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Review Article

Factors associated with stigma in patients undergoing hemodialysis: a meta-analysis and systematic review

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Abstract: Background: Patients with hemodialysis (HD) frequently encounter stigma, which impacts their social network and adherence to treatment, increasing their risk of depression and lowering their quality of life. The factors associated with stigma among patients with HD remain poorly understood due to insufficient evidence. To fill this gap, this meta-analysis was conducted. Methods: We carried out a thorough literature review in both Chinese and English databases like China National Knowledge Infrastructure (CNKI), Wan Fang Knowledge Data Service Platform, PubMed, Embase, PsycINFO, CINAHL (Cumulative Index to Nursing and Allied Health Literature) and Web of Science. We included literature up to May 25, 2024, focusing on the levels and factors related to stigma in HD patients. Data extraction and quality assessment of the included literature were separately carried out by two researchers, who also independently did the literature screening. Data analysis was carried out using Stata 15.1 software. The possible sources of heterogeneity were explored by sensitivity analysis and subgroup analysis, and the robustness of the results was evaluated. Results: A total of 12 papers were included, and the quality of these papers was evaluated as moderate or above. The findings of the meta-analysis demonstrated that the pooled stigma mean score was 59.30 [95% (Confidence interval) *CI*: 55.62 to 62.97]. Per capita monthly family income [*MD (Mean Deviation)* =4.95, 95% CI (1.55 to 8.35), *P*=0.004], residence [*MD*=-4.66, 95% CI (-6.96 to -2.36), *P*<0.001], complications [*MD*=4.76, 95% CI (0.92 to 8.61), *P*=0.015], family function [*Z*=-0.29, 95% CI (-0.38 to -0.21), *P*<0.001], self-efficacy [*Z*=-0.37, 95% CI (-0.48 to -0.26), *P*<0.001], levels of social support [*Z*=-0.35, 95% CI (-0.45 to -0.25), *P*<0.001], and levels of psychological distress [*Z*=0.59, 95% CI (0.26 to 0.91), *P*<0.001] were all significant factors contributing to stigma in patients undergoing HD. Conclusion: Healthcare professionals should pay attention to the early assessment of stigma in patients with HD, implement personalized interventions targeting related factors, and promote effective coping strategies for managing the disease.

Keywords: Hemodialysis, stigma, related factors, systematic review, meta-analysis

Introduction

Renal replacement therapy is essential for managing end-stage renal disease (ESRD), with Hemodialysis (HD) being a critical modality [1]. Nevertheless, dialysis treatment can maintain the life of patients with ESRD, but cannot completely replace the renal function of the patients [2-4]. The patients frequently experience physical symptoms like itchy skin, bone pain, skin pigmentation, restless leg syndrome, and sleep disorders, as well as negative psychological experiences like anxiety, depression and stigma, which seriously impair the patients' quality of life.

Stigma, a negative cognitive psychological response to visible symptoms or physical defects caused by illness, diminishes the patient's self-perception and societal interactions, leading to heightened psychological distress, poor social networking, decreased treatment adherence, increased depression risk, and overall reduced compliance with treatment protocols [5-9]. However, findings regarding the factors associated with stigma in HD patients are varied and sometimes contradictory [10-12]. Thus, this study employs a meta-analysis to synthesize existing research on the factors related to stigma in HD patients, aiming to provide a scientific basis for developing effective interventions to

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reduce stigma and promote adaptive coping strategies for these patients.

Methods

The protocol of the meta-analysis was registered in PROSPERO (http://www.crd.york.ac.uk/prospero/), with registration number of CRD42023460179. The research report follows the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [13]. Supplementary Appendix B in Supplementary Material 1 provides the details of the list.

Search strategy

The search covered the period from each database's inception until May 25, 2024. We utilized both Chinese and English databases, including the China National Knowledge Infrastructure (CNKI), Wan Fang Data Knowledge Service Platform, China Biomedical Literature Database, Cochrane Library, Embase, CINAHL (Cumulative Index to Nursing and Allied Health Literature), PsycINFO, Web of Science, and PubMed. The search terms were focused on a combination of subject headings and free text terms related to both the medical condition and the social perceptions, including: "dialysis", "hemodialysis", "blood purification", "end-stage renal disease", "end-stage kidney disease", "uremia", "chronic renal failure", along with "social stigma", "humiliation", "dishonor", "shame". The details of the search strategy are documented in Supplementary Appendix A of Supplementary Material 1.

Inclusion and exclusion criteria

Inclusion criteria: (a) Studies involving adult patients with HD; (b) Studies reporting on the relationship between stigma and HD, such as a correlation coefficient (r); (c) Studies where the validity and reliability of the stigma assessment tool have been confirmed [14, 15]; (d) Studies examining exposure factors related to stigma in patients undergoing HD; (e) Research outcomes reported in statistical indicators like MD (Mean Deviation) or Pearson correlation coefficient (r). Exclusion criteria: (a) Literature that cannot be accessed in full text; (b) Conference reports, reviews; (c) Studies published in a language other than the Chinese and English language; (d) Studies where statistical data could not be extracted or converted; (e) Studies evaluated as being of low quality.

Quality assessment of included studies

The evaluation of the included studies was independently conducted by two researchers trained in evidence-based nursing techniques. In cases of a disagreement or inconsistency, the two evaluators discussed everything in order to reach a consensus. The Agency for Healthcare Quality and Research's (AHRQ) standards for cross-sectional research quality evaluation were used to rate the literature quality [16]. The assessment tool incorporated 11 criteria, each answerable with "yes", "no", or "unclear", 1 for "yes" and 0 for "no" or "unclear", leading to a maximum possible score of 11. The overall score determined the quality level of the study: scores of 8 or above were considered excellent, scores between 4 and 7 indicated medium quality, and scores below 4 were deemed low quality. Studies scoring below 4 were excluded to minimize research bias.

Data extraction

Data extraction was also performed independently by the same two researchers. They conducted a thorough review of the literature by initially screening titles and abstracts, followed by a detailed examination of the full texts based on the pre-defined inclusion and exclusion criteria. After reading, they extracted the basic data of the included literature, such as the first author, the year of publication, the location of the investigation, the sample size, the assessment tools, and the related factors.

Statistical analysis

All statistical data were analyzed using Stata 15.1. The effect sizes were expressed by *MD* (Mean Deviation), and Pearson correlation coefficient *r*, with their 95% *CI* (Confidence interval). To synthesize the data further, Pearson correlation coefficients were converted to Z-scores using Fisher's Z-transformation for pooled analysis [17]. The *Q* test and I^2 statistics were used to evaluate the heterogeneity among studies. A $P \leq 0.1$ and $I^2 \geq 50\%$ indicates high heterogeneity, and the random effect model was employed. Otherwise, the fixed effect model was used. Subgroup analysis was conducted to explore potential source of het-

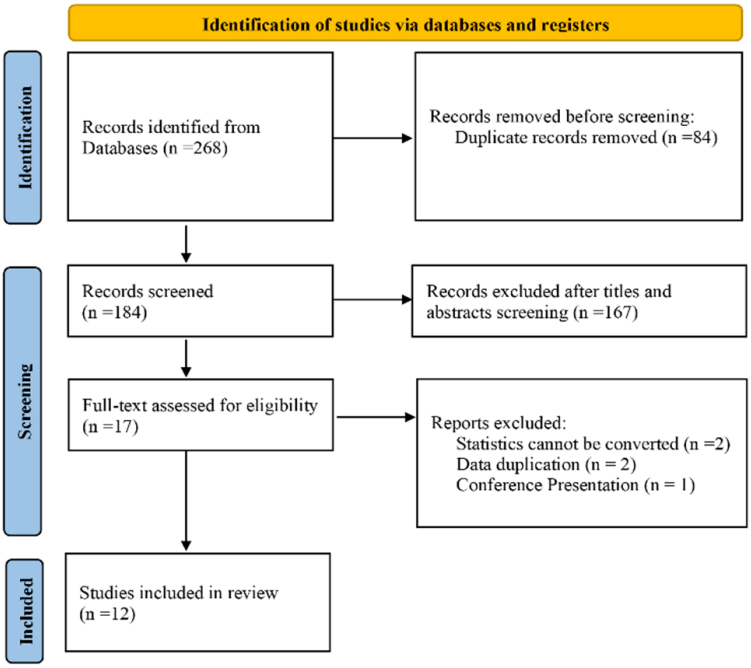

Figure 1. PRISMA flow diagram for the literature screening procedure.

erogeneity. The procedure of removing documents one at a time was used to assess the stability of meta-analysis findings [18]. Publication bias was assessed using the Egger test whenever more than two studies reported on a single associated factor [19]. A $P>0.05$ in the Egger test suggested a low likelihood of publication bias, whereas a $P\leq0.05$ indicated a significant risk of bias. The cut-and-patch method was then used to determine whether the results of the Egger test are stable [20]. For lone studies or where there were data that couldn't be pooled or transferred, qualitative descriptions were used.

Results

Study selection

The study selection process for this meta-analysis involved a thorough screening of 268 documents retrieved from our electronic databases. Initially, 84 duplicates were removed. Further screening of titles and abstracts resulted in the exclusion of 167 documents that did not meet the inclusion criteria. A detailed review of the full texts led to the exclusion of an additional 5 documents due to the following reasons: inability to convert and extract statistical data from 2 documents [9, 21], one document being a conference presentation [22], and duplication of data in 2 documents [23, 24]. Ultimately, 12 articles qualified for inclusion in the systematic review. For the meta-analysis, only factors reported in two or more articles were considered, which included data from 9 articles. The literature screening process is illustrated in **Figure 1**.

General characteristics and quality assessment of included studies

Basic features of the included studies are shown in **Table 1**. Among the 12 studies, 9 were published in Chinese and 3 in English. All studies used the translated version of the Social Impact Scales (SIS), which demonstrated high reliability and validity for assessing stigma in cross-sectional research settings. These studies spanned across 8 different provinces in China. The quality assessment results indicated that all included documents were of medium to high quality, with each study scoring at least 5, as shown in **Table 2**.

Study synthesis

In this study, we synthesized data from 12 articles, extracting 25 different correlates associated with stigma in patients undergoing Hemodialysis (HD). The final results indicate significant variations in the pooled mean stigma scores based on the quality of the included studies. Significant factors correlating with stigma included per capita monthly family income, place of residence, complications, family function, self-efficacy, levels of social support, and levels of psychological distress. The forest plot of current levels of stigma among patients undergoing HD are described in **Figure 2**, and the results of subgroup analyses are described in **Table 3**. For each correlate of stigma, the results of the heterogeneity analysis and the meta-analysis are described in **Tables 4**, **5**. Supplementary Appendix C in Supplementary Material 2, the forest plot for each correlate of stigma is displayed.

Table 1. General characteristics and quality assessment of the studies (n=12)

Author	Year	Country	Sample size	Assessment tools	Relevant factor
Zhang et al.	2022	Shanghai, China	97	SIS	(1), (2), (3), (5), (8)
Chen et al.	2021	Anhui, China	191	SIS	(4), (6), (8), (9), (12)
Zhang et al.	2019	Sichuan, China	134	SIS	(8), (10), (11)
Zheng et al.	2021	Jiangsu, China	213	SIS	(2), (3), (7), (11), (13)
Yu et al.	2019	Zhejiang, China	150	SIS	(1), (3), (8), (15)
Li et al.	2023	Liaoning, China	204	SIS	(12), (19), (21), (22)
He et al.	2022	Fujian, China	382	SIS	(13), (17)
Lu et al.	2022	Shandong, China	301	SIS	(14), (23), (24)
Guan et al.	2022	Anhui, China	117	SIS	(14), (21)
Wang et al.	2020	Shandong, China	156	SIS	(16)
Wei et al.	2022	Sichuan, China	256	SIS	(18), (25)
Chen et al.	2022	Liaoning, China	179	SIS	(19), (20)

Note: SIS = Social Impact Scale. (1) Gender; (2) Age; (3) Per capita monthly family income; (4) Education; (5) Occupation; (6) Residence; (7) Complications; (8) Duration of dialysis; (9) Participation in renal club activities; (10) Nurse attitudes; (11) General self-efficacy; (12) Social support; (13) Family functioning; (14) Psychological distress; (15) Narrative disorders; (16) Self-concealment; (17) Self-esteem; (18) Purposeful rumination; (19) Perceived stress; (20) Coping styles; (21) Hope levels; (22) Fear of progression of illness; (23) Self-care; (24) Depression; (25) Quality of life.

