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Original Research

Association of Anaemia and Depression: A Systematic Review and Meta-analysis

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Abstract

Background: This research aims to find out the prevalence of depression in all types of anaemia patients of all age groups and genders by conducting a comprehensive meta-analysis of observational epidemiological studies.

Methodology: The relevant peer-reviewed literature describing primary data analysis was thoroughly evaluated using the PRISMA checklist as a reference. We searched databases, including PubMed, Scopus, Embase, and Google Scholar, to identify research publications published between 2003 and 2024. R software version 4.3.0 was utilised to perform the meta-analysis, and the JBI score was employed for quality appraisal. Heterogeneity was assessed using the Q and I2 statistics. To pool estimates, a random-effects model was employed. Publication bias was assessed using a funnel plot and Egger's regression test.

Results: After combining the results of the papers, the prevalence of depression was estimated at 36 % (CI = 95: 28–45 %) based on a random effects model. Sub-group analysis showed that the prevalence of depression was higher in patients with sickle cell anaemia (42%) followed by Thalassemia (35%) and Iron deficiency anaemia (20%). Sub-group analysis also found a higher prevalence (almost double) of depression in anaemic patients of Asia (40%) and the African continent (37%,) which is almost double as compared to America (28%) and Europe (20%). The declining trend of meta-regression analysis demonstrates that depression prevalence is higher among young anaemia patients (Children and adolescents) as compared to older ones.

Conclusion: Routine screening for depression may be required during regular follow-ups of anaemic patients, especially in resource-limited settings.

Keywords: Depression; Anaemia; Prevalence.

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Quick Response Code:

Introduction

Depression is a mood disorder that affects a person's feelings, thoughts, and behaviour in day-to-day activities. It is often referred to as a major depressive disorder or clinical depression. According to estimates, 1 in 7 (14%) of children aged 10 to 19 worldwide suffer from mental health issues, with the majority of these being behavioural, anxiety, and depression problems. 1.1% of teenagers aged 10 to 14 and 2.8% of those aged 15 to 19 suffer from depression [1]. Depression alone is expected to rank as the second most common cause of illness burden in middle-income nations and the third most common cause in low-income countries by 2030 [2].

A lesser quantity of red blood cells or a lower concentration of haemoglobin inside them are characteristics of anaemia, which reduces the blood's ability to meet the body's physiological demands [3]. Anaemia prevalence estimates are often higher in nations with low to middle incomes [4] and increase with age [5]. Anaemia impairs the brain's ability to operate by reducing its oxygen supply. Neurotransmitter levels such as serotonin, dopamine, and norepinephrine have been observed to decrease because of anaemia's effects on the brain's myelination and monoamine metabolism [6]. As a result, the impacted people's emotional and psychological functioning is changed, making them more vulnerable to mental illnesses like depression [6].

Maintaining tissue oxygen metabolism requires haemoglobin. Therefore, the most common clinical symptoms of anaemia are fatigue, dyspnoea, palpitations, and arrhythmias [7]. Chronic illnesses and malnourished situations like cancer, renal failure, infections, and neurological disorders are frequently linked to anaemia [8]. Anaemia-induced weakness and exhaustion negatively impact quality of life and the ability to do everyday duties. Anaemia has been related to inferior clinical outcomes, lower quality of life, and even higher mortality, according to pertinent studies [9].

Previous research has shown how crucial it is to consider a variety of potential confounders, especially physical health issues, when analysing the relationship between anaemia and depressive disorders. First, anaemia may cause or exacerbate cardiovascular disorders, or it may impede functioning (e.g., fatigue, cognitive impairments) and result in depressive symptoms [10,11]. Second, sadness and anaemia may potentially be caused by underlying conditions such as renal failure or inflammatory illnesses [12-15]. Finally, depression may result in unhealthy habits like drinking too much alcohol or not eating enough food, which can cause vitamin deficiencies and ultimately lead to anaemia [16-18].

As inconsistent recent findings exist for the association between anaemia and maternal depression, it is worthwhile determining whether anaemia is a risk factor for maternal depression. In this study, it was hypothesized that depression is linked to anaemia. This meta-analysis and systematic review aim to find out the association between anaemia and depression.

Materials and methods

This study was registered by the International Prospective Register of Systematic Reviews PROSPERO (CRD42024513914) and prepared following PRISMA guidelines for systematic review and meta-analysis [19]. Table 1 mentions PICOS criteria for study inclusion and exclusion.

Table 1: PICOS Criteria for Inclusion and Exclusion of Studies

Parameters	Inclusion Criteria	Exclusion Criteria
Population	Anaemic patients	Non-Anaemic patients
Intervention	Depression and Depressive Disorder	No depression
Comparison	Non-depressive anaemic patients	No comparison
Outcomes	Odds ratio	No odds ratio
Study Design	Observational studies	RCT, Case report, case series, etc.

Eligibility criteria

Epidemiological studies that satisfied the following requirements were included: (1) examined the relationship between anaemia and depression; (2) reported outcome measures with adjusted odds ratios (ORs) or relative risks (RRs) and 95% confidence intervals (CIs); and (3) were either case-control, cohort, or cross-sectional studies. The initial published study included if data were shared or duplicated in other studies. We didn't include research or abstracts that had only been presented at academic conferences or weren't published in peer-reviewed publications. We only included studies whose abstracts were published in English.

Literature search sources and strategy

From September 2015 to September 2025, we used popular keywords associated with anaemia and depression to search the PubMed, Scopus, Web of Science, Embase, and Google Scholar databases. For exposure factors, the keywords were "anaemia" or "anaemic patients," and for outcome factors, they were "depression," "depressive mood," or "depressive symptoms," and "association." To find further papers, we also looked through the bibliographies of pertinent articles. If further information was needed, we attempted to get in touch with the writers.

Table 2: Search Strategy and search terms used in various databases

Database	Search Strategy
PubMed	((“Anaemia” OR “Anaemic patients”) AND (“Depression” OR “Major Depressive Disorder” OR “Depressive symptoms”) AND (“Association”))
Scopus	TITLE-ABS-KEY ((“Anaemia” OR “Anaemic patients”) AND (“Depression” OR “Major Depressive Disorder” OR “Depressive symptoms”) AND (“Association”))
Web of Science	TS= (“Anaemia” OR “Anaemic patients”) AND TS= (“Depression” OR “Major Depressive Disorder” OR “Depressive symptoms”) AND TS= (“Association”)
Embase	‘Anaemia’ OR ‘Anaemic patients’ AND ‘Depression’ OR ‘Major Depressive Disorder’ OR ‘Depressive symptoms AND ‘Association’
Google Scholar	“Anaemia” OR “Anaemic patients” AND “Depression” OR “Major Depressive Disorder” OR “Depressive symptoms” AND “Association”

Selection process and Data extraction

Every author separately assessed each study's eligibility that was found in each of the databases. These writers had a lengthy conversation to settle any disputes that might have come up. Variables such as first author name, publication year, study types, country, mean participant age, definitions of anaemia and depression, follow-up duration, adjusted OR or RR and 95% CI as effect estimations and confounding variables were extracted from the retrieved studies using a standardised form.

Assessment of Risk of Bias and Methodological Quality

Using the Newcastle–Ottawa Scale (NOS), which rates the effectiveness of case-control and cohort studies utilised in meta-analyses, we assessed the methodological quality of the studies that were included [20]. Three subscales—study selection, comparability, and exposure—make up the NOS's scoring system, which runs from 0 to 9. We regarded a study as high-quality if it received a score higher than the mean for each study category because there were no set criteria to evaluate the quality of a study. The Joanna Briggs Institute criteria (JBI) were used to qualitatively evaluate the cross-sectional studies throughout the meta-analysis stage [20].

Main and subgroup analyses (Data Items)

As our primary analysis, we investigated the association between anaemia and the risk of maternal depression. We also performed subgroup analyses based on (1) study design type (case-control or cohort),(2)definition/Type of anaemia (based on haemoglobin level or others), (3) definition of depression (Edinburgh Postnatal Depression Scale [EPDS] score or others), (4) region (Asia, America, or Europe), (5) number of study participants (< 500 or ≥ 500), and (6) methodological quality (high or low).

