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A comprehensive systematic review and meta-analysis of the prevalence of anemia in Africa

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Abstract:

The incidence of anemia in Africa is still of major epidemiological significance. This study aims to determine the prevalence of anemia in Africa through a systematic review and meta-analysis of the published studies. We conducted a comprehensive search across five electronic databases (Web of Science, PubMed, ScienceDirect, Scopus, and Google Scholar) using specific keywords to address the prevalence of anemia following the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines. A meta-analysis was performed on our eligible studies using the random-effects model. Our search returned 101 eligible articles involving 79,572 anemia cases in 14 African nations. The overall pooled prevalence of anemia in Africa was 29.2% (95% confidence interval: 25.2%–33.7% I2 = 99.28%). Subgroup analyses revealed variations in the prevalence across different countries, study designs, maturity status of participants, and publication years. Notably, Egypt and South Africa exhibited high prevalence rates of 99.5% and 85.6%, respectively, whereas Ethiopia reported a moderately low prevalence of 19.3%. The maturity status also influenced prevalence rates, with children indicating a higher prevalence (58.8%) compared to adults (21%). The study highlights the significant burden of anemia in Africa; the findings underscore the need for targeted public health interventions and improved standard of living to manage and control anemia in the region.

Keywords:

Africa, anemia, epidemiology, meta-analysis, prevalence, Preferred Reporting Items for Systematic Reviews and Meta-analyses, systematic review

Introduction

Anemia, a disorder defined by a deficiency of red blood cells or hemoglobin, continues to be a widespread public health issue worldwide,[1] especially in Africa.[2] This hematological condition presents in different forms, with iron-deficiency anemia being the most common.[2] Anemia's prevalence in Africa can be ascribed to a complex interplay of causes, encompassing hunger, infectious diseases such as malaria and HIV, and genetic abnormalities like sickle cell disease.[3] Gaining a comprehensive understanding of the frequency of anemia throughout the continent is essential for formulating specific interventions and health strategies to reduce its effects.[4]

Anemia in Africa has a complex etiology that varies by region. Iron, vitamin B12, and folate deficiencies are the main causes of dietary deficiencies.[5] Iron deficiency is the main cause of anemia, and it is made worse by inadequate food intake as well as elevated physiological demands brought on by growth spurts and pregnancy.[6,7] In addition, the elevated incidence of anemia is mostly attributed to the presence of infectious illnesses unique to the area, including schistosomiasis, malaria, and HIV/AIDS. For instance, red blood cell breakdown and buildup brought on by malaria result in the development of anemia.[8] Furthermore, the erythropoiesis

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and iron metabolism processes may be impeded by the chronic inflammation brought on by these diseases.[9]

Socioeconomic factors significantly contribute to the prevalence of anemia in Africa.[10,11] The problem persists due to factors such as poverty, restricted healthcare access, inadequate sanitation, and low educational achievement. In rural and underserved metropolitan regions, the healthcare infrastructure frequently lacks the necessary resources, resulting in delays in diagnosing and treating medical conditions.[10] In addition, the prevalence of anemia can be influenced by cultural norms and dietary habits, particularly among groups that primarily consume plant-based diets that are deficient in easily absorbable iron.[11]

An analysis of anemia's demographic distribution indicates that some susceptible populations, including children under the age of five, pregnant women, and women of reproductive age, are disproportionately impacted.[12] Anemia can cause significant developmental and cognitive problems in children, and it also raises the chances of maternal and perinatal morbidity and mortality in pregnant women.[12] According to the World Health Organization, around 66% of pregnant women in Africa suffer from anemia, highlighting the immediate requirement for comprehensive public health interventions.[6]

Although anemia is widespread and has significant consequences, there is a lack of comprehensive and consistent data on its impact in many regions of Africa.[3] The disagreement arises from differences in study techniques, diagnostic criteria, and population demographics. Performing a systematic review and meta-analysis is crucial to compile available data, gaining a more comprehensive understanding of the prevalence of anemia, and pinpointing areas where current research is lacking.[3]

This systematic review seeks to consolidate existing data on the prevalence of anemia in Africa. This review will provide a thorough evaluation of the prevalence and impact of anemia by using strict criteria for inclusion and reliable statistical techniques. An in-depth analysis is crucial for providing information to policymakers, healthcare professionals, and stakeholders who are responsible for creating and executing effective programs to reduce anemia.

Methods

Data search, eligibility, and extraction

Prior to conducting this review, a preliminary search was conducted on two review databases, PROSPERO and DARE, to avoid redundancy and ensure the uniqueness of the study, preventing any overlap with prior publications or ongoing investigations. This review adheres strictly to the synthesis requirements outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[13] A comprehensive search was carried out on five prominent global electronic databases (PubMed, Google Scholar, Scopus, ScienceDirect, and Web of Science) to find literature pertaining to the prevalence of anemia in Africa. The search terms used to retrieve manuscripts reporting the prevalence of anemia in Africa included the key terms "Anemia" OR "anemia" OR "anaemia" AND "prevalence" OR "occurrence" OR "epidemiology" OR "incidence" AND specific country names such as Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cape Verde, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe, as well as "Africa" OR "Sub-Saharan Africa."

This review encompassed cross-sectional studies, prospective cohorts, and retrospective study. For the research to be considered, the samples or data needed to be acquired from at least one country in Africa. We have excluded works that meet the following criteria: (1) being reviews, (2) being editorials, (3) lacking a clearly defined origin, (4) containing redundant or duplicate data, (5) not being done within Africa, and (6) having an unavailable full text. Three authors (BKE, ASA., and YA) individually evaluated the title, abstract, and full text of the research, adhering to predetermined criteria for inclusion. Disputes were resolved through the attainment of a consensus among the authors. The titles, abstracts, and full texts of the eligible studies were carefully examined based on the relevant categories (title, abstract, and full text). A structured table was employed to collect relevant data, including the names of authors, the year of publication, the prevalence of anemia, and the study designs. Supplementary File 1 provides further information on the search methodology.

Statistical analysis and quality assessment

In all the studies we examined, we used a single-arm random-effects model to calculate the pooled prevalence of anemia in Africa. We efficiently synthesized the data by employing the meta-analysis technique developed by DerSimonian and Laird, which was implemented into the OpenMeta and Comprehensive Meta-analysis

Software.[14] To assess the existence of publication bias, a funnel plot was utilized.[15] The Cochran's Q test was used to measure the differences in estimates among various subgroups, while the heterogeneity index was evaluated using the Cochran Q test and I^2 values. A low, moderate, and high level of heterogeneity corresponded to I^2 values of 25%, 50%, and 75%, respectively.[16]

The methodological quality of the studies that were included was thoroughly assessed using the Joanna Briggs Institute critical assessment standards for prevalence data. The examination yielded a comprehensive quality score ranging from 0 to 18, with a score of "2" assigned for "yes" and "0" designated for "no." Studies with scores ranging from 14 to 18 were considered to have satisfactory quality. Supplementary Table 1 provides a comprehensive evaluation of the quality of the studies that were included.

Results

Selection of the study

A comprehensive search on five electronic databases was carried out and discovered a total of 6619 records. After removing duplicate articles, there remained a total of 1702 articles that were screened based on their titles and abstracts. A grand number of 1216 items were eliminated from consideration based on the specific exclusion criteria. Afterward, the entirety of the remaining articles was assessed to ascertain their appropriateness. An additional 385 studies were excluded from the study because they contained duplicated data, did not provide sufficient information on anemia infection in Africa, or had unclear reporting of prevalence numbers. Ultimately, 101 publications met the requirements and were included in the qualitative synthesis and meta-analysis. Figure 1 presents a thorough summary of the process used to choose the study.