Table 2. Quality assessment of included studies

Study	Item											Total score
	A	B	C	D	E	F	G	H	I	J	K	
Zhang et al. 2022	1	1	1	1	1	0	0	1	0	1	0	8
Chen et al. 2021	1	1	1	1	0	1	0	1	0	1	0	7
Zhang et al. 2019	1	1	1	1	1	1	0	1	0	1	0	8
Zheng et al. 2021	1	1	1	1	1	1	0	1	0	1	0	8
Yu et al. 2019	1	1	1	1	0	0	0	1	0	1	0	6
Li et al. 2023	1	1	1	1	1	1	1	1	0	1	0	9
He et al. 2022	1	1	1	1	0	1	0	1	0	1	0	7
Lu et al. 2022	1	1	1	1	1	1	0	1	0	1	0	8
Guan et al. 2022	1	1	1	1	0	0	0	1	0	1	0	6
Wang et al. 2020	1	1	1	1	0	0	0	0	0	1	0	5
Wei et al. 2022	1	1	1	1	0	0	0	0	0	1	0	5
Chen et al. 2022	1	1	1	1	0	1	0	1	0	1	0	7

Note: A: Is the source of the information clear? B: Are the inclusion and exclusion criteria for exposed and non-exposed groups listed or refer to previous publications? C: Is the time period for identifying patients given? D: If it is not from the population, are the subjects continuous? E: Does the evaluator's subjective factor cover up other aspects of the research subject? F: Describe any evaluation conducted to ensure quality (such as detection/re-detection of main outcome indicators); G: Explained the reasons for excluding any patients from the analysis; H: The measures to evaluate and/or control the confounding factors are described; I: If possible, it explains how to deal with the lost data in the analysis; J: The response rate of patients and the integrity of data collection were summarized; K: If there is follow-up, find out the expected percentage of incomplete data of patients or follow-up results.

Stigma levels among patients undergoing HD

A total of 11 studies [7, 10-12, 25-31] showed a pooled mean score of stigma of 59.30 (95% *CI*: 55.62 to 62.97), with a higher level of heterogeneity (P<0.001, I^2=98.6%). One study [32] was eliminated because it failed to provide the mean score of stigma.

The results of subgroup analyses

Stratified by geographical region, ten studies [7, 10-12, 26-31] reported that patients living in these regions experienced lower stigma pooled mean scores [East: 58.59 CI (53.68, 63.51), West: 58.74 CI (53.52, 63.96)]. However, there was significant heterogeneity among the includ-

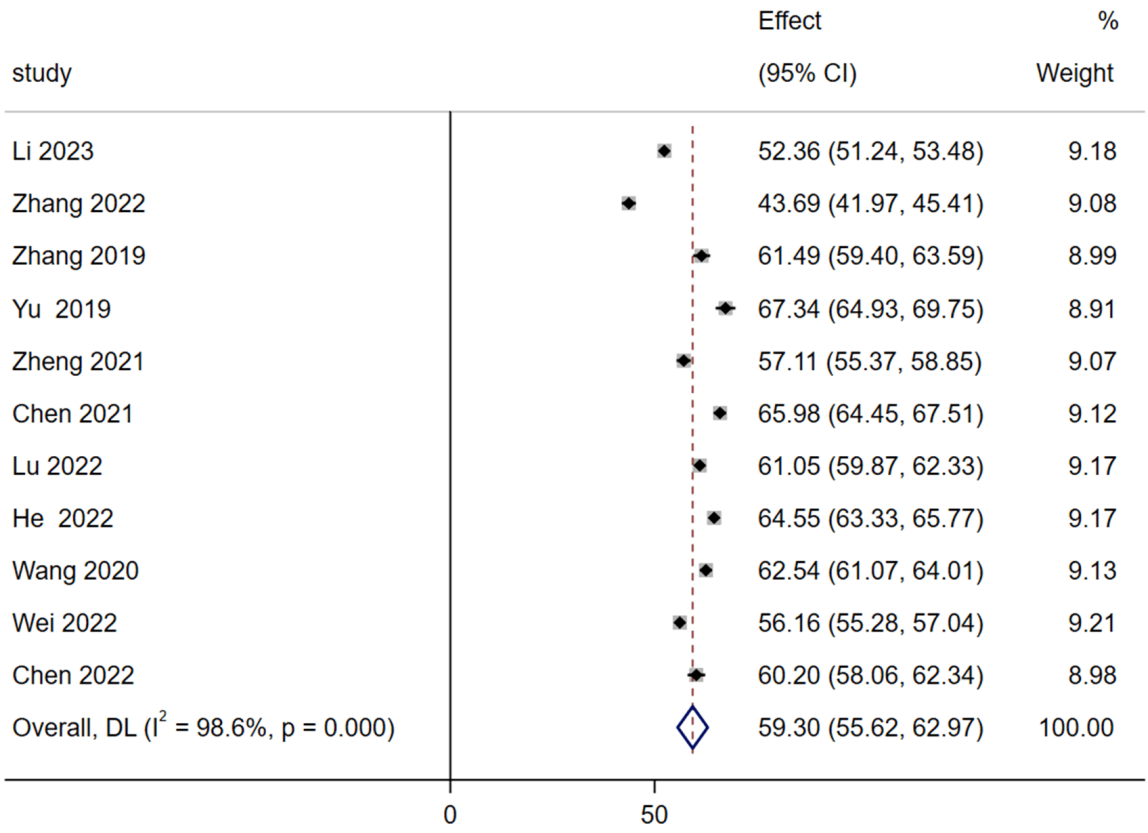

Figure 2. Forest plot of the stigma level among patients undergoing hemodialysis (HD).

Table 3. Subgroup analyses of stigma among patients undergoing HD

Study groups	Variable	N	K	Test of heterogeneity		Stigma pooled mean scores	95% *CI*
				I^2	*P*		
Quality included studies	High	949	5	98.8%	<0.001	55.13	(49.11, 61.16)
	Medium	1314	6	97.7%	<0.001	62.76	(58.86, 66.66)

Note: N = Simple size; K = Number of studies.

Table 4. Results of meta-analysis of factors related to stigma in patients with HD (*MD*)

Relevant factor	Group		Test of heterogeneity		Model	Effect size	
			I^2 (%)	*P*		*MD* (95% *CI*)	*P*
Gender	Male	Female	54.9	0.05	Random	2.10 (0.42, 3.79)	0.015
Age	<60 years old	≥60 years old	85.9	0.001	Random	3.58 (-0.65, 7.81)	0.097
Per capita monthly family income	≤5000 RMB	>5000 RMB	89.4	<0.001	Random	4.95 (1.55, 8.35)	0.004
Education	Middle school and below	High school and above	60.8	0.026	Random	1.39 (-0.56, 3.33)	0.162
Occupation	On job	Jobless	81.1	<0.001	Random	-0.51 (-4.34, 3.32)	0.795
Residence	Urban	Rural	38.9	0.194	Fixed	-4.66 (-6.96, -2.36)	<0.001
Complications	Exist	None	41.7	0.190	Fixed	4.76 (0.92, 8.61)	0.015
Duration of dialysis	<1 years	≥1 years	78	0.001	Random	-0.09 (-2.71, 2.52)	0.944

ed studies (*P*<0.001). Regarding sample size, five studies [7, 10, 12, 27, 29] indicated that larger studies (sample size more than 200) reported lower stigma pooled mean scores [58.24 CI (54.07, 62.41)] compared to studies with smaller sample sizes (less than 200). High

Table 5. Results of meta-analysis of factors related to stigma in patients with HD (*r*)

Relevant factor	Test of heterogeneity		Model	Effect size	
	I^2 (%)	*P*		*Z* (95% *CI*)	*P*
Self-efficacy	0	0.93	Fixed	-0.37 (-0.48, -0.26)	<0.001
Social support	36.5	0.21	Fixed	-0.35 (-0.45, -0.25)	<0.001
Family function	0	0.593	Fixed	-0.29 (-0.38, -0.21)	<0.001
Psychological distress	94.9	<0.001	Random	0.59 (0.26, 0.91)	<0.001

heterogeneity was also observed among the included studies (*P*<0.001).

In terms of study quality, 5 studies [10-12, 27, 31] noted that higher quality studies tended to report lower mean scores of stigma [55.13 *CI* (49.11, 61.16)]. This subgroup also demonstrated considerable heterogeneity (P<0.001).

Factors associated with stigma in patients undergoing HD

Demographic variables

Gender: Six studies [10-12, 25, 30, 31] reported the association between gender and stigma, and the results indicated that gender was associated with stigma (*MD*=2.10, 95% *CI* [0.42 to 3.79]). Additionally, there was obvious heterogeneity among the included studies (I^2=54.9%, *P*=0.05). After omission, a change in the *Z* value was seen in the sensitivity analysis.

Age: Three studies [12, 25, 30] reported the association between age and stigma, and the results revealed that age was not related with stigma in patients with HD (*MD*=3.58, 95% *CI* [-0.65 to 7.81]). These included studies showed a high heterogeneity (I^2=85.9%, *P*=0.001). After omission, a change in the *Z* value was seen in the sensitivity analysis.

Per capita monthly family income: Five studies [10-12, 30, 31] reported the association between monthly income per capital and stigma, and the results demonstrated an association between the income with stigma in patients with HD (*MD*=4.95, 95% *CI* [1.55 to 8.35]). The included studies showed a high heterogeneity (I^2=89.4%, *P*<0.001).

Education: Six studies [10-12, 25, 30, 31] reported the association between education and stigma, and the results revealed that education was not related with stigma in patients with HD (*MD*=1.39, 95% *CI* [-0.56 to 3.33]). There was considerable heterogeneity among the included studies (I^2=60.8%, *P*=0.026).

Occupation: Five studies [10-12, 25, 31] reported the association between occupation and stigma, and the results showed no link between occupation and stigma in patients with HD (*MD*=0.51, 95% *CI* [-4.34 to 3.32]). The eligible studies showed high heterogeneity (I^2=81.1%, *P*=0.001).

Residence: Three studies [11, 12, 25] reported the association between residence and stigma, and the results showed a link between residence and stigma in patients with HD (*MD*=-4.66, 95% *CI* [-6.96 to -2.36]). The heterogeneity among the included studies was low (I^2=38.9%, *P*=0.194).

Disease-related variables

Complications: Two studies [11, 12] were included, and the resulted revealed an obvious relationship between complications and stigma in patients with HD (*MD*=4.76, 95% *CI* [0.92 to 8.61]). The test of heterogeneity of the included studies was not obvious (I^2=41.7%, *P*=0.190).

Duration of dialysis: Five studies [10-12, 25, 30] were included and reported no relationship between duration of dialysis and stigma in patients with HD (*MD*=-0.09, 95% *CI* [-2.71 to 2.52]). High heterogeneity was detected among the eligible studies (I^2=78%, *P*=0.001).

Psychosocial variables

Self-efficacy: The correlation between self-efficacy and stigma was reported in 2 studies [12, 31]: (*Z*=-0.37, 95% *CI* [-0.48 to -0.26]). There was no heterogeneity observed (I^2=0%, *P*=0.93).

