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SYSTEMATIC REVIEW



Suicide risk in patients undergoing hemodialysis: a systematic review and meta-analysis of prevalence

Luigi Zerbinati^a , Federica Caccia^b , Federica Baciga^{b,c} , Martino Belvedere Murri^a , Pasquale Esposito^d , Rosangela Caruso^a , Ionut Nistor^e , Bjorn Meijers^{f,g} , Carlo Basile^h , Christian Combe^{i,j,k} , Luigi Grassi^a , Alessandro Mantovani^l , Yuri Battaglia^{b,c}  and On behalf of EuDial Working Group of ERA

^aInstitute of Psychiatry, Department of Biomedical and Specialty Surgical Sciences, University of Ferrara, Ferrara, Italy; ^bDepartment of Medicine, University of Verona, Verona, Italy; ^cNephrology and Dialysis Unit, Pederzoli Hospital, Peschiera del Garda, Italy; ^dDepartment of Internal Medicine, Division of Nephrology, Dialysis and Transplantation, University of Genoa and IRCCS Ospedale Policlinico San Martino, Genoa, Italy; ^eNephrology Department, University of Medicine and Pharmacy, Grigore T. Popa, Iași, Romania; ^fNephrology Unit, University Hospitals Leuven, Leuven, Belgium; ^gDepartment of Microbiology, Immunology and Organ Transplantation, KU Leuven, Leuven, Belgium; ^hSezione di Nefrologia, Associazione Nefrologica Gabriella Sebastio, Martina Franca, Italy; ⁱUniversity of Bordeaux, INSERM, Bordeaux Public Health, Bordeaux, France; ^jHospices Civils de Lyon, Lyon, France; ^kCentre Hospitalier d'Ardèche Méridionale, Aubenas, France; ^lSection of Endocrinology, Diabetes and Metabolism, Department of Medicine, University and Azienda Ospedaliera Universitaria Integrata of Verona, Verona, Italy

ABSTRACT

Background: Kidney failure is strongly associated with psychological disorders, including anxiety, depression, and suicidal ideation. However, the prevalence of suicide risk in patients undergoing dialysis has not been fully established.

Methods: We performed a systematic review and meta-analysis aimed at assessing the prevalence of suicide risk in adult patients on dialysis and any correlation with demographic and clinical parameters.

Results: Twelve unique cross-sectional studies involving 1259 adult patients on dialysis were included. All patients were receiving hemodialysis treatment. In univariate meta-regression analysis, no significant effect of age, sex, and percentage of patients with diabetes mellitus on the prevalence of suicide risk was found. Overall, the prevalence of suicide risk was 20.6%. It varied widely, ranging from 4.0% to 57.3%, depending on the tools used (i.e. clinical interviews or self-report questionnaires). Among studies with more or less than 40% of patients on dialysis with anxiety and depression, the prevalence of suicide risk was very similar (21.2% vs 20.4%, respectively). The prevalence of suicide risk was more than double in lower-income than in higher-income countries (33.5% vs 15.3%, respectively).

Conclusions: The present systematic review and meta-analysis is a pioneering effort to identify the prevalence of suicide risk in patients on dialysis. It revealed a significant prevalence of suicide risk among hemodialysis patients, with a rate notably higher than that observed in the general population. This elevated risk is influenced by a complex combination of biological, psychological, and socio-economic factors.

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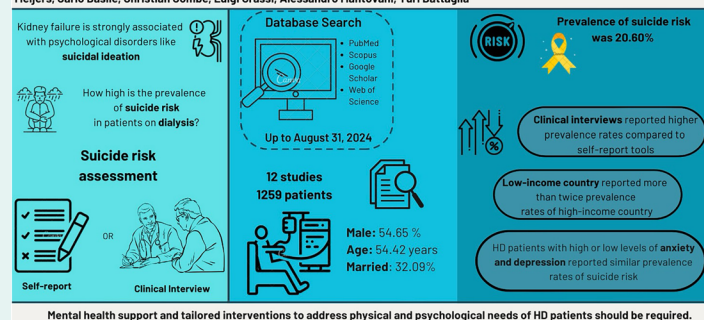
KEYWORDS

Dialysis; kidney failure; depression; anxiety; MINI; suicide

GRAPHICAL ABSTRACT

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CONTACT Yuri Battaglia  yuri.battaglia@univr.it  Department of Medicine, University of Verona, Head of Nephrology and Dialysis, Pederzoli Hospital, Via Monte Baldo, 24, 37019 Peschiera del Garda, Italy.

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1. Introduction

The prevalence of kidney failure is increasing worldwide and is currently estimated to be between 4.9 and 7.0 million people [1,2]. Individuals on maintenance dialysis are frequently affected by mental complications that significantly reduce their health-related quality of life [3,4]. Indeed, patients on dialysis face several dialysis-related stressors and losses [5]: (I) *employment challenges* due to being unable to return to work, leading to issues with self-esteem and financial difficulties; (II) *loss of autonomy* due to the dependence on regular dialysis sessions and the strict medical regimen, which can make patients feel trapped and powerless; (III) *chronic fatigue* which can make it difficult for patients to engage in daily activities and maintain social relationships; (IV) *sexual dysfunction* which can strain personal relationships and contribute to feelings of inadequacy and frustration. *Marital relationships* are also significantly impacted by stress from caregiving responsibilities, time constraints, emotional exhaustion, or the disruption of intimacy caused by the demands of dialysis.

Consequently, the prevalence of psychiatric disorders in patients on dialysis is higher than in the general population [6,7] leading to hospitalization rates for psychiatric disorders that are more than twice as high compared to those with other chronic illnesses, such as diabetes, ischemic heart disease, or cerebrovascular disease [8].

The most prevalent psychiatric conditions among patients on dialysis are anxiety and depression [9], affecting between 27% to 46% and 20% to 47% of individuals, respectively [7,10]. The co-occurrence of anxiety and depression [7] has been demonstrated to be associated with a high risk of suicide and/or suicidal ideation [9,11,12].

The coexistence of psychiatric disorder and suicidality appears to function as a diathesis rather than a cause-and-effect relationship, with each dimension reinforcing the other. This is likely due to various factors, including hopelessness, a lack of strategies to reduce stress, and sleep disturbances [7,13]. Notably, the routine of dialysis and changes in health conditions may contribute to a sense of hopelessness regarding recovery and a rejection of dialysis. These feelings are both indicators of suicidal attitudes and significant complications of depression.

Corroborative evidence has identified a high incidence of suicide threats and attempts among patients on dialysis. A recent study conducted by Mansur et al. revealed that between 1999 and 2020, there were 999 deaths by suicide among individuals with kidney disease, indicating an elevated suicide risk compared to the general U.S. population [14]. Only one previous systematic review, conducted in 2013 by Pompili et al. [7], demonstrated an increased risk of suicidal ideation and suicide attempts in patients on dialysis. However, a meta-analysis was not performed due to data heterogeneity.

Therefore, the aim of this meta-analysis and systematic review was primarily to examine the prevalence of suicide risk in patients undergoing hemodialysis and secondarily to evaluate the influence of various factors, including regional differences, assessment tools, and levels of depression and anxiety.