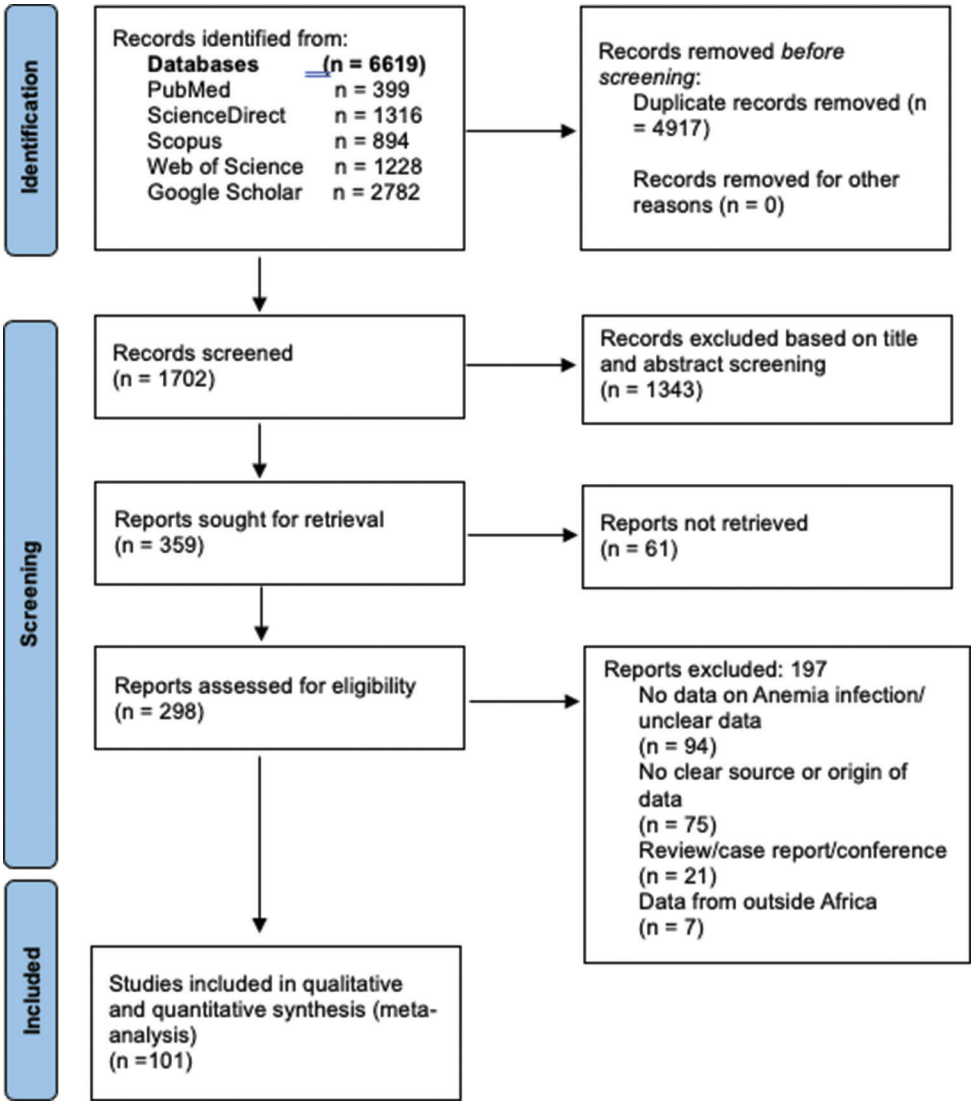

Figure 1: Summary of the studies selection and screening process

The systematic review and meta-analysis on the prevalence of anemia in Africa included a wide array of studies retrieved from 14 different countries in Africa. The research covers a range of years, with publication dates spanning from as early as 2004 to the most recent in 2023. The geographic distribution encompasses a diverse array of countries, such as Ethiopia, Tanzania, Uganda, Sudan, Nigeria, Papua New Guinea, Congo, Togo, Egypt, Rwanda, Guinea Bissau, Malawi, Gambia, and South Africa. Ethiopia is notable for having the greatest number of studies (n = 75/101).

A considerable proportion of the research employed a cross-sectional design (n = 90/101) out of the four different studies observed in the included manuscript (cross-sectional, prospective, and retrospective study designs), which was the predominant methodological approach utilized, accounting for approximately 89% of the included studies. However, there were also studies utilizing cohort (n = 2/101), retrospective (n = 7/101), and prospective designs (n = 2/101), demonstrating a wide range of methodologies used to examine the prevalence of anemia. Most of the research primarily concentrated on adult populations, while a significant proportion also investigated children, thereby emphasizing the issue of anemia across several age cohorts, as represented in Table 1.

The sample size in these studies shows significant variation. For example, Widiyanti *et al*. (2017) did a study in Papua New Guinea that studied a relatively small sample of 90 adults. In contrast, Wolde *et al*. (1993) conducted a much bigger survey in Ethiopia with a sample size of 14,740 persons. There was considerable fluctuation in the number of confirmed instances of anemia. For instance, Khalid *et al*. (2020) conducted a study in Sudan where they found 1520 positive cases out of 4271 individuals investigated. In contrast, investigations conducted by Tamir *et al*. (2018) and Alamdo *et al*. (2015) in Ethiopia reported just 7 and 6 positive cases, respectively.

Studies specifically focused on children also revealed important inferences. In Ethiopia, Gebrehaweria *et al*. (2020) conducted a comprehensive investigation involving 2554 children, revealing an astonishing 1857 instances of anemia, in contrast to Abera's (2018) study in Ethiopia, which analyzed a sample of 410 youngsters and identified 165 cases with positive results. Multiple research investigations undertaken in Ethiopia by authors such as Alemayehub *et al*. (2019), Alem *et al*. (2013), and Alemu *et al*. (2020), among others, have provided a significant amount of data for the overall analysis. The abundance of research conducted in Ethiopia highlights the country's strong emphasis on addressing the issue of anemia in the context of public health.

Additional noteworthy research includes the study conducted by Nagu *et al*. (2014) in Tanzania, which observed a substantial number of positive cases (1067 out of 1245). Similarly, the study conducted by van Lettow *et al*. (2004) in Malawi also revealed a high prevalence, with 270 positive cases out of 319 individuals investigated, as represented in Table 1.

Anemia was highly prevalent in Africa, with an overall pooled estimate of 29.2% with a confidence interval (CI) ranging from 22.5% to 33.7%. Figure 2 shows that the prevalence of Anemia in Africa was determined to be substantial, with a pooled prevalence rate of $P < 0.001$. In addition, there was a significant level of heterogeneity, indicated by an I^2 value of 99.28%. Nevertheless, the studies that were included in the analysis showed a publication bias, as seen by the significant Egger's P value of 0.010 and the asymmetrical distribution of the studies in relation to the standard error, as depicted in Figure 3.

The subgroup meta-analysis, as presented in Table 2, offers a complete assessment of the impact of several factors, including as country, study design, maturity status of participants, and year of publication, on the prevalence of anemia in Africa. The prevalence rates of anemia vary significantly when considering statistics relevant to each country. Egypt has the highest rate of anemia, with a frequency of 99.5% (CI: 92.6–100), indicating that anemia is virtually universally present among its population. In comparison, Ethiopia, which has conducted a significant number of research (75), exhibits a considerably lower prevalence rate of 19.3% (CI: 15.8–23.4). This emphasizes a clear disparity in the burden of anemia between different locations. The significant heterogeneity (I^2 > 90%) seen in many countries, including Tanzania (I^2 = 99.31%) and Nigeria (I^2 = 93.87%), highlights the considerable variation in the prevalence of anemia within these nations.

Studies with a cross-sectional design had the highest pooled prevalence in comparison with other study designs as represented in Figure 4.

An analysis of the participants' maturity status revealed a notable discrepancy in the prevalence of anemia between adults and children. The prevalence rate in adults, as indicated by 75 research, is 21% (CI: 17.6–24.8), whereas children, examined in 26 studies, show a significantly higher prevalence rate of 58.8% (CI: 53.6–63.8). The notable disparity suggests that children are more susceptible to anemia, potentially due to factors including inadequate nutrition and increased metabolic requirements. The substantial heterogeneity (I^2 > 98%) seen in both subgroups indicates significant variations in