Social support: The relationship between social support and stigma was described in 2 studies

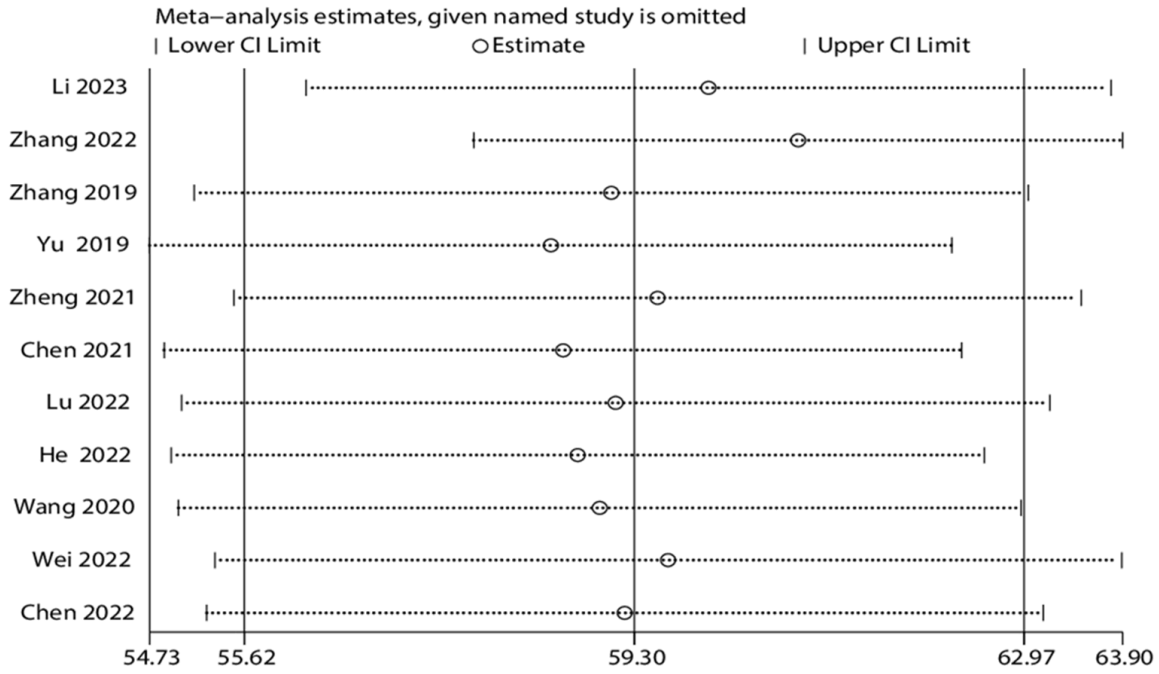

Figure 3. Sensitivity analysis of studies reporting the stigma level among patients undergoing hemodialysis (HD).

[10, 12]: (*Z*=-0.35, 95% *CI* [-0.45 to -0.25]). The included studies demonstrated low heterogeneity (I^2=36.5%, *P*=0.21).

Family function: The correlation between family function and stigma was mentioned in 2 studies [7, 12]: (*Z*=-0.29, 95% *CI* [-0.38 to -0.21]). The included studies yielded an insignificant heterogeneity (I^2=0%, *P*=0.593).

Psychological distress: The correlation between psychological distress and stigma was reported in 3 studies [7, 27, 32]: (*Z*=0.59, 95% *CI* [0.26 to 0.91]). There was a considerable heterogeneity among the included studies (I^2= 94.9%, *P*<0.001).

Sensitivity analysis

Sensitivity analyses were conducted for the pooled stigma mean score and the aforementioned relevant factors using Stata 15.1 by recalculating the impact size after excluding each study in turn. The analyses revealed significant changes in the combined effect sizes for gender and age, suggesting instability in these results. In contrast, the combined effect sizes of the pooled stigma mean score, per capita monthly household income, education, occupation, residence, dialysis time and psychological distress remained stable, indicating robust findings. Sensitivity analysis for factors such as complications, self-efficacy, social support, and family function could not be conducted due to the limited number of studies (only two studies for each factor). The results of the sensitivity analysis for current levels of stigma among HD patients are depicted in **Figure 3**. Detailed findings for each correlate's sensitivity analysis are presented in Supplementary Appendix D of Supplementary Material 2.

Publication bias

Egger's test was applied to detect publication bias using Stata15.1, and the results revealed that there was publication bias for the age factor (*P*=0.046), but no publication bias for the rest factors. After adjusting for potential bias using the cut-and-patch method (adding two hypothetical studies), the effect of age on stigma remained statistically insignificant both before and after adjustment (initial P=0.097; after adjustment P=0.916). This suggests that the detected publication bias had minimal impact on the overall stability and validity of the findings regarding the relationship between age and stigma in HD patients. Detailed findings for publication bias are shown in Supplementary Appendix E of Supplementary Material 2.

Descriptive analysis

Two articles [10, 32] reported a significant predictive effect of hope levels on stigma in patients with HD ($P<0.05$), and 2 studies [10, 26] noted the level of perceived stress affecting the level of patients' stigma. A study found that nurses' apathy [31] and lack of involvement in renal club activities [25] were risk factors for stigma. Other studies noted avoidance ($r=0.711$, $P<0.001$) [26], submission ($r=0.562$, $P<0.001$) [26], narrative disorders ($r=0.353$, $P<0.001$) [30], self-concealment (r=0.374, P=0.005) [28], disease fear progression ($r=0.249$, $P=0.001$) [10], self-coldness (r=0.59, $P<0.001$) [27], depression ($r=0.63$, $P<0.001$) [27] were positively correlated with stigma; while self-esteem ($r=-0.501$, $P<0.001$) [7], self-warmth ($r=-0.21$, $P<0.001$) [27], confrontation ($r=-0.671$, $P<0.001$) [26], purposeful rumination ($r=-0.582$, $P<0.001$) [29], quality of life ($r=-0.312$, $P<0.01$) [29] were negatively correlated with stigma. The data presented from these studies were qualitatively described due to the inability to combine them quantitatively.

Discussion

The stigma levels among patients undergoing HD

This systematic review and meta-analysis incorporated 11 studies with 2263 participants to assess the levels of stigma experienced by patients undergoing hemodialysis (HD). Our findings highlight significant heterogeneity across the included studies, suggesting variability in stigma levels among different patient subgroups. This pattern aligns with existing literature on stigma in other health conditions, such as schizophrenia, where similar variations were observed [33]. The results of subgroup analysis showed that there are differences in stigma scores across different geographical regions in China, sample sizes, and quality of the studies. Patients in Eastern and Western regions reported lower levels of stigma compared to other areas. This variation might be influenced by regional economic development and government support for healthcare policies. However, limited data from Central China (only one study) suggests potential bias and warrants further investigation. Studies with smaller sample sizes (under 200 participants) reported higher levels of stigma. This finding raises concerns about the representativeness and reliability of such studies, as small sample sizes can exacerbate random sampling variance, potentially skewing the results. Furthermore, the medium-quality research had a more overt stigma. The studies included utilized cross-sectional data, which are more prone to bias because they generally doesn't support randomization. Therefore, it is advisable to explore high-quality cross-sectional surveys that utilize the SIS tool. However, the subgroup analysis did not identify the source of heterogeneity due to the limitation of statistical data in the included studies.

Relevant factor of stigma among patients undergoing HD

Demographic factors

Our findings showed that gender, per capita monthly family income, and residence were related to stigma in patients with HD. Male patients receiving HD exhibited a high level of stigma, a finding consistent with observations in cancer patients [34]. However, the stability of this correlation was weak in our study. In a meta-analysis of stigma in stroke patients [35], the results showed that there was no correlation between gender and stigma, suggesting the need for more high-quality original studies to further investigate the relationship between gender and stigma in HD patients.

Patients undergoing HD with low per capita monthly family income and those living in rural areas experienced higher levels of stigma, which was also verified in patients with stroke [35]. This may be because medical resources are well-allocated in urban areas, where urban workers' medical insurance typically offers higher reimbursement rates. In contrast, patients in rural areas with low economic status often lack access to comparable resources and services. The patients undergoing HD not only have to endure physical pain, but also have to bear the high cost of dialysis, which can contribute to stigma. To address these issues, we recommend that the government enhance the allocation of medical resources by improving the rural primary healthcare system and the medical experience for rural HD patients. Implementing these measures could mitigate the stigma experienced by HD patients and

lessen its adverse effects on their physical and mental health.

Disease-related factors

The meta-analysis revealed that HD patients with complications experienced a higher degree of stigma. This is consistent with the previous finding that HD patients with diabetes [36], hypertension [37], and cognitive dysfunction [38] tend to experience higher stigma level. The increased risk of stigma associated with complications may be attributed to poorer physical functioning and prevalent misconceptions about the illnesses. Consequently, healthcare practitioners should promote multidisciplinary teamwork and create comprehensive treatment plans that effectively address complications and improve patients' functional status. Such measures are likely to reduce the stigma experienced by these patients.

Psychosocial factors

This study showed that self-efficacy, family functioning, and social support are negatively correlated with stigma among patients undergoing HD. Self-efficacy, which reflects confidence in one's ability to manage health-related challenges, is a significant predictor of proactive health management and overall well-being [39]. Patients with high self-efficacy tend to be more engaged in seeking and accurately understanding information about their condition, which helps them better manage their disease and enhances their overall happiness [40]. Both family function and social support are closely related to quality of life [41]. Family functioning, which involves maintaining cohesive relationships, fulfilling family roles, coping with problems, and communicating effectively within the family unit, directly impacts the psychological health of its members [42]. Good family functioning has a positive effect on the psychological health of family members. Social support, defined as the material, emotional, and informational resources people receive from others or social networks, can significantly enhance family functioning [43, 44]. In the context of HD treatment, the emotional and practical support from family and the wider community can help patients manage the negative emotions associated with dialysis, thereby fostering emotional bonds and creating a more supportive social environment. Therefore, medical personnel should focus on enhancing patients' self-efficacy, encouraging the development of healthy family relationships, and increasing patients' social support level, to reduce stigma. Additionally, there was a positive association between psychological distress and stigma in HD patients, which has also been seen in patients with Parkinson's disease [45] and diabetes mellitus [36]. Stigmatization can lead to significant psychological distress [7], potentially escalating to suicidal ideation [46]. To address this, healthcare professionals should implement interventions such as cognitive behavioral therapy [47] and comprehensive strategies [48] to manage stigma effectively, which could help reduce the incidence of suicidal thoughts among these patients.

Limitations

The study has several limitations that warrant consideration: (a) The included studies utilized cross-sectional data, which restricts the ability to infer causal relationships between the observed variables; (b) There were a limited number of studies included, resulting in insufficient sensitivity analyses and a lack of robustness in the results of the publication bias test; (c) There were variations in the measurement methods and standards of the correlates across some studies, such as inconsistencies in the assessment tools for psychological distress and differences in the categorization of family per capita monthly income, which may have contributed to increased heterogeneity; (d) The interaction between related factors was not comprehensively accounted for in the included studies. For instance, the integration of studies that solely utilized Pearson correlation analysis may have obscured deeper associations between the relevant factors and stigma.

Conclusion

In conclusion, factors associated with stigma in patients undergoing HD include per capita monthly family income, residence, complications, self-efficacy, family functioning, social support, and psychological distress. Healthcare professionals are encouraged to enhance early assessment and management of stigma in HD patients and to tailor interventions based on

these relevant factors to promote healthier coping mechanisms and improve quality of life. However, the results of this study are constrained by design and sample size of the included studies. Future research should involve high-quality prospective cohort studies to further substantiate these findings and provide more definitive evidence on the impact of these factors on stigma in HD patients.

Disclosure of conflict of interest

None.

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References

[1] Pecoits-Filho R, Okpechi IG, Donner JA, Harris DCH, Aljubori HM, Bello AK, Bellorin-Font E, Caskey FJ, Collins A, Cueto-Manzano AM, Feehally J, Goh BL, Jager KJ, Nangaku M, Rahman M, Sahay M, Saleh A, Sola L, Turan Kazancioglu R, Walker RC, Walker R, Yao Q, Yu X, Zhao MH and Johnson DW. Capturing and monitoring global differences in untreated and treated end-stage kidney disease, kidney replacement therapy modality, and outcomes. Kidney Int Suppl (2011) 2020; 10: e3-e9.

[2] Casey JR, Hanson CS, Winkelmayer WC, Craig JC, Palmer S, Strippoli GF and Tong A. Patients' perspectives on hemodialysis vascular access: a systematic review of qualitative studies. Am J Kidney Dis 2014; 64: 937-53.