Statistical analysis of Effect measures

To report the relationship between anaemia and an increased likelihood of depressive moods, we calculated a pooled OR or RR with a 95% CI using the adjusted ORs or RRs and 95% CIs from each trial. We calculated Higgins I^2 (Higgins and Thompson, 2002) using the following formula to assess heterogeneity across the studies:

$$I^2 = 100\% \text{ x } (Q\text{-}df)/Q,$$

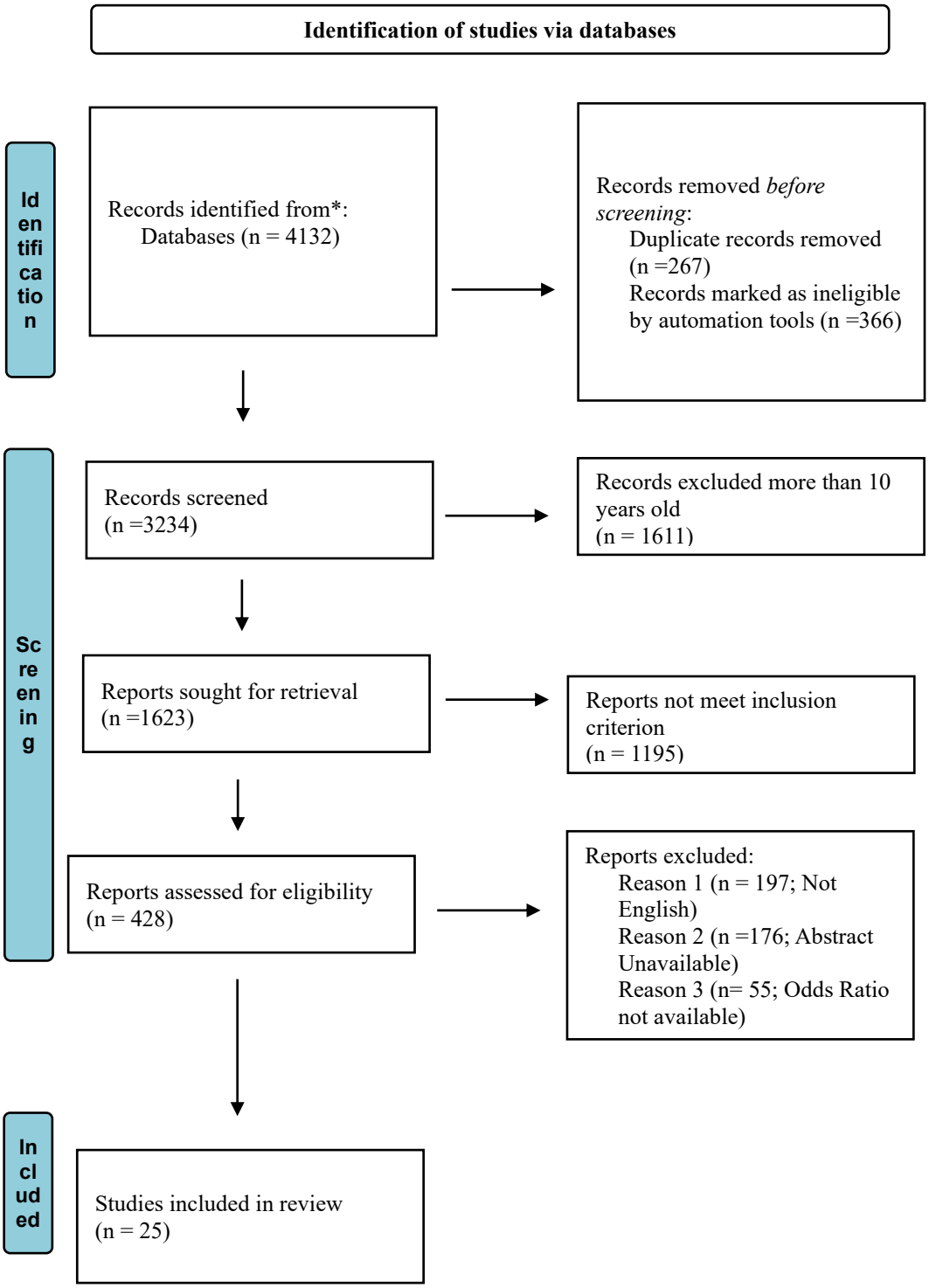
$I^2 = 100\%$ x (Q-df)/Q, where df is the degree of freedom and Q is the Cochran's heterogeneity statistic. The range of the I^2 value is 0%, which indicates no heterogeneity, to 100%, which indicates maximum heterogeneity. According to Higgins and Thompson (2002), significant heterogeneity is indicated by an I^2 value of more than 50% [21]. The Der Simonian and Laird technique, which uses a random-effects model, was used in this investigation to compute the pooled OR or RR with 95% CI [22]. The Egger's test and Begg's funnel plot were used to assess publication bias. Begg's funnel plot displays asymmetry, or Egger's test yields a p-value of less than 0.05 when publication bias is present. Publication bias was also discovered using the DOI plot. The R software was used for all analyses.

Results

Study Selection

Figure 1 is a flow diagram showing how relevant studies were identified. We found a total of 4132 studies from the databases (PubMed, Scopus, Web of Sciences, EMBASE and Google Scholar) and by manually searching relevant bibliographies. 1611 articles were older than 10 years, so excluded. We excluded 267 duplicate articles and an additional 1195 articles that did not meet the inclusion criteria. 197 articles not in the English language were removed further. Abstract was not available in 176 articles. Among these, we excluded 55 articles for the following reasons: failure to report OR or RR with 95% CI. The remaining 25 articles were included in the final analysis—12cross-sectionaland 13 cohort studies.

Figure 1: PRISMA Flow Diagram



Study Characteristics

A total of 256,013anaemic patients were assessed across 25 observational studies that were included in the meta-analysis. Of them, the majority were conducted in USA (n=4), Korea (n=3), India (n=2), Canada (n=2), and Japan (n=2), while, the rest were conducted in Tanzania (n=1), Nigeria (n=1), Malawi (n=1), Finland (n=1), Ethiopia (n=1), Sweden (n=1), Bangladesh (n=1), Australia (n=1), Paris (n=1) and Pakistan (n=1). The earliest and newest papers were published in 2015 and 2025, respectively. The details of the reported studies are presented in Table 3.

Table 3: Characteristics of the studies included

Author, Country and year of publication	Type of study	Country	Sample size	Mean Age of patients (years)	Depression scale used	Definition/Type of Anaemia	Follow-up period	Odds/Risk ratio
Athman et al, 2025 [23]	Cross-sectional	Tanzania	326	13.9	PHQ-9 (≥10)	SCA	Oct 2023-March 2024	2.49 (1.17-5.29)
Babah et al, 2025 [24]	Cohort	Nigeria	438	29.5	EPDS (≥10)	IDA (Hb <11 g/dL)	Aug 9, 2021-Dec 15, 2022	4.9 (1.18-20.36)
Leung et al, 2024 [25]	Cross-sectional	USA	917	21.1	PHQ-9 (≥10)	IDA (Ferritin <30µg/L, S. Iron levels <60µg/L, transferrin saturation <16%)	United States' NHANES 2017 to 2020 dataset	1.32 (0.51-3.4)
Ahmed et al, 2023 [26]	Cross-sectional	Canada	1447	73.3	DSM-5 criteria	IDA (Self-reported)	2011–2013	2.64 (1.31–5.33)
Cheng et al, 2023 [27]	Cross-sectional	Malawi	829	24.9	PHQ-9 (≥10), DSM-4 criteria	IDA (Hb ≤110 g/L)	2017-2018	3.48 (1.15–10.57)
Ciulei et al, 2023 [28]	Cross-sectional	USA	2516	32.7	PHQ-9 (≥10)	IDA (Ft <15 µg/L, Hb <12 g/dL, TfR<8.3 mg/L)	2005-2010	1.82 (1.24, 2.68)
Nam et al, 2023 [29]	Cross-sectional	Korea	18,622	-	PHQ-9 (≥5)	IDA (Males aged >15 years with HB <13 g/dL, pregnant females aged >15 years with HB <11 g/dL, and non-pregnant females aged >15 years with HB <12 g/dL)	2014-2020	0.875 (0.782–0.978)
Wang et al, 2023 [30]	Cross-sectional	China	29,391	-	-	IDA (Hb <11 g/dL)	2005-2018	1 (0.99-1.01)
Kemppinen et al, 2022 [31]	Cohort	Finland	1273	30	EPDS (≥10)	IDA (Hb <11 g/dL)	Dec 2011-April 2015	1.32 (0.75-2.31)