Table 1: Characteristic table of the included studies

Name of author	Year of publication	Country	Total examined	Positive cases	Study designs	Adult/ children
Widiyanti *et al*.[17]	2017	Papua new gunnie	90	50	Cross-sectional	Adult
Msemo *et al*.[10]	2018	Tanzania	1248	458	Cross-sectional	Adult
Bongomin[18]	2021	Uganda	263	37	Cross-sectional	Adult
Tamir *et al*.[19]	2018	Ethiopia	394	7	Cohort	Adult
Alamdo *et al*.[20]	2015	Ethiopia	411	6	Cross-sectional	Adult
Woldeamanuel and Wondimu[21]	2018	Ethiopia	255	8	Cross-sectional	Adult
Beyene *et al*.[22]	2017	Ethiopia	528	8	Cross-sectional	Adult
Melese *et al*.[23]	2017	Ethiopia	377	8	Cross-sectional	Adult
Alem[24]	2013	Ethiopia	384	8	Cross-sectional	Adult
Deressa *et al*.[8]	2018	Ethiopia	320	8	Cross-sectional	Adult
Fiseha *et al*.[25]	2017	Ethiopia	373	8	Cohort	Adult
Tesfaye and Enawgaw[26]	2014	Ethiopia	349	8	Cross-sectional	Adult
Gedefaw *et al*.[27]	2013	Ethiopia	234	6	Cross-sectional	Adult
Milkias *et al*.[28]	2014	Ethiopia	616	5	Cross-sectional	Adult
Assefa *et al*.[29]	2015	Ethiopia	1061	8	Cross-sectional	Adult
Enawgaw *et al*.[30]	2014	Ethiopia	319	5	Cross-sectional	Adult
Daka *et al*.[31]	2013	Ethiopia	384	7	Cross-sectional	Adult
Ferede and Wondimeneh[32]	2013	Ethiopia	400	5	Cross-sectional	Adult
Dessalegn *et al*.[33]	2016	Ethiopia	425	8	Cross-sectional	Adult
Sahle *et al*.[34]	2017	Ethiopia	172	8	Cross-sectional	Adult
Wubetu and Mebratu[35]	2018	Ethiopia	376	5	Cross-sectional	Adult
Gelde *et al*.[36]	2015	Ethiopia	305	8	Cross-sectional	Adult
Hadgu *et al*.[37]	2013	Ethiopia	376	8	Cross-sectional	Adult
Alemayehu *et al*.[38]	2019	Ethiopia	993	650	Cross-sectional	Children
Woldie *et al*.[39]	2015	Ethiopia	366	231	Cross-sectional	Children
Tegegne *et al*.[40]	2022	Ethiopia	787	369	Cross-sectional	Children
Gebrehaweria Gebremeskel and Lemma Tirore[41]	2020	Ethiopia	2554	1857	Cross-sectional	Children
Sorsa *et al*.[42]	2021	Ethiopia	917	407	Cross-sectional	Children
Molla *et al*.[43]	2020	Ethiopia	577	242	Cross-sectional	Children
Malako *et al*.[44]	2018	Ethiopia	522	255	Cross-sectional	Children
Malako *et al*.[45]	2019	Ethiopia	477	248	Cross-sectional	Children
Roba *et al*.[46]	2016	Ethiopia	216	116	Cross-sectional	Children
Heinrichs *et al*.[47]	2021	Ethiopia	1290	918	Cross-sectional	Children
Heinrichs *et al*.[47]	2020	Ethiopia	2790	1809	Cross-sectional	Children
Heinrichs *et al*.[47]	2020	Ethiopia	3064	2204	Cross-sectional	Children
Abebaw *et al*.[48]	2020	Ethiopia	424	103	Cross-sectional	Adult
Bireda *et al*.[49]	2022	Ethiopia	476	128	Cross-sectional	Adult
Abebe *et al*.[50]	2022	Ethiopia	484	136	Cross-sectional	Adult
Bambo *et al*.[51]	2023	Ethiopia	282	132	Cross-sectional	Adult
Elmugabil and Adam[52]	2023	Sudan	208	92	Cross-sectional	Adult
Elmardi *et al*.[53]	2020	Sudan	4271	1520	Cross-sectional	Adult
Regasa and Haidar[54]	2019	Ethiopia	454	122	Cross-sectional	Adult
Teji *et al*.[55]	2016	Ethiopia	600	192	Cross-sectional	Adult
Seyoum *et al*.[56]	2019	Ethiopia	257	22	Cross-sectional	Adult
Gonete *et al*.[57]	2018	Ethiopia	462	118	Cross-sectional	Adult
Mengistu *et al*.[58]	2019	Ethiopia	443	49	Cross-sectional	Adult
Engidaw *et al*.[59]	2018	Ethiopia	456	100	Cross-sectional	Adult
Demelash and Murutse[60]	2015	Ethiopia	594	125	Cross-sectional	Adult
Tura *et al*.[61]	2020	Ethiopia	551	232	Cross-sectional	Adult
Alemu and Gebremedhin[62]	2020	Ethiopia	407	62	Cross-sectional	Adult
Gebreyesus *et al*.[63]	2019	Ethiopia	1323	384	Cross-sectional	Adult
Wolde-Gebriel *et al*.[64]	1993	Ethiopia	14740	2742	Cross-sectional	Adult
Mekasha and Zerfu[65]	2009	Ethiopia	707	41	Cross-sectional	Adult
Herrador *et al*.[66]	2014	Ethiopia	764	236	Cross-sectional	Adult

Contd...

Table 1: Contd...

Name of author	Year of publication	Country	Total examined	Positive cases	Study designs	Adult/ children
Alelign *et al*.[67]	2015	Ethiopia	384	41	Cross-sectional	Adult
Mahmud *et al*.[68]	2013	Ethiopia	525	58	Cross-sectional	Adult
Assefa *et al*.[69]	2014	Ethiopia	404	152	Cross-sectional	Adult
Mesfin *et al*.[70]	2015	Ethiopia	1755	476	Cross-sectional	Adult
Teji *et al*.[71]	2016	Ethiopia	547	175	Cross-sectional	Adult
Desalegn Wolide *et al*.[72]	2014	Ethiopia	586	256	Cross-sectional	Adult
Gutema *et al*.[73]	2014	Ethiopia	355	84	Cross-sectional	Adult
Adem *et al*.[74]	2015	Ethiopia	338	77	Cross-sectional	Adult
Tesfaye *et al*.[75]	2015	Ethiopia	405	62	Cross-sectional	Adult
Chane[76]	2016	Ethiopia	517	112	Cross-sectional	Adult
Tandu-Umba and Mbangama[77]	2015	Congo	412	202	Cross-sectional	Adult
Addis Alene and Mohamed Dohe[12]	2014	Ethiopia	581	330	Cross-sectional	Adult
Kefiyalew *et al*.[78]	2014	Ethiopia	637	125	Cross-sectional	Adult
Alemu and Umeta[79]	2015	Ethiopia	1212	267	Cross-sectional	Adult
Obse *et al*.[80]	2013	Ethiopia	1678	737	Cross-sectional	Adult
Nega *et al*.[81]	2015	Ethiopia	354	123	Cross-sectional	Adult
Yihunie Akalu *et al*.[82]	2020	Ethiopia	837	333	Cross-sectional	Children
Ajakaye and Ibukunoluwa[83]	2020	Nigeria	103	52	Cross-sectional	Children
Getawa *et al*.[84]	2020	Ethiopia	251	134	Cross-sectional	Children
Adelman *et al*.[85]	2019	Uganda	627	451	Retrospective	Children
Tekile *et al*.[86]	2019	Ethiopia	6354	4003	Retrospective	Children
Girum *et al*.[87]	2017	Ethiopia	545	68	Retrospective	Children
Padovese[88]	2014	Ethiopia	410	165	Cross-sectional	Children
Cheong *et al*.[89]	1996	Uganda	400	296	Retrospective	Children
Roba *et al*.[46]	2016	Ethiopia	215	166	Cross-sectional	Children
Ughasoro *et al*.[90]	2015	Nigeria	209	100	Cross-sectional	Children
da Silva-Junior[91]	2019	Ethiopia	193	119	Retrospective	Children
Nambiema *et al*.[11]	2019	Togo	213	172	Retrospective	Children
Thorne *et al*.[92]	2013	Guinea Bissau	440	353	Cross-sectional	Children
Mbabazi[93]	2021	Rwanda	113	78	Cross-sectional	Children
Abaker and Mohammed[94]	2016	Sudan	40	34	Cross-sectional	Adult
Isanaka *et al*.[95]	2012	Tanzania	684	438	Cross-sectional	Adult
Abdelkareem *et al*.[96]	2019	Egypt	100	100	Cross-sectional	Adult
Atomsa *et al*.[97]	2014	Ethiopia	108	40	Cross-sectional	Adult
Gunda *et al*.[98]	2016	Tanzania	701	358	Retrospective	Adult
van Lettow *et al*.[99]	2005	Malawi	500	427	Cross-sectional	Adult
Abay *et al*.[100]	2018	Ethiopia	100	53	Cross-sectional	Adult
Bashir *et al*.[101]	2015	Sudan	100	44	Cross-sectional	Adult
Yang *et al*.[102]	2022	Congo	200	139	prospective	Adult
Pessoa *et al*.[103]	2016	Nigeria	80	71	Cross-sectional	Adult
Minchella *et al*.[4]	2015	Gambia	39	26	Cross-sectional	Adult
Kerkhoff *et al*.[104]	2016	South Africa	153	131	Cross-sectional	Adult
Kahase *et al*.[105]	2020	Ethiopia	40	10	Cross-sectional	Adult
Hella *et al*.[106]	2018	Tanzania	102	74	Cross-sectional	Adult
Yesuf[107]	2017	Ethiopia	44	30	Cross-sectional	Adult
Nagu *et al*.[108]	2014	Tanzania	1245	1067	Prospective	Adult
Islam *et al*.[109]	2017	Malawi	319	270	Cross-sectional	Adult

study outcomes, likely attributable to diverse techniques and demographic characteristics, as represented in Table 2.