[3] Li H, Xie L, Yang J and Pang X. Symptom burden amongst patients suffering from end-stage renal disease and receiving dialysis: a literature review. Int J Nurs Sci 2018; 5: 427-31.

[4] Ng MSN, So WKW, Wong CL, Hui YH, Ho EHS, Choi KC, Cooper B and Miaskowski C. Stability and impact of symptom clusters in patients with end-stage renal disease undergoing dialysis. J Pain Symptom Manage 2020; 59: 67-76.

[5] Fox AB, Earnshaw VA, Taverna EC and Vogt D. Conceptualizing and measuring mental illness stigma: the mental illness stigma framework and critical review of measures. Stigma Health 2018; 3: 348-76.

[6] Cervantes L, Rizzolo K, Carr AL, Steiner JF, Chonchol M, Powe N, Cukor D and Hasnain-Wynia R. Social and cultural challenges in caring for latinx individuals with kidney failure in urban settings. JAMA Netw Open 2021; 4: e2125838.

[7] He LF, Li QQ and Gan X. Influence of stigma on psychological distress among young and middle-aged maintenance hemodialysis patients. Chin J Nurs 2022; 57: 2585-91.

[8] Shouket H, Gringart E, Drake D and Steinwandel U. "Machine-Dependent": the lived experiences of patients receiving hemodialysis in Pakistan. Glob Qual Nurs Res 2022; 9: 23333936221128240.

[9] Sugisawa H, Shimizu Y, Kumagai T, Shishido K, Koda Y and Shinoda T. Influence of dialysis-related stigma on health-related indicators in Japanese patients undergoing hemodialysis. Ther Apher Dial 2023; 27: 855-65.

[10] Li B, Liu D, Zhang Y and Xue P. Stigma and related factors among renal dialysis patients in China. Front Psychiatry 2023; 14: 1175179.

[11] Zhang N, Lai F, Guo Y and Wang L. Status of and factors influencing the stigma of Chinese young and middle-aged maintenance hemodialysis patients: a preliminary study. Front Psychol 2022; 13: 873444.

[12] Zheng WW. Study on the status and influencing factors of stigma in patients with two different methods of renal replacement therapy. Nanjing University 2021.

[13] Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE, Chou R, Glanville J, Grimshaw JM, Hróbjartsson A, Lalu MM, Li T, Loder EW, Mayo-Wilson E, McDonald S, McGuinness LA, Stewart LA, Thomas J, Tricco AC, Welch VA, Whiting P and Moher D. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021; 372: n71.

[14] Fife BL and Wright ER. The dimensionality of stigma: a comparison of its impact on the self of persons with HIV/AIDS and cancer. J Health Soc Behav 2000; 41: 50-67.

[15] Pan AW, Chung L, Fife BL and Hsiung PC. Evaluation of the psychometrics of the Social Impact Scale: a measure of stigmatization. Int J Rehabil Res 2007; 30: 235-8.

[16] Rostom A, Dubé C, Cranney A, Saloojee N, Sy R, Garritty C, Sampson M, Zhang L, Yazdi F, Mamaladze V, Pan I, McNeil J, Moher D, Mack D and Patel D. Celiac disease. Evid Rep Technol Assess (Summ) 2004; 1-6.

[17] Zeng L, Wang JL, Zuo M, Jin M, Tang P and Xie WQ. Correlation between sleep quality and social support for the elderly in China: a meta-analysis. Chinese Journal of Evidence-Based Medicine 2021; 21: 401-6.

[18] Zhang J, Lu X, Li H and Wang S. Risk factors for mortality in patients undergoing peritoneal di-

alysis: a systematic review and meta-analysis. Ren Fail 2021; 43: 743-53.
[19] Wang HJ, Xu YF, Zhang W, Yuan MY, Gao YT, Zhang HM and Zhu LL. Influencing factors of family resilience in stroke patients: a systematic review. Military Nursing 2023; 40: 1-5.
[20] Duval S and Tweedie R. Trim and fill: a simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. Biometrics 2000; 56: 455-63.
[21] Zheng H, Yi W and Shen JS. The relationship between stigma and family care in elderly hemodialysis patients with diabetic nephropathy. Chinese Journal of Dialysis and Artificial Organs 2022; 33: 96-98, 108.
[22] Yang YY, Lu MX, Feng DJ, et al. Mediating role of stigma on the relationship between type D personality and depression symptoms among maintenance hemodialysis patients. Hohhot, Inner Mongolia, China: 23rd Chinese Psychological Society; 2021.
[23] Chen XT. Mediating effect of Perceived Stress on relationship between Copying Style and Stigma of patients living with the maintenance hemodialysis. Dalian Medical University 2023.
[24] Zheng WW, Lu CH, Lv GL and Wang F. Analysis of stigma and its influencing factors in 222 patients with maintenance hemodialysis. J Nurs 2020; 27: 44-8.
[25] Chen L, li AM, Liu YJ, Liu X, Zhao XY and Li P. Analysis of stigma and its influencing factors in maintenance hemodialysis patients. Chinese Journal of Integrated Traditional and Western Nephrology 2021; 22: 1008-10.
[26] Chen XT, An YQ, Luo N and Ding SZ. Mediating role of perceived stress in the relationship between stigma and coping modes in maintenance hemodialysis patients. Shanghai Nursing Journal 2022; 22: 24-8.
[27] Lu MX, Yang YY, Wang GM, Wang H and Feng DJ. Effects of perceived stigma on depressive symptoms and demoralization in maintenance hemodialysis patients: self-warmth and self-coldness as mediators. Mindfulness 2022; 13: 3058-69.
[28] Wang XN, Zhang H and Xie ZY. Self-concealment of maintenance hemodialysis patients and its correlation with stigma and social support and its influencing factors. Shandong Medical Journal 2020; 60: 84-6.
[29] Wei P, He P, Wang ML, Hu YH and Chen YQ. The mediating role of purposeful rumination in stigma and quality of life in maintenance hemodialysis patients. J Nurs Admin 2022; 22: 246-50.
[30] Yu FE, Lin JJ and Jiang LY. Effect of alexithymia on stigma for maintenance hemodialysis patients. Journal of Nursing and Rehabilitation 2019; 18: 24-6.
[31] Zhang E, He XQ, Huang XR, Gou QY and Diao YS. Analysis of the status and influencing factors of stigma in uremic patients. Modern Clinical Nursing 2019; 18: 1-5.
[32] Guan YL, Gu Y and Jiang Y. Status quo of mental vulnerability in elderly maintenance hemodialysis patients and its correlation with hope level and social impact. Chinese Nursing Research 2022; 36: 3977-81.
[33] Fond G, Vidal M, Joseph M, Etchecopar-Etchart D, Solmi M, Yon DK, Correll CU and Boyer L. Self-stigma in schizophrenia: a systematic review and meta-analysis of 37 studies from 25 high- and low-to-middle income countries. Mol Psychiatry 2023; 28: 1920-1931.
[34] Huang Z, Yu T, Wu S and Hu A. Correlates of stigma for patients with cancer: a systematic review and meta-analysis. Support Care Cancer 2021; 29: 1195-203.
[35] Li C, Hu M, Yang T, Shao X and Zheng D. Correlates of stigma for poststroke patients: a meta-analysis. J Clin Nurs 2023; 32: 1952-62.
[36] Guo X, Wu S, Tang H, Li Y, Dong W, Lu G, Liang S and Chen C. The relationship between stigma and psychological distress among people with diabetes: a meta-analysis. BMC Psychol 2023; 11: 242.
[37] Abel WM, Spikes T and Greer DB. A qualitative study: hypertension stigma among black women. J Cardiovasc Nurs 2021; 36: 96-103.
[38] Lion KM, Szcześniak D, Bulińska K, Evans SB, Evans SC, Saibene FL, d'Arma A, Farina E, Brooker DJ, Chattat R, Meiland FJM, Dröes RM and Rymaszewska J. Do people with dementia and mild cognitive impairments experience stigma? A cross-cultural investigation between Italy, Poland and the UK. Aging Ment Health 2020; 24: 947-55.
[39] Chalfont G, Mateus C, Varey S and Milligan C. Self-efficacy of older people using technology to self-manage COPD, hypertension, heart failure, or dementia at home: an overview of systematic reviews. Gerontologist 2021; 61: e318-e334.
[40] Du JM, Yan J, Ma XW, Zhao YP and Xie H. Correlation among overall well-being, self-efficacy and family factors in maintenance hemodialysis patients. Chin Nurs Res 2018; 32: 2571-5.
[41] Wang J, Chen Y, Tan C and Zhao X. Family functioning, social support, and quality of life for patients with anxiety disorder. Int J Soc Psychiatry 2016; 62: 5-11.
[42] Zhang Y. Family functioning in the context of an adult family member with illness: a concept analysis. J Clin Nurs 2018; 27: 3205-24.
[43] Malecki CK and Demary MK. Measuring perceived social support: development of the

child and adolescent social support scale (CASSS). Psychol Sch 2002; 39: 1-18.
[44] Wu ZB, Han XW, Lan LJ, Xu HD, Lv CQ, Sun L, Fu HZ, Lu Y, Luo DG and Zhong LY. Characteristics and influencing factors of family functioning in fatients undergoing hemodialysis: an analysis of middle-aged and young adults. Chin Nurs Manag 2019; 19: 1816-21.
[45] Eccles FJR, Sowter N, Spokes T, Zarotti N and Simpson J. Stigma, self-compassion, and psychological distress among people with Parkinson's. Disabil Rehabil 2023; 45: 425-33.
[46] Verrocchio MC, Carrozzino D, Marchetti D, Andreasson K, Fulcheri M and Bech P. Mental pain and suicide: a systematic review of the literature. Front Psychiatry 2016; 7: 108.
[47] Wood L, Byrne R, Varese F and Morrison AP. Psychosocial interventions for internalised stigma in people with a schizophrenia-spectrum diagnosis: a systematic narrative synthesis and meta-analysis. Schizophr Res 2016; 176: 291-303.
[48] Li J, Huang YG, Ran MS, Fan Y, Chen W, Evans-Lacko S and Thornicroft G. Community-based comprehensive intervention for people with schizophrenia in Guangzhou, China: effects on clinical symptoms, social functioning, internalized stigma and discrimination. Asian J Psychiatr 2018; 34: 21-30.

Supplementary Material 1

Supplementary Appendix A: Searching expressio

PubMed		
#1	"Renal Dialysis"[Mesh Terms]	
#2	"Hemodialysis"[Title/Abstract] OR "blood purification"[Title/Abstract] OR "end stage renal disease"[Title/Abstract] OR "end stage kidney disease"[Title/Abstract] OR "uremia"[Title/Abstract] OR "chronic renal failure"[Title/Abstract]	
#3	#1 OR #2	
#4	"Social Stigma"[Mesh]	
#5	"Stigma"[Title/Abstract] OR "humiliation"[Title/Abstract] OR "dishonor"[Title/Abstract] OR "shame"[Title/Abstract]	
#6	#4 OR #5	
#7	#3 AND #6	32
Web of science		
	Dialysis or haemodialysis or blood purification or end stage renal disease or end stage kidney disease or uraemia or Chronic renal failure (Topic) and Stigma or humiliation or dishonour or shame (Topic)	63
Embase		
	(Dialysis: ti, ab, kw OR hemodialysis: ti, ab, kw OR 'blood purification': ti, ab, kw OR 'end stage renal disease': ti, ab, kw OR 'end stage kidney disease': ti, ab, kw OR uremia: ti, ab, kw OR 'chronic renal failure': ti, ab, kw) AND (stigma: ti, ab, kw OR humiliation: ti, ab, kw OR dishonor: ti, ab, kw OR shame: ti, ab, kw)	75
Cochrane Library		
#1	(MeSH descriptor: [Renal Dialysis] explode all trees)	
#2	(MeSH descriptor: [Social Stigma] explode all trees)	
#3	(Dialysis or hemodialysis or blood purification or end stage renal disease or end stage kidney disease or uremia or Chronic renal failure): ti, ab, kw	
#4	(Stigma or humiliation or dishonor or shame): ti, ab, kw	
#5	#1 or #3	
#6	#2 or #4	
#7	#5 and #6	11
CINAHL (Cumulative Index to Nursing and Allied Health Literature)		
S1	MH Renal Dialysis OR SU (Dialysis or hemodialysis or blood purification or end stage renal disease or end stage kidney disease or uremia or Chronic renal failure)	
S2	MH social stigma OR SU (Stigma or humiliation or dishonour or shame)	
S3	S1 AND S2	9
	PsycINFO	
S1	SU Dialysis or hemodialysis or blood purification or end stage renal disease or end stage kidney disease or uremia or Chronic renal failure	
S2	SU Stigma or humiliation or dishonor or shame	
S3	S1 and S2	3
China National Knowledge Infrastructure (CNKI)		
	(hemodialysis + blood purification + uremia + end-stage renal disease + chronic renal failure (accurate)) AND (humiliation + stigma + shame(accurate))	26
Wan Fang Knowledge Data Service Platform		
	(Title or keyword: hemodialysis or blood purification or uremia or end-stage renal disease or chronic renal failure(blurred)) and (Title or keyword: humiliation or stigma or shame(blurred))	23