2. Materials and methods

2.1. Protocol registration

The present systematic review and meta-analysis was registered in advance on Open Science Frameworks (registration Doi:10.17605/OSF.IO/37GJU).

2.2. Search strategy and selection criteria

We systematically searched PubMed, Scopus, Google Scholar, and Web of Science databases from the inception to Dec 31, 2024, to identify observational studies reporting the current prevalence of suicide risk in adults (age ≥ 18 years) with end-stage kidney disease receiving hemodialysis or peritoneal dialysis. Grey literature from Google Scholar was excluded.

Search free-text terms were: “suicide” AND “dialysis” (OR “hemodialysis” OR “peritoneal dialysis” OR “end-stage renal disease” OR “renal failure”). No language restriction was applied. We also reviewed references from original papers and review articles to identify additional studies not covered by our original database searches. This systematic review and meta-analysis were performed according to the updated Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement [15]. Exclusion criteria were: 1) congress abstracts, case reports, reviews, and practice guidelines; 2) studies conducted in the pediatric population (< 18 yrs).

2.3. Data extraction and quality assessment

Two authors (F.C. and F.B.) independently extracted data from eligible observational studies. Disagreements were resolved by consensus and a third author if needed (am). For all observational studies, we extracted data on the first author, publication year, study country, sample size, population characteristics, the prevalence of suicide risk, the prevalence of depression and/or anxiety, and the type of tools used for detecting these conditions [16]. In the case of multiple publications, we included the most up-to-date or comprehensive information. Two investigators independently evaluated the risk of bias for each eligible observational study. We used the Newcastle-Ottawa scale (NOS). Any disparities in scoring were reviewed, and consensus was obtained following discussion.

The effect sizes of the primary outcome measures of interest for each study were displayed as pooled prevalence and 95% confidence intervals (CI) for the suicide risk in patients with renal failure undergoing hemodialysis or peritoneal dialysis. The overall estimate of effect size was calculated using a random-effects model. We used the Score (Wilson) method to compute the confidence intervals.

Visual inspection of the forest plots was used to estimate the heterogeneity. The heterogeneity across the included observational studies was also tested by the I^2 -statistics. The interpretation of the I^2 -statistics is as follows: I^2 -values of approximately 25% show low heterogeneity, I^2 -values of approximately 50% show medium heterogeneity, whereas

I^2 -values of approximately 75% show high heterogeneity. Publication bias was assessed by the visual inspection of the funnel plots and Egger's regression test.

Subgroup analyses were also performed to test the potential effect of specific factors (such as assessment tools, prevalence of anxiety and depression, income) on the effect size for the pooled prevalence of the suicide risk in patients with renal failure undergoing hemodialysis or peritoneal dialysis. Univariable meta-regression analyses were also performed to test the potential effect of other moderator variables (such as age, sex, and percentage of patients with type 2 diabetes [T2DM]) on the effect size for the pooled prevalence for the suicide risk in patients with renal failure undergoing hemodialysis or peritoneal dialysis. Finally, we tested for possible excessive influence of individual studies using a meta-analysis influence test that eliminated each included study one at a time.

Given that the aim of the present meta-analysis and systematic review was to assess the prevalence of suicide risk in patients undergoing hemodialysis, we did not assess the risk of bias using formal tools, as a validated tool for these meta-analyses has not yet been developed [17].

All statistical tests were two-sided and used a significance level of p -value <0.05 . All statistical analyses were performed using R software V.4.4.0 (R Foundation for Statistical Computing, Vienna, Austria) with “meta” and “metafor” packages.

3. Results

The results of the literature search and study selection are summarized in Figure 1. Based on the titles and abstracts of

430 selected papers (after excluding duplicates), we initially identified 30 potentially eligible studies from PubMed, Scopus, Google Scholar, and Web of Science databases. After reviewing the full text of these potentially eligible studies, we excluded 18 studies [12,18–34] due to unsatisfactory inclusion criteria, such as patients with renal failure not on dialysis, kidney transplant recipients, and/or unsatisfactory outcome measures. 12 unique [10,11,35–44] cross-sectional studies involving 1259 patients of various ages on dialysis were included. The characteristics of the studies are described in Table 1. Briefly, the patients were primarily male (54.65%) and married (32.09%), with a mean age of 54.42 years. T2DM was diagnosed in 10.80% of the entire cohort. All patients were receiving hemodialysis (HD) treatment. At univariate meta-regression, no significant effect of age, sex, and percentage of patients with T2DM on the prevalence of suicide risk in HD patients was found (Table 2).

Overall, the prevalence of suicide risk in individuals treated with hemodialysis is high (20.60%; 95% CI, 12.45–32.13; $I^2 = 91\%$) (Figure 2). The prevalence varied widely among studies, ranging from 4.00% to 57.33%, with only two studies [38,39] reporting a prevalence of more than 50% of the sample. Of note, four studies contributed over 60% of the total data. Given the significant heterogeneity and relative weight of a few studies, we used the meta-analysis influence test to determine the robustness of the findings. In a procedure similar to bootstrapping, we sequentially removed each time one of the twelve studies from the pooled primary analysis. This did not materially alter the prevalence of suicide risk (Figure 3). The prevalence of suicide risk was detected using specific tools or direct questions about the severity of

