approaches to improve comparability between various studies. More research investigating poor psychological outcomes in other organ donors besides kidney and liver donors, donors who have past psychiatric history, unrelated and parent donors is warranted.

1. Introduction

The process of organ transplantation encompasses several stages that are inherently distressing and may pose negative psychological impacts on recipients and donors [1,2]. With increasing reports on the effects of poor psychiatric outcomes on recipients' morbidity and mortality post-donation [3], much of the current research continues to focus on psychological outcomes on recipients, aiming to recommend improvements to better recipient care such as implementing intensive pre-transplant and post-transplant psychiatric evaluation and treatment [4,5].

Despite transplant donors serving as important stakeholders in the transplant process as well, there is not as much existing literature about the psychiatric complications and psychological outcomes of donation on donors [6]. The current state of literature concludes that the psychological health of kidney donors appears largely unchanged or positively improved by donation [7], and similar conclusions with regards to wellbeing of liver donors were made in another review [8]. However, it is consistently found that depression and anxiety are the most common psychiatric disorders in donors following organ donation [9]. There are

also growing evidences of dire and severe psychiatric complications such as suicide in donors [10]. Therefore, it is worthwhile to focus on evaluating psychiatric outcomes in donors given the lack of current literature.

Understandably, the organ transplant process differs for different organs [11]. This may be reflected in the different mortality and morbidity rates. Mortality rates for kidney donors and liver donors are 0.03% [93] and 0.15–0.50% [92] respectively. Risks of surgical complications for kidney donors and liver donors are 17–18% [93] and 15–25% [92] respectively. Moreover, there are also different expectations of post-surgical outcomes in different organ transplantations. For example, liver donors can expect a regeneration of the liver remnant and that this process may be almost complete by 1 year post-donation [94]. However, this is unrealistic for other organ donors such as kidney, lung and uterus donors.

The primary aim of this systematic review was to summarise evidence and provide prevalence of depression and anxiety in all organ donors based on a systematic search of the current existing literature. By examining all adult organ donors to understand the full landscape of different organ donation types, we also aim to explore if there were

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Abbreviations

DSM	Diagnostic and Statistical Manual of Mental Disorders
PRISMA	Preferred reporting items for systematic reviews and meta-analysis

different depression and anxiety outcomes in different types of organ donors. Given that organ transplantation activity continues to increase over the years [12], we believe that the paper will serve to identify special considerations in psychiatric care on the mental health of these organ donors.

2. Materials and methods

The methodology and results of this systematic review are reported in line with the preferred reporting items for systematic reviews and meta-analysis (PRISMA) guidelines [13].

2.1. Search strategy

We performed a systematic search of the available literature using PubMed, Embase and PsycINFO with the following search strategy: ((transplant) AND (donor)) AND ((depress*) OR (Anxi*)). The terms were searched as both text words and subject headings. This was supplemented by papers that were identified by scanning reference lists of articles. The search was run on 9 March 2020 and concluded on 26 March 2020.

2.2. Eligibility criteria

All observational studies that studied depression and/or anxiety outcomes in transplant donors after transplantation surgery were included. Besides being a human organ donation, there were no other restrictions on transplant donors e.g. age at donation or transplantation surgery, type of organ being transplanted or time since donation. In terms of measuring depression and/or anxiety outcomes, only papers that objectively studied these outcomes were included e.g. validated questionnaire, psychiatric evaluation according to the Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria and diagnoses recorded in databases.

The team scanned for related publications and bibliography of papers gathered manually. Only published peer-reviewed full papers in journals in the English language were included. Study designs other than observational, such as reviews, oral presentations and abstracts were excluded. No publication date restriction was imposed.

2.3. Study selection

Two authors (JQO,CSH) independently screened all titles and abstracts for eligibility. Where appropriate, full text papers were extracted for closer review. Studies that were shortlisted by either reviewer and fulfilled the inclusion criteria were then selected for full-text analysis. As much data as possible were acquired from the articles, and efforts were made to contact the authors if additional data were required.

2.4. Data extraction

One author abstracted data using a standardized data collection form and the findings were independently reviewed by the second author. The data collection form captured study methodology, donor characteristics, psychiatric measurements and their outcomes. Any discrepancies were resolved by discussion between the two authors. If no agreement could be reached, another author (RCH) was consulted to

resolve the disagreements.

To evaluate the study methodologic quality and risk of bias, two authors independently rated each paper using McMaster University critical appraisal tool [14], designed for observational studies. A score of 1 or 0 was given to each of the components depending on whether requirements of the specific component were met by the paper. As the “Intervention” component under McMaster guidelines was not applicable to our study, it is reported as Not Applicable (NA) for each of the papers that we have included. A maximum score of 8 may be attained by each paper, excluding the “Intervention” component. Any discrepancies between the two authors were resolved by discussion before assigning a final score. The third author was brought in when there were unresolved disagreements.

3. Results

3.1. Study selection

We identified 62 papers for inclusion in the review. A total of 2032 papers were identified from the search of PubMed (n = 759), Embase (n = 1225) and PsycINFO (n = 48) databases. An additional 8 papers were identified by checking references. After screening of titles and abstracts and with the removal of 4 non-English papers and 41 duplicated papers, a total of 71 full papers were assessed for eligibility. After assessing full text articles, 62 papers met the inclusion criteria and were included in the systematic review. A PRISMA flow diagram depicting this process is presented in Fig. 1.

3.2. Study characteristics

There is a total of 30 cross-sectional studies (Table 1A) and 32 prospective studies (Table 1B). With regards to the different organ types being studied on, 25 papers studied kidney transplantation, 25 papers studied liver transplantation, 7 papers studied bone marrow transplantation, 2 papers studied uterus transplantation, 1 paper studied lung transplantation and 2 papers studied both kidney and liver transplantation concurrently. With regards to the region that these studies were carried out in, 26 papers were from Europe, 17 papers were from Asia, 16 papers were from North America and 1 paper each from Middle East, Northern Africa and Australia.

A total of 45 papers studied both depression and anxiety, 15 papers studied depression only and 2 papers studied anxiety only. For assessment methods, we found that 49 papers used validated questionnaires, 8 papers conducted patient interviews, 4 papers obtained information from patient medical records or clinical databases. 1 paper created an original survey for the study, whereby its construct validity was evaluated using a multi trait-multimethod matrix derived from components of a validated scale. With regards to the 8 papers that conducted patient interviews, 4 papers specified assessment method to be Structural Clinical Interview for DSM-IV Axis I Disorders, 3 papers conducted formal psychiatric assessments and 1 paper conducted interviews with physician ratings.

3.3. Quality of studies

Of the 62 papers evaluated for quality, all papers scored at least 6 out of 8, with one paper scoring 5. This was excluding the intervention component in the original McMaster critical appraisal tool. (Table 2).

3.4. Main results

3.4.1. Depression

There were a total of 60 papers that studied depression, of which 39 papers provided prevalence rates of depression. Instead of reporting prevalence, 19 papers [32–34,37–39,41,44,47,51,52,56,59,66,72,74,75,77,78] reported mean score for depression based on the specific

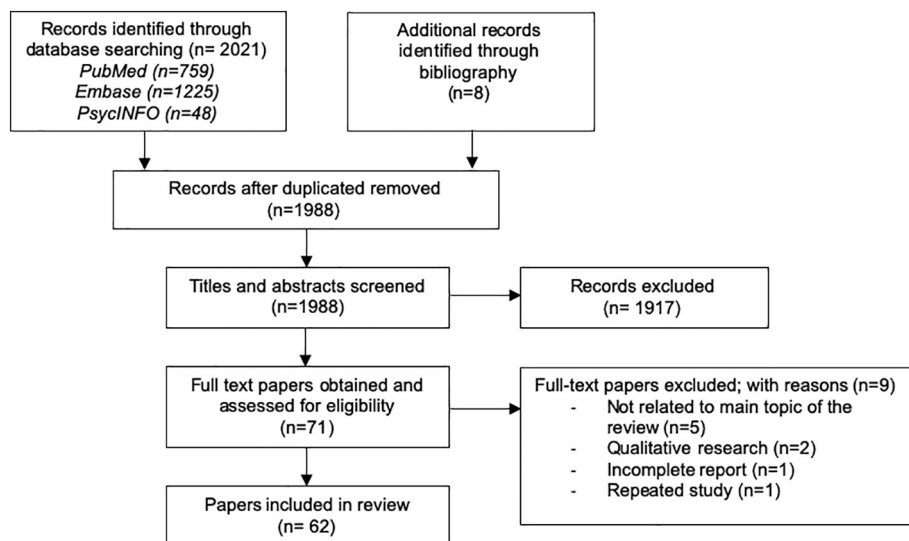


Fig. 1. Flow chart of the study selection process according to PRISMA guidelines.

validated questionnaire used. The most commonly used questionnaire was Hospital Anxiety and Depression Scale, followed by Patient Health Questionnaire and Beck Depression Inventory. 2 papers [42,79] used the Profile of Mood States questionnaire that measured Total Mood Disturbance, which takes into account depression as a mood state. Prevalence rates or mean scores of depression were unavailable in the remaining 2 papers [35,46].

Considering the 39 papers, the prevalence of depression ranged from 0 to 46.9%. For kidney and liver donors, prevalence rates of depression were 2–46.9% and 0–34% respectively. For the 19 papers which reported mean scores, all reported mean scores of depression were within normal range. For the papers that studied Total Mood Disturbance, one paper [79] suggested 20% of donors to report moderate to severe mood disturbance at least once post-donation and the other paper [42] suggested that percentage of donors whose scores had significantly worsened, significantly improved and did not change significantly post-donation were 34.5%, 16.1% and 42.5% respectively.

14 papers compared depression rates between pre-donation and post-donation, of which 4 papers [40,45,55,68] concluded that depression rate was higher pre-donation and 10 papers [51,52,56,59,72,75,77,78,82,83] concluded that there was no difference in depression rates pre-donation and post-donation.

7 papers compared depression rates between donor population and the general population, of which 5 papers [34,36,59,74,75] concluded that depression rate was lower in donor population and 2 papers [45,66] concluded that there was no difference in depression rates between donor and the general population.

5 papers compared depression rates between donor population and healthy controls for the study. While one paper [33] suggested no difference in depression rates, and another paper [32] suggested a higher depression rate in donors, 3 papers [34–36] reported depression rates to be lower in donor population.

2 papers also compared depression rates between donors and recipients and they concluded lower depression rates in donors post-donation [33,37].

3.4.2. Anxiety

There were a total of 47 papers that studied anxiety, of which 22 papers provided prevalence rates of anxiety. 21 papers [27–39,41,44,47,51,52,57,59,66,74,75,77,78,80,81] reported mean score for anxiety based on the specific validated questionnaire used. The most commonly used questionnaire was Hospital Anxiety and Depression Scale, followed by Patient Health Questionnaire and State Trait

Anxiety Inventory. 2 papers [42,79] used the Profile of Mood States questionnaire that measured Total Mood Disturbance, which takes into account anxiety as a mood state. Prevalence rates or mean scores of anxiety were unavailable in the remaining 2 papers [35,46].