Sino Med	
(“hemodialysis” [common field: intelligence] OR “blood purification” [common field: intelligence] OR “uremia” [common field: intelligence] OR “end-stage kidney disease” [common field: intelligence] OR “chronic renal failure” AND OR “stigma” [common field: intelligence] OR “shame” [common field: intelligence])	26

Supplementary Appendix B: PRISMA list

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Lines 1-2
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Lines 4-22
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Lines 24-41
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Lines 37-41
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Lines 57-63
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Lines 48-55
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplementary Material 1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Line 65
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Line 75
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	**Table 1** & **Table 2** & **Table 3** & **Table 4**
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	**Table 1** & **Table 2** & **Table 3** & **Table 4**
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Lines 65-73

Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Lines 81-82
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	**Table 1**
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Lines 82-83
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Lines 92-93
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Lines 81-85
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Line 86
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Lines 86-87
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Not applicable
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Line 82
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Lines 96-103 & **Figure 1**
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Lines 98-100
Study characteristics	17	Cite each included study and present its characteristics.	Lines 105-110
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	**Table 1** & Supplementary Material 1
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	**Table 2** & **Table 3** & **Table 4**
Results of syntheses	20a	For each synthesis, briefly summarize the characteristics and risk of bias among contributing studies.	Lines 112-121
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	**Table 2** & **Table 3** & **Table 4**
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Lines 126-138
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Lines 194-206
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Not applicable

Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	**Table 2** & **Table 3** & **Table 4**
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Lines 232-306
	23b	Discuss any limitations of the evidence included in the review.	Lines 308-317
	23c	Discuss any limitations of the review processes used.	Lines 308-317
	23d	Discuss implications of the results for practice, policy, and future research.	Lines 322-324
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Line 44
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Not prepared
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	None
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Lines 337-338
Competing interests	26	Declare any competing interests of review authors.	Line 343
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Lines 328-329

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/.

Supplementary Material 2

Supplementary Appendix C: Forest plot of the MD or Z value

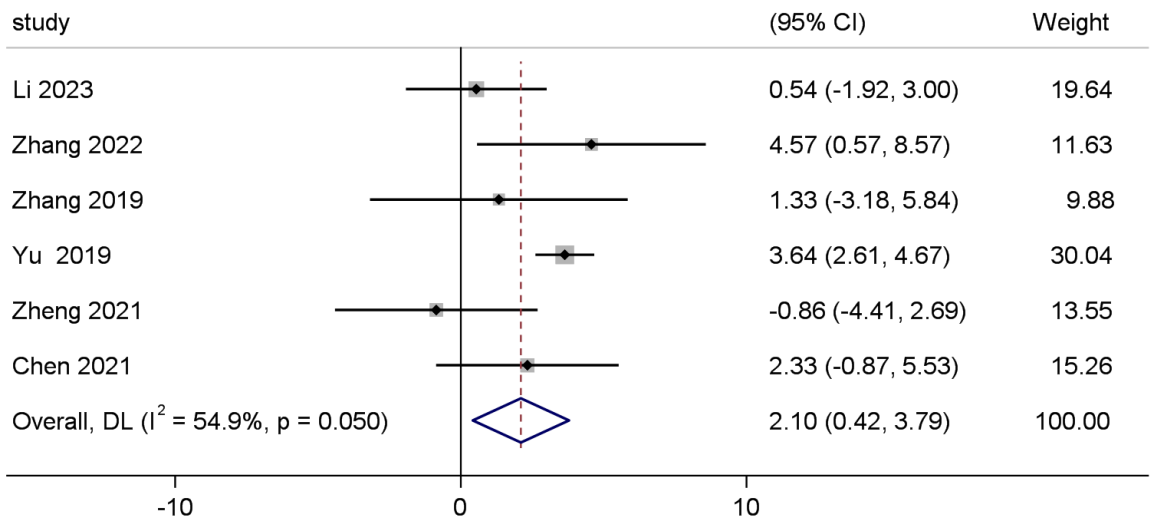

Figure 1. Forest plot: the MD (mean difference) with corresponding 95% CIs (Confidence interval) for the correlation between gender and stigma for patients undergoing hemodialysis.

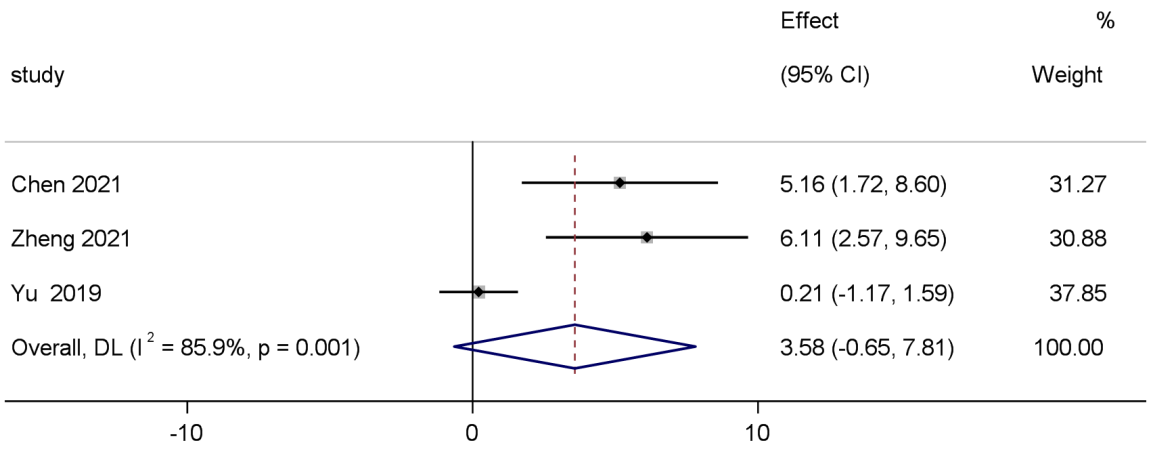

Figure 2. Forest plot of the correlation between age and stigma for patients undergoing hemodialysis.

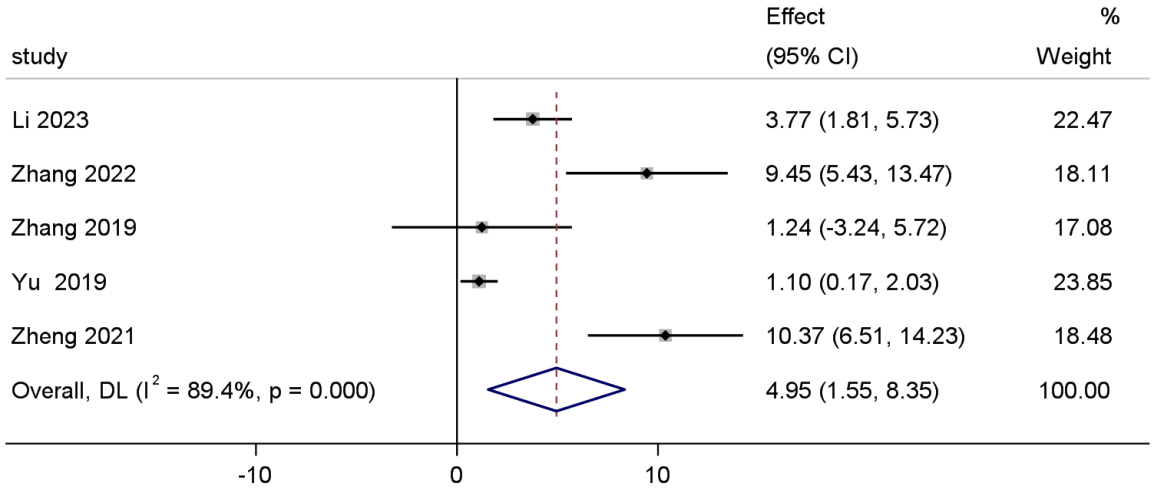

Figure 3. Forest plot of the correlation between per capita monthly family income and stigma for patients undergoing hemodialysis.

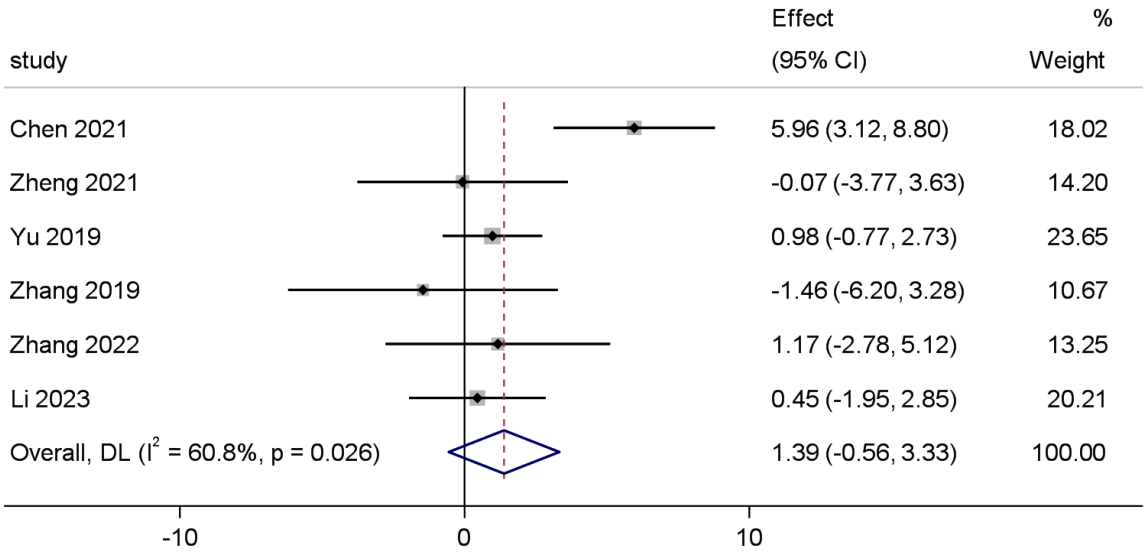

Figure 4. Forest plot of the correlation between education and stigma for patients undergoing hemodialysis.

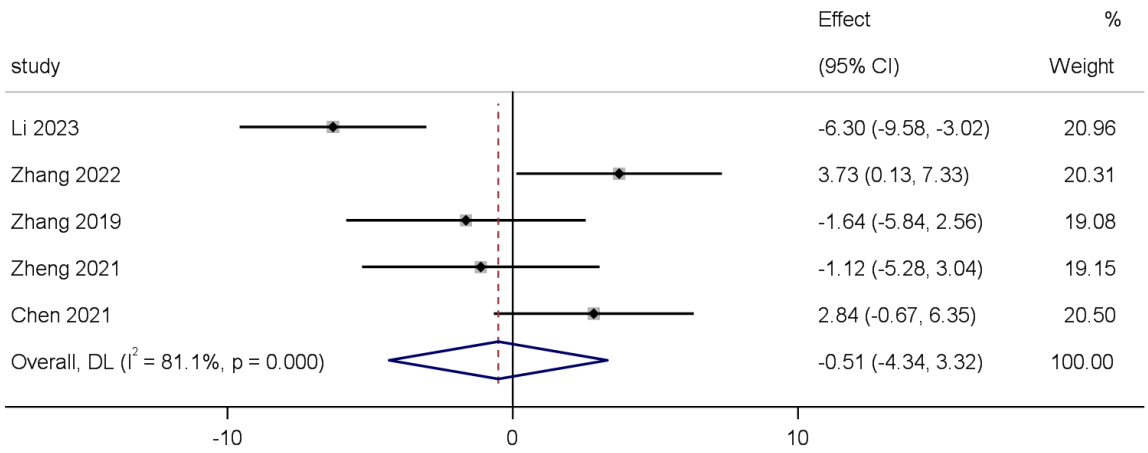

Figure 5. Forest plot of the correlation between occupation and stigma for patients undergoing hemodialysis.