Kwak et al, 2022 [32]	Prospective cohort	Korea	4067	-	EPDS (≥10)	IDA (Hb <11 g/dL)	2013-2017	1.61 (0.93–2.80)
Park et al, 2022 [33]	Cross-sectional	Korea	15,472	-	EPDS (≥10)	IDA (Hb level <13 g/dL in men and <12 g/dL in women)	2014, 2016, 2018	1.37 (1.08-1.75)
Tian et al, 2022 [34]	Cohort	China	519	37.2	EPDS (≥9)	IDA (Hb ≤110 g/L)	Aug 2014-Dec 2019	4.75 (1.55-14.53)
Maeda et al, 2019 [35]	Prospective Cohort	Japan	1128	35.7	EPDS (≥9)	IDA (Hb <11.0 mg/dL in the third trimester)	May 2010-Nov 2013	1.63 (1.17-2.26)
Peppard et al, 2019 [36]	Cross-sectional	USA	174	27.19	PHQ-9 (≥10)	Pernicious anemia (Vitamin B12 levels<190 pg/ml)	2005-2006	1.6 (0.45-5.7)
Vindhya et al, 2019 [37]	Cohort	India	280	23.02	EPDS (≥10)	IDA (Hb <11 g/dL)	Aug 1, 2017-April 30, 2018	1.62 (0.97-2.7)
Babu et al, 2018 [38]	Cohort	India	823	-	Kessler Scale (K-10 Scale) ≥20	IDA (Hb <11 g/dL)	Nov 2013-June 2015	1.92 (1.17-3.15)
Chandrasekaran et al, 2018 [39]	Cohort	Canada	103	34.1	EPDS (≥10)	IDA (Hb ≤110 g/L)	6 weeks postpartum	1.03 (-0.34-2.94)
Hidese et al, 2018 [40]	Cross-sectional	Japan	11,879	41.4	Kessler Scale (K6) (≥13)	IDA (Self-reported)	-	1.13 (0.82-1.54)
Shafi et al, 2018 [41]	Cross-sectional	Pakistan	200	37.74	ICD10, HAMD≥8	IDA (Hb ≤110 g/L)	Jan-July 2017	0.487 (0.37-0.64)
Sutherland et al, 2018 [42]	Retrospective cohort	USA	922	-	EPDS (≥11)	IDA	Jan 2014-Jan 2017	2.25 (1.22-4.16)
Vulser et al, 2016 [43]	Cross-sectional	Paris	44,173	38.4	Questionnaire of Depression 2nd version, Abridged (QD2A)>7	IDA (Hb <12 g/dl (7.5 mmol/l) in women and <13 g/dl (8.1 mmol/l) in men)	Jan 2002-Feb 2010	1.36 (1.18; 1.57)
Woldetensay et al, 2018	Cohort	Ethiopia	4680	26	PHQ-9 (≥8)	IDA (Hb <11 g/dL)	March 2014-	1.3 (1.04-1.61)

[44]							March 2016	
Xu et al, 2018 [45]	Cohort	Australia	75,954	-	ICD-10	Nutritional, Aplastic and Hemolytic	1 Jan 2004-31 Dec 2008	2.01 (1.7-2.38)
Surkan et al, 2017 [46]	Cohort	Bangladesh	39,434	-	PHQ-9 (≥10)	Both symptoms present in the past 30 days: (1) breathlessness at rest, and (2) weakness resulting in an inability to work	2001-2007	1.38 (1.31-1.46)
Eckerdal et al, 2016 [47]	Cohort	Sweden	446	31.1	EPDS≥12	IDA (Hb<110 g/L)	May 2006-June 2007	2.29 (1.15-4.58)

Risk of Bias in Studies

Table 4 shows the methodological quality of the cohort studies based on the Newcastle Ottawa Scale. The quality score ranged from 4 to 8, and the average score was 6.7 for cohort studies. A totalof 7 cohort studies (score of > 6) were considered high quality. Cross-sectional studies were assessed using JBI criteria. The average score was 6.3. 10 cross-sectional studies were moderate to high quality (Table 5).

Table 4: Methodological quality of the studies included in the final analysis based on the Newcastle–Ottawa Scale for assessing the quality of cohort studies

	Selection				**Comparability (control for important factors or additional factors)**	**Outcome**			
Cohort studies	**Representativeness of the exposed cohort**	**Selection of the non-exposed cohort**	**Ascertainment of exposure**	**Outcome of interest not present at the start of the study**		**Assessment of outcome**	**Follow-up long enough for outcomes to occur**	**Adequacy of follow-up of cohorts**	**Total**
Babah et al, 2025	1	1	1	1	1	1	1	0	7
Kemppinen et al, 2022	1	1	1	1	1	1	1	1	8
Kwak et al, 2022	1	0	1	1	0	1	1	1	6
Tian et al, 2022	1	1	1	1	1	1	1	1	8
Vindhya et al, 2019	1	1	1	1	0	0	0	0	4
Babu et al, 2018	1	1	1	1	1	1	0	0	6

Chandrasekaran et al, 2018	1	1	1	1	1	1	0	0	6
Hidese et al., 2018	1	1	1	0	1	1	1	0	6
Sutherland et al, 2018	1	1	1	1	1	1	0	0	6
Woldetensay et al, 2018	1	1	1	1	2	1	0	1	8
Xu et al, 2018	1	1	1	1	2	1	0	1	8
Surkan et al, 2017	1	1	1	1	2	1	0	0	7
Eckerdal et al, 2016	1	1	1	1	1	1	0	0	6

Table 5: The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-sectional study

Major Components	**1. Were the criteria for inclusion in the sample clearly defined?**	**2. Were the study subjects and the setting described in detail?**	**3. Was the exposure measured validly and reliably?**	**4. Were objective, standard criteria used for measurement of the condition?**	**5.Were confounding factors identified?**	**6. Were strategies to deal with confounding factors stated?**	**7. Were the outcomes measured validly and reliably?**	**8. Was an appropriate statistical analysis used?**	**Overall appraisal: Include**
Athman et al, 2025	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	7/8
Leung et al, 2024	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	7/8
Ahmed et al, 2023	Yes	Yes	Yes	No	Yes	Yes	Yes	No	6/8
Cheng et al, 2023	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	7/8
Ciulei et al, 2023	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	7/8
Nam et al, 2023	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	7/8
Wang et al, 2023	Yes	Yes	Yes	Yes	Yes	Yes	No	No	6/8
Park et al, 2022	Yes	Yes	No	No	Yes	Yes	No	No	4/8
Maeda et al, 2019	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	7/8

Peppard et al, 2019	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	7/8
Shafi et al, 2018	Yes	Yes	No	No	Yes	Yes	No	No	4/8
Vulser et al, 2016	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	7/8

Results of synthesis

The study found a positive and significant association between depression and anaemia (Figure 2) with a pooled odds ratio of 1.77 (95%CI: 1.39;2.25). P-value was found to be <0.01. Heterogeneity was found to be high (I^2=94%).

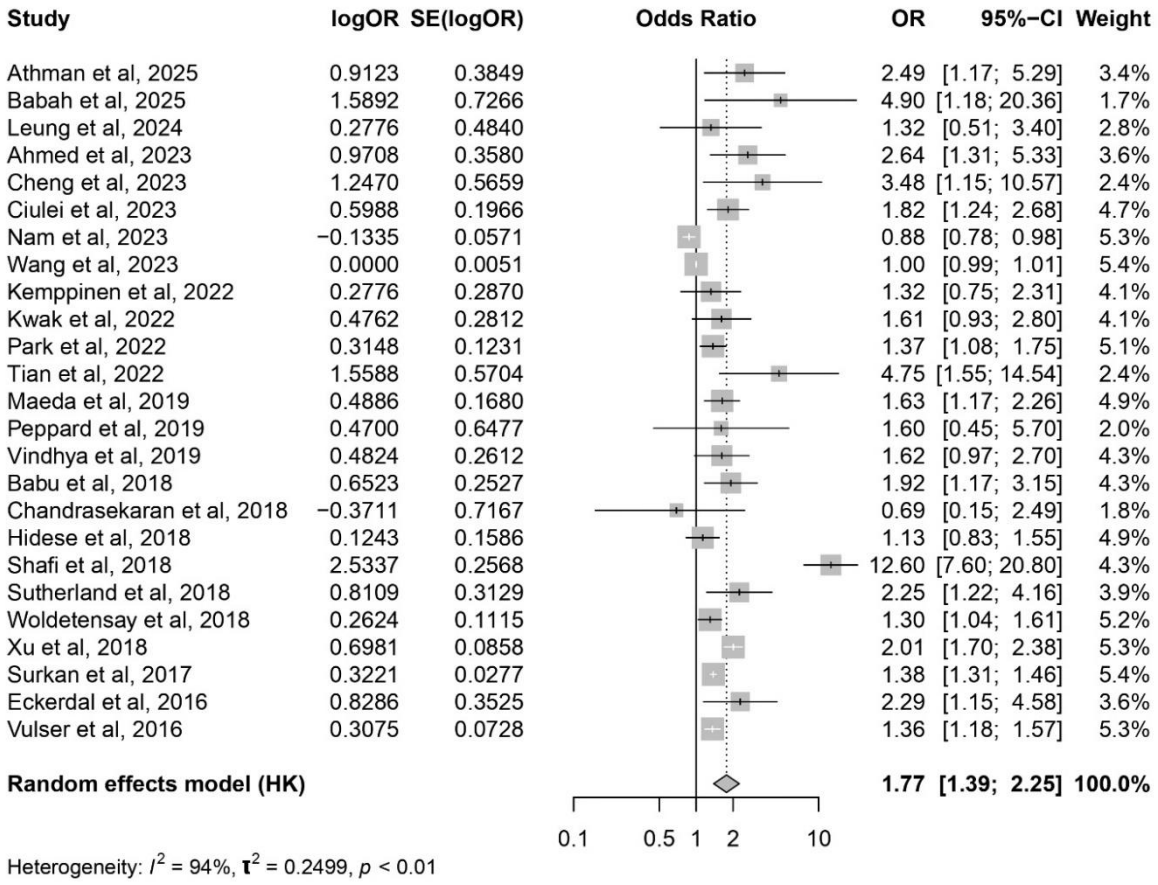


Figure 2: Forest plot showing the odds ratio of depression in patients suffering from anaemia