Considering the 22 papers, the prevalence of anxiety ranged from 0 to 66.7%. For kidney and liver donors, prevalence rates of anxiety were 0–66.7% and 0–51.1% respectively. For the 21 papers which reported mean scores, 20 papers reported mean scores of anxiety to be within normal range while 1 paper [37] reported mean score to be within the mild anxiety range. The results of the 2 papers that reported Total Mood Disturbance were described previously.

14 papers compared anxiety rates between pre-donation and post-donation, of which 8 papers [41,45,50,52,55,56,75,81] concluded that anxiety rate was higher pre-donation and 6 papers [40,59,77,78,82,83] concluded that there was no difference in anxiety rates pre-donation and post-donation.

7 papers compared anxiety rates between donor population and the general population, of which 2 papers [74,84] concluded that anxiety rate was higher in donor population, 3 papers [55,59,75] concluded that anxiety rate was lower in donor population and 2 papers [45,66] concluded that there was no difference in anxiety rates between donor and the general population.

2 papers compared anxiety rates between donor population and healthy controls for the study. While one concluded that donor anxiety rates were higher than controls post-donation [38] the other had contradicting results [34].

3.4.3. Risk factors for depression and anxiety

Many papers identified that depression and anxiety were correlated with one another [39–42]. As expected, risk factors that papers identified that predisposed donors to depression or anxiety were largely the same and thus will be discussed together (Table 3).

Socioeconomic factors that predisposed donors to depression and/or anxiety included being single [43] and having to face a greater financial burden [44,45] as a result of surgery. While some papers found that being female [45,46] and of an older age [46] increased one's risk of depression and/or anxiety post-donation, other papers had contrasting findings [36,47].

Donors' physical health status also greatly affected their risk of depression and/or anxiety. This included both actual and perceived health status. With regards to actual health of donors, comorbid conditions that increased risk included obesity [45], chronic pulmonary disorders, hypertension [43] and hypothyroidism [46]. Having current

Table 1
Summary of main findings of included studies.[#]

Table 1A cross sectional studies							
No.	Author (yr)	Country	Sociodemographic features	Assessment tools	Time since donation	Pre-transplant findings	Main findings ^a
Kidney							
1	Krishnan et al. (2020)	UK	- S: 9750 - 47% M - Age range: 18 and above - No data on donor types	- Retrieved from UK transplant registry database	Median 8.4 yrs. (6–11.3)	NA	Depression: NA Anxiety: NA Other correlations: - Depression rates lower in donor group than non-donor cohort taken from UK primary healthcare database (p < 0.001)
2	Oguten et al. (2019)	Turkey	- S: 208 - 41.9% M - Mean age: 48.74 +/- 11.78 yrs. (22–79) - 81% related, 19% unrelated donors	- BDI - BAI - CLAS	Mean 4.5 +/- 2.5 yrs. (1–11)	NA	Depression: 7.2% (moderate to severe) Anxiety: 2.8% (moderate to severe) Other Psychological Outcomes: - 86% satisfied with life - 2.4% reported regret Other Correlations: - Higher depression scores in donors who: had thoughts of getting ill easily (p < 0.001), regret donation (p < 0.001) - Lower depression scores in donors who: has unchanged/improved relationships with recipients (p < 0.05) - Higher anxiety scores in donors who: had thoughts of getting ill easily (p < 0.001), had postoperative complications (p < 0.05) - Lower life satisfaction found in donors who: had thoughts of getting ill easily (p < 0.001), regret donation (p < 0.001), had postoperative complications (p < 0.05)
3	Holscher et al. (2018)	USA	- S: 825 - 36.5% M - Median 46 (36–54) - 61.8% related, 38.2% unrelated	- PHQ-2 - GAD-2	Median 6 yrs. (3–10)	NA	Depression: 4.2% Anxiety: 5.5% Other Psychological Outcomes: - 2.1% reported regret Other Correlations: - Depression found more in donors whose recipients had experience graft loss (p = 0.02) - Anxiety and regret after donation were positively correlated (p = 0.03) - Higher depression scores in: higher education levels (p < 0.001), current/former smoker (p = 0.02), hypertension (p < 0.001), diagnosed with depression before (p = 0.004), less likely to be married/living with a partner (p = 0.001) - Higher anxiety scores in: less likely to have high education level (p < 0.05), current/former smoker, hypertension, less likely to be married/ living with a partner - Regret found more in donors who: less likely to be married/living with a partner, more likely to have trouble obtaining/changing health or life insurance
4	Chen et al. (2016)	Taiwan	- S 34 - 47.1% M - Mean age: 51 +/- 10.8 (30–70) - 100% related	- HADS - SF36	Mean 6.7 +/- 4.4 yrs.	NA	Depression: 2.9% Anxiety: 14.7% Other Psychological Outcomes: - Mean score of QOL was rated low to moderate Other Correlations: - Mental health QOL had negative correlation with anxiety (p < 0.001) and depression (p < 0.01)
5	Sommerer et al. (2015)	Germany	- S: 295 - 35.9% M - Mean age: 58 +/- 11 - 91% related, 9% unrelated	- PHQ - SF36	Mean 8.4 +/- 6 yrs	NA	Depression: 7.5% Anxiety: Not studied Other Psychological Outcomes:

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Table 1 (continued)

Table 1A cross sectional studies							
No.	Author (yr)	Country	Sociodemographic features	Assessment tools	Time since donation	Pre-transplant findings	Main findings ^a
6	Chen et al. (2015)	China	<ul style="list-style-type: none"> - S: 98 - 36.7% M - Mean age: 50.7 +/- 9.3 yrs. - 100% related (61% parents, 39% siblings) 	<ul style="list-style-type: none"> - SDS - SAS - SF36 - SSRS 	Mean 1.6 +/- 0.78 yrs.	NA	<ul style="list-style-type: none"> - 1.7% donors denied willingness to donate if given the chance again, 10.5% were uncertain - 96.5% donors reported stable/improved relationships with recipients Depression: 5.1% (severe) Anxiety: 2% (severe) Other Correlations: - Parent donors experienced stronger depression (p = 0.000), stronger anxiety (p = 0.001) and poorer subjective social support (SSS) (p = 0.019) after donation compared to sibling donors - Parent donor's anxiety scores were higher than that of general population (p = 0.000) - Sibling donor's depression scores were lower than that of general population (p = 0.000) - Mental health QOL predictors include: older donors (p = 0.002), depression (p = 0.016), anxiety (p = 0.004), social support (p = 0.002) - In parent donors, anxiety and SSS were the only two predictors for both physical (anxiety, P = 0.000; SSS, P = 0.045) and mental (anxiety, P = 0.004; SSS, P = 0.035) health QOL.
7	Zheng et al. (2014)	China	<ul style="list-style-type: none"> - S: 110 - 38.2% M - Mean age: 42.1 +/- 9.7 (20–55) - 100% related 	<ul style="list-style-type: none"> - SDS - SAS 	Median 3.3 yrs. (0.080–8.4)	NA	<ul style="list-style-type: none"> Depression: Mean score was within normal range Anxiety: Mean score was within normal range Other Psychological Outcomes: - 0% reported regret, 2.7% donors uncertain if they will donate if given another chance - 34.5% donors reported improved relationship with recipients, 59.1% reported no significant change Other Correlations: - Depression scores were lower than that of the Chinese norm (p < 0.01) - Anxiety scores were higher than that of the Chinese norm (p < 0.01)
8	Maple et al. (2014)	UK	<ul style="list-style-type: none"> - S: 190 - 51% M - Mean age: 49.8 yrs. (19–83) - 42% related donors, 58% unrelated donors 	<ul style="list-style-type: none"> - PHQ2 - STAI 	NA	NA	<ul style="list-style-type: none"> Depression: Mean scores were within normal range Anxiety: Mean scores were within normal range Other Psychological Outcomes: - 5% reported regret Other Correlations: - No significant difference between related and unrelated donors in terms of post-donation psychosocial outcomes - Related kidney donors had received more praise (p = 0.02), had higher perceived social support for their decision to donate (p < 0.001) and considered their donation as a more significant life event (p = 0.002)
9	Jowsey et al. (2014)	USA	<ul style="list-style-type: none"> - S: 2455 - 38.7% M - Insufficient data on age - 86.6% related, 13.4% unrelated 	<ul style="list-style-type: none"> - PHQ9 - LOT-R - SF36 	Range 5 to 48 yrs.	8% with history of depression, 2% with history of anxiety.	<ul style="list-style-type: none"> Depression: 7.8% Anxiety: Not studied Other Psychological Outcomes: - 4% reported emotional, psychological or substance abuse difficulties post-donation Other Correlations: - Depression was associated with a pre-donation history of depression (p < 0.001), longer post-donation recovery time (p = 0.009), greater financial burden (p = 0.013), stronger agreement with the statement "It

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Table 1 (continued)

Table 1A cross sectional studies							
No.	Author (yr)	Country	Sociodemographic features	Assessment tools	Time since donation	Pre-transplant findings	Main findings ^a
10	Schold et al. (2013)	USA	- S: 69117 - 41% Ma - Mean age: 40.1 - No data on donor types	- Retrieved from National Inpatient Sample database	NA	NA	was my moral obligation to donate" (p = 0.003), and emotional, psychological or substance abuse problems following donation (p = 0.010) - Donors who reported emotional, psychological or substance abuse concerns post-donation were more likely to have reported history of drug use at the pre-donation evaluation (p = 0.010), history of chronic pain prior to donation (p = 0.014), feeling that once the surgery was over they did not receive attention (p < 0.001), and were more likely to encounter post-donation re-hospitalization (p < 0.001) or medical complications not requiring hospitalization (p < 0.001) Depression: NA Anxiety: Not studied Other Correlations: - Depression was associated with older donors, women, and patients who had diagnoses of obesity, chronic pulmonary disorders, hypothyroidism and longer length of stay (p = 0.005) Depression: mean score was within normal range Anxiety: mean score was within normal range Other Correlations:
11	Kadioglu et al. (2012)	Turkey	- S: 30 - 30% M - Mean age: 47.2 +/- 11.9 - 100% related (all spouses)	- BDI - HADS - DAS	Range 3mths to 1 yr	NA	- Donor depression values correlated with donor anxiety levels (P < 0.01), donor dyadic adjustment levels (p < 0.01) and recipient depression values (P < 0.01). - Donor and recipient dyadic adjustment levels correlated (p < 0.01) Depression: 7.1% (mild) Anxiety: 0% screened positive Other Psychological Outcomes: Other Correlations:
12	Zhao et al. (2010)	China	- S: 84 - 28.6% M - Mean age: 45.3 +/- 7.8 - 100% related	- BDI - SAS - SF36	Mean 0.7 yrs. (0.5–1 y)	NA	- Donor's anxiety score is higher than Chinese norm (p = 0.006) - Donors had better mental health QOL than the general population (p = 0.03) Depression: 12.2% (moderate to severe) Anxiety: 20.7% (moderate to severe) Other Psychological Outcomes: Other Correlations:
13	Wiedebusch et al. (2009)	Germany	- S: 131 - 35.1% M - Mean age: 56.3 +/- 10.9 yrs. (32–80) - 97.7% related, 2.3% unrelated	- HADS - SF36 - FQCI	Mean 5.1 +/- 3.7 yrs. (0.2–23.3)	NA	- Average QOL reported - 98.5% did not regret donation, 96.1% would donate again - 27.5% donors reported improved relationship with recipients, 67.9% reported no significant change Other Correlations: - Donors who reported depression and anxiety experienced lower QOL (p < / = 0.01) - Mental component of QOL was correlated with ways of coping: depressive coping, distraction and self-confidence, religiousness and search for meaning, dissimulation and wishful thinking (all p < / = 0.01)
14	Taskintuna et al. (2009)	Turkey	- S: 35 - 40% M - Mean age: 44.7 +/- 11.1 yrs. (24–66) - 100% related	- BDI - BAI - SF36	Mean 2.8 +/- 2.5 yrs.	NA	Depression: Mean score was within normal range Anxiety: Mean score was in mild anxiety range Other Psychological Outcomes: - 20% reported dissatisfaction with QOL Other Correlations:

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Table 1 (continued)

Table 1A cross sectional studies							
No.	Author (yr)	Country	Sociodemographic features	Assessment tools	Time since donation	Pre-transplant findings	Main findings ^a
15	Tanriverdi et al. (2004)	Turkey	- S: 18 - 38.9% M - Mean age: 43 +/- 10.98 yrs. (24 to 62) - No data on donor types	- BDI - BAI - SF36	Mean 3.0 +/- 2.4 yrs.	NA	- Donor had lower depression scores than recipients (p < 0.05) - Mental health QOL of donors were better than recipients (p < 0.05) and control group matched for age, sex and level of education (p < 0.01) Depression: Mean score was within normal range Anxiety: Mean score was within normal range Other Correlations: - Donor had lower depression scores than recipients (p < 0.05) but no difference with that of controls that were matched for age, sex and level of education - Mental health QOL of donors were better than recipients (p < 0.05)
No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Time Since Donation	Pre-transplant Findings	Main Findings ^a
Liver							
1	Janik et al. (2019)	Poland	- S: 101 - 31.7% M - Median 36.8 (24–59) - 92% related, 8% no data	- PHQ-9 - SF36	Median 5.2 yrs. (0.58–14.1)	NA	Depression: 30.6% (17.8% mild, 12.8% moderate to severe) Anxiety: Not studied Other Correlations: - Mental and physical health QOL decreased with age (p < 0.05, p < 0.01) - Depression was correlated with QOL (p < 0.001)
2	Wang et al. (2017)	Taiwan	- S: 60 - 46.7% M - Mean age: 30.1 +/- 6.8 yrs. (18–62) - 86.7% related, 13.3% unrelated	- CES-D - CHQ - WHOQOL-BREF	0.25 yrs	33.3% high depression state	Depression: 16.7% (high depression state) Anxiety: Not studied Other Psychological Outcomes: - Improved QOL from pre-donation: physical health domain (p = 0.031), psychological health domain (p = 0.005), social relationships domain (p = 0.005), environmental health domain (p = 0.01) Other Correlations: - Reduction in depressive symptoms post-donation (p = 0.031)
3	Humphreville et al. (2016)	USA	- S: 127 - 44.1% M - Age range: 19 yrs. and above - 67.7% related, 32.3% unrelated	- Donor Specific Survey (developed by study based on literature review) - SF36	Mean 6.9 yrs.	8.7% history of depression	Depression: 22.4% Anxiety: Not studied Other Psychological Outcomes: - 30.8% reported improved self-esteem, 3.7% reported poorer self esteem - 97.2% express that they will donate again, 2.8% were uncertain Other Correlations: - Mental and physical health QOL were statistically higher compared to US population norm (p < 0.001)
4	Shen et al. (2016)	Taiwan	- S: 97 - 47.4% M - Mean age: 36.3 +/- 9.7 - 100% related	- HADS - SF36	4 time frames: 1 yr (n = 31), 2 yrs. (n = 31), 3 yrs. (n = 21), >/=4 yrs. (n = 14)	NA	Depression: 9.7% (I), 29% (II), 0% (III), 7.1% (IV) screened positive Anxiety: 36.5% (I), 51.1% (II), 23.8% (III), 42.9% (IV) screened positive Other Correlations: - Depression in 2-yr group was higher than that of other groups (p = 0.014)
5	Kimura et al. (2015)	Japan	- S: 142 - 46.5% M - Mean age: 36.6 +/- 11.4 yrs. (19–62)	- SCID	Mean 5.4 +/- 3.2 yrs. (0.02–10.3)	0.7% history of bipolar II disorder in remission	Depression: 1.4% (Major depressive disorder) Anxiety: 1.4% (Panic disorder)

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Table 1 (continued)

No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Time Since Donation	Pre-transplant Findings	Main Findings ^a
			- 100% related				Other Psychological Outcomes:
6	Jin et al. (2012)	China	- S: 71 - 56.3% M - Mean age: 38.94 ±10.44 yrs. - 100% related	- SCL-90-R - SF36	Range 6mths to 3 yrs	NA	- 0.7% conversion disorder - 0.7% substance use disorder Depression: NA Anxiety: NA Other Psychological Outcomes: - General QOL did not differ between donors and Chinese norm - General mental health QOL of donors was higher than Chinese norm Other Correlations: - Depression and anxiety scores were not statistically different from general population - Better QOL of donors associated with: full-time employment (p < 0.001), health of liver recipient, older donors (above 40 yrs. old) Depression: 4% Anxiety: Not studied Other Psychological Outcomes: - 14% improved self-esteem - 6% were unwilling to donate again Other correlations: - Improved self-esteem was observed in younger donors Depression: 12.5% Anxiety: 6.2% Other Psychological Outcomes: - 6.3% reported regret - 46.9% reported improved donor recipient relationship Other Correlations: - Correlation between psychological disruption in donors and presence of medical problems in the recipient (p < 0.01) Depression: 3% Anxiety: 0.5% Other psychological outcomes: - 0.25% suicide - 0.25% suicide attempt - 0.25% bipolar disorder - 0.25% insomnia - 0.5% substance abuse Depression: 7% Anxiety: Not studied Other psychological outcomes: - 4.8% adjustment disorder - 2.4% post-traumatic stress disorder - 19.2% would not donate again, 7% unsure Other correlations - Mental health QOL scores were not different from potential donors or general population Depression: 34% (mild) Anxiety: 40% (mild) Other correlations - Lower mental and physical health QOL scores compared to healthy population
7	Sotiropoulos et al. (2011)	Germany	- S: 83 - 51.8% M - Median age: 36 yrs. (23–63) - No data on donor types	- Patient interview with physician ratings - SF36	Median 5.8 yrs. (3.83–10.7)	NA	
8	Gökçe et al. (2011)	Turkey	- S: 32 - 40.6% M - Mean age: 31.8 +/- 7.1 yrs. (21–55) - 100% related	- Official patients' medical records	Median 2.3 yrs. (0.67–7)	NA	
9	Trotter et al. (2007)	USA	- S: 392 - No data on other sociodemographic features	- HADS	NA	NA	
10	Erim et al. (2006)	USA	- S: 42 - 55% M - Mean age: 37.49 yrs. - 90.5% related, 10.5% unrelated	- Official patients' medical records - BSI - SF36	6mths	NA	
11	Hsu et al. (2006)	Taiwan	- S: 35 - 40% M - Mean age: 34 +/- 8.6 yrs. (19–56) - 100% related	- Psychological Distress Scale - WHOQOL - Physical Symptom Disturbance Scale	Median 25.9mths (0.6–92mths)	NA	
12		Germany	- S: 36	- HADS		NA	

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Table 1 (continued)

No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Time Since Donation	Pre-transplant Findings	Main Findings ^a
	Kroencke et al. (2006)		- 44% M - Mean age: 32 +/- 5 yrs. (21–40) - 100% related	- SF36	Mean 4.5 +/- 2.8 yrs		Depression: Mean score was within normal range Anxiety: Mean score was within normal range Other Correlations: - Depression and anxiety were lower compared to healthy controls (both P < 0.001) - Anxiety higher in: persistent symptoms eg pain, fatigue, more than 1 year post-donation (p = 0.02) - Mental and physical health QOL for donors were higher than German normative sample (p = 0.02)
No.	Author (yr)	Country	Sociodemographic features	Assessment tools	Time since donation	Pre-transplant findings	Main findings ^a
Bone marrow							
1	Erden et al. (2019)	Turkey	- S: 20 - 55% M - Mean age: 13.6 ±3.64 yrs. - 100% related (all siblings)	- CDI - STAI - K-SADS-PL - RSE	At least 2mths	NA	Depression: Mean score was above cut-off for pathologic depression Anxiety: Mean score revealed low anxiety Other Psychological Outcomes: - Children in donor group had higher self-esteem compared to recipient group (p = 0.048) Other Correlations: - Depressive symptom levels were higher in donor group than non-donor group (p = 0.013). (Non-donor group was formed by children and adolescents who had a sibling undergoing transplantation but who were not ill or a donor themselves) - Positive correlations identified between persistence scores of anxiety scale and state anxiety scores (0 < 0.01) and self-esteem scores (p < 0.05)
2	Packman et al. (1997)	USA	- S: 21 - 19% M - Mean age: 11 +/- 2.9 yrs. - 100% related	- CDI - RCMAS - RSE	Mean 2.87 +/- 2.08 yrs.	NA	Depression: Mean score was within normal range Anxiety: Mean score was within normal range Other Correlations: - Donor group revealed higher levels of anxiety compared to non-donor group (p = 0.006). (Non-donor group was formed by children and adolescents who had a sibling undergoing transplantation but who were not ill or a donor themselves) - Donor group revealed lower self-esteem than non-donor group (CSI: p = 0.021, RSE: p = 0.04)
No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Time Since Donation	Pre-transplant Findings	Main Findings ^a
Others							
1	Mathur et al. (2020)	USA	- S: 2848 - 30% M - Mean age: 41 +/- 11.2 yrs. - 78% related, 22% unrelated - 6.8% liver donations, 93.2% kidney donations	- PHQ8 - SWLS	NA	NA	Depression: 7.5% Anxiety: Not studied Other Psychological Outcomes: - Donors were satisfied with life based on mean score - 96% would donate kidney again, 4% were uncertain Other Correlations: - Donors had worse depressive symptom scores than potential donors (p < 0.001) but were less likely to be depressed as compared to the general population (p = 0.049) - Donors had higher life satisfaction than the healthy middle-aged control group (p = 0.03) - Higher depression score was correlated with lower life satisfaction (p < 0.001) and liver donation as compared to kidney donation (p = 0.001) while lower depression score was correlated with older age (p = 0.04) and males (p < 0.001) - Lower life satisfaction was correlated with higher depression scores (p < 0.001), older age (p = 0.03), males (p < 0.001) and being single (p < 0.001)