The methodology, which considers the year of publication, also reveals varying prevalence of anemia across time. Prior to 2005, studies indicate a prevalence rate of 52.8% (CI: 4.7–96.2). However, the broad CI and substantial heterogeneity (I^2 = 99.76%) suggest that the data is inconsistent. During the period from 2005 to 2010, a solitary investigation indicates a significantly reduced occurrence rate of 5.8% (CI: 4.3–7.8). Nevertheless, the

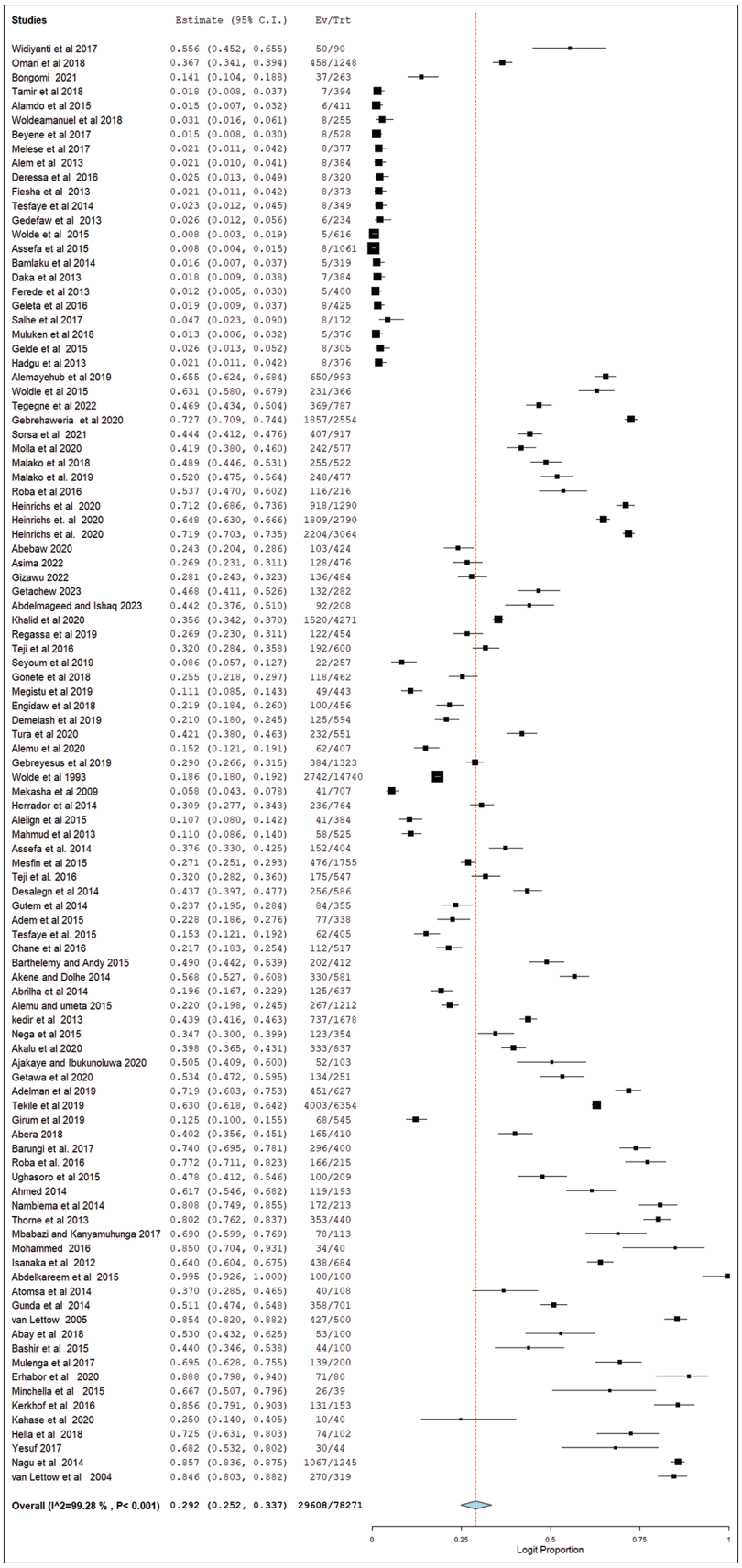

Figure 2: A forest plot showing the pooled prevalence of anemia in Africa

following time periods, specifically 2011–2015 and 2016–2020, exhibit higher prevalence rates of 22% (CI: 16.4–28.8) and 34.9% (CI: 29.5–40.8), respectively, accompanied by significant heterogeneity (I^2 > 98%), suggesting diverse research findings. The prevalence of anemia remained constant at 34.9% (CI: 27.0–43.7) for research published from 2021 to 2024, indicating a consistent and noteworthy burden of anemia in recent years, as represented in Table 2. The corresponding forest plots for the pooled prevalence of anemia in Africa in relation to country, maturity status, and year of publication are presented in the Supplementary Figures 1-3.

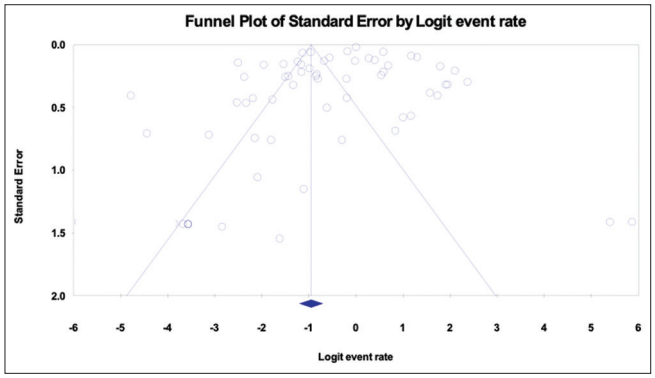

Figure 3: A funnel plot showing no publication bias of anemia in Asia (Egger's *P* = 0.00914)

Figure 5 illustrates the prevalence of anemia in several African countries, highlighting significant regional differences that are important to understand the disease's epidemiological effects. Egypt is depicted as having the most vivid shade in Northern Africa, signifying the highest frequency range of 91.8% to 99.5%. This is in line with the results of the subgroup meta-analysis, which demonstrate that Egypt has a 99.5% prevalence of anemia, a critical public health concern requiring immediate attention.

East African nations, such as Tanzania, Uganda, and Rwanda, have a significant prevalence of anemia. Specifically, the incidence ranges from 53.6% to 61.2% in Tanzania, 45.9% to 53.6% in Uganda, and 61.2% to 68.9% in Rwanda [Figure 5]. The meta-analysis confirms these results, indicating that the prevalence rates in Tanzania and Uganda are 63.7% and 51.7%, respectively. The high frequency of anemia in these places highlights the substantial burden of this condition, which can be related to causes such as inadequacies in nutrition, infectious illnesses, and poor healthcare access. Despite having the highest number of papers included in the meta-analysis, Ethiopia is depicted with a lighter hue, indicating a lower prevalence range of 15.3-23%. The prevalence identified in the subgroup analysis is 19.3%, indicating a comparatively lesser burden of anemia in this region compared to others.

Table 2: Subgroup meta-analysis of the prevalence of anemia in Africa in relation to country, type of study designs, maturity status of participants and year of publication

Parameter	Number of studies	Prevalence	CI (%)	Q	I^2	Heterogeneity	
						DF	*P*
Country							
Papua Guinea	1	55.6	45.2–65.5	-	-	-	-
Tanzania	5	63.7	42.4–80.8	579.94	99.31	4	<0.001
Uganda	3	51.7	20.6–81.5	214.63	99.07	2	<0.001
Ethiopia	75	19.3	15.8–23.4	1142.45	99.35	74	<0.001
Sudan	4	49.3	37.0–61.6	35.95	91.66	3	<0.001
Congo	2	59.5	38.7–77.4	22.34	95.52	1	<0.001
Nigeria	3	64.7	41.1–82.8	32.65	93.87	2	<0.001
Togo	1	80.8	74.9–85.5	-	-	-	-
Guinea Bissau	1	80.2	76.2–83.7	-	-	-	-
Rwanda	1	69.0	59.9–76.9	-	-	-	-
Egypt	1	99.5	92.6–100	-	-	-	-
Malawi	2	85.1	82.5–87.4	0.09	0.0	1	0.766
Gambia	1	66.7	50.7–79.6	-	-	-	-
South Africa	1	85.6	79.1–90.3	-	-	-	-
Maturity							
Adult	75	21.0	17.6–24.8	6297.61	98.82	74	<0.001
Children	26	58.8	53.6–63.8	1442.31	98.27	25	<0.001
Year of publication							
<2005	2	52.8	4.7–96.2	412.43	99.76	1	<0.001
2005–2010	1	5.8	4.3–7.8	-	-	-	-
2011–2015	40	22.0	16.4–28.8	3696.46	98.94	39	<0.001
2016–2020	51	34.9	29.5–40.8	5542.83	99.1	50	<0.001
2021–2024	7	34.9	27.0–43.7	152.36	96.06	6	<0.001