Sub-group analysis

To deal with high heterogeneity, subgroup analysis was performed as shown in Figures 3-8. The subgroup analysis found that cross-sectional studies (OR=1.82, 95%CI: 1.18- 2.80, I^2=93%, p<0.01) had a higher association of Depression and anaemia as compared to cohort studies (OR=1.65, 95%CI: 1.42- 1.92, I^2=63%, p<0.01).Low-quality studies (OR=2.00, 95%CI: 1.20- 3.33, I^2=89%, p<0.01) included in meta-analysis had a higher association as compared to those with high methodological quality (OR=1.53, 95%CI: 1.26- 1.86, I^2=94%, p<0.01). The subgroup analysis also found that studies with <500 participants showed a higher association (OR=2.68, 95%CI: 1.32- 5.44, I^2=86%, p<0.01) of Depression

and Anaemia as compared to those with >500 participants (OR=1.46, 95%CI: 1.26- 1.70, I^2=94%, p<0.01). Subgroup analysis also found that most studies included had Iron Deficiency Anaemia (IDA) as compared to Sickle Cell Anaemia (SCA), Pernicious Anaemia (PA) and other types of anaemia. The majority of studies used the Patient Health Questionnaire-9 and Edinburgh Postnatal Depression Scale as a Depression measurement scale, while other studies used DSM-5, ICD-10, Kessler's scale and QD2A scales, etc. Association of Depression and Anaemia was highest in Africa (OR=2.20, 95%CI: 1.19- 4.04, I^2=63%, p=0.04) followed by Australia (OR=2.01, 95%CI: 1.70- 2.38) , America (OR=1.87, 95%CI: 1.43- 2.45, I^2=0%, p=0.58) , Asia (OR=1.76, 95%CI: 1.14- 2.73, I^2=96%, p<0.01) and Europe (OR=1.39, 95%CI: 1.21- 1.59, I^2=6%, p=0.35).