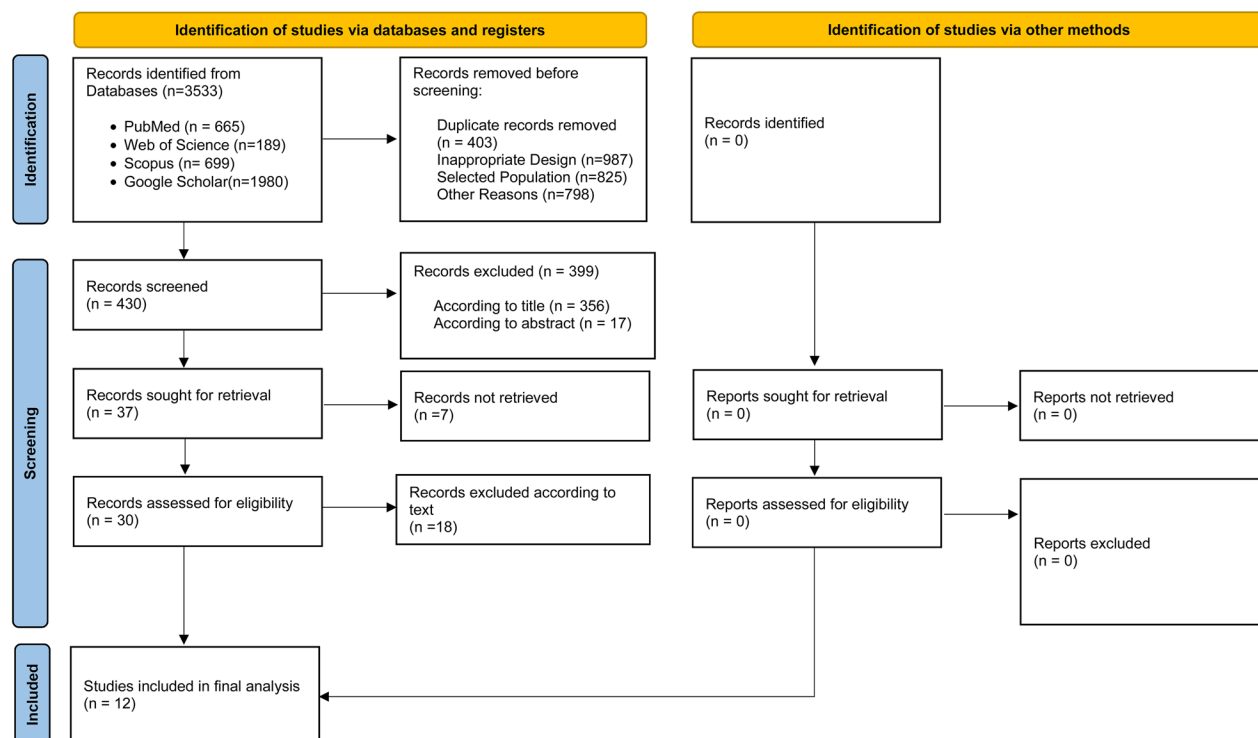


Figure 1. Prisma flow diagram.

Table 1. Summary of characteristics and assessment tools used in the 12 included cross-sectional studies.

Authors, year, country, study design, (PMID) [ref]	Sample		Intervention	
	Inclusion/exclusion criteria	Sample Size	Study Duration (months)	Assessment Tools
Khoury et al., 2023, Lebanon, cross-sectional, (37087412) [34]	<u>Inclusion:</u> - Age > 18 years - HD treatment <u>Exclusion:</u> - History of major neurocognitive disorder/dementia or intellectual disability	42	6	- Hospital Anxiety and Depression Rating Scale - Direct questions regarding wishes/ thoughts, plans, attempt
Korkut et al., 2021, Turkey, cross-sectional, (35770373) [35]	<u>Inclusion:</u> - Age > 18 years - HD treatment for at least 1 year - Communication, reading, and understanding ability <u>Exclusion:</u> - Psychiatric treatment in the last 3 months - Serious psychiatric and neurological disorders impairing cognition	114	3	- Turkish Death Anxiety Scale - Suicide probability scale
Romano et al., 2022, Brazil, cross-sectional, (35475809) [36]	<u>Inclusion:</u> - Age > 18 years - HD patients waiting on a list for the transplantation of insulin-dependent <u>Exclusion:</u> None	39	NA	- Beck Depression Inventory - Beck Anxiety Inventory
Elkheir et al., 2020, Sudan, cross-sectional, (33102343) [37]	<u>Inclusion:</u> - End-stage renal disease undergoing dialysis <u>Exclusion:</u> - Drug abuse - Low general medical condition - Depression diagnosis	75	3	- Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition - Text Revision (DSM-IV-TR)
Wang et al., 2018, China, cross-sectional, (30577220) [38]	<u>Inclusion:</u> - HD treatment for at least 1 year - Stable clinical status <u>Exclusion:</u> - Acute infectious or concomitant disease - Time since renal transplant of less than 1 year	42	24	- Structured Clinical Interview for the diagnostic and statistical manual IV
Loureiro et al., 2017, Brazil, cross-sectional, (28972917) [10]	<u>Inclusion:</u> - Age > 18 years - HD treatment for over 3 months <u>Exclusion:</u> - Inpatients - Kidney transplant recipients - Health conditions preventing participation in the study	264	12	- Mini International Neuropsychiatric interview
El Filali et al., 2017, Morocco, cross-sectional, (28352018) [39]	<u>Inclusion:</u> - Age > 18 years - HD treatment for at least 1 month - Moroccan dialect speakers <u>Exclusion:</u> - Intellectual disability - Sensory deficit - psychiatric disorder	103	12	- Mini International Neuropsychiatric interview
Song et al., 2017, North Carolina, cross-sectional, (25998623) [40]	<u>Inclusion:</u> - Age > 18 years - HD treatment for at least one month - English speakers <u>Exclusion:</u> - Hearing impairment - Ill to participate in an hour-long data collection session - > 3 errors on a gross cognitive screening test - Advanced dementia assessed by 10-item Short Portable Mental Status Questionnaire	210	12	- Center for Epidemiologic Studies Depression Scale-Short Form (CESD-SF)
Andrade et al., 2015, Brazil, cross-sectional, (25923751) [41]	<u>Inclusion:</u> - HD treatment for more than six months - Clinical successful treatment adopted - Age: 18-65 years - Outpatients - No clinical complications for at least four months before the interview - Good treatment compliance - Clinical stable conditions <u>Exclusion:</u> - Cognitive disorders - History of psychiatric illness - Use of psychotropic agents - Scheduled kidney transplant - Unwillingness to participate	50	12	- Instruments-Beck Hopelessness Scale - Beck Scale for Suicide Ideation - Beck Depression Inventory
Macaron et al., 2013, Lebanon, cross-sectional, (24337520) [42]	<u>Inclusion:</u> - Age > 18 years - French or English speakers <u>Exclusion:</u> - Psychiatric illness other than mood disorders - Temporary dialysis for acute renal failure	51	1	- Hospital Anxiety and Depression Score (HADS) - Mini International Neuropsychiatric Interview (module C)

(Continued)

Table 1. Continued.

Authors, year, country, study design, (PMID) [ref]	Sample	Sample Size	Intervention	
	Inclusion/exclusion criteria		Study Duration (months)	Assessment Tools
Martiny et al., 2011, Brazil, cross-sectional, (21193182) [43]	<u>Inclusion:</u> - Age > 18 years - HD sessions 3 times a week for more than 30 days <u>Exclusion:</u> - Bearers of HIV - Hepatitis C virus - Psychotic disorder	69	NA	- Mini International Neuropsychiatric interview
Chen et al., 2010, Taiwan, cross-sectional, (21051686) [9]	<u>Inclusion:</u> - Age > 18 years - HD treatment <u>Exclusion:</u> None	200	24	- Hospital Anxiety and Depression Score (HADS) - Mini International Neuropsychiatric Interview (module C)

HD: hemodialysis; HIV: human immunodeficiency virus; NA: not available.

Table 2. Univariate meta-regression analyses evaluating the effects of age, sex, and percentage of patients with established type 2 diabetes on the suicide risk prevalence in patients on dialysis.

Variables	Beta coefficients (standard errors)	P values
Age, years	0.0273 (0.0398)	0.4918
Men, %	-0.0207 (0.0691)	0.7645
Type 2 Diabetes, %	-0.0109 (0.0259)	0.6733

suicidal ideation, passive death wishes, or specific suicide plans or attempts. The severity of suicide risk or suicide ideation (i.e. low, moderate, severe) was not analyzed due to the high heterogeneity of available data.