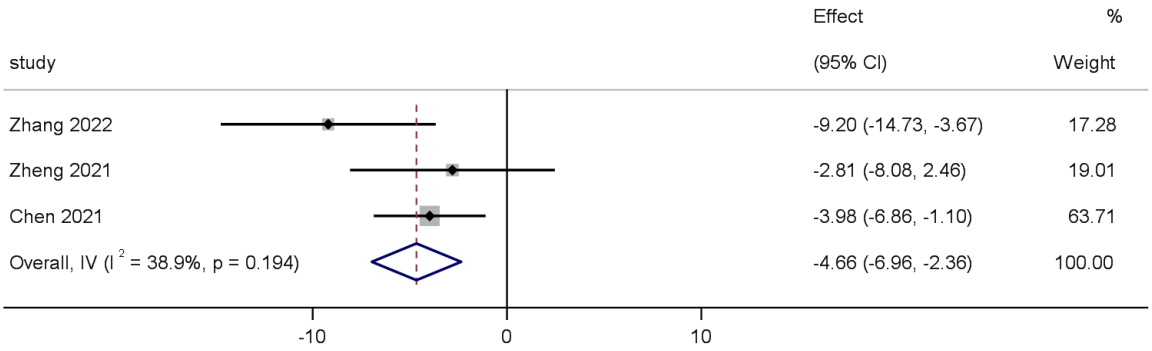

Figure 6. Forest plot of the correlation between residence and stigma for patients undergoing hemodialysis.

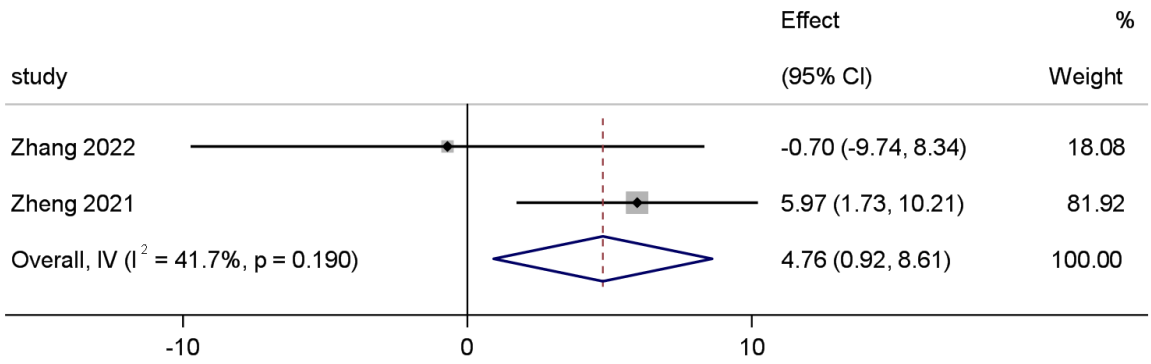

Figure 7. Forest plot of the correlation between complications and stigma for patients undergoing hemodialysis.

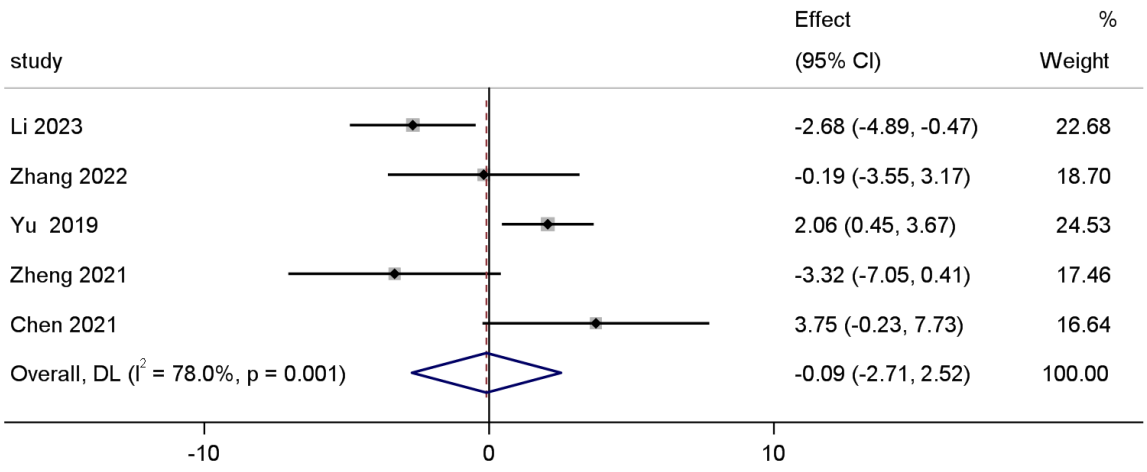

Figure 8. Forest plot of the correlation between duration of dialysis and stigma for patients undergoing hemodialysis.

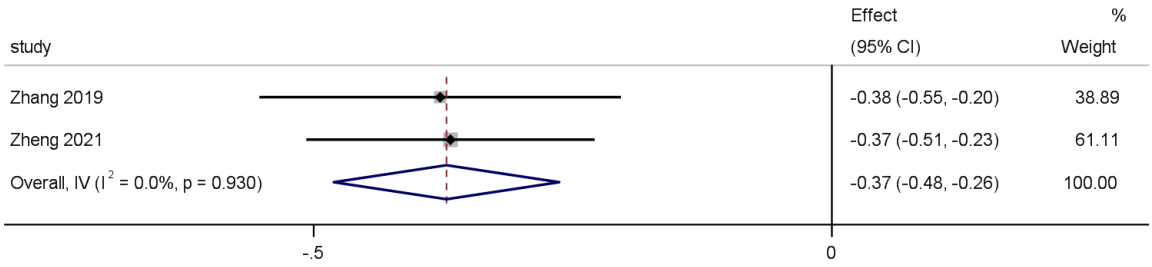

Figure 9. Forest plot of the correlation between self-efficacy and stigma for patients undergoing hemodialysis.

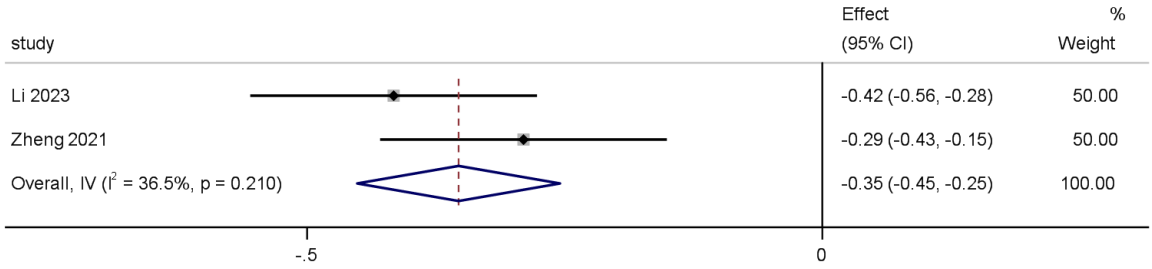

Figure 10. Forest plot of the correlation between social support and stigma for patients undergoing hemodialysis.

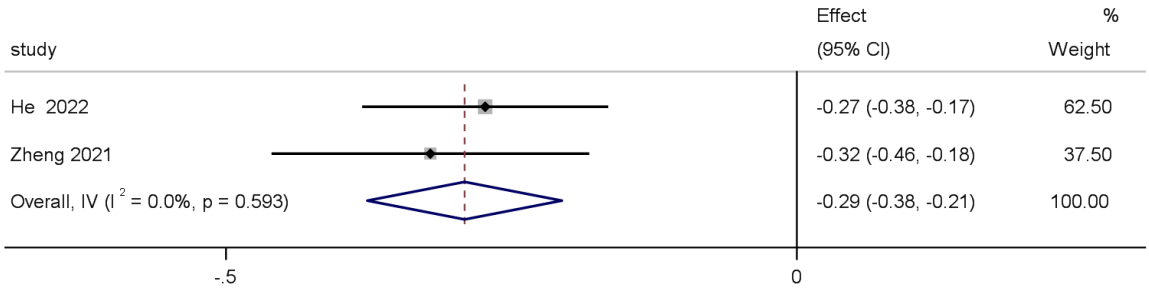

Figure 11. Forest plot of the correlation between family functioning and stigma for patients undergoing hemodialysis.

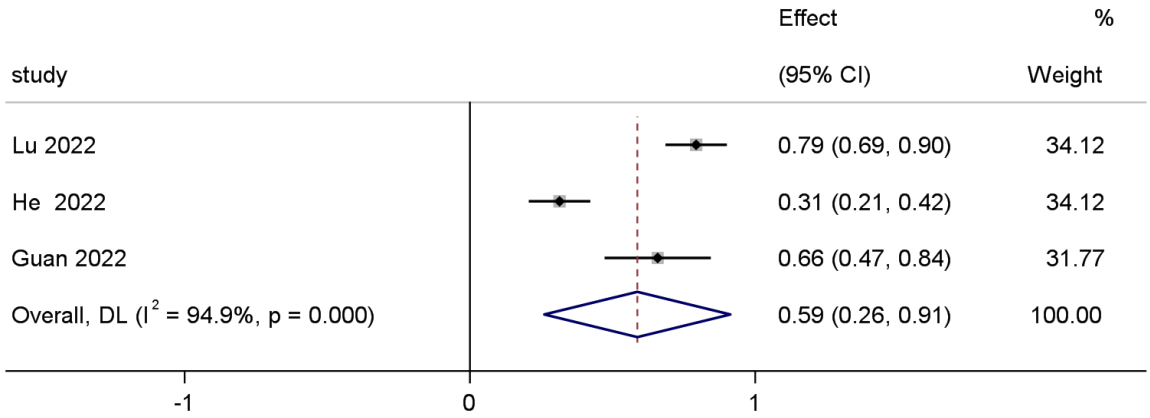

Figure 12. Forest plot of the correlation between psychological distress and stigma for patients undergoing hemodialysis.