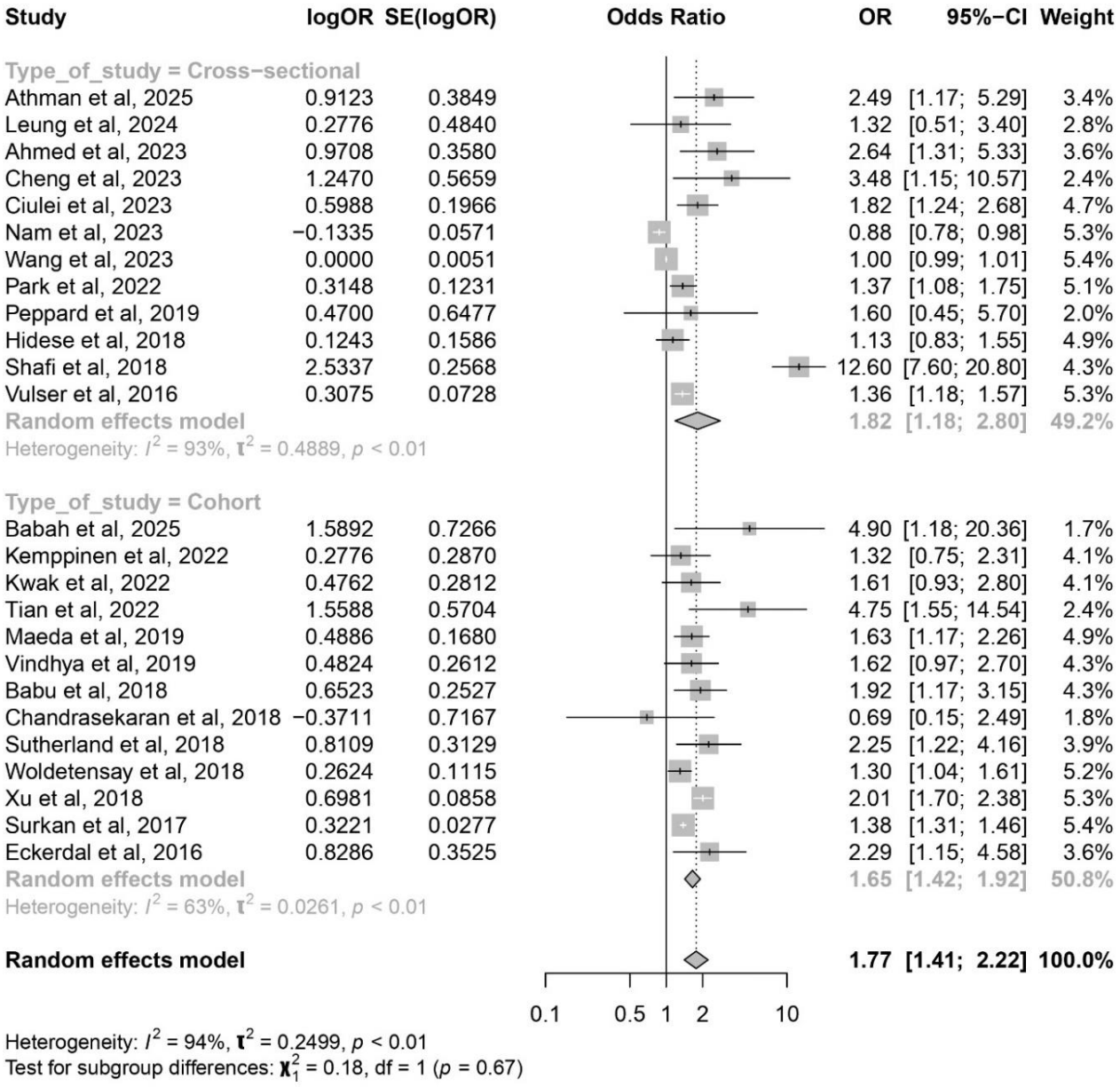


Figure 3: Forest plot showing subgroup analysis by type of study

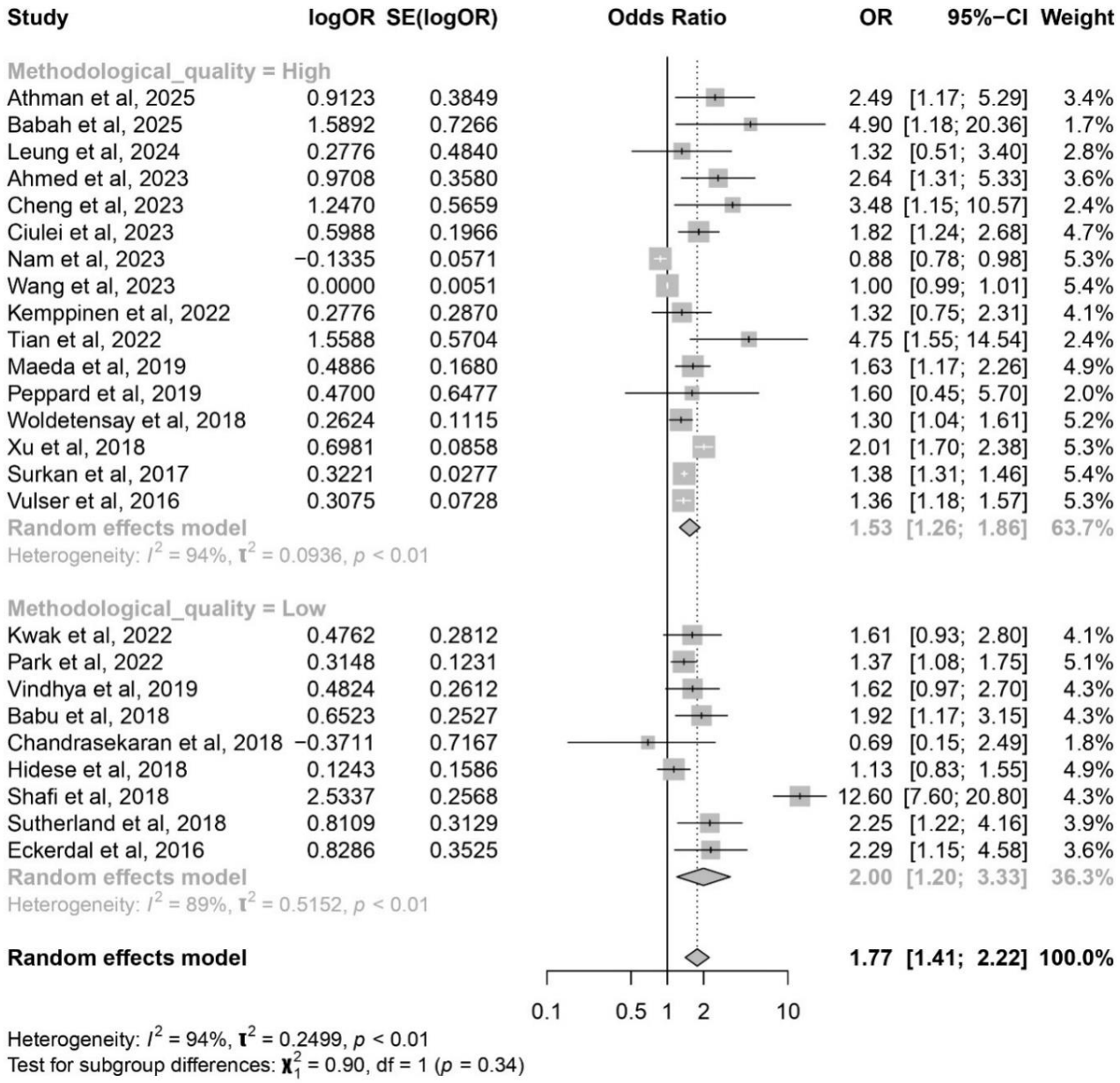


Figure 4: Forest plot showing subgroup analysis by methodological quality

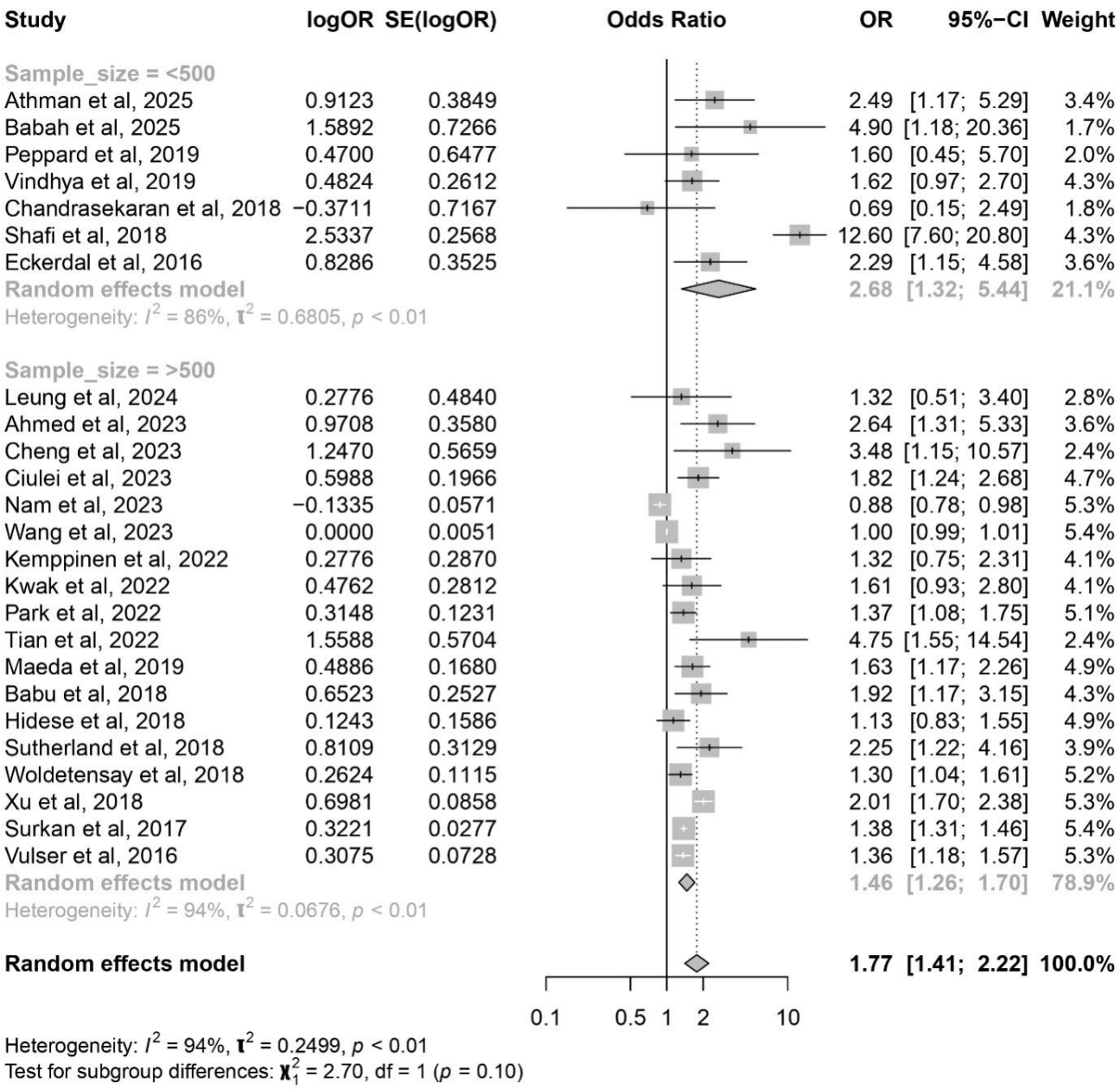


Figure 5: Forest plot showing subgroup analysis by sample size

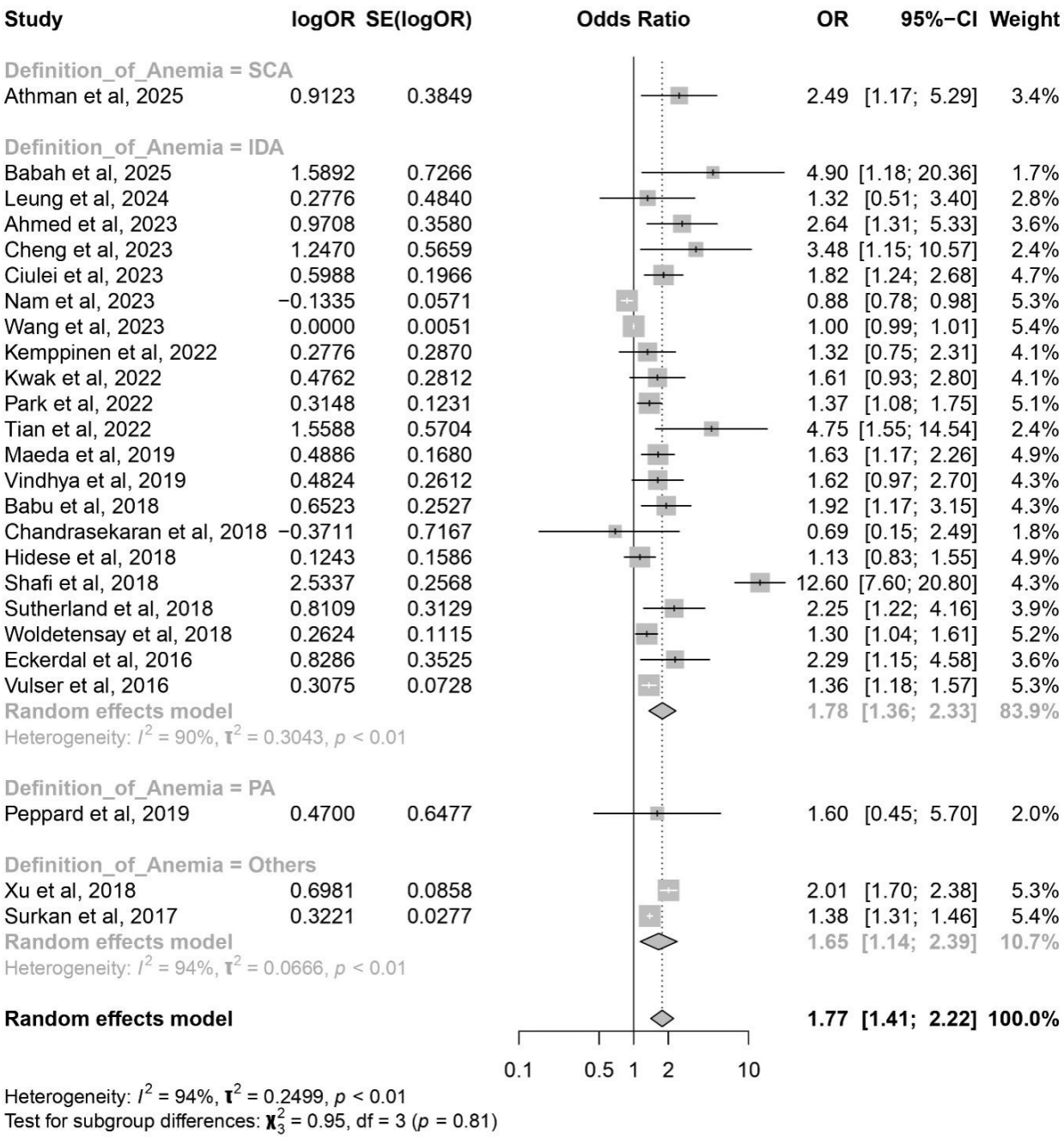


Figure 6: Forest plot showing subgroup analysis by Definition/Type of Anaemia

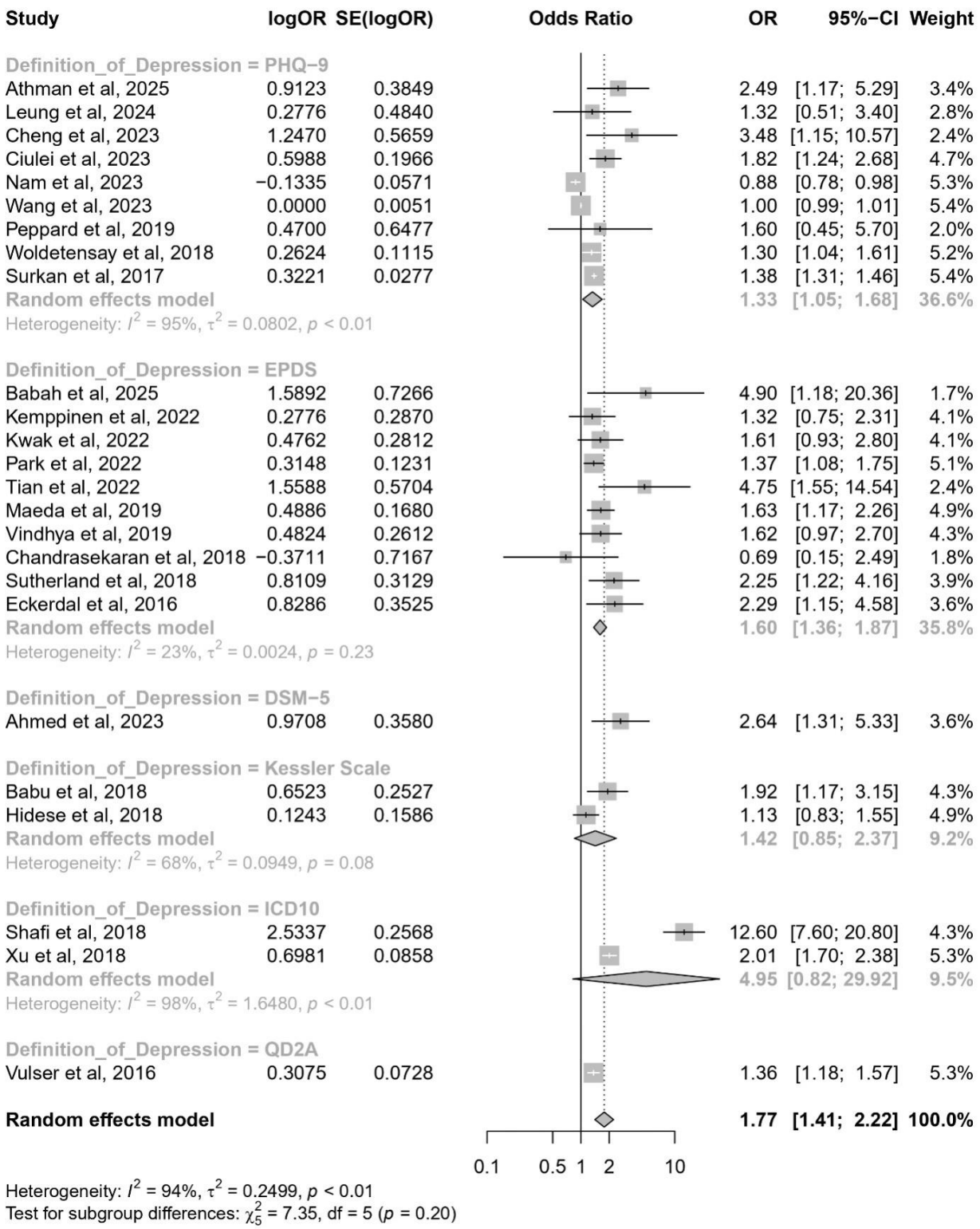