Next, we examined the prevalence of suicide risk stratified for the various assessment strategies employed in the studies (Figure 4). These approaches were categorized into self-report scales, Mini Neuropsychiatric Interview (MINI), and other structured or unstructured clinical interviews (see Table 3 for details on the tools). Three studies [35,38,39] assessed suicide risk in 159 patients using either structured or unstructured clinical interviews, detecting a prevalence of 48.95% (95% CI, 34.56-63.52; $I^2=69$). Specifically, one study [38] employed the Structured Clinical Interview for DSM (SCID). In contrast, the other two studies used unstructured clinical interviews based on either the Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition - Text Revision (DSM-IV TR) criteria [38] or the interviewer's clinical judgment alone [35].

Compared to clinical interviews, a lower prevalence of 22.11% (95% CI, 15.19-31.05; $I^2=78$ %) was reported using the suicide risk module of MINI [45], a brief structured diagnostic interview across a total of 687 patients in five studies [10,11,40,43,44] (Table 3). This module allows for an accurate and straightforward evaluation of suicide risk.

In contrast, the prevalence of suicide risk using self-report scales was lower (8.00%; 95% CI, 5.71-11.10; $I^2=0$) in four studies [36,37,41,42] involving 413 patients. There was high heterogeneity among the four self-report scales administered. Two of these were specifically designed to aid in the assessment of suicide risk: the Suicide Probability Scale (SPS) [46] and the Back Scale For Suicide Ideation (BSI) [47]. The other two self-report scales, the Center for Epidemiologic Studies Depression Scale-Short Form (CESD-SF) [48] and Beck Depression Inventory (BDI) [49], were primarily developed for

assessing depression with good reliability but also included items to evaluate the severity of suicide ideation (Table 3).

As suicide risk is related to other psychological problems, we analyzed the suicide risk in relation to the presence of anxiety and/or depression (Figure 5). A threshold of 40% was adopted, categorizing the studies into two groups based on the percentage of patients with depressive and anxiety symptoms.

The suicide risk in three studies [35,37,38,41], where more than 40% of patients exhibited symptoms of anxiety and depression, was similar (21.03%; 95% CI, 6.22-51.65; $I^2=96$ %) compared to the other group (20.60%; 95% CI, 12.45-32.13; $I^2=91$ %). The majority (8 out of 12) of studies, comprising 893 patients, reported that less than 40% of patients experienced symptoms of anxiety and/or depression. High heterogeneity was observed in the tools and related cutoffs used to detect depression and anxiety. For instance, three studies [9,35,43] used the Hospital Anxiety and Depression Scale (HADS), a self-report tool. However, they applied different cutoffs for anxiety and depression: ≥ 7 for depression and ≥ 6 for anxiety, ≥ 7 for anxiety and depression [35,43] (preferable for HD patients), or ≥ 8 [9] (significant in the general population). Additionally, three studies [10,35,43] used different tools for assessing the prevalence of anxiety and depression as well as suicide risk (self-report measure vs MINI or unstructured clinical interview).

We then examined the geographic spread of the included studies. Most studies came from Brazil ($n=4$), the Middle East ($n=3$), Africa ($n=2$), and China ($n=2$, one from mainland China, one from Taiwan). We identified only one study from the US and none from the European Union. Given the known association between income level and the risk of psychological problems, we then analyzed the prevalence of suicide risk based on the income levels of the countries (Figure 6). Income levels were categorized using the World Bank's classification system, accessible at World Development Indicators [50], corresponding to the year in which each study was conducted. For this analysis, the "high" and "high-middle" as well as "low" and "low-middle" income classifications were grouped as "high" and "low", respectively.

The prevalence of suicide risk (33.49%, 95% CI, 19.79-50.69; $I^2=89$ %) among 420 patients living in low-income countries (Morocco, Sudan, Lebanon, China [2007-2009 years]) [10,35,

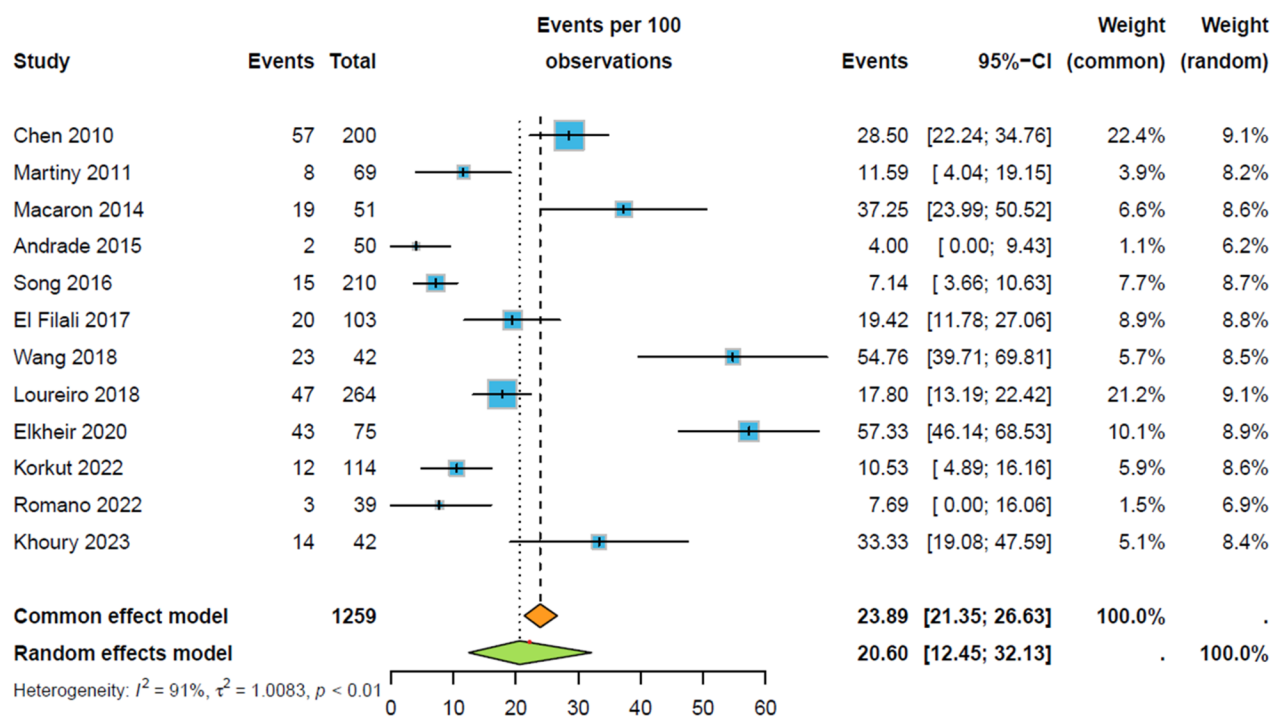


Figure 2. Forest Plot and pooled estimates of suicide risk prevalence.