Table 1B: prospective studies

No.	Author (yr)	Country	Assessment Tools	Pre-transplant Findings	Main Findings ^a
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Table 1 (continued)

Table 1B: prospective studies							
No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
Kidney							
1	Wadstöm et al. (2019)	Sweden	<ul style="list-style-type: none"> - S: 24 - 50% M - Mean age: 48 +/- 13 yrs. (31–79) - 100% unrelated (anonymous donors) 	<ul style="list-style-type: none"> - Pre-donation assessment by psychiatrist / psychologist - Post donation: HADS 	6mths	25% with psychiatric history	Depression: Mean score was within normal range Anxiety: Mean score was within normal range Other Psychological Outcomes: <ul style="list-style-type: none"> - 50% reported increase in self-esteem
2	Rodrigue et al. (2018)	USA	<ul style="list-style-type: none"> - S: 182 - 37% M - Mean age: 42.6 +/- 11.8 - 74% related, 26% unrelated 	<ul style="list-style-type: none"> - POMS - 5-item Fear of Kidney Failure - 10-item Body Image Scale - SWLS - SF36 - LOT-R 	1, 6, 12 and 24mths	9% reported total mood disturbance	Depression: NA (measured as Total Mood Disturbance) Anxiety: NA (measured as Total Mood Disturbance) Other Psychosocial Outcomes: <ul style="list-style-type: none"> - 20% reported moderate to severe mood disturbance at least 1 post donation time point - 29% reported moderate to high fear of kidney failure at least 1 post-donation time point - 19% reported moderate to high body image concerns post-donation - 13% reported low life satisfaction post-donation - 4% reported regret Other Correlations: <ul style="list-style-type: none"> - Higher mood disturbance post-donation was correlated with younger age (p = 0.001) and pre-donation mood disturbance (p = 0.01) - Higher fear of kidney failure post-donation was correlated with being single (p = 0.004) and having higher pre-donation fear of kidney failure (p < 0.001) - Moderate to high body image concerns post-donation was correlated with perceived pressure to donate (p = 0.02) and pre donation body concerns (p = 0.002) - No significant differences between donor and healthy cohort for all categories at all time points: mood disturbance, body image concerns, fear of kidney failure and life dissatisfaction
3	Maple et al. (2017)	UK	<ul style="list-style-type: none"> - S: 100 - 55% M - Mean age: 45 +/- 12.98 yrs. - 89% related, 11% unrelated 	<ul style="list-style-type: none"> - PHQ-2 - STAI-6 - GHQ-12 - RSE - Office of National Statistics Wellbeing questions 	3mths, 12mths	22% history of depression, 8% history of anxiety. 6% were taking antidepressant medications at time of donation. 4.1% screened positive for possible clinical depression at baseline.	Depression: 5.5% (3mths), 11.6% (12mths) Anxiety: Mean score was within normal range Other Psychological Outcomes: <ul style="list-style-type: none"> - 6.8% (3mths) and 10.7% (12mths) reported regret Other Correlations: <ul style="list-style-type: none"> - Anxiety mean score had no significant change from baseline - At 12mths, donors whose recipients had suffered complications were found to be lower in mood than those whose

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Table 1 (continued)

Table 1B: prospective studies							
No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
4	Kroencke et al. (2012)	Germany	- S: 79 - 46.7% M - Mean age: 53.6 +/- 11.3 - 92.4% related, 7.6% unrelated	- HADS - SF36	3mths, 12mths	Mean scores were within normal range	recipients had not suffered a complication (p = 0.031) - No significant change in self-esteem (LKD questions revealed increased self-esteem but this did not translate to a change in RSE scores even though validation tests showed a medium to high correlation between the two scales) Depression: Mean score was in normal range Anxiety: Mean score was in normal range Other Psychological Outcomes: - Mental health QOL did not differ significantly from that of either the normative or the healthy sample Other Correlations: - Mean depression and anxiety score did not change across time and was lower than that of the healthy reference sample at all data points - At 3mths post-donation, there are correlations between donors' perception of the recipient's health and functioning status and donor's mental health QOL (p = 0.03), anxiety (p = 0.002), depression (p = 0.008).
5	Lopes et al. (2011)	Portugal	- S: 45 - 42.2% M - Mean age: 41.2 (20–60) - 100% related	- ZSRDS - ZSRAS	At least 12mths	16.3% moderate to severe depression, 64.4% anxiety.	Depression: 22.2% (moderate to severe) Anxiety: 66.7% Other Correlations: - No significant changes in depression and anxiety pre- and post-donation
6	Guleria et al. (2011)	India	- S: 73 - 0% M - Mean age: 42.58 +/- 10.50 yrs. - 100% related	- HADS - WHOQOL-BREF	6mths	15.1% depression, 4.1% anxiety	Depression: 5.5% Anxiety: 1.4% Other Psychological Outcomes: - QOL improved post-donation - 100% indicated willingness to donate again - 13.7% reported improvement in donor-recipient relationship, 84.9% reported no significant change Other Correlations: - Post-donation depression scores decreased from pre-donation (p < 0.0001) - No significant change in the anxiety scores pre-donation and post-donation (p = 0.065) - Depression and anxiety scores were correlated with one another (p = 0.0001) and were negatively correlated with QOL
7	Frade et al. (2008)	Portugal	- S: 32 - 46.9% M - Mean age: 41 (21–64) - 100% related	- ZSRDS - ZSRAS - SF36 - Kidney Donor Perceptions Questionnaire	Mean 18.8 +/- 12.8mths	66.7% depression, 15.6% anxiety	Depression: 46.9% Anxiety: 9.3% Other Psychological Outcomes: - No significant improvement of QOL except social functioning scores (p = 0.038) - 3.1% denied willingness to donate again

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Table 1 (continued)

Table 1B: prospective studies							
No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
8	Virzi et al. (2007)	Italy	<ul style="list-style-type: none"> - S: 48 - 20.8% M - Mean age: 54.2 years (range 33 to 81 years) - 100% related 	<ul style="list-style-type: none"> - SCID - Mini Mental State Examination - HDRS - HAM-A - SAS 	4mths	Mean scores were within normal range	<p>Other Correlations:</p> <ul style="list-style-type: none"> - No significant changes in depression scores and anxiety scores pre- and post-donation <p>Depression: Mean score was within normal range</p> <p>Anxiety: Mean score was within normal range</p> <p>Other Correlations:</p> <ul style="list-style-type: none"> - No significant changes in depression scores and anxiety scores pre- and post-donation - Reduction in depressive symptom frequency from 37.5% to 33.3% and a decrease among high score donors from 12.6% to 0%
9	Minz et al. (2005)	India	<ul style="list-style-type: none"> - S: 75 - 28% M - Mean age: 42.8 +/- 11.6 years - 96% related, 4% unrelated 	<ul style="list-style-type: none"> - Modified BDI - STAI 	3mths	Mean scores were within normal range	<p>Depression: 5.3%</p> <p>Anxiety: 0%</p> <p>Other Psychological Outcomes:</p> <ul style="list-style-type: none"> - 68% experienced improved donor-recipient relationship, 4% experienced negative impact on donor-recipient relationship - 0% reported regret - 25.3% reported loss of sleep - 22.6% reported loss of appetite - 21.3% felt that donation process had left negative impact on their health <p>Other Correlations:</p> <ul style="list-style-type: none"> - Post-donation depression score was higher in donors who perceived donation had left negative impact on health (P < 0.0001) - Anxiety scores were lower in post-donation than pre-donation (p = 0.0001)
10	Smith et al. (2004)	Australia	<ul style="list-style-type: none"> - S: 48 - 45.8% M - Age range: 26–72 - No data on donor types 	<ul style="list-style-type: none"> - PHQ - SF36 - TERS 	4mths, 12mths	2% active depression, 4% history of depression in remission	<p>Depression: 2% (4mths), 10% (12mths)</p> <p>Anxiety: 6% (4mths), 2% (12mths)</p> <p>Other Psychological Outcomes:</p> <ul style="list-style-type: none"> - 0% reported regret - 16% (4mths), 2% (12mths) adjustment disorder - Mental health QOL worsened between preoperative period and 4mth postoperative period (p = 0.002), and even further 12mths postoperatively (p = 0.02) <p>Other Correlations:</p> <ul style="list-style-type: none"> - Donor psychiatric disorders was associated with poorer QOL at both 4mths and 12mths post-donation (ranging from p < 0.0001 to p = 0.009) - Donor psychiatric disorders (depression, anxiety and adjustment disorder) were associated with recipient psychiatric disorders at 12mths post-donation (p = 0.048)
No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a

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Table 1 (continued)

No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
Liver							
1	Shizuku et al. (2020)	Japan	<ul style="list-style-type: none"> - S: 254 - 46.9% M - Median 35 (20–63) - 96.5% related, 3.5% unrelated 	<ul style="list-style-type: none"> - SCID-1 or SCID-5 - GAF 	1, 3, 6, and 12mths after hospital discharge and annually thereafter (Median duration of follow up: 4 yrs. (6mths-18 yrs))	0.4% depression, 0.4% anxiety, 0.8% comorbid bipolar II disorder and obsessive-compulsive disorder	Depression: 1.6% Anxiety: 1.2% Other Psychological Outcomes: <ul style="list-style-type: none"> - 0.4% conversion disorder - 0.4% adjustment disorder Other Correlations: <ul style="list-style-type: none"> - Psychiatric disorders found more in donors who: had longer duration of hospital stay after operation (p = 0.002), perioperative complications (p = 0.006)
2	Dew et al. (2018)	USA, Canada	<ul style="list-style-type: none"> - S: 517 - 45.5% M - Mean age: 81.6% related, 18.4% unrelated 	<ul style="list-style-type: none"> - PHQ - PHQ-9 (symptoms) - PRIME-MD-PHQ 	Baseline for current study was not pre operation but rather a mean of 5.8 +/- 1.9 yrs. post donation when enrolment for a previous cross-sectional study was done Current study conducted 1 yrs. and 2 yrs. follow up from enrolment baseline.	3.1% depression, 4.9% anxiety	Depression: 1.5% Anxiety: 1.7% Other Psychological Outcomes: <ul style="list-style-type: none"> - 3.3% alcohol use disorder Other Correlations: <ul style="list-style-type: none"> - Decrease in depression and/or anxiety from baseline at all time points (p = 0.01, p = 0.026) - No significant differences between donor and general population for depression and anxiety post-donation - Higher depressive symptoms found in: females (p = 0.019), obese donors (p = 0.002), unrelated donors (p = 0.003), longer post-donation hospitalization (p = 0.011), burdensome financial costs (p < 0.001) and having health related concerns related to donation (p < 0.001) - Anxiety was associated with having burdensome financial costs (p < 0.001) - Donor alcohol use disorder rate was higher than normal population 2 yrs. post enrolment (p < 0.05) - Mental health QOL was poorer for donors than general population at all time points (p < 0.05)
3	Butt et al. (2017)	USA, Canada	<ul style="list-style-type: none"> - S: 271 - 42.8% M - Mean age: 36.79 +/- 10.51 yrs. - 78.6% related, 21.4% unrelated 	<ul style="list-style-type: none"> - PHQ9 - PRIME-MD - SF36 - PTGI-SF - Better person scale 	3, 6, 12, 24mths	0.4% depression, 2% anxiety, 4% alcohol abuse syndrome	Depression: 0.4% (3mths), 2.5% (12mths), 0% (other time frames). 2.3% screened positive at any post-donation time point Anxiety: 1.4% (3mths), 1.7% (6mths), 3.5% (12mths), 2.2% (2 yrs). 5.3% screened positive at any post-donation time point Other Psychological Outcomes: <ul style="list-style-type: none"> - Alcohol abuse: 2.4% (3mths), 4.2% (6mths), 5.5% (12mths), 3.6% (2 yrs). 8.4% of donors abused alcohol at any post-donation time point. - 11.4% reported regret at some point - Of donors reporting recipient death during the study follow up, 33% had ever felt guilt and 22% had ever felt responsible for recipient death Other Correlations: <ul style="list-style-type: none"> - Better general mental health QOL of donors than US general