CI=Confidence interval

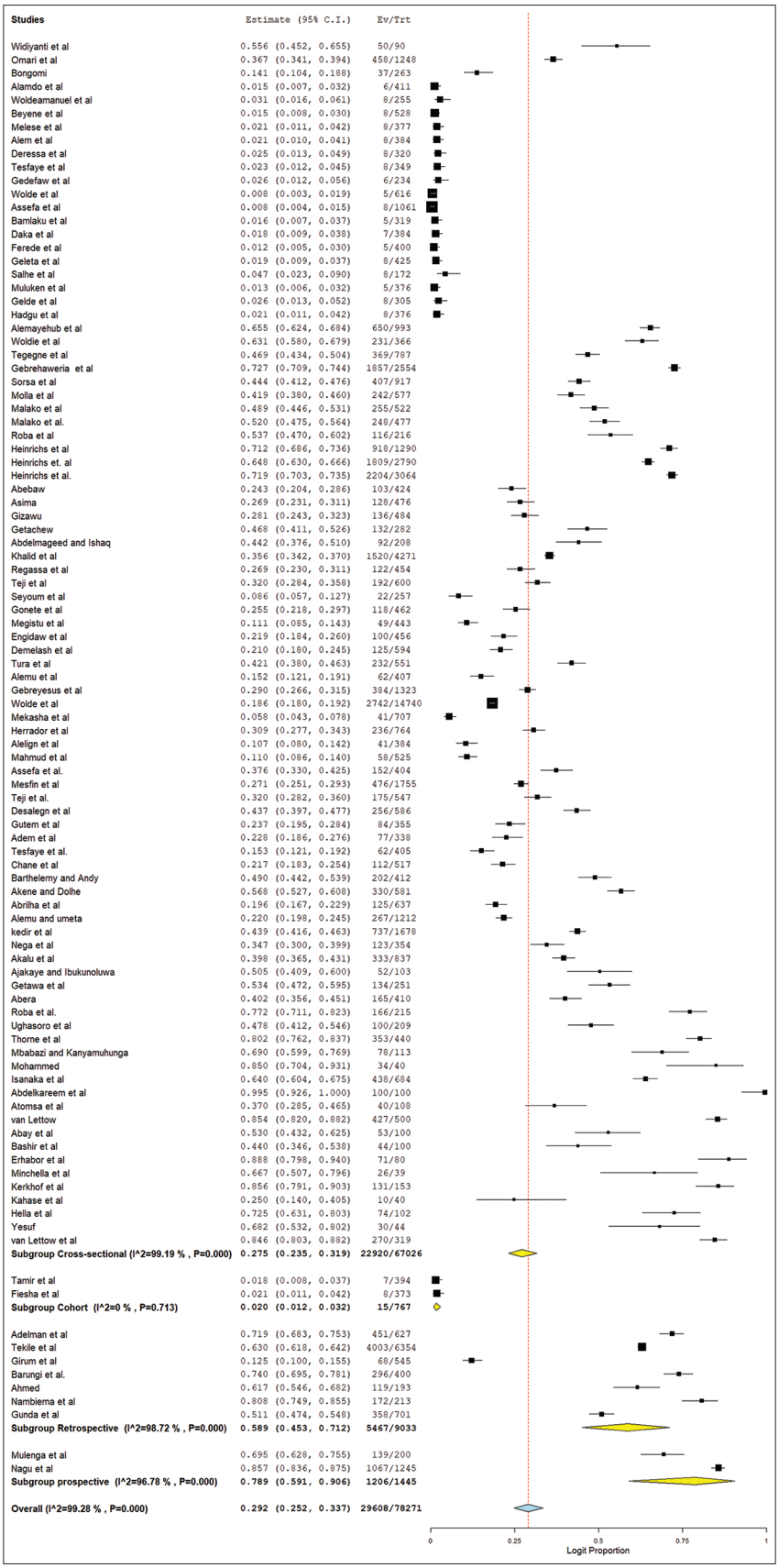

Figure 4: Subgroup meta-analysis of the prevalence of anemia in Africa in relation to the type of study designs

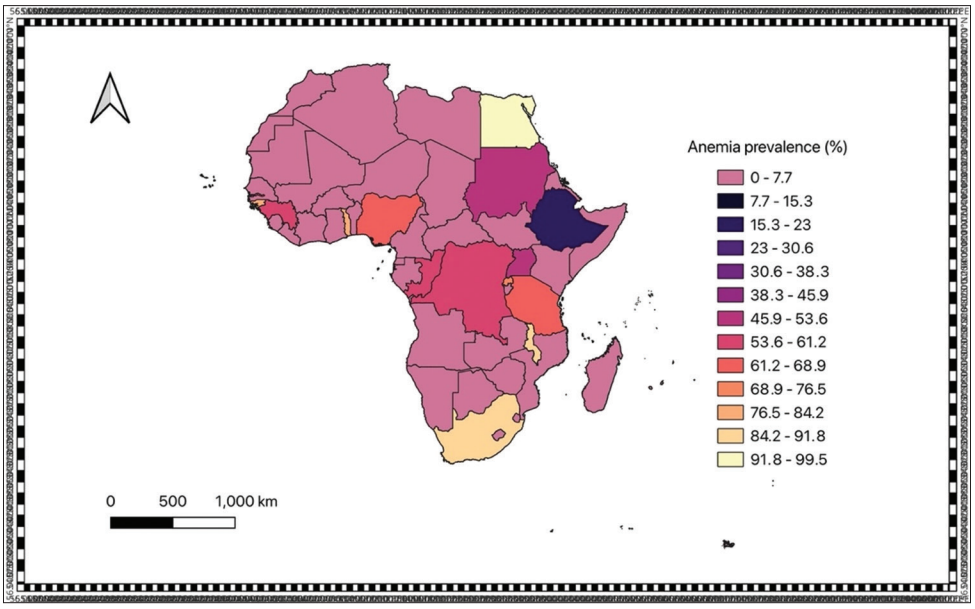

Figure 5: A spatial distribution map showing prevalence of anemia in Africa

West African countries such as Nigeria and Guinea-Bissau are depicted with shaded areas representing prevalence ranges of 68.9-76.5% and 76.5-84.2%, respectively. The meta-analysis confirms these findings, indicating a significant prevalence of anemia in Nigeria (64.7%) and Guinea-Bissau (80.2%). Togo's prevalence rate of 80.8% is within the high range of 76.5-84.2%, as indicated in the meta-analysis. The elevated rates may be indicative of fundamental problems such as poverty, food insecurity, and insufficient healthcare services. Malawi and South Africa, both located in Southern Africa, exhibit a significant prevalence range of 76.5-84.2% and 84.2-91.8%, respectively. Both results align with the findings of the meta-analysis, which indicate that Malawi has a prevalence of 85.1% and South Africa has 85.6%. This highlights the significant burden of anemia in both locations, as seen in Figure 5.

Discussion

Anemia continues to be a significant public health concern throughout Africa, as indicated by this meta-analysis data, which reveals a combined prevalence rate of 29.2%. The forecast highlights the extensive influence of anemia throughout the continent.[1] The exact cause of the high frequency of Anemia in Africa remains uncertain, however it may be linked to the low quality of life in many African nations, as their diets often lack proper nutrition.[110] The results of this research align with the findings of previous studies.[72,110] Insufficient availability of diagnostic techniques and facilities in many major cities throughout Africa may contribute to the high prevalence of Anemia in the region, along with its accompanying health complications. The outcomes of this investigation are consistent with the reports of others.[20] The statistical significance of the combined prevalence of anemia in this study emphasizes the immediate requirement for comprehensive and efficient public health efforts to tackle this crucial problem.[20]

The study exhibited significant levels of heterogeneity. The large variability indicates notable disparities in the prevalence of anemia among studies, possibly attributed to varying diagnostic techniques, demographic variances, and regional factors.[18] The wide range of differences makes it difficult to create a standardized plan for managing anemia. This emphasizes the need for strategies that are customized to each region in Africa, considering the distinct conditions of different places. Publication bias indicates that studies with significant or favorable findings are more likely to be published.[15]

The subgroup meta-analysis reveals substantial disparities in the prevalence of anemia, which are impacted by factors such as the country of study, the age of participants, and the year of publication. This underscores the intricate nature of anemia as a public health issue. Egypt has an extremely high incidence rate of 99.5%, while Ethiopia claims a lower rate of 19.3%. This difference highlights the necessity for implementing policies tailored to each country to effectively address anemia. The presence of heterogeneity among countries, specifically Tanzania and Nigeria, with I^2 values surpassing 90%, indicates that factors such as disparities in nutrition, access to health care, and socioeconomic conditions play a role in these variations. These findings align with previous studies.[10,106]

The cross-sectional studies in this review showed the highest combined incidence of anemia. This high prevalence is likely due to the systematic research conducted in both hospital and non-hospital settings. The findings of this investigation are consistent with the reports of other studies.