Supplementary Appendix D: Sensitivity analysis

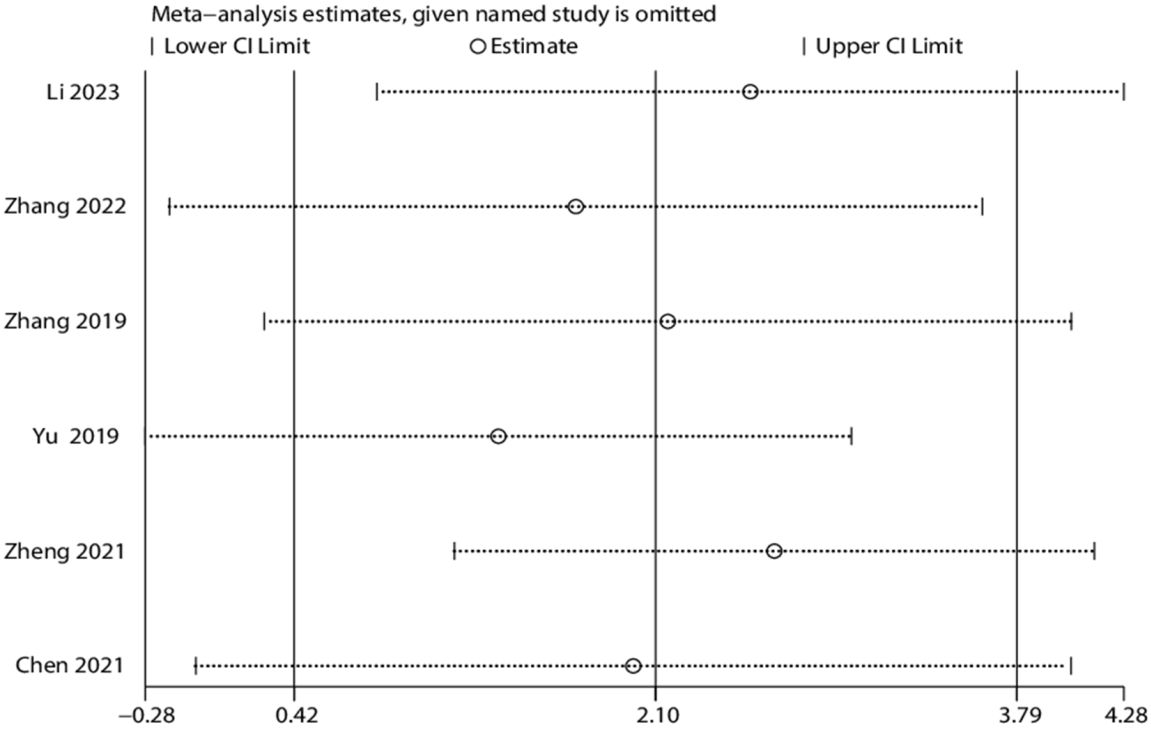

Figure 1. Sensitivity analysis of the publications reporting the correlation between gender and stigma in patients undergoing hemodialysis.

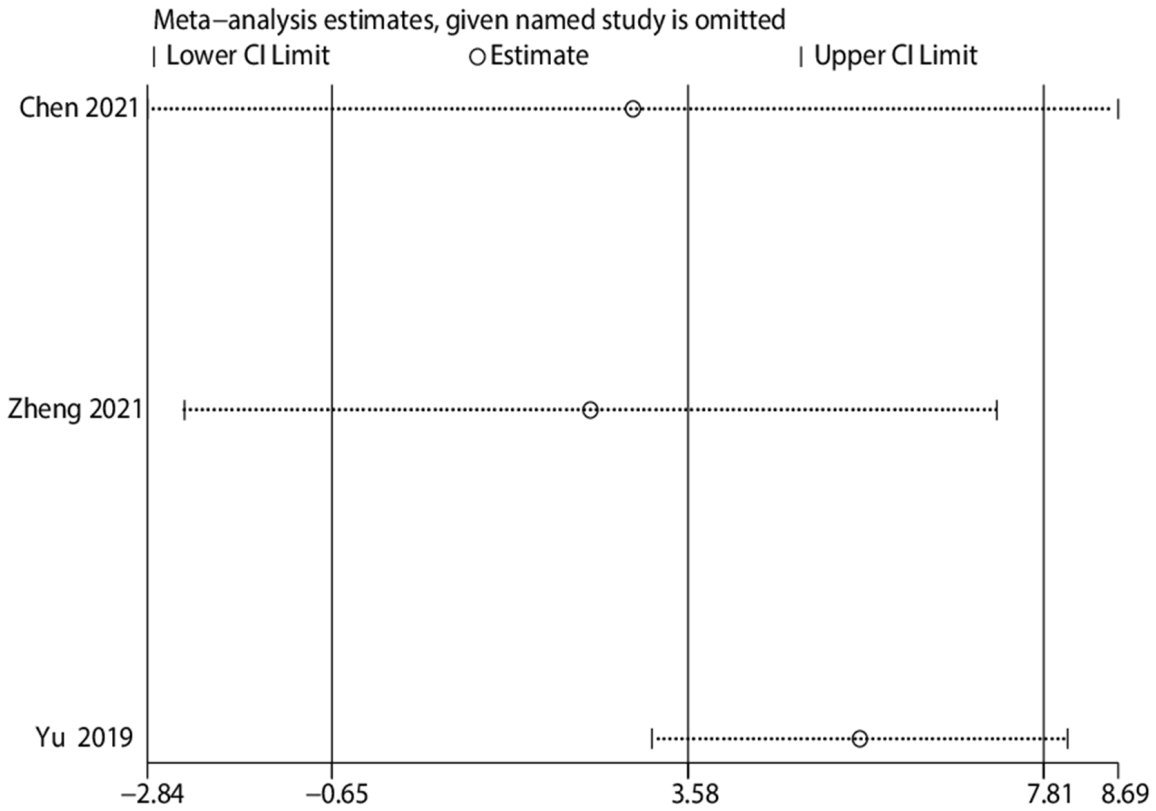

Figure 2. Sensitivity analysis of the publications reporting the correlation between age and stigma in patients undergoing hemodialysis.

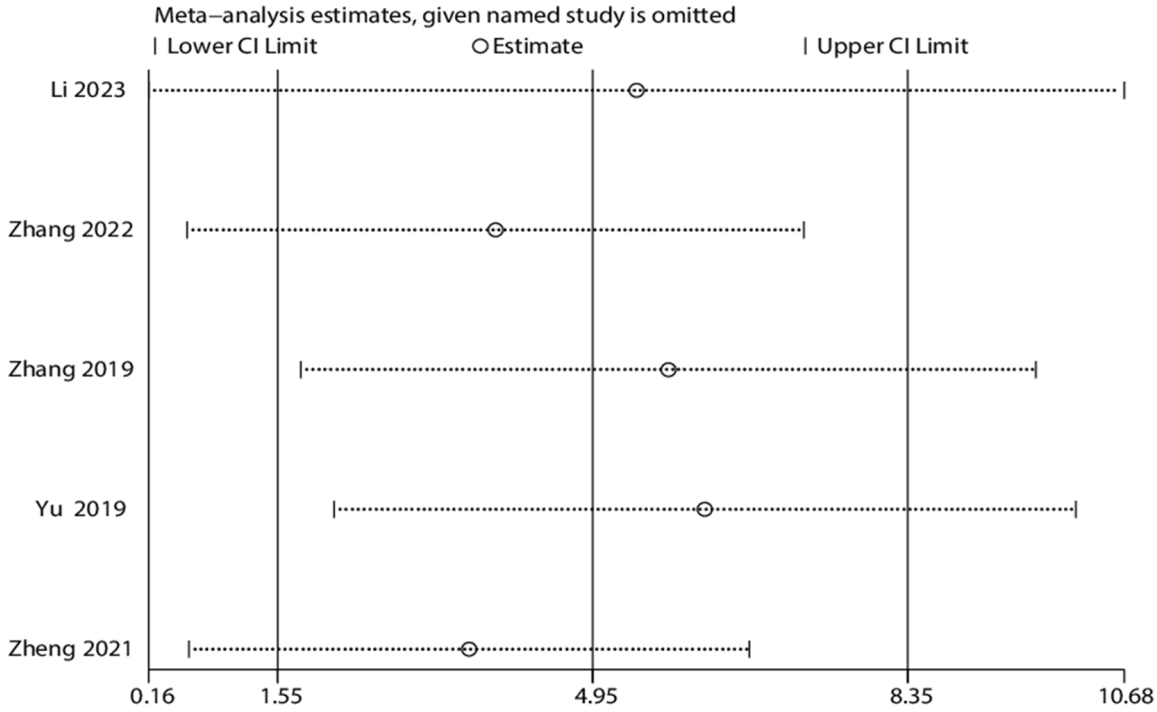

Figure 3. Sensitivity analysis of the publications reporting the correlation between per capita monthly family income and stigma in patients undergoing hemodialysis.

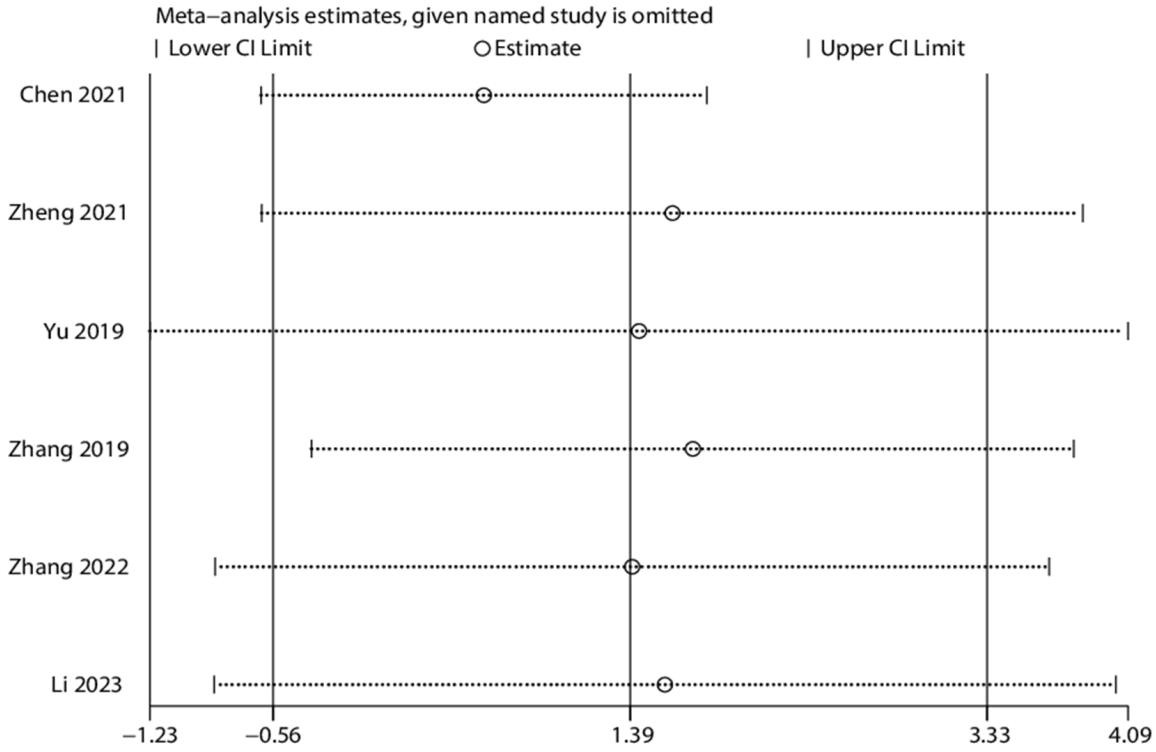

Figure 4. Sensitivity analysis of the publications reporting the correlation between education and stigma in patients undergoing hemodialysis.

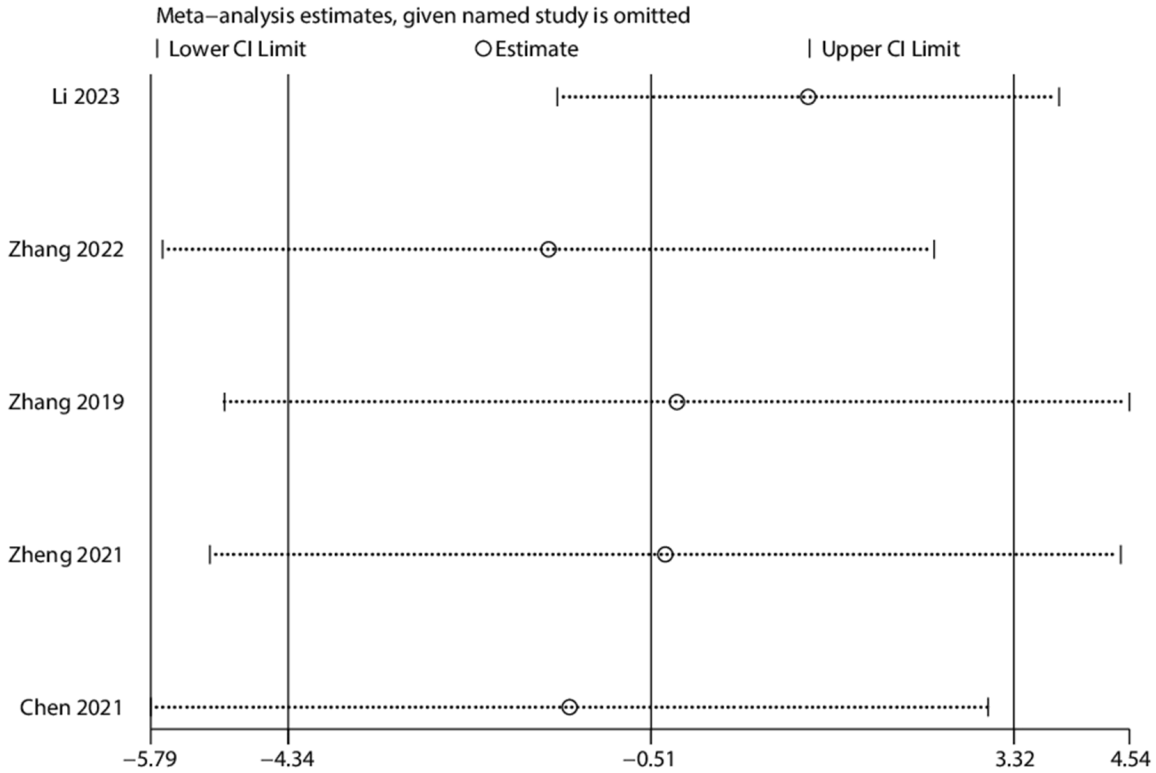

Figure 5. Sensitivity analysis of the publications reporting the correlation between occupation and stigma in patients undergoing hemodialysis.