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Table 1 (continued)

No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
4	Kroencke et al. (2014)	Germany	<ul style="list-style-type: none"> - S: 40 - 47.5% M - Mean age: 37.85 +/- 10.47 yrs. - 92.5% related, 7.5% unrelated (47.5% donated to a child recipient) 	<ul style="list-style-type: none"> - HADS - SF36 	3mths, 12mths, 2 yrs	Mean scores were within normal range	<p>population, however 18.6% of donors had impaired mental health QOL (defined as <0.5 SD of the US mean) at any post-donation time point.</p> <ul style="list-style-type: none"> - Donors whose recipients died were 8 times more likely to report regret (p = 0.047) - Donors donating to first degree relative had higher scores on Simmons better person scale (p = 0.012) - Lower Simmons better person scale scores in: females (p = 0.008) and those whose recipients died (p < 0.001) - Donors who anticipated before donation that their life would be more worthwhile after donation had significantly more growth (p < 0.001). Average scores were not significantly different over time. <p>Depression: Mean score was in normal range Anxiety: Mean score was in normal range Other Correlations:</p> <ul style="list-style-type: none"> - Lower depression in donors than the healthy sample up to 1 yr post operation (p = 0.01) - Lower anxiety in donors than the healthy reference sample at all data points (p = 0.001) - Neither mental health QOL nor depression showed significant changes across time, while anxiety decreased at all time frames (p = 0.002, p = 0.004, p = 0.02) - Adult to paediatric donors experienced more preoperative psychological strain than adult to adult donors (p = 0.01 for anxiety, p = 0.03 for depression), which improved after donation (p = 0.001 for anxiety at all time frames, p = 0.007 for depression at 1 yr post-donation) - Adult to adult donors showed unchanged anxiety and depression, with slight decrease in mental health QOL 2 years after surgery (p = 0.004) <p>Depression: Mean score was within normal range Anxiety: Mean score was within normal range Other Psychological Outcomes:</p> <ul style="list-style-type: none"> - Mental health QOL score showed no significant changes post-donation - Other correlations - No significant differences in depression and anxiety mean scores pre- and post-donation <p>Depression: 1.1% Anxiety: NA Other psychological outcomes:</p>
5	Ishizaki et al. (2012)	Japan	<ul style="list-style-type: none"> - S: 21 - 57.1% M - Mean age: 43 +/- 12 yrs. - 100% related 	<ul style="list-style-type: none"> - POMS - SF36 	Median 10mths	Mean scores were within normal range	<p>Depression: Mean score was within normal range Anxiety: Mean score was within normal range Other Psychological Outcomes:</p> <ul style="list-style-type: none"> - Mental health QOL score showed no significant changes post-donation - Other correlations - No significant differences in depression and anxiety mean scores pre- and post-donation <p>Depression: 1.1% Anxiety: NA Other psychological outcomes:</p>
6	Azoulay et al. (2011)	France	<ul style="list-style-type: none"> - S: 91 - 34% M - Mean age: 37.7 +/- 11.7 	<ul style="list-style-type: none"> - Formal psychiatric assessments 	NA	NA	<p>Depression: 1.1% Anxiety: NA Other psychological outcomes:</p>

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Table 1 (continued)

No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
7	Noma et al. (2011)	Japan	<ul style="list-style-type: none"> - 99% related, 1% unrelated - S: 30 - 43.3% M - Mean age: 42.2 +/- 11 (22–63) - 100% related 	<ul style="list-style-type: none"> - BDI - STAI - WHOQOL-26 - PACT 	Range 3-5 yrs.	Mean scores were within normal range	<ul style="list-style-type: none"> - 96% were satisfied with their life - 98% would donate again - 0% reported regret Depression: Mean score was within normal range Anxiety: Mean score was within normal range Other Psychological Outcomes: <ul style="list-style-type: none"> - Donor's total QOL (p = 0.005) and social QOL (p = 0.026) became worse Other Correlations: <ul style="list-style-type: none"> - Donor's anxiety scores decreased post-donation (p = 0.027) and is predicted by family or support system availability (p = 0.026) - Higher depression scores associated with: personal anxiety scores (p = 0.043), recipient's depression scores (p = 0.001), personal risk for psychopathology (p = 0.001), length from onset to transplantation (p = 0.039)
8	Schulz et al. (2009)	Germany	<ul style="list-style-type: none"> - S: 43 - 58.1% M - Mean age: 34.8 +/- 8.9 - 95.3% related, 4.7% unrelated 	<ul style="list-style-type: none"> - HADS - SF36 - Modified European Multicenter Study of Transplantation of Organs from Living Donors Questionnaire 	3mths	Mean scores were within normal range	<ul style="list-style-type: none"> Depression: Mean score was within normal range Anxiety: Mean score was within normal range Other Psychological Outcomes: <ul style="list-style-type: none"> - 32.6% reported increased self-esteem (p = 0.008) Other correlations: <ul style="list-style-type: none"> - No significant changes in depression pre- and post-donation - Anxiety scores decreased post-donation (p = 0.04) - Depression scores (p = 0.01), anxiety scores (p = 0.04) and mental health QOL scores (p = 0.008) were negatively correlated with complications in the recipient
9	Shibata et al. (2009)	Japan	<ul style="list-style-type: none"> - S: 6 - 66.7% M - Mean age: 33.7 yrs. - 100% related 	<ul style="list-style-type: none"> - STAI - POMS 	Range 10 days to 1mth	Mean score was within normal range	<ul style="list-style-type: none"> Depression: Not studied Anxiety: Mean score was in normal range Other Psychological Outcomes: <ul style="list-style-type: none"> - Decrease in anger/hostile score of POMS (p = 0.03)
10	Erim et al. (2007)	Germany	<ul style="list-style-type: none"> - S: 123 (inclusive of potential donors. Actual donor pool n = 55) - 60.2% M - Mean age: 34.98 +/- 8.43 yrs. - 89.4% related, 10.6% unrelated 	<ul style="list-style-type: none"> - HADS - SF36 	3mths	Mean scores were within normal range	<ul style="list-style-type: none"> Depression: 16.3% Anxiety: Mean scores were within normal range Other psychological outcomes: <ul style="list-style-type: none"> - Mental health QOL was within range of German normative sample Other correlations: <ul style="list-style-type: none"> - Mean values for anxiety (p = 0.048) and depression (p = 0.005) decreased post-donation - Anxiety scores were lower compared to German normative sample (p < 0.05) - Higher depression (p = 0.038) and anxiety (p = 0.006) scores with lower mental health QOL

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Table 1 (continued)

No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
11	Esmat et al. (2005)	Egypt	- S: 50 - 68% M - Mean age: 29.2 +/- 6.4 yrs. (20–47) - No data on donor types	- Formal psychiatric assessment	Mean 6mths	NA	scores (p = 0.007) in donors were correlated with the severity of recipient complications Depression: 15% (mild) Anxiety: Not studied
12	Shah et al. (2005)	Canada	- S: 101 - 57% M - Mean age: 37.7 +/- 11.7 - 83% related, 17% unrelated	- Formal psychiatric assessments	1mth	NA	Depression: 2% Anxiety: NA
13	Taghavi et al. (2001)	Iran	- S: 40 - 72.5% M - Mean age: 22 (18–40) - 72% related, 28% unrelated	- SCL-90-R	1mth, 3mths	All screened normal	Depression: 17.5% Anxiety: 15% Other Psychological Outcomes: - Obsession in 22.5% - 2.5% conversion disorder
No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
Bone marrow							
1	Labott and Pfammatter (2014)	USA	- S: 28 - 50% M - Mean age: 48.1 +/- 11.44 (20–74) - 100% related	- BDI - POMS - ARI	1mth, 1 yr	Mean scores were within normal range	Depression: NA Anxiety: Not studied Other Psychological Outcomes: - 10.7% of donors had ambivalence with regards to donation - 80% would donate again Other Correlations: - No significant changes in depression, mood changes and self-esteem overtime - At pre-donation, it was found that better donor-recipient relationship quality was associated with less guilt (p < 0.01) and responsibility (p < 0.01) if the stem cell transplant fails. This was not true for depression, mood states and self-esteem at pre-donation - At 1 yr post-donation, it was found that better relationship quality was associated with less depression (p < 0.02) and mood disturbance (p < 0.03). Higher self-esteem was associated with less guilt (p < 0.03) and responsibility (p < 0.03)
2	Bredeson et al. (2004)	Canada	- S: 87 - 56% M - Median age: 45 (15–74) - 100% related	- POMS - SF36	1wk (POMS), 4wks (SF36)	NA	Depression: NA (measured as Total Mood Disturbance) Anxiety: NA (measured as Total Mood Disturbance) Other Psychological Outcomes: - The percentage of donors whose Total Mood Disturbance score that significantly worsened, significantly improved and did not change significantly were 34.5%, 16.1% and 42.5% respectively - 2.3% were unwilling to donate again, 20.7% expressed uncertainty Other Correlations: - Mental health QOL did not show significant differences pre- and post-donation - Donors who had improved mood states had anxiety as the identified individual mood state that improved the most
3	Chang et al. (2003)	USA	- S: 23 - 52% M - Mean age: 37.6 +/- 11.7 yrs.	- BDI	2wks, 6mths	Mean score was within normal range	Depression: Mean score was within normal range Anxiety: Not studied Other Psychological Outcomes:

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Table 1 (continued)

No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
			- 100% related				Other Correlations:
4	Munzenberger et al. (1999)	France	- S: 22 - 68% M - Mean age: 42.1 +/- 9 (25–63) - 100% related	- STAI	1wk	Mean score was within normal range	- No significant changes in depression pre- and post-donation - Donors whose recipients died had worsened depression scores (p = 0.03) and also had higher depression scores (p = 0.003) than those whose recipient relatives were alive Depression: Not studied Anxiety: Mean score was within normal range Other Correlations:
5	Chang et al. (1998)	USA	- S: 77 - % M - Mean age: 38.6 (17–70) - 46.8% related, 53.2% unrelated	- BDI	2wks	12% depression (12% unrelated donors, 12% related donors)	- Anxiety scores decreased post-donation (p < 0.05) Depression: 6.4% (5% of unrelated donors, 8% of related donors) Anxiety: Not studied Other Correlations: - Related donors had higher depression scores than unrelated donors both pre-donation (p = 0.01) and post-donation (p = 0.07)
No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
Lung							
1	Chen et al. (2013)	Japan	- S: 33 - 42.4% M - Mean age: 40.5 +/- 11.4 - 100% related	- HADS - SF36 - PSQI	1 yr	Mean scores were within normal range	Depression: Mean score was within normal range Anxiety: Mean score was within normal range Other Correlations: - No significant changes in depression pre- and post-donation - Post-donation anxiety was lower than pre-donation value (p = 0.023) - Donors whose recipients died had poorer general health (p = 0.019), social functioning p = 0.032) scores and poorer quality of sleep (p = 0.0037) as compared to donors who recipients did not. No significant differences for depression and anxiety scores.
No.	Author (yr)	Country	Sociodemographic Features	Assessment Tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
Uterus							
1	Järholm et al. (2019)	Sweden	- S: 9 - 0% M - Range (39–62) - 88.9% related, 10.1% unrelated	- HADS - SF36	2 yrs., 3 yrs	Mean scores were within normal range. 11.1% anxiety.	Depression: 10.1% (3 yrs) Anxiety: 10.1% (3 yrs) Other Psychological Outcomes: - Mental and physical health QOL was better than normal population
2	Kvarnström (2017)	Sweden	- S: 9 - 0% M - Mean age: 53 (37–62) - 88.9% related, 10.1% unrelated	- HADS - SF36 - PGWB	3, 6, 12mths	Mean scores were within normal range. 11.1% anxiety.	Depression: 0%, mean score was in normal range Anxiety: 0%, mean score was in normal range. (The donor that had anxiety pre operatively was not found to be positive after operation at all time points.)
No.	Author (yr)	Country	Sociodemographic Features	Assessment tools	Follow Up Assessments After Donation	Pre-transplant Findings	Main Findings ^a
Others							
1	Fukunishi et al. (2002)	Japan	- S: 31 (liver), 65 (kidney) - 58% M (liver), 46% M (kidney) - Mean age: 44.5 (20–61) for liver, 53.1 (31–64) for kidney - 100% related	- SCID	3mths, 1 yr	No psychiatric diagnoses	Depression: 9.7% (liver), 3.3% (kidney) Anxiety: 0%

ARI = Autonomy and Relatedness Inventory.

BAI = Beck Anxiety Inventory.

BDI = Beck Depression Inventory.

BSI = Brief Symptom Index.

CDI = Children's Depression Inventory.

CES-D = Center for Epidemiologic Studies Depression Scale.

CHQ = Chinese Health Questionnaire.
 CLAS = Contentment with Life Assessment Scale.
 DAS = Dyadic Adjustment Scale.
 FQCI = Freiburg Questionnaire of Coping with Illness.
 GAD = Generalised Anxiety Disorder Scale.
 GAF = Global Assessment Functioning Scale.
 GHQ = General Health Questionnaire.
 HADS = Hospital Anxiety and Depression Scale.
 HAM-A = Hamilton Anxiety scale.
 HDRS = Hamilton Rating Scale for Depression.
 K-SADS-PL = Schedule for Affective Disorders and Schizophrenia for School Age Children, Present and Lifetime Version.
 LOT-R = Life Orientation Test-Revised.
 NA = Not Available.
 PACT = Psychosocial Assessment of Candidates for Transplantation.
 PGWB = Psychological General Well Being Index.
 PHQ = Patient Health Questionnaire.
 POMS = Profile of Mood States.
 PRIME-MD-PHQ = Primary Care Evaluation of Mental Disorder.
 PSQI = Pittsburgh Sleep Quality Index.
 QOL = Quality of Life.
 RCMAS = Revised Children's Manifest Anxiety Scale.
 RSE = Rosenberg Self-Esteem Scale.
 SAS = Self-Rating Anxiety Scale.
 SCID = Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision.
 SCL-90-R = Symptom Checklist-90-Revised.
 SDS = Self-Rating Depression Scale.
 SF36 = Short Form 36 Health Survey.
 SSRS = Social Support Rating Scale for Chinese.
 STAI = State Trait Anxiety Inventory.
 SWLS = Satisfaction with Life Scale.
 TERS = Transplant Evaluation Rating Scale.
 WHOQOL-BREF = World Health Organization Quality of Life.
 ZSRAS = Zung Self-Rating Anxiety Scale.
 ZSRDS = Zung Self-Rating Depression Scale.

^a Unless stated otherwise, prevalence of depression and anxiety included mild, moderate and severe depression and anxiety.

or past history of smoking habits also played a part [43]. Several papers concluded that poor health outcomes post-donation were risk factors as well. Such physical outcomes included experiencing perioperative [48] or postoperative complications [49], persistent symptoms post-donation [34], having longer hospital stay [45,46,48] and having a longer post-donation recovery time [44]. With regards to perceived health, donors who perceived that their health was negatively impacted by surgery had higher risks of depression [50]. Having health related concerns related to surgery pre-donation [45] and perceived susceptibility to illness [49] were identified by papers to be risk factors as well.

Besides donor's physical health status, several papers identified that donor's psychological health also impacted their risk of depression and/or anxiety. This included having a personal history of depression [43,44] or having a personal risk for psychopathology [41]. Another paper also reported that personal pre-donation mood disturbance influenced depression rates [47]. Modifying factors of psychological health such as having psychosocial support like family or a support system were important protective factors picked up by one paper [41].

Many papers reported a strong association between poor outcomes in recipients post-donation and depression and/or anxiety in donors [55]. One of these poor outcomes that was studied in several papers was recipient death [51]. Besides increasing donor's risk of depression and/or anxiety, recipient death predisposed donors to other negative psychological outcomes such as poor social functioning and poor quality of sleep [52]. One paper also reported that of donors reporting recipient death during the study follow up, 33% had ever felt guilt and 22% had ever felt responsible for recipient's death [53]. Other poor outcomes in recipients that were associated with increased risk of depression and/or anxiety in donors include recipient graft loss [43,54], medical or surgical complications [55–57] and psychiatric disorders [58] including depression [39,41,55,56]. Donor's perception of recipient's health and functioning status also played a similar role [59].

As expected, depression and/or anxiety were found to be correlated with other psychological outcomes including poorer mental quality of life [40,60,61], lower life satisfaction [36] and post-donation regret [49].

3.4.4. Other psychological outcomes

3.4.4.1. Other psychiatric disorders. Many papers identified other psychiatric disorders besides depression and anxiety. 4 papers reported prevalence rate of substance use or alcohol use to be 0.5–8.4% [45,53,62,63]. One paper reported that the prevalence rate of alcohol use is higher than that of the normal population [45]. A paper found that higher rates of alcohol or substance use was found in donors who had a history of drug use or chronic pain. Moreover, they tend to be individuals who had post-surgery complications, post-donation rehospitalisation or had felt that they received insufficient attention post-surgery [44]. 3 papers reported the prevalence rate of conversion disorder to be 0.4–2.5% [48,63,64]. 3 papers reported the prevalence rate of adjustment disorder to be 0.4–16% [6,48,58]. One paper reported that the prevalence of adjustment disorder had decreased from 16% at 4 months post-donation to 2% at 12 months post-donation [58]. 2 papers reported difficulties with sleep in donors. One concluded that 0.25% of donors suffered from insomnia post-donation [62] and the other concluded that 25.3% of its donors had loss of sleep post-donation [50]. One paper reported prevalence rate of 0.25% for suicide, 0.25% for suicide attempt and 0.25% for bipolar disorder in its donors [62]. Another paper reported body image concerns to be present in 19% of its donors, which is associated with perceived pressure to donate and pre-donation body concerns [47].

3.4.4.2. Mental health quality of life. We looked at papers that studied mental health quality of life of donors who undergo organ transplantation.

Table 2
Quality appraisal of included studies[#].

	Study Purpose	Literature	Research design	Sample size, description	Valid, reliable outcome measures	Intervention	Results with statistical significance, appropriate analysis methods	Dropouts/exclusions	Conclusions/clinical importance	Total score (exclusive of NA)
Azoulay et al. (2011)	1	1	1	1	0	NA	1	1	1	7
Bredeson et al. (2004)	1	1	1	1	0	NA	0	1	1	6
Butt et al. (2017)	1	1	1	1	1	NA	1	1	1	8
Chang et al. (2003)	1	1	1	1	1	NA	1	1	1	8
Chang et al. (1998)	1	1	1	1	1	NA	1	1	1	8
Chen et al. (2013)	1	1	1	1	1	NA	1	1	1	8
Chen et al. (2016)	1	1	1	1	1	NA	1	1	1	8
Chen et al. (2015)	1	1	1	1	1	NA	1	1	1	8
Dew et al. (2018)	1	1	0	1	1	NA	1	1	1	7
Erden et al. (2019)	1	1	1	1	1	NA	1	1	1	8
Erim et al. (2007)	1	1	0	1	1	NA	1	1	1	7
Erim et al. (2006)	1	1	1	1	1	NA	1	1	1	8
Esmat et al. (2005)	1	1	1	0	1	NA	0	1	1	6
Frade et al. (2008)	1	1	1	0	1	NA	1	1	1	7
Fukunishi et al. (2002)	1	1	1	1	1	NA	1	1	1	8
Gokce et al. (2011)	1	1	1	0	1	NA	1	1	1	7
Guleria et al. (2011)	1	1	1	1	1	NA	1	1	0	7
Holscher et al. (2018)	1	1	1	1	1	NA	1	1	1	8
Hsu et al. (2006)	1	1	1	1	0	NA	1	1	1	7
Humphreville et al. (2016)	1	1	1	1	0	NA	1	1	1	7
Ishizaki et al. (2012)	1	1	1	0	0	NA	1	1	1	6
Janik et al. (2019)	1	1	1	1	1	NA	1	1	1	8
Jarvholm et al. (2019)	1	1	1	1	1	NA	0	1	1	7
Jin et al. (2012)	1	1	1	1	0	NA	1	1	1	7
Jowsey et al. (2014)	1	1	1	1	1	NA	1	1	1	8
Kadioglu et al. (2012)	1	1	1	1	1	NA	1	1	1	8
Kimura et al. (2015)	1	1	1	1	1	NA	1	1	1	8
Krishnan et al. (2020)	1	1	1	1	1	NA	0	1	1	7
Kroencke et al. (2012)	1	1	1	1	1	NA	1	1	1	8
Kroencke et al. (2014)	1	1	1	1	1	NA	1	1	1	8
Kroencke et al. (2006)	1	1	1	1	1	NA	1	1	1	8
Kvarnstrom et al. (2017)	1	1	1	1	1	NA	0	1	1	7
Labott and Pfammatter (2014)	1	1	1	1	1	NA	1	1	1	8
Lopes et al. (2011)	1	1	1	1	1	NA	1	1	1	8
Maple et al. (2014)	1	1	1	1	1	NA	1	1	1	8
Maple et al. (2017)	1	1	1	1	1	NA	1	1	1	8