The significant disparity between the frequency of anemia in adults (21%) and children (58.8%) is particularly alarming. The disparity suggests that children are more susceptible to anemia due to their heightened nutritional requirements and increased vulnerability to infections. Previous research confirms this, highlighting that iron deficiency, a significant factor in causing anemia, is more common among children in low-resource environments.[72] The significant diversity (I^2 > 98%) within these subgroups also indicates the variation in study techniques and demographic characteristics, which affects prevalence estimates.[110] The prevalence data exhibits temporal fluctuations when analyzed. Prior to 2005, there was a significant range of uncertainty and a high degree of variation, indicating irregularities in the available data. The decrease in prevalence between 2005 and 2010 can be linked to specific public health efforts or enhancements in data accuracy during this time. Nevertheless, the continuing rise from 2011 to 2020 underscores the enduring difficulties in managing anemia, despite worldwide health initiatives. This pattern indicates that although there has been some progress, there are still severe deficiencies in the management of anemia. Prior research indicates the necessity for more targeted and enduring endeavors, notwithstanding progress in worldwide health measures.[1,2]

Egypt stands out in Northern Africa with the highest level of shading, indicating a concerning prevalence range of 91.8% to 99.5%. This finding is supported by the meta-analysis. The significant occurrence of this problem indicates the presence of serious underlying problems, such as inadequate nutrition and inefficient healthcare systems.[72]

In East Africa, the prevalence rates of Tanzania range from 53.6% to 61.2%, Uganda from 45.9% to 53.6%, and Rwanda from 61.2% to 68.9%. The meta-analysis confirms these statistics, showing that Tanzania has a prevalence rate of 63.7% and Uganda has a prevalence rate of 51.7%. Rwanda's prevalence rate is within the higher range indicated on the map. The burden encompasses challenges such as insufficient nourishment, elevated rates of illness, and restricted availability of health care.[111]

In addition, West African countries demonstrate elevated prevalence rates. The incidence rates in Nigeria range from 68.9% to 76.5%, in Guinea-Bissau from 76.5% to 84.2%, and in Togo it is 80.8%. The meta-analysis validates these percentages, with Nigeria at 64.7% and Guinea-Bissau at 80.2%. The heightened rates underscore enduring issues such as poverty, food insecurity, and insufficient healthcare services.[83] In Southern Africa, the prevalence rates are very high. Specifically, Malawi has a prevalence rate ranging from 76.5% to 84.2%, while South Africa has a prevalence rate ranging from 84.2% to 91.8%. The meta-analysis reveals that the prevalence rates for these nations are 85.1% and 85.6%, respectively. The data presented suggests a substantial prevalence of anemia, which may be attributed to factors such as inadequate nutrition and long-term illnesses. Addressing these concerns would necessitate the implementation of comprehensive healthcare initiatives.[69]

Strength and limitations

The review follows the PRISMA standards and conducts a comprehensive search of different databases to ensure the inclusion of a wide range of studies. Using a systematic methodology for data extraction and the establishment of specific criteria for inclusion, the review effectively reduces bias and improves the dependability of its conclusions. By employing a single-arm random-effects model and employing numerous statistical tests such as funnel plots and subgroup analyses, the meta-analysis gains strength and enables a nuanced comprehension of anemia incidence in many locations and populations in Africa. The analysis uncovers substantial variability (I^2 values reaching 99.28%) and publication bias, which may distort the findings and impact the precision of the prevalence estimations. The significant variation in the incidence of anemia observed in different research, along with the possibility of biases in study publication, emphasizes the challenge of developing a standardized measure of anemia prevalence and emphasizes the importance of being cautious when interpreting the findings.

Conclusion

This systematic review and meta-analysis underscores the critical and widespread prevalence of anemia across Africa, with an overall pooled estimate of 29.2%. Notably, the high prevalence found in countries such as Egypt, Nigeria, and Malawi, compared to lower rates in Ethiopia, indicates regional disparities that require targeted interventions. Addressing anemia in Africa will necessitate region-specific strategies that consider local conditions and challenges, alongside broader initiatives to improve nutritional quality and healthcare access.

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Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Quality of included studies by Joanna Briggs Institute critical appraisal checklist for studies reporting prevalence data

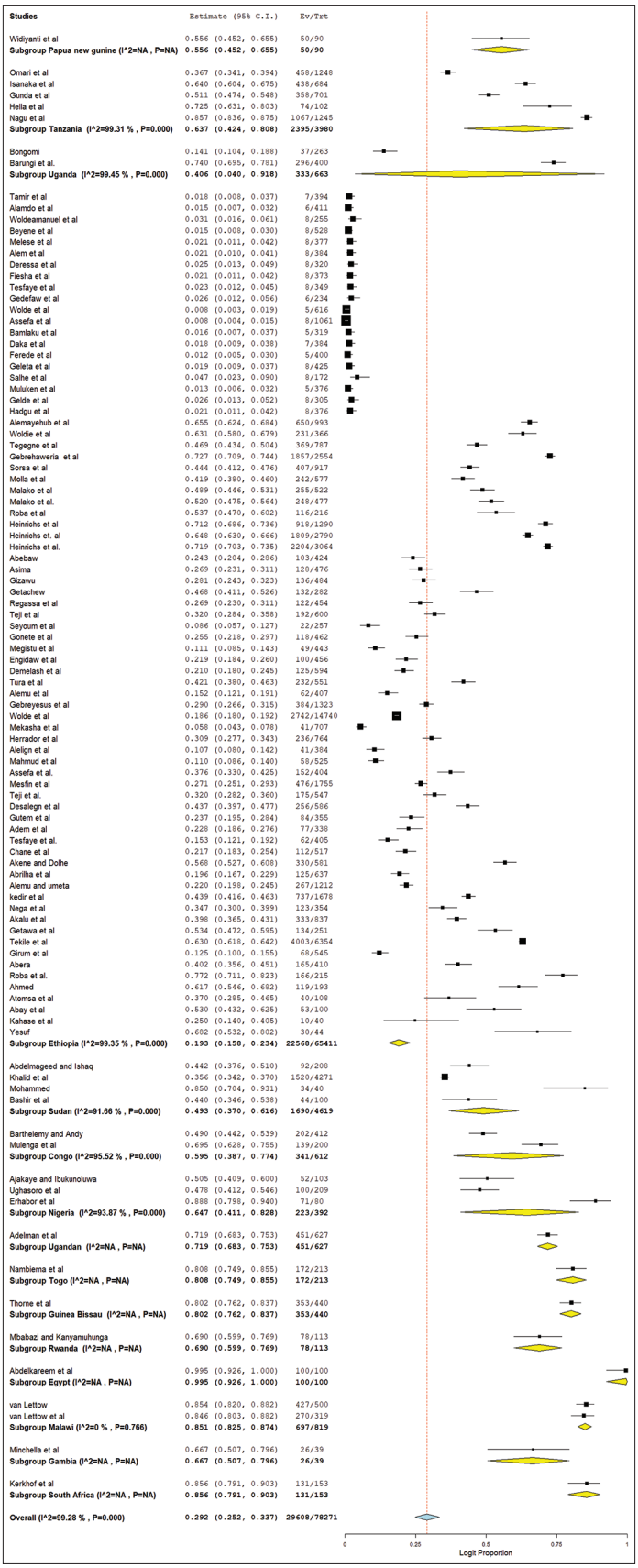
Name of authors and year of publication	JBI checklist*									Total
	1	2	3	4	5	6	7	8	9	
Widiyanti *et al.*, 2017[17]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Msemo *et al.*, 2018[10]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Bongomin *et al.*, 2021[18]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Tamir *et al.*, 2018[19]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Alamdo *et al.*, 2015[20]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Woldeamanuel and Wondimu, 2018[21]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Beyene *et al.*, 2017[22]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Melese *et al.*, 2017[23]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Alem, 2013[24]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Deressa *et al.*, 2018[8]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Fiseha *et al.*, 2017[25]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Tesfaye and Enawgaw, 2014[26]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Gedefaw *et al.*, 2013[27]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Milkias *et al.*, 2014[28]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Assefa *et al.*, 2015[29]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Bamlaku *et al.*, 2014[30]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Daka *et al.*, 2013[31]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Ferede and Wondimeneh, 2013[32]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Dessalegn *et al.*, 2016[33]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Salhe *et al.*, 2017[34]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Wubetu and Mebratu, 2018[35]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Gelde *et al.*, 2015[36]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Hadgu *et al.*, 2013[37]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Alemayehub *et al.*, 2019[38]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Woldie *et al.*, 2015[39]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Tegegne *et al.*, 2022[40]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Gebrehaweria Gebremeskel and Lemma Tirore, 2020[41]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	18
Sorsa *et al.*, 2021[42]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	18
Molla *et al.*, 2020[43]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Malako *et al.*, 2018[44]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Malako *et al.*, 2019[45]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Roba *et al.*, 2016[46]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Heinrichs *et al.*, 2020[47]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Heinrichs *et al.*, 2020[47]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Heinrichs *et al.*, 2020[47]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Abebaw *et al.*, 2020[48]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Bireda *et al.*, 2022[49]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	18
Abebe *et al.*, 2022[50]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Bambo *et al.*, 2023[51]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	18
Elmugabil and Adam, 2023[52]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Elmardi *et al.*, 2020[53]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	18
Regasa and Haidar, 2019[54]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Teji *et al.*, 2016[55]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Seyoum *et al.*, 2019[56]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Gonete *et al.*, 2018[57]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	18
Mengistu *et al.*, 2019[58]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Engidaw *et al.*, 2018[59]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	18
Demelash and Murutse, 2016[60]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Tura *et al.*, 2020[61]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	18
Alemu and Gebremedhin, 2020[62]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Gebreyesus *et al.*, 2019[63]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Wolde-Gebriel *et al.* 1993[64]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Mekasha and Zerfu, 2009[65]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16