Figure 7: Forest plot showing subgroup analysis by type of depression scale used

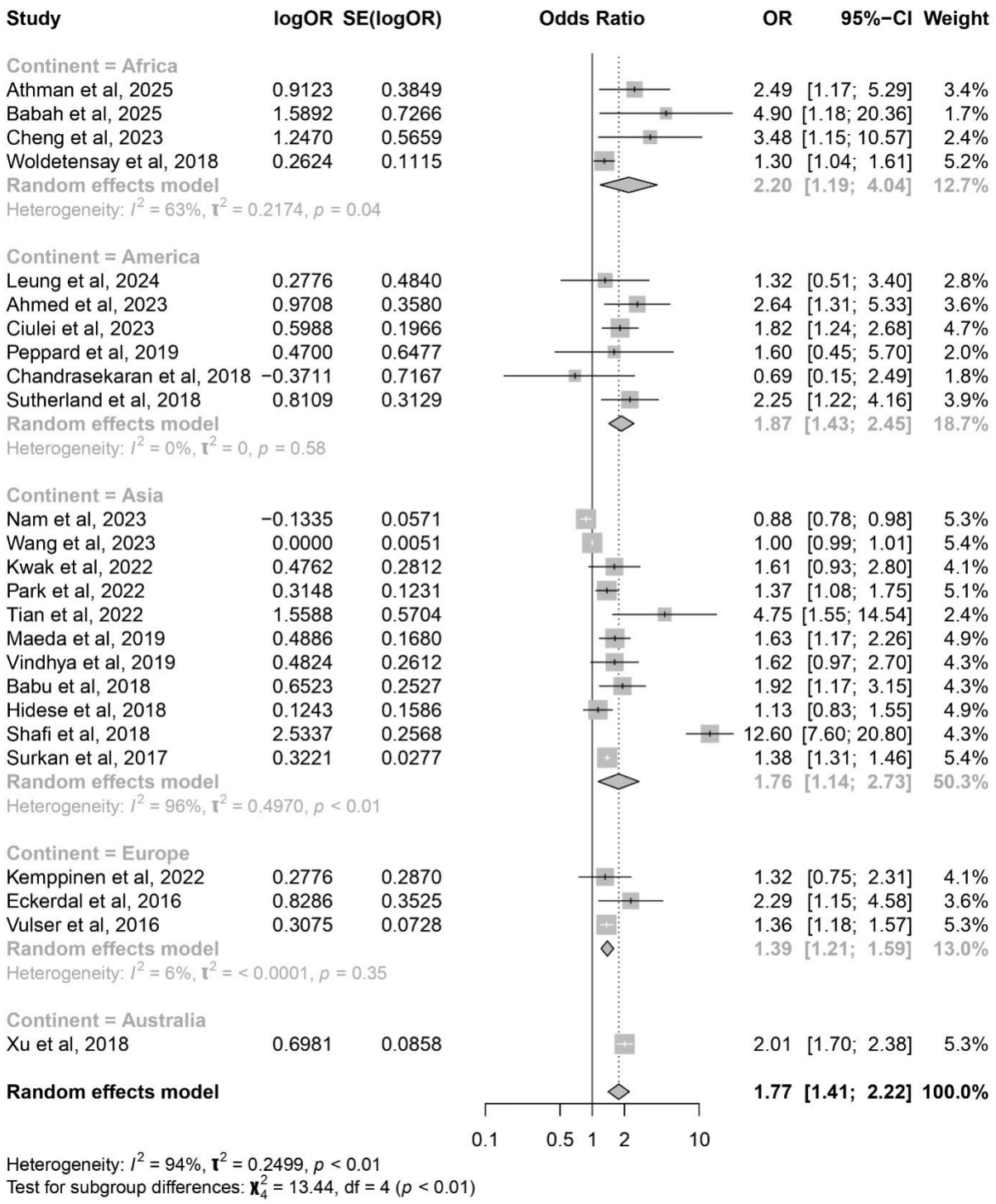


Figure 8: Forest plot showing subgroup analysis by Continent

Publication Bias

Publication bias was assessed using the funnel plot (Figure 9), Egger's test and DOI plot (Figure 10). Linear regression test of funnel plot asymmetry found t = 4.25, df = 23, p-value = 0.0003, Bias estimate= 2.8190 (SE = 0.6633). The LFK index in the DOI plot was found to be 9.03, indicating a high level of publication bias.