(continued on next page)

Table 2 (continued)

Study Purpose	Literature	Research design	Sample size, description	Valid, reliable outcome measures	Intervention	Results with statistical significance, appropriate analysis methods	Dropouts/exclusions	Conclusions/clinical importance	Total score (exclusive of NA)
Mathur et al. (2020)	1	1	1	1	NA	1	1	1	8
Minz et al. (2005)	1	1	1	0	NA	1	1	1	7
Munzenberger et al. (1999)	1	1	1	1	0	NA	1	1	7
Noma et al. (2011)	1	1	1	0	NA	1	1	1	7
Oguten et al. (2019)	1	1	1	1	NA	1	1	1	8
Packman et al. (1997)	1	1	1	1	NA	1	1	1	8
Rodrigue et al. (2018)	1	1	1	1	0	NA	1	1	7
Schold et al. (2013)	1	1	1	1	NA	0	1	1	7
Schulz et al. (2009)	1	1	1	1	NA	1	1	1	8
Shah et al. (2005)	1	1	1	1	NA	1	1	1	8
Shen et al. (2016)	1	1	1	1	NA	1	1	1	8
Shibata et al. (2009)	1	0	1	1	NA	1	1	1	7
Shizuku et al. (2020)	1	1	1	1	NA	1	1	1	8
Smith et al. (2004)	1	1	1	1	NA	1	1	1	8
Sommerer et al. (2015)	1	1	1	1	NA	1	1	1	8
Sotiropoulos et al. (2011)	1	1	1	1	0	NA	1	1	7
Taghavi et al. (2001)	1	0	1	0	NA	1	1	1	5
Tanriverdi et al. (2004)	1	1	1	0	NA	1	1	1	7
Taskintuna et al. (2009)	1	1	1	1	NA	1	1	1	8
Trotter et al. (2007)	1	1	1	0	NA	1	1	1	6
Virzi et al. (2007)	1	1	1	1	NA	1	1	1	8
Wadstom et al. (2019)	1	1	1	1	NA	1	1	1	8
Wang et al. (2017)	1	1	1	1	NA	1	1	1	8
Wiedebusch et al. (2009)	1	1	1	1	NA	1	1	1	8
Zhao et al. (2010)	1	1	1	1	NA	1	1	1	8
Zheng et al. (2014)	1	1	1	1	NA	1	1	1	8

NA = Not Available.

1 = component criteria met by paper.

0 = component criteria not met by paper.

When conclusions of mental quality of life of donors could not be ascertained, general quality of life was interpreted instead. We found that there were varying conclusions drawn by different papers.

Of papers that compared mental quality of life pre-donation and post-donation, 3 papers [40,68,69] reported an improvement from pre-donation, 2 papers [42,78] reported no change from pre-donation and 2 papers [41,58] reported a deterioration from pre-donation. Of papers that compared mental quality of life in donors post-donation with the mental quality of life of the general population, 7 papers [34,37,53,66,70,84,85] reported mental quality of life to be better in donors, 5 papers [6,55,59,61,75] reported no significant difference from the general population and 2 papers [45,86] reported that donors experienced a poorer mental quality of life. Several papers also

identified that mental quality of health in their donors were better compared to the recipients [33,37] or selected controls for their study [37].

Several papers identified risk factors that predisposed donors to experience a poorer quality of life post-donation. They included socio-demographic factors e.g. being female [66], not having full time employment [66], and being older [67,68]. However, there were conflicting results to age being a risk factor for poorer quality of life as reported by another paper [66].

Poorer quality of life was observed in donors whose recipients had experienced poor outcomes post donation such as medical complications [55,56,66]. Interestingly, donor’s perception of recipient’s health and functioning status post donation was reported to affect mental quality of

Table 3
Risk factors, protective factors and correlations of depression and anxiety.

Risk Factors for Depression and Anxiety:
- Sociodemographic factors
o Having greater financial burden
o Being single
- Donor's physical health status
o Actual health
■ Comorbid medical conditions eg obesity, hypertension
■ Poor outcomes post-surgery eg post-operative complications, persistent symptoms, longer duration of stay
o Perceived health
■ Pre-surgical health related concerns
■ Perceived susceptibility to illness
■ Perceived negative health due to surgery
- Donor's psychosocial health
o Psychiatric history of depression
o Pre-donation mood disturbance
- Actual and perceived poor physical or psychological outcomes in recipients post-transplant
Protective factors against depression and anxiety:
- Available support system, including family support
- Improved or maintained relationship with recipient
Higher depression and anxiety were most often found to be correlated with:
- Regret after donation
- Poorer mental QOL
- Poorer life satisfaction

life as well [59].

With regards to psychosocial factors, having poor social support post-donation increases risks of poorer quality of life [67]. As expected, many papers found that depression and anxiety were strongly correlated with a poorer quality of life. [40,58,60,61,68,69]. A paper specifically identified ways of coping in donor's post-donation that affected their mental quality of life. They found that depressive coping, self-confidence, and dissimulation or wishful thinking were significantly correlated with a lower mental quality of life post-donation, with active problem-focused coping mechanism as the exception [61].

3.4.4.3. Satisfaction with life. There were 5 papers studied donor's satisfaction with life after donation, of which 3 papers reported that 80–96% of their donors were satisfied with their life [37,49,65]. However, one paper reported that level of satisfaction with life was low, at 13% [47]. The remaining paper found that their donor's level of satisfaction with life was higher than that of the control group for the study [36]. Lower life satisfaction was found more in older adults, males and those who are single [36]. Other factors predisposing donors included having thoughts of getting ill easily, having experienced post-operative complications, and having experienced other psychological outcomes such as regret after donation and depression [36,49].

3.4.4.4. Regret. There was a prevalence rate of 0–11.4% for regret. 0–19.2% of donors denied willingness to donate and 2–20.7% of donors were uncertain about their decision to donate if given another chance. One paper found out that donors whose recipients had died post-donation were 8 times more likely to report regret than donors whose recipients did not die [53]. Another paper had found that being single and having trouble obtaining of changing health/life insurance predisposed donors to regret donating their kidney [43].

3.4.4.5. Self-esteem. There were 4 papers reported a range of 14–50% of its donors experience improved self-esteem post-donation [47,56,70,71], while 2 papers that reported no change in donor's self-esteem [57,72]. One paper reported self-esteem to be higher in donors as compared to recipients [32], and one paper reported self-esteem to be lower in donors as compared to control group [38]. Those who reported

higher self-esteem post donation tend to be younger donors [71] and donors who perceived less guilt and responsibility towards failure of donation pre-donation [72]. One paper also reported that donating to a first degree relative than unrelated recipients was a protective factor to low self-esteem [53]. One paper reported that donors who reported lower self-esteem tend to be females, and donors whose recipients had died [53].

3.4.5. Significance of donor-recipient relationship

Most papers identified most of their donor and recipient participants to be related to one another. There were 3 papers studied whether being a related or unrelated donor predisposes donors to depression and/or anxiety. One paper suggested related donors experienced higher depression risk than unrelated donors [72], but another paper had results contrary to it [45]. The last paper did not find any significant differences between related and unrelated donors [44]. One paper found that donating out of moral obligation was a risk factor for depression in donors [44]. Some papers also observed other psychosocial outcomes in related donors. For instance, as compared to unrelated donors, related donors received more praises and higher perceived social support for their decision to donate [44]. Moreover, they perceived themselves to be a better person for having donated [53] and considered their donation as a more significant life event [44].

While conclusions cannot be made about whether being related or unrelated increases one's risk of depression and anxiety, papers emphasized the importance of donor-recipient relationship in influencing psychological outcomes in donors. Of the papers that studied donor-recipient relationship post-donation, 13.7–68% donors reported improved relationship with recipients, 59.1–84.9% donors reported no significant change and 4% donors reported a negative impact of donation on relationship with recipients [40,50,54,61,74]. 2 papers highlighted that having unchanged or improved relationship with the recipients post donation were protective factors that decreased risk of depression [49,72].

There were 2 papers also studied psychological outcomes in different donor subgroups. One paper compared psychological outcomes between donors who are parents of the recipients and donors who are siblings of the recipients. It was found that parent donors had higher risks of depression and anxiety compared to sibling donors and higher risks of anxiety compared to the general population. Compared to the sibling donor population, parents perceived poorer subjective social support, which was also a risk factor of poor quality of life [67]. Another paper compared psychological outcomes between adult donors donating to paediatric recipients and adults donors who are donating to adult recipients. They found that adult donors donating to paediatric recipients, who were often their children, experienced higher pre-operative psychological strain. Adult donors donating to adult recipients however, showed no significant differences in anxiety and depression rates pre-donation and post-donation [75].

4. Discussion

4.1. Summary of current evidence and implications

Our paper had found that across all organ types, prevalence rates were 0–46.9% and 0–66.7% for depression and anxiety respectively. For depression, 71% of papers that compared prevalence rates between pre-transplant and post-transplant concluded that there was no difference and 71% of papers that compared prevalence rates between donor and general population concluded that depression rates were lower in donor population. For anxiety, 57% of papers that compared prevalence rates between pre-transplant and post-transplant concluded that there was an improvement of anxiety rates from pre-transplant levels. Of papers that compared prevalence rates of anxiety between donor and general population, 43% of papers concluded that anxiety rates were lower in donor population and 29% of papers concluded no difference between the two

populations. These findings suggest that depression and anxiety in donors are largely unchanged from pre-donation and prevalence of such disorders may be lower than that of the general population post-donation. The role of donor altruism may be important in allaying anxiety [82], as it is an important part of donor satisfaction post-transplant. This may occur when the donor has the knowledge that he had done all he could to help the recipient.