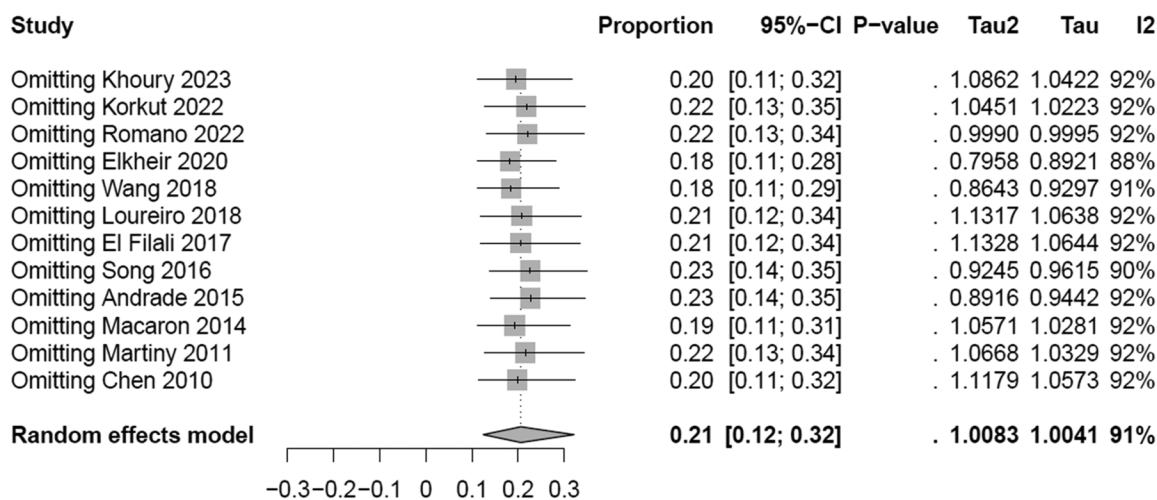


Figure 3. Meta-analysis estimates, given named study is omitted (for all 12 studies).

38,40] was more than double that observed (15.28%, 95% CI, 7.74-27.92; $I^2=90\%$) among 839 patients living in high-income countries (Brazil, Lebanon, North Carolina, Turkey, China [2011-2012 years]) [11,36,37,39, 41-44].

Publication bias was unlikely, as shown in Figure 7. Egger's regression test revealed no statistically significant asymmetry in the funnel plots of the 12 eligible studies examining the prevalence of suicide risk.

Discussion

This is the first systematic review and meta-analysis of twelve observational studies, identifying a prevalence of suicide risk

of 20.6% among 1259 patients undergoing dialysis. This figure is remarkably high compared to the general population, where rates range from 1.53 to 10.50 per 100 individuals for suicidal ideation and from 0.01 to 1.5 per 100 individuals for suicide attempts [51]. This finding is consistent with a previous study indicating that the risk of suicide was over 30% higher in patients undergoing HD compared to those without chronic kidney disease (CKD) [11].

The first possible explanation is the significant burden of comorbidities, including hypertension, diabetes, coronary artery disease, congestive heart failure, and cerebrovascular disease. Gomez et al. found that at the start of dialysis, 48% of patients had diabetes, 31% had a history of myocardial infarction, and

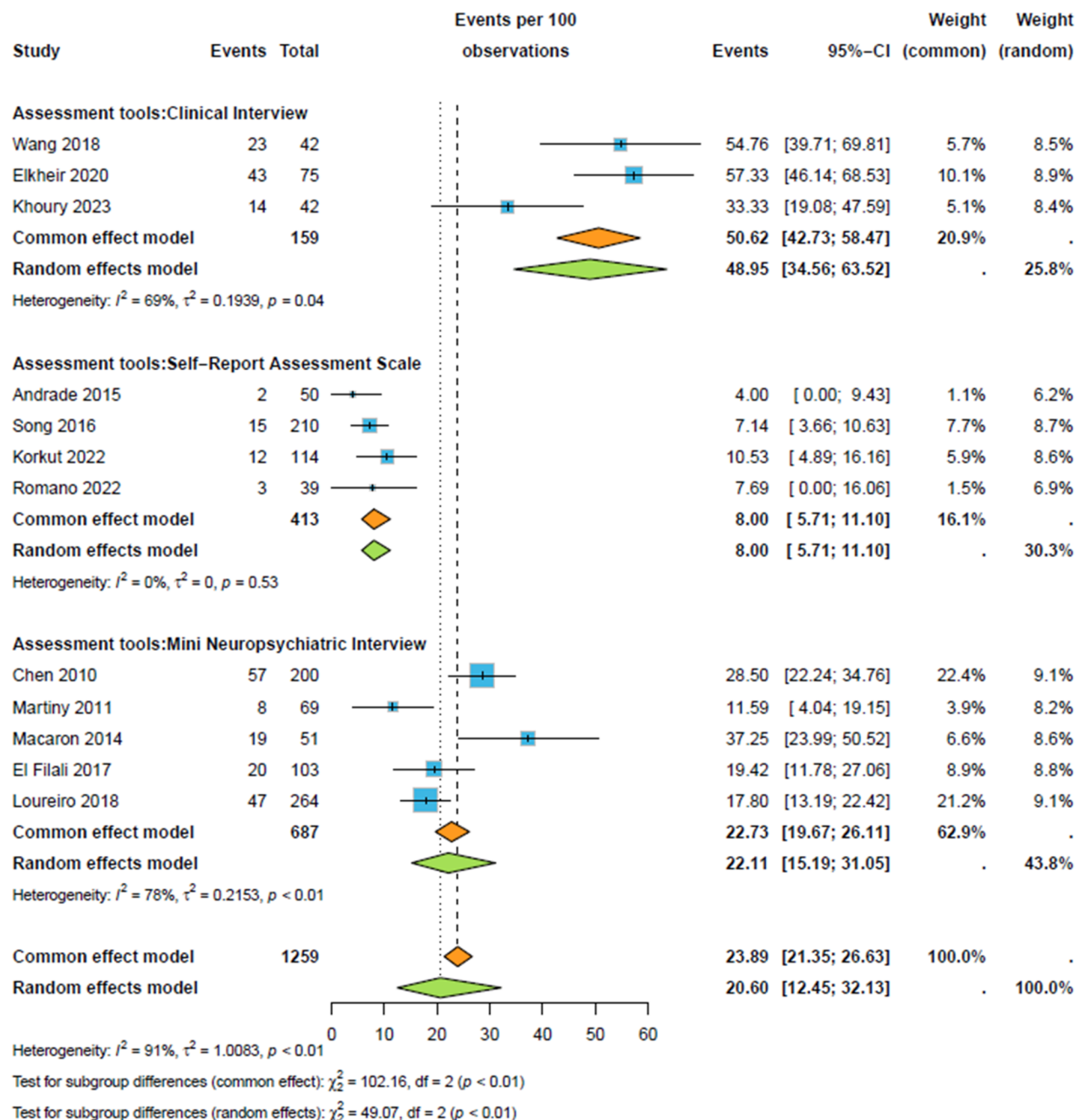


Figure 4. Forest Plot and pooled estimates of suicide risk prevalence by assessment tools.

22% had congestive heart failure [52]. The presence of multiple physical health conditions is known to amplify the risk of suicidal behavior, as these comorbidities can significantly impact mental health and overall well-being [53,54].