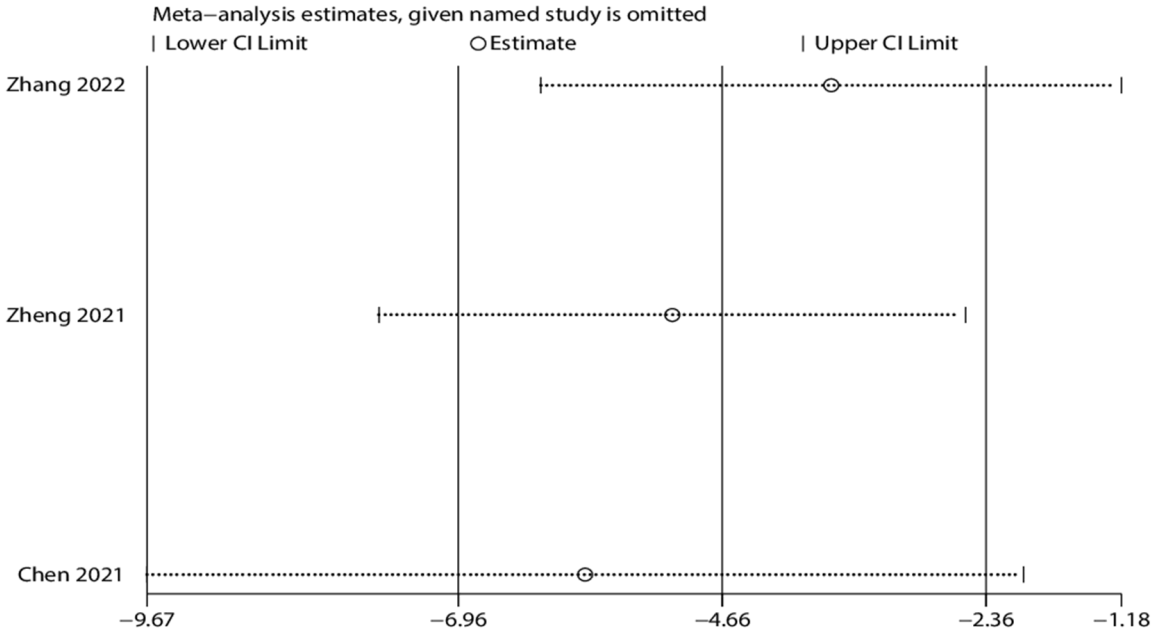

Figure 6. Sensitivity analysis of the publications reporting the correlation between residence and stigma in patients undergoing hemodialysis.

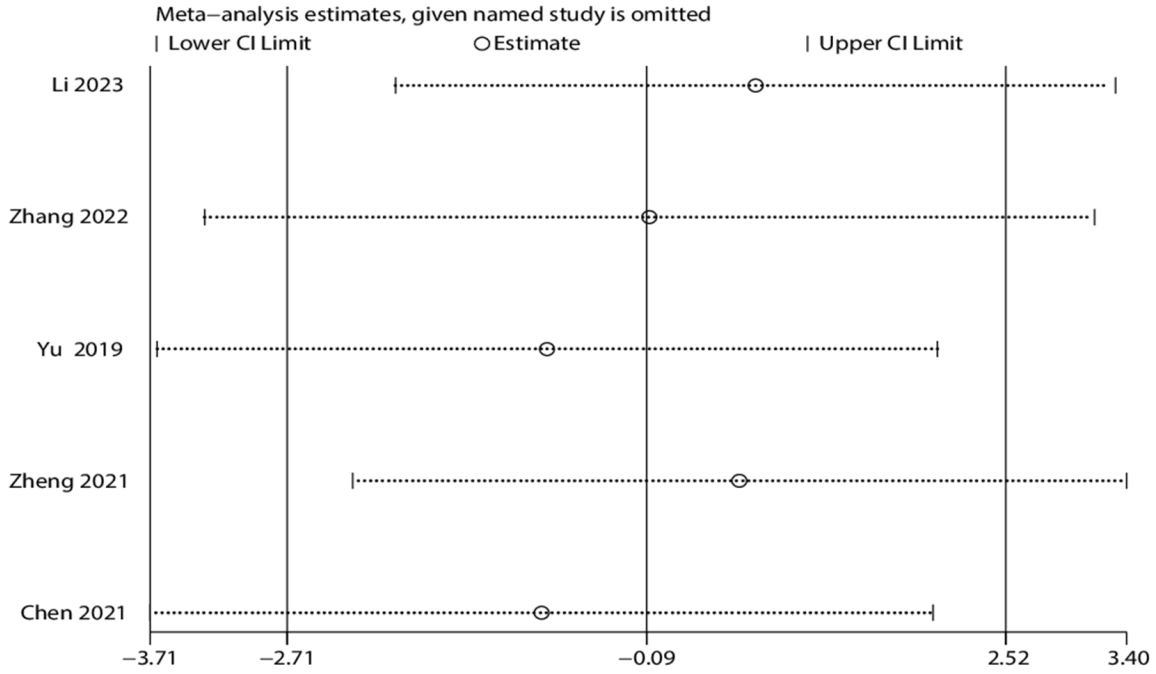

Figure 7. Sensitivity analysis of the publications reporting the correlation between duration of dialysis and stigma in patients undergoing hemodialysis.

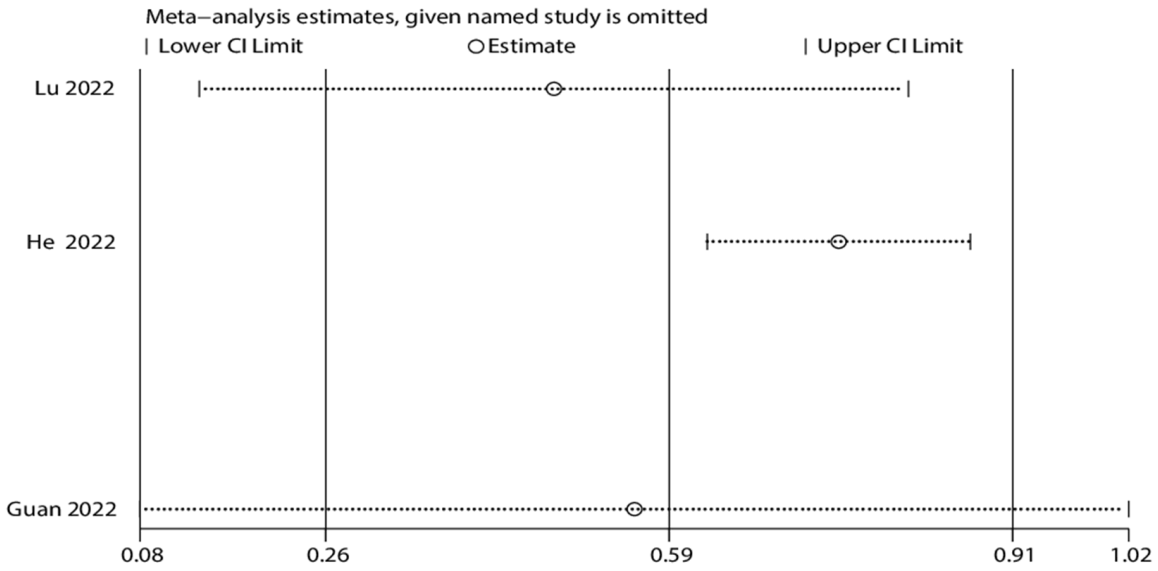

Figure 8. Sensitivity analysis of the publications reporting the correlation between psychological distress and stigma in patients undergoing hemodialysis.

Supplementary Appendix E: Publication bias

Publication bias of correlation between age and stigma in patients undergoing hemodialysis

Std_Eff	Coef.	Std. Err.	T	P>|t|	[95% Conf. Interval]	
Slope bias	-3.3313	.3841391	-8.67	0.073	-8.21225	1.549651
	5.033455	.3613247	13.93	0.046	.4423897	9.624521

Test of H0: no small-study effects, P=0.046.

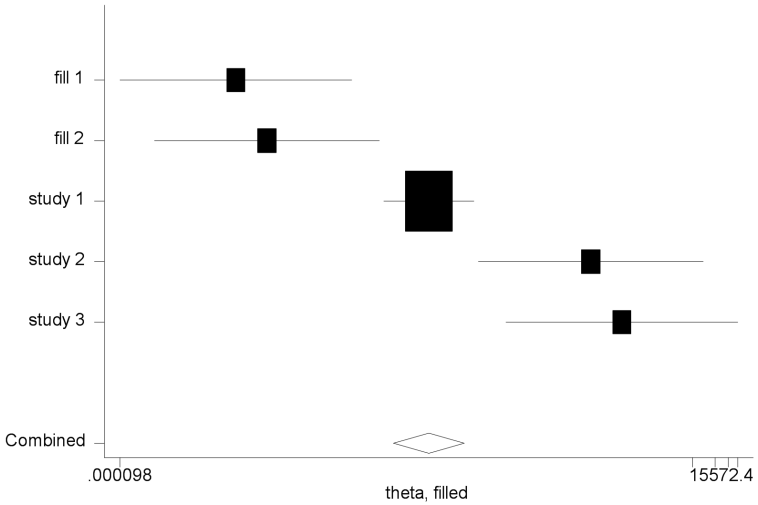

Figure 1. The cut-and-patch method. Graph: Publication bias in terms of correlation between age and stigma for patients undergoing hemodialysis.

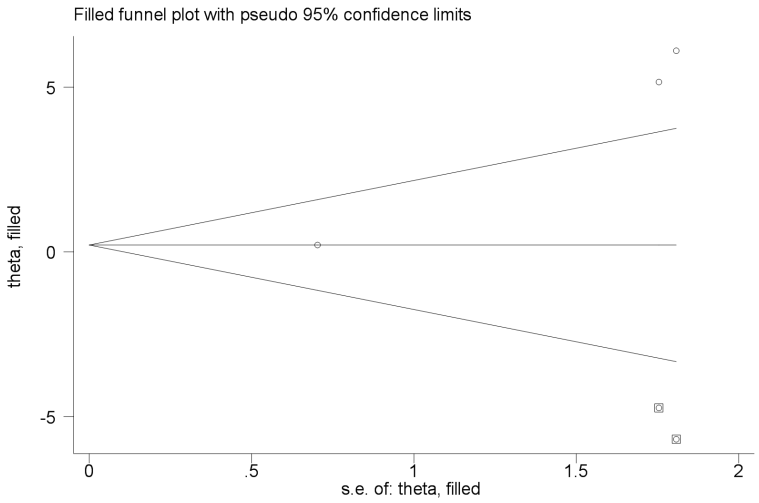

Figure 2. The cut-and-patch method. Funnel plot: Publication bias in terms of correlation between age and stigma for patients undergoing hemodialysis.