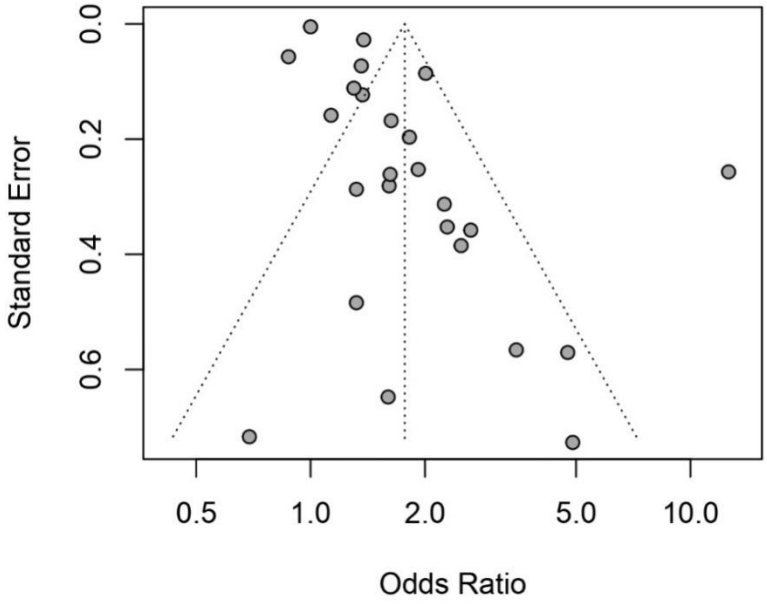


Figure 9: Funnel plot showing publication bias

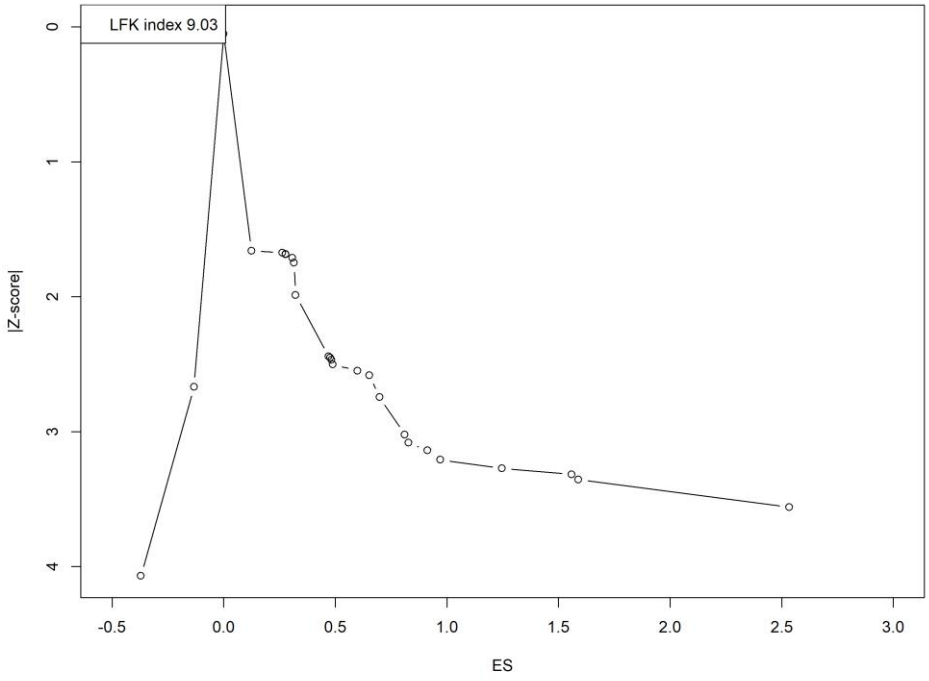


Figure 10: DOI plot showing publication bias

Sensitivity Analysis

Sensitivity analysis was performed using the leave-one-out method. There was no change in odds ratio measures after sensitivity analysis, as shown in Figure 11.

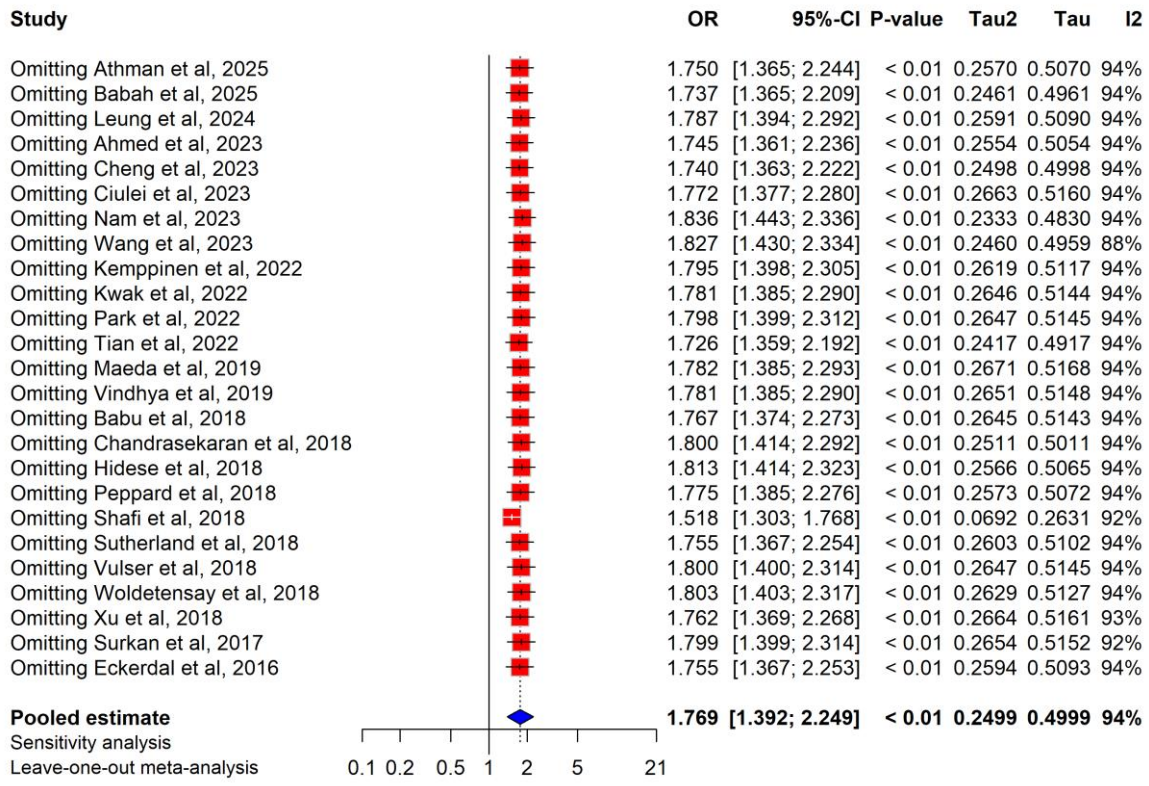


Figure 11: Forest plot showing sensitivity analysis using the Leave-one-out method

Discussion

This systematic review and meta-analysis demonstrate a significant association between anaemia and depression, reinforcing the importance of examining the intersection between physical and mental health. Anaemia was linked to a higher incidence of depression, according to our meta-analysis of descriptive epidemiological research. Similar results were shown by subgroup meta-analyses based on the study type, definitions of anaemia and depressive disorder, continents, and methodological quality. These findings are consistent across diverse populations and age groups, underscoring anaemia as a potential risk factor for depression and highlighting the need for integrated healthcare approaches.

Our results align with previous meta-analyses, such as Azami et al. (2019) [6] and Kang et al. (2020) [7], which reported that anaemia, particularly during pregnancy and postpartum, substantially increased the risk of depression [6]. Similarly, Lee et al. (2020) [4] found that anaemia was strongly linked with adult depression, especially in older populations. By including 25 recent studies and over 250,000 participants, our review provides a more updated and comprehensive synthesis, confirming that this association is not limited to perinatal or elderly populations but extends across broader demographic groups.