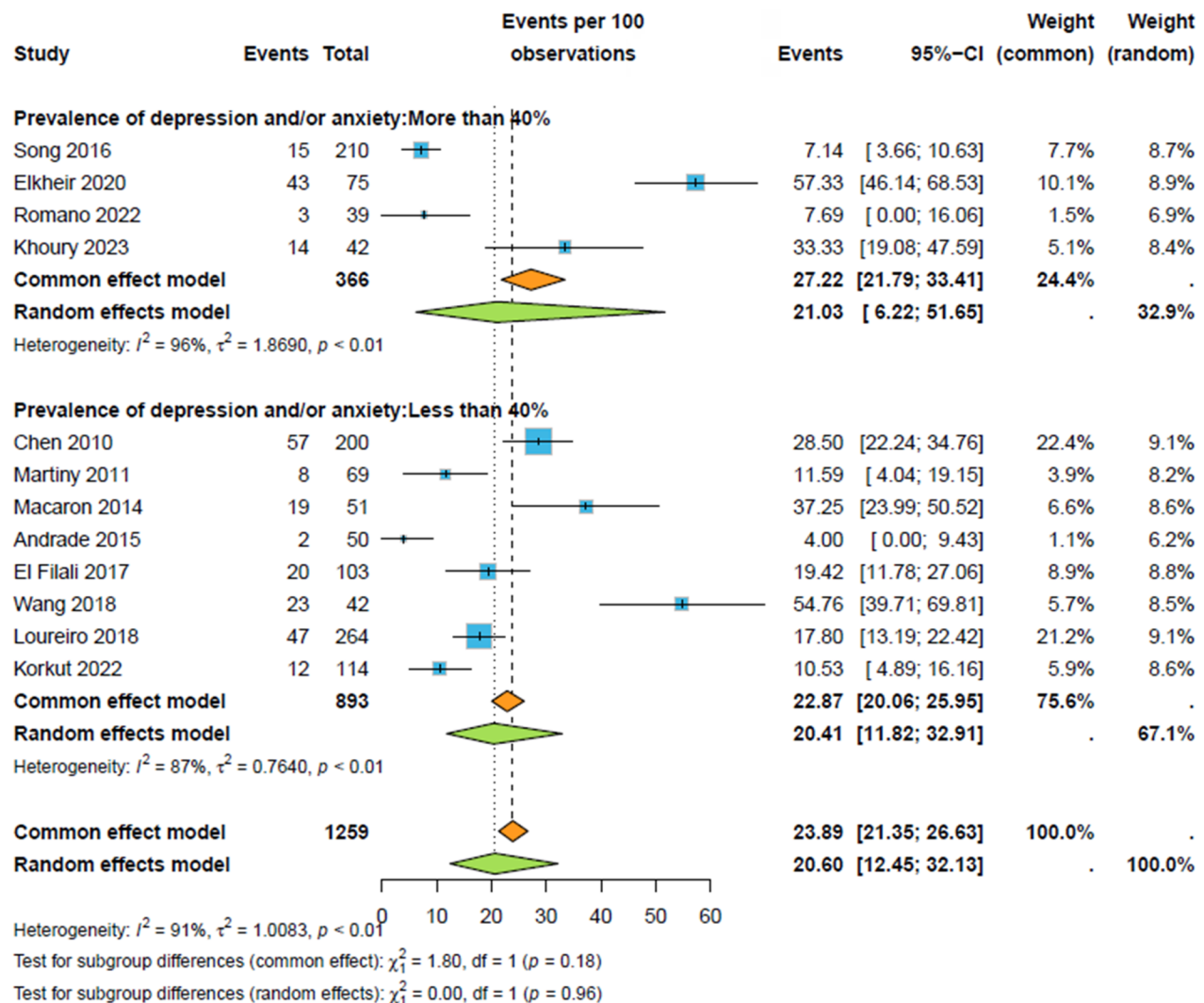
Secondly, it might be related to the direct impact of renal failure. Jhee et al. observed that the prevalence of suicidal ideation tended to increase as the glomerular filtration rate declined [55]. Recent studies have also highlighted the complex interplay of inflammation, hormonal imbalances, and nutritional deficiencies with suicidal ideation in patients with HD [56]. Specifically, vitamin D (vit-D) deficiency has been shown to intersect with mental health in CKD patients [57]. It is well-documented that individuals with CKD often suffer

from insufficient vit-D levels [58]. This deficiency is linked not only to physical health problems [59,60] but also to mental health conditions, including major depressive disorder and suicidal ideation. While further research is necessary to fully understand the relationship between vit-D levels and suicide, current evidence suggests a relationship between lower vitamin D levels and increased risks of depression and suicidal behavior [61]. Indeed, Vit-D appears to play a protective role by inhibiting the synthesis of inflammatory markers such as IL-6, a key cytokine associated with suicidal tendencies [56]. Conversely, vit-D deficiency is associated with higher levels of these inflammatory markers, which may exacerbate depressive symptoms and suicidal thoughts [62,63].

Table 3. Findings of the tools used across the 12 studies.

Clinical Interview	Characteristics
Structured Clinical Interview. (SCID)	It is a semi-structured interview administered by trained clinicians, designed to yield psychiatric diagnoses in adults consistent with DSM-IV/DSM-IV-TR diagnostic criteria. Open-ended questions introduce each content area (e.g., "Have you ever had...?"), followed by a series of scripted questions that are asked verbatim.
Mini Neuropsychiatric Interview (MINI)	It is a structured interview based on the DSM-IV, consisting of modules for 17 psychiatric diagnoses. Questions are phrased to elicit "yes" or "no" answers. Modulo C pertains to suicide risk, which is scored as "No risk" (0 points), "Low" (1–8 points), "Moderate" (9–16 points), and "High" (≥ 17 points).
Self-Report Assessment Scale	
Suicide Probability Scale (SPS)	It measures 36 items on a four-point Likert scale, ranging from 1 (never) to 4 (always). Higher scores indicate a greater risk of suicide.
Beck Scale for suicidal ideation (BSI)	It is a scale that evaluates the presence of suicidal ideation and the severity of thoughts, plans, and desire for suicide, helping to identify individuals at risk. A score > 0 indicates suicidal ideation and warrants attention.
Beck Depression Inventory-II (BDI-II)	Item nine is used to measure patients' explicit expression of thoughts about death. It consists of a four-point Likert scale, with scores ranging from 0 (no suicidal thoughts), 1 (suicidal thoughts without action), 2 (desire to kill oneself), to 3 ("I would kill myself if I had the chance").
Center for Epidemiologic Studies Depression Scale – Short Form (CESD-SF)	The 11th item assesses suicidal ideation with the statement "I had thoughts of ending my life"). Response options range from 0 to 3.

DSM-IV-TR: Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition - Text Revision.

**Figure 5.** Forest Plot and pooled estimates of suicide risk prevalence by anxiety and/or depression.

In the second step of our analysis, we found a similar prevalence of suicide risk in cohorts with high or low levels of anxiety and depression. These findings align with the existing literature in other settings, as both

conditions are strongly associated with suicide ideation [64,65].