Other reviews of specific organs had made similar observations [7,8] Many papers identified significant correlation between depression and anxiety and other poor psychological outcomes such as lower quality of life, lower satisfaction of life and regret after donation. Furthermore, it is observed that some living donors suffer from other psychiatric disorders post-donation such as bipolar disorder, conversion disorder, adjustment disorder, sleep disorder, including severe outcomes such as suicides, although it must be mentioned that some of these studies did not screen for pre-operative anxiety and mood problems. These psychological outcomes are important to mitigate for organ donors, given the altruistic premise of the procedure [15]. There is still value in consistent psychiatric evaluation of donors to prevent and mitigate any of the observed poor psychological outcomes.

We also observed that in kidney donors, prevalence rates were 2–46.9% and 0–66.7% for depression and anxiety respectively. For liver donors, prevalence rates were 0–34% and 0–51.5% for depression and anxiety respectively. One reason could be due to the donor's fear that they may be susceptible to ill health, and potentially having to go through dialysis themselves should the remaining kidney fail [95], compared to liver donation where the donated part of the liver would grow again. Secondly, there were differences in transplant experiences for kidney and liver donors were observed previously, for example the donor's perceived intra-operative risk, altered body appearance post donation and post-operative infection risk [16]. The prevalence rates of depression and anxiety cannot be obtained for other types of organs due to the lack of papers for the remaining organ types (bone marrow, uterus and lung). This probes for not only more research on psychiatric outcomes in donors for other types of organs, but also research to explain the variability in prevalence rates in different transplantation types.

Our paper identified common risk factors predisposing donors to depression and anxiety. These can be categorized into pre-donation and post-donation risk factors.

For pre-transplant risk factors, having comorbid medical conditions affecting physical health status is significant. This is no surprise as correlation between mental and physical health was previously reported, with better past physical health affecting present mental health [18]. Interestingly, one's perceived health status was also identified as a risk factor. This included having health related concerns [45] and beliefs in one's increased susceptibility to illness [49]. Other pre-donation risk factors include psychological health status which includes having a past history of psychiatric disorder or mood disturbance, or having a greater risk of psychopathology pre-donation. Optimization of donor's mood state by the psychiatrist prior to donation would be important in those who suffer from psychiatric illness. Additionally having a member of the transplant team, usually in the form of a transplant coordinator to counsel and educate the donor, and to allay fears and concerns will be crucial. Considering that interventions targeting these risk factors are still lacking [19], attention should be given to evaluate and prepare donors prior to the surgery in order to promote smooth and uncomplicated recovery [20].

However, while many papers identified having past history of psychiatric disorders or mood disturbance to be significant risk factors affecting psychological outcomes in donors, there were insufficient information for conclusions to be made on whether there are any differences in prevalence of psychiatric outcomes between donors who have past history of mental health struggles and donors who do not. Currently, there is a lack of consensus whether a donor with past psychiatric history is eligible for organ donation [21]. Some transplant centres consider this as a contraindication to donation due to risk of

relapse arising from the transplant process. Other centres may consider individuals to be suitable as long as they maintain stability for a sustained period with adequate adherence [22]. This disparity in practice is observed in the papers included in our paper as well.

For post-donation risk factors, having compromised physical health post-surgery is significant. This includes surgical complications, persistent physical symptoms and longer post-donation recovery time. Pain has been shown to increase rates of anxiety and depression [96]. It is also known that the clinical severity of complications may not always indicate severity of psychological impact, but other factors matter such as how they coped with stress, their self-assessment of the surgery, as well as their perceptions of post-operative support from their loved ones [23]. Social support is an important factor identified by many papers that impacts mental health [24]. For individuals who face stressful physical and psychological events, such as an organ transplantation surgery, having social support reduces some of this distress [25]. Specifically, families not only play the central role of providing psychological support, they also provide material and practical support, which enhances a sense of security, reducing stress in individuals [26]. Besides actual support, perceived support received plays an important role as well [27]. Addressing donor's physical health concerns adequately during post-donation evaluations is crucial to mitigate risk as well.

Majority of donors reported an improved or unchanged relationship with the recipient, which is supported by other review papers [29]. More importantly, this has been found to be a protective factor of poor psychological outcomes in donors [49,72]. Evidently, the dynamic of the donor-recipient relationship poses as a significant modifying factor to psychological outcomes of the donor. We were interested in knowing whether there are differences in psychological outcomes between related and unrelated donors. For unrelated donors, there is still much uncertainty in the healthcare system regarding their motives for donation and possible psychological consequences [30], therefore causing much variation in practices across different transplantation centres [31]. However, there were insufficient papers in our study that provided insight. Further research should compare these two populations of donors in order to better understand if either donor groups are at higher risk of poor psychological outcomes, so as to shed light on whether current hesitance towards altruistic donations is warranted.

Another specific type donor-relationship worth mentioning is the parent-child relationship. We identified two papers [67,75] that explored how this unique dynamic may pose as a risk factor. Both papers highlighted that fulfilling both the role of a donor and a parent places immense psychological strain uniquely to parent donors. Not only do they experience a stronger emotional involvement and may take it upon themselves to bear the responsibility of their children's health by undergoing surgery, they also experience higher caregiver burden while also having to bear economic costs of surgery. It may be a challenge for parents to wean off habits of being anxious about and overprotecting the child which are already formed prior to transplantation. Post transplantation, the anxiety and overprotectiveness may be further elevated as it is reinforced by the continual concern about the health of the child, and their own donated organ [97]. Overall family functioning has been cited to be the strongest contributor to psychosocial adjustments in both chronically ill and healthy children [98].

This review has reiterated the importance of psychiatric evaluation for transplant donors, and in light of the above risk factors predisposing donors to poor psychological outcomes, we recommend the following measures to improve the transplant selection and process to minimize psychological issues. On selecting transplant donors, individuals who have pre-existing medical conditions and psychiatric disorders should be evaluated by the medical and psychiatric teams to re-consider for eligibility. If they are accepted as eligible donors, prompt treatment of comorbid medical conditions or psychiatric disorders is necessary to optimize control and stability prior to the operation. These individuals should also receive frequent monitoring with appropriate interventions post-transplantation to prevent worsening of comorbid medical

conditions or relapse of psychiatric disorders. In pre-donation evaluation, donor's social support network should be identified. This will help the transplant team to identify individuals with suboptimal social support systems, and thus allow for opportunities to strengthen existing systems prior to the operation. Hence, there may be a role for pre-surgery psychoeducation and counselling for the donor and his/her family members so that the family members understand the significance of their roles and how they may be better prepared to take up caregiving responsibilities post-surgery. After the surgery, the following specific donor populations should be identified to receive close surveillance due to their increased risk of developing poor psychological outcomes. The first would be donors who personally experienced a complicated recovery post-surgery due to factors such as medical and/or surgical complications, and the second would be donors whose recipients had experienced complicated post-surgery and these may include physical and/or psychological complications. Furthermore, the transplant team should elicit any concerns that donors may have with regards to the donor-recipient relationship such as dissatisfaction in order to shed light on the change in dynamics between donors and recipients. For donors who are identified to be at increased risk of poor psychological outcomes, we recommend early post-surgery interventions such as psychotherapy such as supportive psychotherapy, cognitive behavioural therapy, and acceptance and commitment therapy. Relevant themes to be explored may include dealing with loss of a previously well maintained health status and managing expectations with regards to post-surgical recovery. We recognize that the current literature affirms that the prevalence rates of depression and anxiety in transplant donors do not differ from the general population and that majority of transplant donors do not experience poor psychological outcomes post-donation. As such, we only recommend the abovementioned measures for individuals who have these identifiable risk factors for early intervention. Long-term follow up to monitor for development and/or progression of psychological outcomes should be implemented as well.

4.2. Strengths and limitations

It is critical to address the limitations we faced when conducting the review in order to consider the results appropriately. We were unable to combine data across all papers to provide point estimates of prevalence of depression and anxiety due to different methodology used by different papers. Assessment methods varied across papers as some conducted patient interviews with psychiatric evaluation according to DSM criteria while majority of papers resorted to using validated questionnaires. Furthermore, more than 10 different types of questionnaires were used across all papers. Some are screening tools e.g. Hospital Anxiety and Depression Scale and Zung Depression Self-Rating Scale, while some are diagnostic tests e.g. Primary Care Evaluation of Mental Disorders and Patient Health Questionnaire. These assessment tools serve different functions and may use different thresholds to determine psychiatric disorders [17]. Secondly, different papers measured psychiatric outcomes at different time points. There are individual papers that yielded different prevalence rates at different time points, suggesting that time after donation may affect psychiatric outcomes [53,57,58,76]. We postulate that these differences in methodology contribute to the varying prevalence rates that we observe currently. We suggest that further papers use a consistent approach to improve comparability across different populations being studied.

In this review, we conducted a search of major databases and additional sources to retrieve relevant articles but it was limited within the peer-reviewed journal articles. Articles such as institutional reports or unpublished articles were excluded. We also excluded papers that studied outcomes qualitatively e.g. interviews for fear of biased conclusions drawn from interpretation of outcomes. The potential exclusion of such studies which could meet our criteria highlights a publication bias within the existing body of knowledge. Furthermore, our study is limited by its search for English publications only. This is a potential

source of bias as this may lead to inclusion of studies that are conducted in selected geographical regions, therefore causing an over-representation of studies from certain regions. As such, our results may not be truly representative of the entire landscape of living donors. Further research should include studies of non-English language to broaden understanding of cross-cultural or global mental health statistics in living donors.

Our study has strengths in being the first systematic review that compared prevalence rates of depression and anxiety in transplant donors across all organ types with no limitations imposed on the time of study. We were not only able to make conclusions about the prevalence of psychological outcomes in all donor types, but we also ascertained current research gaps that should be filled. Another strength is that a holistic view of psychiatric outcomes in organ donors is captured as it also summarises other psychiatric outcomes that occur in the context of depression and anxiety. This helps readers to gain a better understanding of the extent in which organ donation process may impose negative impacts on donors' mental health.

4.3. Conclusion

This review seeks to conclude that the process of organ transplantation had not significantly affected the prevalence rates of depression and anxiety in donors. The prevalence of depression and anxiety in donors post-transplantation were largely comparable and may be lower than that of the general population. However, individuals with identifiable pre-donation and post-donation risk factors should be monitored and managed accordingly through methods such as provision of social support, psychoeducation, psychotherapy and long-term follow up. We suggest future studies to adopt a consistent methodological approaches so as to improve the comparability between various studies. Furthermore, more research should be conducted to fill in the gaps with regards to poor psychological outcomes in other organ donors besides kidney and liver donors, donors who have past psychiatric history, unrelated donors and parent donors.

Authorship

Jun QL Ong participated in drafting the paper.

Lucas JH Lim participated in revision of the paper.

Roger CM Ho participated in revision of the paper.

Cyrus SH Ho participated in research design and revision of the paper.

Statement of disclosure

We certify that we have each made a substantial contribution so as to qualify for authorship and that we have approved the contents.

Ethical approval

Not required.

Declaration of competing interest

None.

Data availability

No data was used for the research described in the article.

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