Contd...

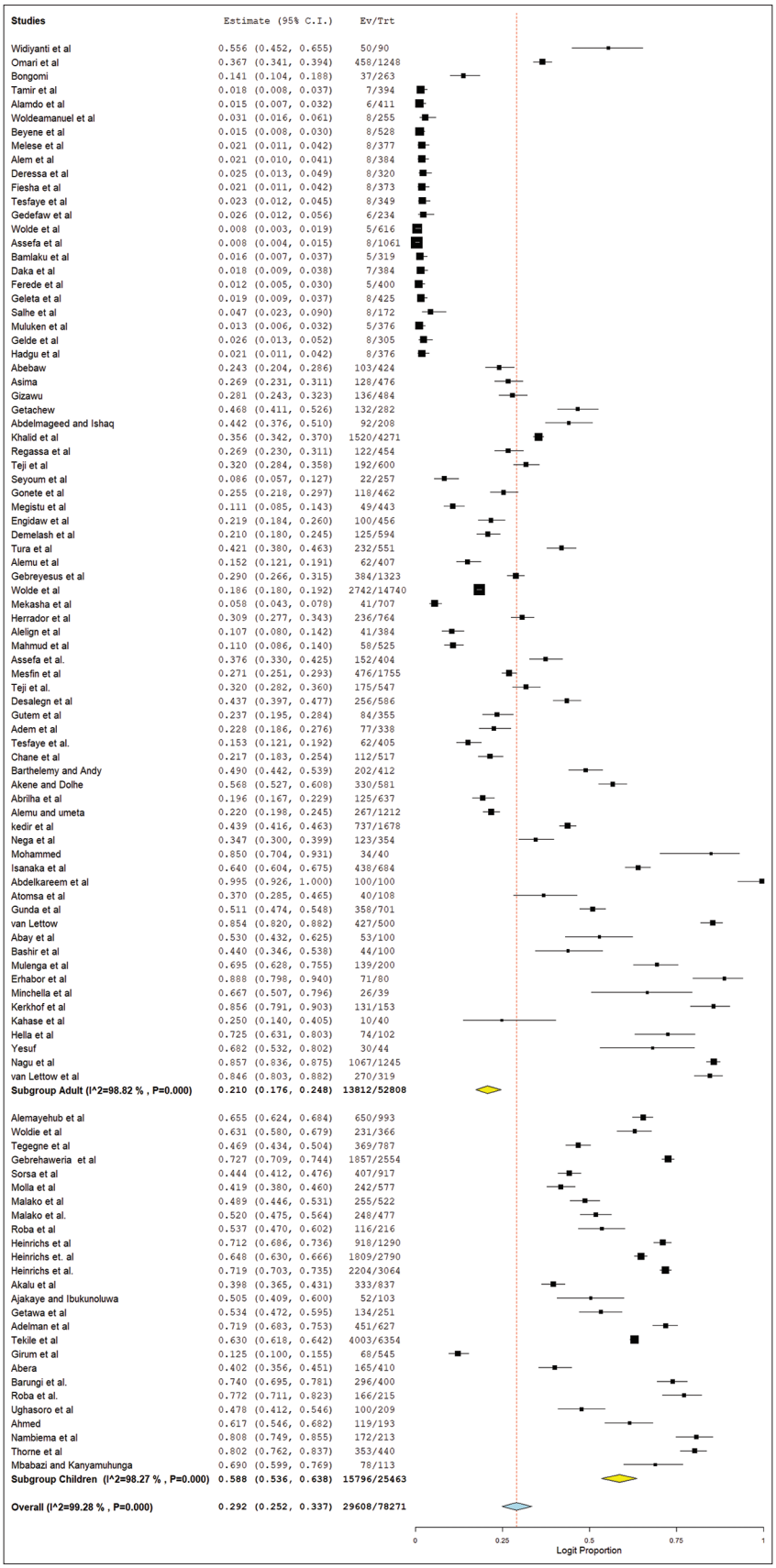
Supplementary Table 1: Contd...

Name of authors and year of publication	JBI checklist*									Total
	1	2	3	4	5	6	7	8	9	
Herrador *et al.*, 2014[66]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	18
Alelign *et al.*, 2015[67]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	18
Mahmud *et al.*, 2013[68]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Assefa *et al.*, 2014[69]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Mesfin *et al.*, 2015[70]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Teji *et al.*, 2016[71]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Desalegn Wolide *et al.*, 2014[72]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Gutema *et al.*, 2014[73]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Adem *et al.*, 2015[74]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Tesfaye *et al.*, 2015[75]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Chane, 2016[76]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Tandu-Umba and Mbangama, 2015[77]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Addis Alene and Mohamed Dohe, 2014[12]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Kefiyalew *et al.*, 2014[78]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Alemu and Umeta, 2015[79]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Obse *et al.*, 2013[80]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Nega *et al.*, 2015[81]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Yihunie Akalu *et al.*, 2020[82]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Ajakaye and Ibukunoluwa, 2020[83]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Getawa *et al.*, 2020[84]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Adelman *et al.*, 2019[85]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Tekile *et al.*, 2019[86]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Girum *et al.*, 2017[87]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Padovese *et al.*, 2014[88]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Cheong *et al.*, 1996[89]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Roba *et al.*, 2016[46]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Ughasoro *et al.*, 2015[90]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
da Silva-Junior *et al.*, 2019[91]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Nambiema *et al.*, 2019[11]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Thorne *et al.*, 2013[92]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Mbabazi, 2021[93]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Abaker and Mohammed, 2016[94]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Isanaka *et al.*, 2012[95]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Abdelkareem *et al.*, 2019[96]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Atomsa *et al.*, 2014[97]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Gunda *et al.*, 2016[98]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
van Lettow, 2005[99]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Abay *et al.*, 2018[100]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Bashir *et al.*, 2015[101]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Yang *et al.*, 2022[102]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Pessoa *et al.*, 2016[103]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Minchella *et al.*, 2015[4]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Kerkhof *et al.*, 2016[104]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Kahase *et al.*, 2020[105]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Hella *et al.*, 2018[106]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Yesuf, 2017[107]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Nagu *et al.*, 2014[108]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16
Islam *et al.*, 2017[109]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	16