Subgroup analyses revealed several important patterns. First, cross-sectional studies showed stronger associations than cohort studies, possibly reflecting reverse causality, where depression leads to poor diet or health behaviors that worsen anaemia. Second, studies with smaller sample sizes and lower

methodological quality tended to report stronger associations, suggesting possible overestimation of effects. However, even in larger, higher-quality studies, the association remained statistically significant, reinforcing the robustness of the relationship. Anaemia and depression were found to be significantly and robustly associated with healthy persons from the general population in a study conducted by Vulser et al (2016) in Paris [43].

Geographic variation was also observed. Studies conducted in Africa and Asia demonstrated stronger associations than those in Europe or North America. For example, Athman et al. (2025) [23] reported high rates of depression among Tanzanian adolescents with sickle cell anaemia, emphasizing the unique vulnerability of this group. Similarly, Babah et al. (2025) [24] in Nigeria found that anaemia in pregnancy significantly increased the risk of postpartum depression. In contrast, large-scale studies from Korea (Nam et al., 2023; Park et al., 2022) [29,33] and China (Wang et al., 2023) [30] reported weaker or null associations, highlighting the possibility of cultural differences in reporting depressive symptoms, genetic factors, or differences in healthcare access. These regional variations suggest that socioeconomic and environmental factors may modify the anaemia–depression relationship.

Leung et al recommend in their study that young individuals should be screened for depression regardless of their low iron levels [25]. Iron deficiency anaemia and depressive disorder (DD) are related, according to Shafi et al, and the degree of IDA increases the severity of DD symptoms [41].

The biological plausibility of the observed association is strong. Anaemia leads to hypoxia, which impairs brain function and may contribute to mood disturbances. Iron deficiency, the most common cause of anaemia worldwide, plays a direct role in neurotransmitter metabolism, including serotonin, dopamine, and norepinephrine—key regulators of mood and behavior. Disruptions in these pathways may partly explain the higher prevalence of depression among individuals with iron deficiency anaemia. Studies such as Ciulei et al. (2023) in the United States support this mechanism, showing that somatic depressive symptoms were more common in women of reproductive age with biochemical evidence of iron deficiency [28]. Conversely, depression itself may exacerbate anaemia through poor nutrition, increased inflammation, or reduced healthcare utilization, suggesting a bidirectional relationship.

Several individual studies further illustrate the complexity of this relationship. For instance, Ahmed et al. (2023) found that untreated anaemia in older adults was associated with a 2.6-fold increased risk of depression, emphasizing the importance of anaemia management in ageing populations [26]. Cheng et al. (2023) in Malawi highlighted that anaemia significantly increased the risk of postpartum depression, underscoring the dual burden faced by women in low-resource settings [27]. On the other hand, Chandrasekaran et al. (2018) [39] and Kemppinen et al. (2022) [31] found no clear association, suggesting that not all forms of anaemia, or not all populations, may be equally affected.

In a study conducted by Tian et al, it was found that the risk of postpartum depression is greatly increased by moderate to severe anaemia, which should be treated early to reduce its detrimental effects [34]. Maeda et al also found that an elevated risk of postpartum depression has been linked to postpartum anaemia [35]. Vindhya et al found in their study that prenatal depression and anaemia were revealed to be substantially correlated using the bivariate and multivariate logistic regression analyses [37]. Anaemia at the time of maternity ward discharge was positively correlated with the onset of PPD symptoms (Eckerdal et al) [47].

Because it directly affects the foetus, early diagnosis of mental disturbance during pregnancy is essential. Among low- and middle-income nations like India, public health facilities ought to think about introducing and expanding screening programs for mental health issues among expectant mothers (Babu et al) [38]. Given that anaemia during pregnancy or the postpartum period is linked to a higher frequency of Post-Partum Depression, it warrants additional research as a possible risk factor for PPD (Sutherland et al) [42].

Prenatal depression management may be improved by identifying and treating pregnant women with low-normal vitamin B12 levels (Peppard et al) [36]. The community-based study by Woldetensay et al (2018) found a substantial correlation between prenatal depression symptoms and intimate partner violence, anaemia, and household food hardship. Strong social support of friends, family, and the spouse was protective for the mother. The study emphasises the necessity of focused prenatal screening for intimate partner violence and depression. Depression may be lessened by policies targeted at lowering maternal anaemia, intimate partner violence during pregnancy, and household food hardship [44].

Prioritising national or local strategies to increase postpartum women's access to primary health care in rural areas is important since, in addition to relieving postpartum illness, these initiatives may also have a positive knock-on effect on depressed symptoms. Primary care physicians may also think about screening women for heightened depressed symptoms when they are visited for postpartum sickness (Surkan et al) [46]. Given the connection between the two, this discovery emphasises the critical role primary care physicians play in screening for the two conditions, anaemia and symptoms of depressive disorder, simultaneously. Postpartum depression may be avoided by treating or avoiding anaemia (Xu et al) [45].

The clinical implications of these findings are considerable. Screening for depression among anaemic patients should be considered, particularly in high-risk groups such as pregnant and postpartum women, adolescents, and the elderly. Addressing anaemia through iron supplementation, nutritional interventions, or treatment of chronic illnesses may have the added benefit of improving mental health outcomes. For example, interventions aimed at correcting anaemia during pregnancy may reduce the incidence of postpartum depression, a condition with significant consequences for both maternal and child health. Similarly, integrating mental health support into clinics treating sickle cell disease or chronic anaemia could address unmet psychological needs.

Nevertheless, several caveats must be acknowledged. Significant heterogeneity across studies limits the precision of our pooled estimates. Publication bias was evident, suggesting that studies reporting positive associations may be overrepresented. Additionally, the reliance on observational designs prevents definitive conclusions about causality. Standardization of definitions for anaemia and depression, along with rigorous adjustment for confounders such as socioeconomic status, comorbidities, and nutritional factors, would strengthen future research.

In conclusion, our findings support a robust association between anaemia and depression across diverse populations. While the relationship appears strongest in resource-limited settings and among women of reproductive age, the evidence suggests that anaemia may be an important risk factor for depression globally. Early identification and treatment of anaemia, alongside routine mental health screening, may represent a cost-effective strategy to reduce the dual burden of physical and mental illness. Future research, particularly randomized controlled trials and longitudinal studies, is needed to clarify causal pathways and evaluate whether treating anaemia can reduce the risk or severity of depression.

Limitations and future implications

This study has certain limitations. Only observational studies were available, preventing firm conclusions about causality. Considerable heterogeneity existed across studies due to differences in populations, study design, sample size, and diagnostic criteria for anaemia and depression. Most studies focused on iron deficiency anaemia, limiting generalizability to other forms such as sickle cell or pernicious anaemia. Depression assessment tools varied, ranging from self-reported questionnaires to structured diagnostic scales, which may have influenced consistency. Important confounders, including socioeconomic status, comorbidities, nutrition, and gender, were not uniformly controlled. Evidence of publication bias and the exclusion of non-English literature may also have influenced results.

Future research should aim to address these gaps. Longitudinal and interventional studies, particularly randomized controlled trials, are needed to establish causal pathways. Standardized diagnostic criteria for anaemia and depression would enhance comparability across studies. Greater attention should be paid to

gender- and age-specific effects, as well as the influence of social and nutritional determinants. Investigating diverse forms of anaemia and their psychiatric implications remains essential. Importantly, trials assessing whether treatment of anaemia can reduce depressive symptoms—especially in high-risk groups such as pregnant and postpartum women—would provide valuable clinical guidance. Such evidence would help integrate mental health screening and anaemia management into holistic care strategies.

Conclusion and Recommendations

This systematic review and meta-analysis demonstrated a significant association between anaemia and depression, highlighting the complex interplay between physical and mental health. Patients with anaemia were found to have an increased likelihood of developing depressive symptoms across diverse populations, age groups, and geographic regions. Subgroup analyses further suggested that the association was stronger in studies with smaller sample sizes, lower methodological quality, and among populations in Africa and Asia, indicating potential sociodemographic influences. Despite some inconsistencies across studies and the presence of publication bias, the pooled evidence supports the notion that anaemia particularly iron deficiency anaemia may serve as an important risk factor for depression.

These findings emphasise the need for integrated screening and management strategies, where clinicians not only assess haematological status but also consider mental health evaluations in anaemic patients, especially among pregnant and postpartum women. Early detection and treatment of anaemia may play a vital role in reducing the burden of depression and improving overall quality of life. Future research, particularly well-designed longitudinal and interventional studies, is essential to clarify causal pathways, evaluate the impact of treatment, and explore the role of gender and socioeconomic factors in this relationship.

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