These high-risk suicide rates, even in HD populations with a low prevalence of anxiety and depression, can be due to

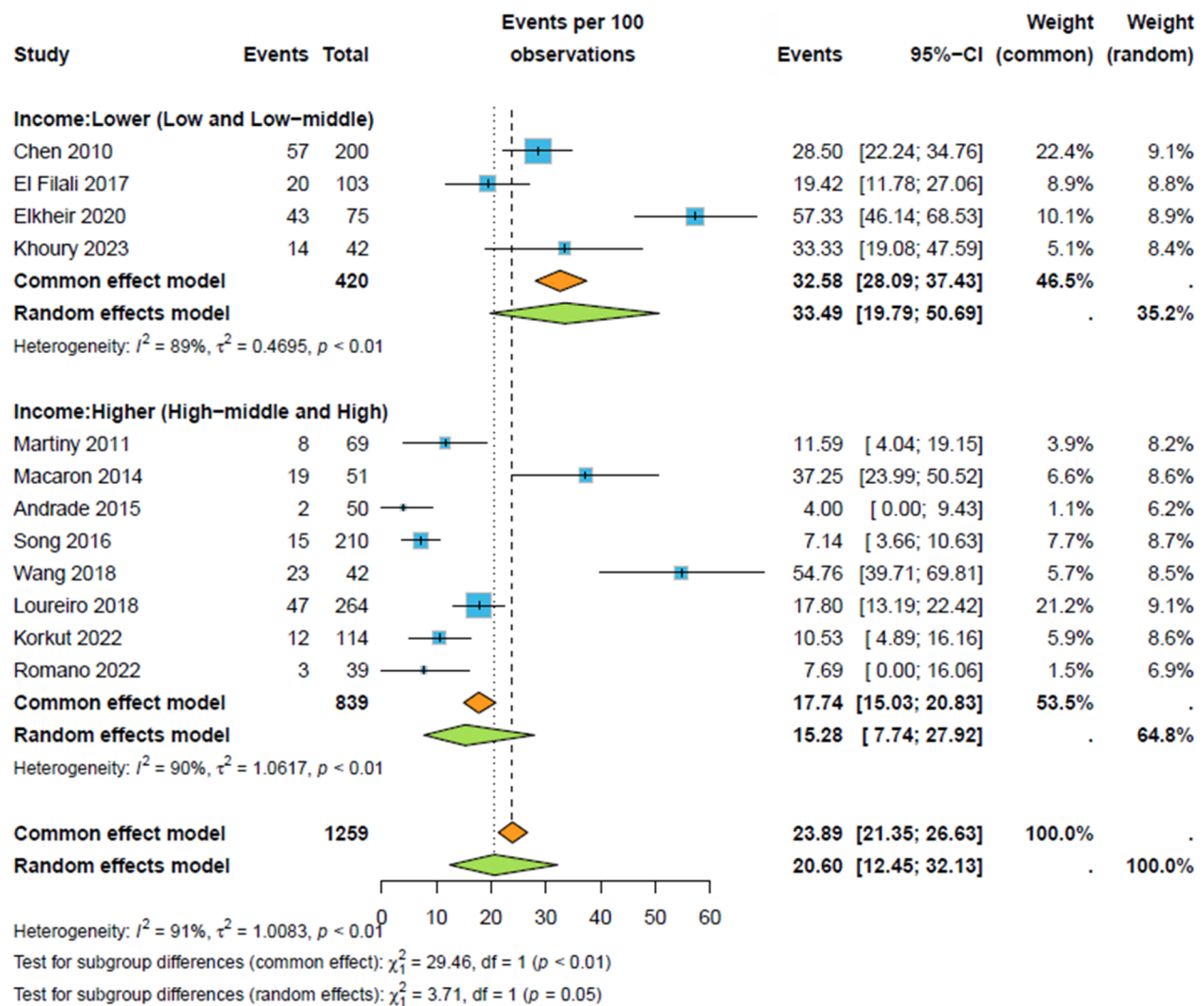


Figure 6. Forest Plot and pooled estimates of suicide risk prevalence by income.

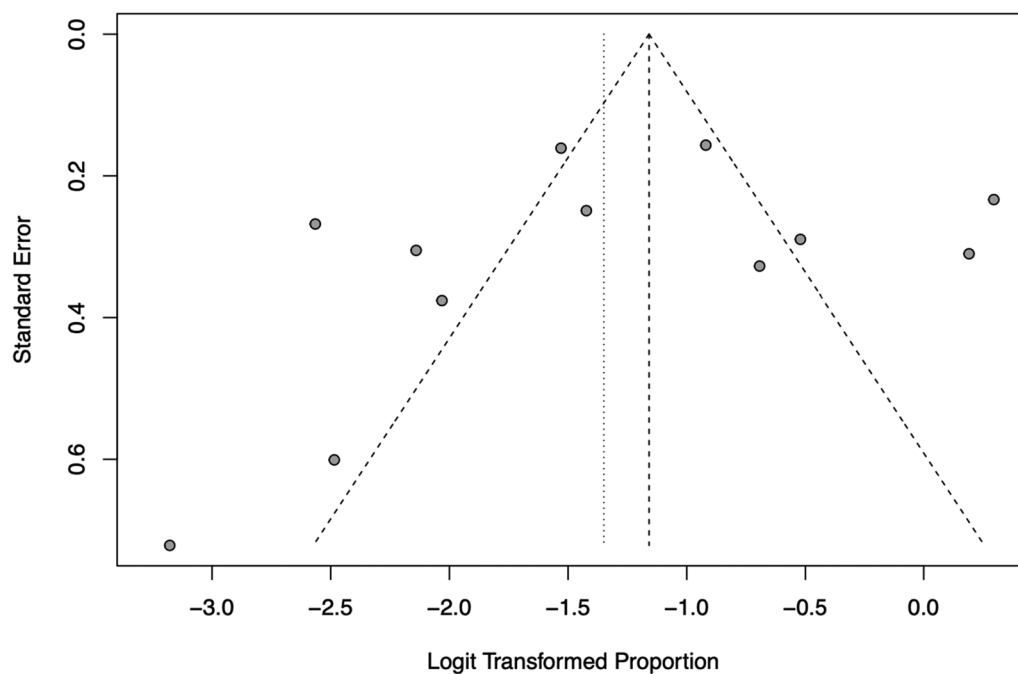


Figure 7. Funnel plots of the 12 studies assessing the suicide risk prevalence.

various factors, including comorbidities, antihypertensive medications, creatinine and blood urea nitrogen levels, body mass index, the vintage of hemodialysis, the length and frequency of hemodialysis sessions, the type of vascular access, and the lifestyle changes (e.g. dietary and fluid restrictions) [43,66–68]. Studies have shown that marital consensus, affection, overall satisfaction, and cohesion are markedly poorer in HD patients compared to controls [69–71]. An early study found that more than half of couples involving a patient with renal failure experienced marital disruption [72]. These strains on marital relationships can exacerbate feelings of isolation and emotional distress. These obstacles can profoundly impact mental health, increasing the risk of suicide and/or developing anxiety and depression [5] as interrelated phenomena. These two risks can combine and influence each other negatively, creating a dangerous vicious circle.