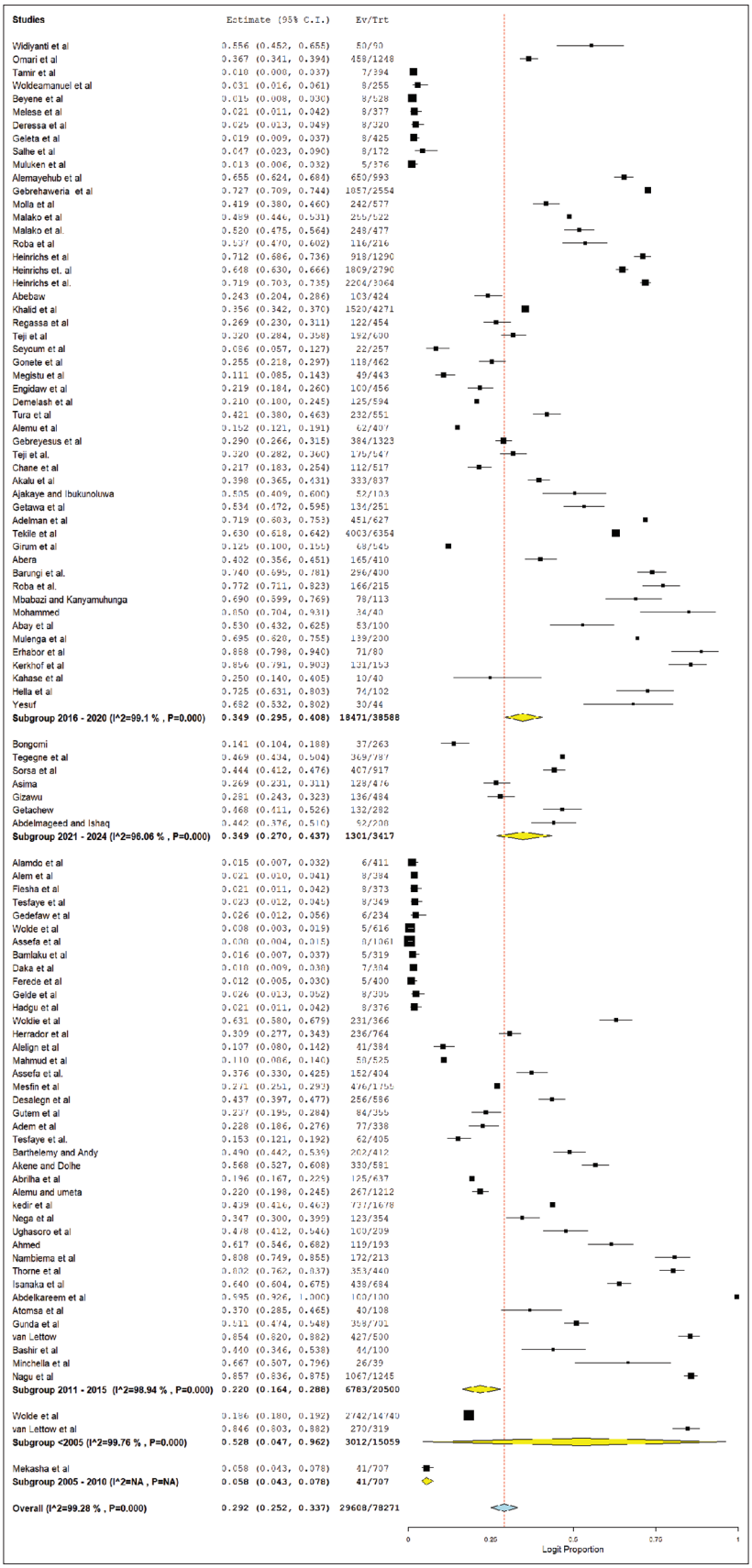
Scores are coded as Yes=2 and No=0. 1=Appropriate sampling frame to address target population, 2=Appropriate sampling way of study participants, 3=Adequate sample size, 4=Detail description of study participants and settings, 5=Data analysis with sufficient coverage of identified sample, 6=Use of valid methods to identify the condition, 7=Standard, reliable way of measurement of condition for all participants, 8=Availability of appropriate statistical analysis, 9=Adequate response rate and management of low response rate, JBI=Joanna Briggs Institute



Supplementary Figure 1: Subgroup in relation to country



Supplementary Figure 2: Subgroup in relation in relation to maturity



Supplementary Figure 3: Subgroup analysis in relation to year of publication

Supplementary File

Supplementary File 1: Search strategies for the prevalence of anemia in Africa

1. PubMed

(("Anemia"[MeSH] OR "Anaemia" OR "Iron Deficiency Anemia"[MeSH] OR "Hemoglobinopathies"[MeSH]) AND ("Prevalence"[MeSH] OR "Epidemiology"[MeSH] OR "Incidence"[MeSH] OR "Frequency") AND ("Africa"[MeSH] OR "Sub-Saharan Africa"[MeSH] OR "North Africa" OR "Nigeria" OR "Kenya" OR "South Africa") AND ("Children"[MeSH] OR "Pregnant Women"[MeSH] OR "Women of Reproductive Age" OR "Adolescents" OR "Adults"))

("Anemia"[MeSH Terms] OR "Anaemia"[All Fields] OR "Hemoglobinopathies"[MeSH Terms]) AND ("Prevalence"[MeSH Terms] OR "Epidemiology"[MeSH Terms] OR "Incidence"[MeSH Terms] OR "Frequency"[All Fields]) AND ("Africa"[MeSH Terms] OR "North Africa"[All Fields] OR "Nigeria"[All Fields] OR "Kenya"[All Fields] OR "South Africa"[All Fields]) AND ("Pregnant Women"[MeSH Terms] OR "Women of Reproductive Age"[All Fields] OR "Adolescents"[All Fields] OR "Adults"[All Fields])

2. Scopus

("anemia" OR "anaemia") AND ("prevalence" OR "epidemiology" OR "incidence" OR "frequency" OR "rate") AND ("Africa" OR "Sub-Saharan Africa" OR "North Africa" OR "East Africa" OR "West Africa" OR "Central Africa" OR "Southern Africa" OR "Nigeria" OR "Kenya" OR "South Africa" OR "Egypt" OR "Ghana" OR "Ethiopia" OR "Tanzania" OR "Uganda" OR "Morocco" OR "Algeria" OR "Angola" OR "Zimbabwe")

3. ScienceDirect

(prevalence OR incidence) AND (anemia OR anaemia OR "iron deficiency anemia" OR "sickle cell anemia") AND ("Sub-Saharan Africa" OR "North Africa" OR "West Africa" OR "East Africa" OR "Central Africa" OR "Southern Africa") AND (children OR "pregnant women" OR "women of reproductive age" OR "HIV/AIDS" OR malaria OR "adult")

4. Google Scholar

Main search terms

- Prevalence of anemia in Africa
- Anemia in African countries
- Iron deficiency anemia in Africa
- Hemoglobin levels in Africa
- Nutritional anemia in Africa
- Pediatric anemia in Africa
- Anemia in pregnant women in Africa

Specific conditions

- Malaria-associated anemia in Africa
- HIV/AIDS and anemia in Africa
- Sickle cell anemia in Africa
- Genetic anemia in Africa
- Infectious diseases and anemia in Africa

Regions and demographics

- Anemia in sub-Saharan Africa
- Anemia in North Africa
- Rural vs. urban anemia in Africa
- Anemia in children in Africa
- Anemia in women of reproductive age in Africa
- Regional disparities in anemia prevalence in Africa

Combining terms

- "Prevalence of anemia in Africa" AND "iron deficiency"
- "Anemia in African countries" OR "hemoglobin levels in Africa"
- "Malaria-associated anemia" AND "sub-Saharan Africa"
- "Nutritional anemia" AND "pregnant women" AND "Africa"

Exclusion terms

- "Anemia in Africa" -animal -plant (to exclude studies not related to human anemia)
- "Prevalence of anemia in Africa" -review (to exclude review articles if primary studies are desired)

Date range

- We set a specific date range to retrieve old to recent studies (1900-2024), to ensure the inclusion of all data to get an up-to-date research.

5. Web of Science

TS=(anemia OR anaemia OR "iron deficiency anemia" OR "iron deficiency anaemia" OR hemoglobin OR haemoglobin) AND TS=(prevalence OR incidence OR epidemiology OR frequency OR occurrence) AND TS=(Africa OR "Sub-Saharan Africa" OR Algeria OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR "Cape Verde" OR "Central African Republic" OR Chad OR Comoros OR "Democratic Republic of the Congo" OR Djibouti OR Egypt OR "Equatorial Guinea" OR Eritrea OR Eswatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR Ivory Coast OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Morocco OR Mozambique OR Namibia OR Niger OR Nigeria OR Rwanda OR "Sao Tome and Principe" OR Senegal OR Seychelles OR Sierra Leone OR Somalia OR "South Africa" OR "South Sudan" OR Sudan OR Tanzania OR Togo OR Tunisia OR Uganda OR Zambia OR Zimbabwe).