Furthermore, a meta-analysis and systematic review have demonstrated that spirituality (S) and religiosity (R) positively impact most parameters of quality of life in patients on dialysis. However, assessment of patients' R/S needs is not routinely performed, even though R/S plays a fundamental role in coping strategies during dialysis, influencing depression and suicidal risk [73].

A further analysis of our study revealed notable variations in the prevalence of suicide risk depending on the assessment tool used. The prevalence of suicide risk was 48.95% when assessed through structured or unstructured clinical interviews (excluding MINI), 22.11% using the MINI, and 8.00% *via* self-report scales. Previous research indicates that the choice of assessment method can significantly influence participant responses [74].

Clinical interviews, including MINI, provide more detailed and nuanced insights, often resulting in higher reported prevalence rates. However, these structured interviews require the expertise of mental health expert professionals. Therefore, self-report scales are anonymous [75], more convenient, less resource-intensive, and can be easily administrated by healthcare personnel in HD units. Despite these advantages, self-report scales may not fully capture the complexity of suicidal ideation. For instance, the BDI, used in some studies, might have led to an underestimation of suicide risk due to its specific items on suicidal ideation, even though it has good psychometric properties [76]. Similarly, the addition of a single item on suicidal ideation in the CESD-SF could also impact the reported prevalence in the study of Song et al. [41]. Generally, using self-report scales with a single item to assess suicide risk is not recommended, as these scales may not fully capture the complexity of an individual's thoughts and behaviors [77].

These findings underscore the importance of selecting an appropriate and comprehensive approach for accurately assessing suicide risk among HD patients. Future research should focus on developing and validating reliable self-report screening scales to identify, at an early stage, patients who require referral to psychiatrists for structured clinical interviews. This approach could enhance the accuracy of suicide risk assessments while accommodating the practical

constraints of healthcare settings. Additionally, a standardized approach would increase clinical suspicion of suicide risk, improve awareness among patients and healthcare personnel, reduce data heterogeneity, and promote further large-scale multicenter prospective trials in HD patients.

Furthermore, when analyzing the prevalence of suicide risk based on the income level of the country, a marked difference was found. Specifically, a prevalence of 33.49% in low-income countries compared to 15.28% in high-income countries was observed. This disparity aligns with broader trends, as 77% of suicides occur in low- and middle-income countries (LMICs) [52]. There is a well-documented positive association between poverty and suicide, though this relationship is complex and multifaceted [78]. Several factors contribute to this relationship, including social integration, the lack of unemployment, the absence of robust social welfare systems, the high rates of crime and violence, and the lack of access to healthcare, mainly mental health services [79–84].

Another underrecognized contributor to risk suicide is the patient's willingness to withdraw from dialysis. Historically, this has been considered a form of suicide, but in many countries, dialysis can be discontinued when it no longer serves a meaningful purpose for the patient [85]. Although there are broad ethical and legal consensus permitting the cessation of dialysis, a deep assessment should be conducted to evaluate whether the desire to stop treatment stems from underlying psychological factors [86].

However, it is worth noting that even in high-income countries, access to mental health professionals, like psychologists, can be limited for HD patients. The integration of physiological and mental support is fundamental for improving these patients' health-related quality of life. Therefore, healthcare systems should consider investing more resources into promoting a multidisciplinary approach that includes physical and mental support for HD patients [87].

The main strength of this meta-analysis is its pioneering identification of the prevalence of suicide risk in patients undergoing dialysis. This topic is crucial in the field of dialysis, where there is an ongoing debate about whether withdrawal from dialysis should be considered a suicidal act (given that it is a life-sustaining therapy) or an expression of self-determination to cease unnecessary suffering [88]. Additionally, to ensure the highest level of reliability, two reviewers independently conducted the literature search, data extraction, and bias assessment with oversight from a third reviewer. This process was guided by a prespecified and preregistered review protocol, enhancing the rigor and validity of our findings.

Despite this, our meta-analysis also has some important limitations. (I) Discrepancies in the term "suicide risk": the varying definitions adopted across the studies limit the generalizability of our results. Distinguishing between passive suicidal ideation, active suicidal ideation, and suicide attempts is crucial [80]. For example, passive suicidal ideation involves thoughts of death without specific intent or plans, while active suicidal ideation includes thoughts with a clear intent or plan to act on them. The presence of chronic, vague ideation

without intent may not necessarily indicate an immediate risk, suggesting that an ambulatory approach might be more appropriate than hospitalization for some individuals [89]. In contrast, detailed plans and intent represent a significantly higher risk that requires immediate intervention. Future studies should adopt more precise and consistent definitions of suicidal behaviors and risks in HD patients to standardize these terms and enhance the comparability of studies. (II) High heterogeneity among the collected data: the studies exhibited differences in target parameters, measurement methods, and study populations [90,91]. Despite using random-effects meta-analysis to mitigate these effects, the conclusions must be interpreted with caution and may not be generalizable to all contexts. (III) Lack of some confounding variables: physical activity [92,93], socio-demographic factors (e.g. education, unemployment) and biopsychosocial factors (e.g. history of psychiatric disorder) were not accounted for.

Conclusions

Our study revealed a significant prevalence of suicide risk among hemodialysis patients, with a rate notably higher than that observed in the general population. However, data from Europe and Australia are non-existent, and data from other regions with many patients on maintenance dialysis (e.g. the US and China) are scant. These findings underscore the need for comprehensive mental health support and tailored interventions to address both the physical and psychological needs of HD patients. These efforts are essential to improving their overall health-related quality of life and reducing the risk of suicidal behavior. Continued research is essential to understand and mitigate these complex challenges, aiming to provide better care for this vulnerable population.

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Author contributions

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Ethical approval

The study has been conducted according to the 1995 Declaration of Helsinki and its revisions

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ORCID

Luigi Zerbinati  <http://orcid.org/0000-0001-6821-1005>
 Federica Caccia  <http://orcid.org/0009-0003-3179-9193>
 Federica Baciga  <http://orcid.org/0009-0002-8866-3660>
 Martino Belvedere Murri  <http://orcid.org/0000-0002-7262-3528>
 Pasquale Esposito  <http://orcid.org/0000-0002-0834-5586>
 Rosangela Caruso  <http://orcid.org/0000-0002-6662-2270>
 Ionut Nistor  <http://orcid.org/0009-0003-1659-7294>
 Bjorn Meijers  <http://orcid.org/0000-0002-2846-2026>
 Carlo Basile  <http://orcid.org/0000-0001-8152-5471>
 Christian Combe  <http://orcid.org/0000-0002-0360-573X>
 Luigi Grassi  <http://orcid.org/0000-0002-1050-4494>
 Alessandro Mantovani  <http://orcid.org/0000-0002-7271-6329>
 Yuri Battaglia  <http://orcid.org/0000-0003-3947-1814>

Data availability statement

The data underlying this article will be shared on reasonable request to the corresponding author.

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